Mathew Kurian · Patricia McCarney
Editors

Peri-urban Water and Sanitation Services

Policy, Planning and Method

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Preface

Issues relating to the supply of water and sanitation in peri-urban settings located in developing countries are of critical importance for public officials, scholars, and the citizens of the world given the large number of people affected and the impact of water and sanitation on the health and longevity of people living in these regions. Mathew Kurian and colleagues have written an excellent book that will be of great value not only for teaching students at various levels about the challenge of designing institutions and physical water systems, but also for policymakers facing tough decisions related to how they reduce unhealthy and fragile systems at a reasonable cost. It is easy to criticise the failure of many top-down decision processes – including funds and plans developed by international aid agencies. It is far more difficult to assess how to reform systems that are already in place and dependent on continued funding from either international aid agencies or national governments. It is tragic indeed that water supplies are generally more abundant now than half a century ago, but that marginalised groups and households living in megacities around the world still have little access to water supply and sewer networks in their everyday environments.

This volume contains excellent case studies from Africa, Asia and South America (as well as the Netherlands) that draw on a unifying framework for examining developmental and environmental challenges facing the people living in peri-urban settings. Because of the increase in the proportion of the population of the world moving from rural settings to urban areas, competition over obtaining sufficient water to provide safe water for urban residents has been increasing. Further, urban areas are now also increasing the volume of wastewater that generates higher pollution levels in both urban and rural settings as well as having a negative impact on the supply of water itself. Solving the positive feedback problems caused by changing population distributions, water demand and generation of wastewater has become ever more severe.

The authors of these chapters in this book draw on good theoretical foundations as well as generating carefully written case studies. They point to the need for institutional arrangements nested at multiple levels, which in some developing countries is particularly challenging to achieve. Modernisation for some policymakers has been equated with a strong national government and an active market for private goods. Overly simplistic reliance on idealised governmental and private organisational arrangements can reduce the likelihood of grappling with real environmental problems at multiple scales. Matching the structure of governance arrangements to specific ecological conditions is pointed out by the authors to be more important than creating structures that are recommended in textbooks but do not fit the particular problems under consideration. Instead of following single blueprint solutions, the book re-enforces the need for innovative solutions involving a variety of organisational arrangements at multiple scales. Each of the studies provides excellent information about particular urban and peri-urban water problems and provides the reader with general lessons that can help in the design of new systems that build on knowledge of the particular biophysical and institutional foundation for creating better solutions.

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Mathew Kurian

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Abbreviations

AC	Averting Costs
ADB	Asian Development Bank
AP	Andhra Pradesh
BOD	Biological Oxygen Demand
BOO	Build-Own-Operate
BOT	Build, Own, Transfer
BSC	Balanced Score Card
CBA	Cost-Benefit Analysis
CBO	Community Based Organisation
CCP	Climate Change Programme
CCPC	Cities for Climate Protection Campaign
CEA	Cost-Effectiveness Analysis
CENDES	Centre for Development Studies, Caracas
CFC	Chlorofluorocarbons
CGIAR	Consultative Group on International Agriculture Research
CIRAD	French Research Centre for Agriculture and Development
CLIFF	Community-Led Infrastructure Finance Facility
CLTS	Community Led Total Sanitation
CMR	Caracas Metropolitan Region
COI	Cost of Illness
CP	Contour Planting
CPHEEO	Central Public Health and Environmental Engineering Office
CPR	Common Pool Resource
CQI	Continuous Quality Improvement
CSA	Centre for Social Accountability, South Africa
CSC	Community Score Cards, Tanzania
CSR	Corporate Social Responsibility
CVM	Contingent Valuation Methods
DA	Decision Analysis
DALY	Disability Adjusted Life Years
DFS	Design for Service

DPU	Development Planning Unit
DRC	Democratic Republic of the Congo
EC	Electrical Conductivity
ELSR	Elevated Service Reservoir
EMR	Extended Metropolitan Regions
EOP	Effects On Production
EWPCA	European Water Pollution Control Association
FC	Faecal Coliform
FC	Fully Covered
FCM	Federation of Canadian Municipalities
FGD	Focus Group Discussion
FLACSO	Faculty for Social Sciences, Mexico City
FS	Faecal Sludge
GCIF	Global City Indicators Facility
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIS	Geographic Information System or, Global Information Systems
GKCR	Greater Kumasi City Region
GMMC	Greater Mumbai Municipal Corporation
GNCTD	Government of National Capital Territory of Delhi
GNI	General National Income
GoI	Government of India
GoL	Government of Lao
GPS	Global Positioning System
GTZ	Deutsche Gesellschaft fur Technische Zusammearbeit
HI	Homeless International
ICSU	International Council for Science
ICT	Information and Communication Technology
IDA	International Development Agency
IF	Improved Fallow
IPCC	Intergovernmental Panel on Climate Change
ISP	Incentives for Source Protection
ISSDP	Indonesia Sanitation Sector Development Project
IWA	International Water Association
IWK	Indah Water Konsortium
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
KL	KiloLitre
KMA	Kolkata Metropolitan Area
KRW	European Guideline Water

LAC	Latin America and the Caribbean
LBD	Locally Based Demand
LCCA	Life Cycle Cost Assessment
LF	Large Farmers
LG	Local Government
LMD	Lower Mannair Dam
LPCD	Litres Per Capita Daily
MBO	Management by Objectives
MCA	Multi-Criteria Analysis
MCGM	Municipal Corporation of Greater Mumbai
MDG	Millennium Development Goal
MF	Medium Farmers
MLD	Million Litres per Day
MMDA	Metropolitan Manila Development Authority
MMR	Mumbai Metropolitan Region
MMRDA	Mumbai Metropolitan Region Development Authority
MRB	Mekong River Basin
MSE	Management of Soil Erosion Consortium
MTEF	Medium Term Expenditure Framework
MUWSA	Moshi Urban Water and Sewerage Authority
MWNT	Mulch with No Tillage option
NCTD	National Capital Territory of Delhi
NEAA	Netherlands Environmental Assessment Agency
NGO	Non-Governmental Organisation
NHB	National Housing Bank
NIE	New Institutional Economics
NPM	New Public Management
NRW	Non-Revenue-Water
NSDF	National Slum Dwellers Federation
NTFP	Non Timber Forest Product
O&M	Operations and Maintenance
OBA	Output Based Aid
OHSR	Overhead Service Reservoir
ORT	Oral Rehydration Therapy
PC	Partially Covered
PDCA-cycle	Plan-Do-Check-Act-cycle
PE	Person Equivalents
PETS	Public Expenditure Tracking Surveys
PI	Performance Indicator
PPB	Planning-Programming-Budgeting
PPBS	Planning-Programming-Budgeting-Systems
PPIAF	Public Private Infrastructure Advisory Facility
PPM	Parts Per Million

PPP	Purchasing Power Parity
PSP	Private Sector Participation
PUI	Peri-urban Interface
QMRA	Quantitative Microbial Risk Assessment
RBA	Risk-Benefit Analysis
RC	Replacement Cost
RWSS	Report on the World Social Situation
S&B	Slash and Burn
S&M	Small and Marginal Farmers
SEAWUN	South East Asian Water Utility Network
SES	Socio-Ecological Systems
SPV	Special Purpose Vehicle
SSPSS	Small Scale Private Sanitation Sector
STP	Sewerage Treatment Plant
SuSanA	Sustainable Sanitation Alliance
SUSTAIN	Citizens Alliance for Sustainable Living, Chennai
SWAP	Sector Wide Approach
SWNM	Soil, Water and Nutrient Management
TCM	Travel Cost Method
TDS	Total Dissolved Solids
TNC	Transnational Corporation
TQM	Total Quality Management
TWF	Technical Water Fora
UASB	Up Flow Anaerobic Sewage Blanket
UCLAS	University College of Lands and Architectural Studies, Dar es Salaam
UDIC	Urban Development Investment Corporation, Shanghai
UFRD	Urban Functions in Rural Development
UFW	Unaccounted-For-Water
UNEP	United Nations Environmental Programme
UNFCCC	UN Framework Convention on Climate Change
UTI	Urban Studies and Training Institute, Cairo
UWSA	Urban Water and Sanitation Agency, Tanzania
VEWIN	Association of Water Supply Companies, the Netherlands
VNG	Association of Dutch Municipalities
WaSH	Water, Sanitation and Hygiene
WATSAN	Water and Sanitation
WCP	Water Conservation Programmes
WHO	World Health Organization
WMO	World Meteorological Organization
WSP	Water and Sanitation Programme

WTP	Willingness to Pay
WVO	Pollution Surface Water Act of 1970 (Dutch Law)
WW	Wastewater
ZBB	Zero-Based Budgeting

Chapter 1
Introduction

Institutions and Economic Development: A Framework for Understanding Water Services

Mathew Kurian

Abstract The Millennium Development Goal (MDG) target is to halve the number of people without access to improved water and sanitation services. This chapter provides a framework that can be employed to understand the institutional context within which policy and management decisions are made with regard to delivery of water services in developing countries. The potential role that international development cooperation can play in furthering discussions on accountability and autonomy of local governments is examined in the context of trends such as rapid urbanization, expansion of information technology and use of innovative instruments of infrastructure financing to meet basic needs.

1.1 Introduction

More than 2.6 billion people in the developing world lack access to safe water and sanitation services (Rijsberman 2004). The Millennium Development Goal (MDG) target is to halve the number of people without access to an improved service by 2015: for example, sustainable source of water supply or connection to a sewer network. That target in unlikely to be met. Largely an explanation of this failure can be found in institutions that have mediated technology adoption in the sector. In the years following World War II, a large number of developing countries adopted centralised systems of water supply and underground drainage as central pillars of their plans for urban development and modernisation (Scott 1998). Most of these technologies were based on advances made in industrialising countries; war reconstruction, like the Marshall Plan, financed adoption of centralised water and sanitation technologies in many instances. Developing countries who adopted these technologies supported in large measure by development aid, realised that these systems were expensive to establish and maintain. As a result, a powerful argument was built for

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central fiscal transfers that supported infrastructure creation.[1] Consequently, a large number of countries achieved infrastructure coverage but issues of service standards, affordability and water quality remained unaddressed. In India, for example, although rural water supply coverage is as high as 90%, the proportion of the population with access to reliable services is lower than 50% (GoI, 2006). Therefore, if there is anything that can be learned from the experience of Europe it is that institutional reform occurs incrementally when politically enfranchised urban populations perceive a threat to their material well being due to contamination of water sources (Fischer et al. 2006). The outbreak of water borne diseases like cholera in cities in the UK for example, led gradually to legislative reform, delineation of roles of municipalities and private sector and adoption of financing mechanisms that ensured safe sanitation and waste disposal.

How can *incremental* improvements in delivery of water and sanitation services in developing countries be achieved? This collection of papers was initially developed to support a distance-learning course at UNESCO-IHE Institute for Water Education. A large proportion of course participants are mid-career professionals engaged in management and planning at municipalities and water utilities in developing countries. The chapters that follow are an attempt to challenge water professionals to think of water service challenges from the perspective of institutions and economic development. New Institutional Economics (NIE) has made an interesting contribution to the debate on institutional reform by its focus on issues of transaction costs, property rights and technological change (North 1990). A particularly relevant contribution of NIE has been a focus on micro-analytics of governance structures under conditions of opportunism; a marked departure from the neoclassical economics emphasis on price and output. It is for this same reason we take issue with New Public Management (NPM) for over-emphasising the role of technical efficiency without adequately understanding the political and historical context within which decisions regarding technology choice, pricing structures and tariff models are made. 'In the field of public management reform broader forces of economics and politics are mediated by networks of institutions. The specific characteristics of these networks and of the individual institutions which compose them, frequently have a profound shaping effect upon what actually happens during the course of reform' (Pollitt and Bouckaert 2000: 23).

Over the past decade, international development agencies[2] have contributed enormously towards furthering the reform discussion. Institutional reform themes have gained prominence in the case of water services include the following:

[1]Bhagwati in reviewing Moyo's scathing critique of development aid in Africa notes that throughout the 1970s, aid policy was predicated on increasing domestic savings in recipient countries. But many aid recipients were smart enough to realise that once wealthy nations had committed to support them, shortfalls in their domestic efforts would be compensated by increased, not diminished aid flows. The World Bank, which provided much of the multilateral aid flows was then judged by how much money it disbursed, not by how well that money was spent and recipients knew this (Bhagwati 2010; Moyo 2009).

[2]Oversees Development Assistance for water and sanitation accounted for the largest share of all basic social services in 1996 (USD 3.1 billion) (Mehrotra 2002).

(1) integration, (2) decentralisation and (3) participation. Discussions on Integrated Water Resources Management (IWRM) emphasised: (1) inter-sectoral competition for surface freshwater water resources, (2) integration of water management at farm, system and basin scales, (3) conjunctive use of surface and groundwater resources, and 4) prioritising water for human consumption and environmental protection (Turral 1998). But others have been justifiably less optimistic of IWRM pointing out that the approach neglects the political dimension through a reification of 'natural boundaries' and emphasis on 'neutral planning and participation' (Wester and Warner 2002: 65). There has also been a lot of discussion on the merits of political decentralisation in enhancing service delivery. The debate on political decentralisation has raised a number of issues related to equity of fiscal transfers from higher to lower tiers of government and autonomy of local authorities to raise taxes and impose tariffs on consumers. But discussions have been unable to account for the role of discretion of street level bureaucrats in implementation of social programmes (Minogue 1983). Issues related to accountability of sub-national budgeting processes remain largely unexamined (Iyer et al. 2005). Further, besides some discussion of aid conditionality, policy science has largely been silent on political processes that shape budget support and sector-wide approaches of donor financing (World Bank 2009). Finally, NIE has made a major contribution towards articulating the need for simplified technologies of particular relevance to resource poor communities in developing countries. Discussions surrounding the 'co-production' concept are particularly appealing since they emphasise the relevance of voice mechanisms in improving service delivery. But the neoliberal emphasis on privatisation and efficiency improvements (through a separation of asset ownership from management roles) has largely served to obfuscate the message (World Bank 2004). What happened as a consequence is an increasing separation of the roles of citizen and consumer in deliberations on institutional reform; and underplaying issues of inequality and social justice in public debate (Sen 2009).

The subsequent section of the chapter reviews important themes relating to IWRM within a framework of urban environmental governance. The role of institutions in influencing management of common pool resources like rivers and groundwater resources is discussed. In the light of this discussion the following section outlines the specific nature of water supply and sanitation infrastructure. The equity effects of policy intervention on public health outcomes are discussed. The section also discusses the role of institutional environment in influencing the credibility of international contracts involving the private sector in delivery of water services. A discussion of infrastructure financing and costs leads us to argue that simplified water and sanitation technologies could greatly improve access of the poor to services. We draw on analysis of condominial sewer technologies in Brazil to argue that co-production has much to offer to the discussion on cost-effective delivery of water services. The final section 1.4 of the chapter outlines a framework that can be employed for a reading of the chapters in this volume; issues that are discussed include the role of institutional arrangements, emerging disconnect between time, space and information in the context of globalisation of urban spaces and their implications for design of developmental interventions in pursuit of improvements in service delivery.

1.2 Urban Environmental Governance

1.2.1 Interdependence of the Water Cycle

In 2007, the world crossed an important demographic threshold because a larger proportion of the world's population began to reside in urban versus rural areas (UNDP 2006). From a water services point of view this event signalled two possibilities: first, competition for water between agriculture and urban water supply was bound to increase (IWMI 2007). Second, with an increase in urban population densities and accompanying water supplies larger volumes of wastewater were bound to be generated from domestic and commercial establishments. A commonly used rule of thumb calculation is that approximately 80% of urban water supply is converted into domestic wastewater. Domestic wastewater constitutes the largest proportion of total wastewater generated and poses a serious threat to water supply sources, such as surface water and groundwater. Climate variability (*trends in precipitation and temperature*) is known to exacerbate some of the above risks through an increase in frequency, intensity and duration of storm drain overflows. In Chapter 4, Dietz attempts a categorisation of climate-based risks in cities depending on their location (coast, delta or inland).

1.2.2 Architecture of Water Service Provision

Parallel with developments on the physical water resources front, there has been a notable change in the architecture of water service provision in developing countries. This change has been fostered by a transformation of relations between national states and their citizens, which is reflected in three trends. One, a process of devolution of decision-making power to lower tiers of government. Two, growth of new public management that legitimised a role for the private sector in delivery of basic services. Three, the rise of transnational networks aided by the internet revolution (Sassen 2006). An important consequence of these processes has been the destabilisation of older hierarchies of scale, necessitating in many instances a re-scaling of politico-administrative territorialities. The destabilising of national state-centred hierarchies of legitimate power has also unleashed a multiplication of non-formal political dynamics. Conventional territorial boundaries of sub-national entities (*village or town*) so critical to binding time and space and ordering socio-cultural and political relations are being shaken by forces of modernisation including state policies and transnational markets for goods and services (Giddens 1999). The disembedding influences of modernisation weakened the levers of the bureaucratic organisation previously so adept at linking the local with the national or global.

1.2.3 Governance Arrangements at the Peri-urban Interface

There is clear evidence that secondary towns in the developing world are experiencing the fastest growth of urbanisation and consequently placing huge demands on freshwater resources. The analytic category of peri-urban has emerged to describe a situation where both rural and urban features coexist at the fringe of a city. From an environmental perspective, this interface is characterised by natural ecosystems, agro-ecosystems and urban ecosystems affected by material and energy flows (Allen et al. 2006: 21). From a socioeconomic viewpoint, the peri-urban interface exhibits peculiarities such as land speculation, changing land use practices and emergence of informal service providers. The peri-urban interface is also characterised by an institutional vacuum that makes it difficult to deal with the challenges posed by rapid urbanisation. This is evident from a convergence of sectoral and often overlapping organisations with varying spatial coverage and jurisdictional mandates. Very often, roles and responsibilities for private, public and civil society players are not clear; municipal authority is usually weak. Such a situation has serious implications for delivery of water and sanitation services.

1.2.4 Common Pool Resources and Environmental Externalities

Public health and environmental costs of dumping untreated wastewater into rivers are seldom internalised in costs of water supply projects and prices that consumers pay for services (Kurian et al. 2009). Water borne sewerage can be expensive and, if it involves treatment, quite costly (Ferguson and Navarrete 2003). Pricing may be a powerful instrument to restrict certain patterns of behaviour related to waste disposal. However, new ecology scholars have been quick to remind us that the effects of wastewater contamination on the environment need not be uniform; the effects can vary across space and time. For example, later in this volume Raschid-Sally and van Rooijen describe how wastewater agriculture in the periphery of Hyderabad town in India was actually serving to reduce levels of contamination before wastewater returned to a river that was a source of drinking water for settlements farther downstream. A more pertinent question then arises as to how costs of water pollution are distributed among rural and urban populations: well to do and the marginalised groups and households.

Scoones (1999) reports on studies that support articulations of non-equilibrium and non-linear environmental change of which, new ecology scholarship highlights two issues. (1) A need for a wider understanding of spatial patterning of ecological processes from small patches to larger landscapes. (2) A need for research on adaptive management through an improved understanding of equity issues and environmental history (Turner 1989; Holling 1986). Within the social sciences similar discussions have been undertaken by fields of ecological anthropology that emphasise that as natural environments are homeostatically regulated, so are societies that rely on nature. Political ecology has explored themes of structural relations of power and domination over environmental resources (Bryant 1992). Scholarship in this field tends to believe that in the past, forces of modernisation disturbed what were previously essentially harmonious and balanced ecological systems. Environmental economics literature focused on explaining natural resource issues from the point of view of a failure of markets arising from externalities and non-rational allocation of resources (Markandaya and Richardson 1992). New Institutional Economics (NIE) scholars like Bromley (1992) and Ostrom (1990) have been concerned with constructing collective action arrangements for management of common pool resources.

Environmental externalities capture human–environment interactions that go on within complex socio-ecological systems (Ostrom 2009). Given rapid expansion of piped and non-piped water supply and exponential rates of growth in wastewater generation relative to infrastructure coverage for treatment and reuse, clean sources of water: rivers and groundwater are in short supply in developing countries. This discussion sits well with the debate on the public goods Common Pool Resource (CPR) continuum. Take for instance the contention that 'before Chlorofluorocarbons (CFCs) were invented, the stratospheric ozone layer was a public good; and since it was provided by nature, there was no under-provision. Now it is a CPR, subject to human depletion' (Keohane and Ostrom 1995: 15). Likewise one may argue that rivers and groundwater were public goods provided by nature but with increasing disposal of untreated waste into them, they have become subject to human depletion for which common property resource management regimes need to be designed. Design of CPR regimes for rivers and groundwater requires a multi-level, nested framework for analysing outcomes in complex Socio-Ecological Systems (SES) (Ostrom 2009). Ostrom provides an overview of the framework, showing the relationships among four first level core sub-systems of an SES: (1) resource systems (*specific territory containing water system*), (2) resource units (*amount and flow of water*), (3) governance systems (*government and other organisations that manage the part, specific rules related to use of water resources and how these rules are made*), and (4) users (*individuals, households, groups who use water*).

1.2.5 Institutions and Economic Development

Each core sub-system is made up of multiple second-level variables (examples include size of the resource system, mobility of resource unit, level of governance, etc.). One second-level variable of particular interest to our analysis has to do with mobility of resource units; CPR regimes are more difficult to design for mobile resources like rivers when compared to a stationary resource like water in a lake. Likewise, CPR rules are easier to design for resources for which users have knowledge (based on information) like a visible surface water body when compared to a resource that is less visible (an underground aquifer). Quite clearly then community level collective action will not suffice to protect water in rivers and underground aquifers given the diverse number of polluters involved (agriculture, industry or domestic wastewater), overlapping administrative jurisdictions and many times conflicting decision-making/policy objectives of ministries and line agencies. In this regard, Ostrom highlights the role of higher-level collective choice rules that relate to autonomy of resource managers to create and enforce some of their own rules. A major insight offered by Ostrom's framework relates to nesting of rules: 'all rules are nested in another set of rules that define how the first set of rules can be changed. Whenever one addresses questions about *institutional change* it is essential to recognise the following: (i) changes in rules used to order action at one level occur within a currently "fixed" set of rules at a deeper level and (ii) changes in deeper-level rules usually are more difficult and more costly to accomplish, thus increasing the stability of mutual expectations among individuals interacting according to a set of rules' (ibid: 51–52). In this connection Ostrom distinguishes between Constitutional Choice, Collective Choice and Operational Rules whereby processes of appropriation, provision, monitoring and enforcement occur at the operational level, processes of policymaking, management and adjudication of policy decisions occur at the collective choice level and formulation, adjudication and modification of constitutional decisions occur at the constitutional level.

1.3 Water and Sanitation Services: Infrastructure, Policy and Co-production

1.3.1 Equity Effects of Policy Intervention

Effective water supply and sanitation service delivery serves as a powerful preventive health measure. But for it to be effective it must be provided in tandem with other interventions aimed at raising awareness of safe hygiene practices (Bartlett 2003; Rijsberman 2004). Interventions like Oral Rehydration Therapy (ORT); a low-cost easily administered measure aimed at rehydration by perfusion of fluids lost during periods of acute and prolonged diarrhoea can be ineffective if applied without major changes in nutrition (Okun 1988). When preventive health measures fail, the consequences in terms of a descent of households into poverty can be significant. For instance, a longitudinal study of 35 north Indian villages over a period of 25 years found that health care expenses was one of the principal reasons for decline into poverty (Krishna 2004). Households amass debt typically owing to unexpected health care expenses and recourse to private credit channels with relatively higher rates of interest. Interestingly, in countries like Vietnam where State policy supports effective delivery of health care services, the link between poverty and lack of access to water and sanitation services can be effectively broken (Dasgupta et al. 2005).

1.3.2 Infrastructure and Contracts

A combination of three factors, huge sunk costs, economies of density/scale and massive consumption leads to significant politicisation of pricing and operations in the water sector (Savedoff and Spiller 1999). The sector has large sunk costs because like investments in gas and electricity sectors, the fixed assets have few alternative uses. Further, for a given distribution network, increasing the number of connected households reduces the network's average operating costs. Finally, unlike roads or telecommunications, consumers normally associate water services as free goods. Politicians can use this argument regarding pricing as an instrument of political mobilisation. In Chapter 2 on service delivery options that work for peri-urban poor, we find that financing requirements in water supply infrastructure tend to be lower than in wastewater or sewage infrastructure. This is because of relatively expensive capital costs of transport and treatment of wastewater. More importantly, we find that although the World Bank estimates huge potential for private investments in wastewater management, absent government guarantees that the rules of the game will remain fixed throughout project execution, mean that investments are not forthcoming. There is documented evidence of government u-turns from Latin America where after investments are made, governments intervene to lower prices, disallow costs, restrict operating company's autonomy to fix tariffs, require that company's make special investments, influence recruitment or restrict movement or composition of capital.

One outcome of government's tendency to renege on service contracts is that operators may not invest sufficiently in maintaining assets thus lowering service standards and increasing physical water losses. Privatisation experience in Honduras, Mexico and Peru for instance resulted in unaccounted water losses reaching up to 50% because of reduced maintenance of assets. Another outcome could be that providers could increase tariffs making services unaffordable for the poor. In the case of the Buenos Aires concession, the Argentine government raised tariffs for water services in Greater Buenos Aires to recover capital investments. This trend is related to an outcome of non-credible regulatory frameworks, a tendency of providers to transfer financing of sunk costs to consumers through high connection charges. Thus by overlooking issues of equity, efficiency and performance, a non-credible regulatory framework eventually creates conditions for government takeover of assets. Opportunistic government behaviour usually stymies the development of institutions necessary to support plan prioritisation, capacity for implementation and norms for monitoring and evaluation. This is an issue of particular relevance to the wastewater sector where although technologies for wastewater treatment[3] may be readily available based on western design, 'they still need to be adapted to local demand, scales of production, worker skills and quality of raw materials' (Lall and Pietrobelli 2002: 9). It is little wonder that scholars emphasised, 'technological

[3] Technologies include Up Flow Anaerobic Sewage Blanket (UASB), Activated Sludge Plant, Trickling Filters and Oxidation ponds.

upgrading and innovation requires enterprises to invest in more advanced – more costly – more uncertain and prolonged learning processes. Policy interventions are then needed to overcome market failures – to tackle learning costs, prevent externalities, coordinate factor market improvements with needs and develop institutions' (ibid: 10).

1.3.3 Infrastructure: Cost and Price Considerations

Adapting technology to local conditions is predicated upon a *learning by doing* approach to public policy formulation and implementation. Some of the important institutional questions that could be addressed by such an approach include: Choice of centralised or decentralised technologies for water supply/sanitation; and choice of single or multi-purpose organisations for delivery of water services. In terms of financing arrangements: What items of project costs (capital or operation and maintenance) should be met through central transfers or taxes. Salomé's review of the Dutch water boards points out that environmental externalities related to management of common pool river systems could be addressed through transfers but must be supported by robust mechanisms for monitoring of environmental and service standards.

In Chapter 5, Salomé also addresses some of the challenges associated with choice of water pricing strategies. Here again Dutch experience suggests that recourse to local taxes and tariffs could support the principle of maintaining strong links between delivery of reliable and quality services and accountability of cash flows and decisions surrounding infrastructure creation.

Another important infrastructure question relates to combined versus separate wastewater management systems. Both systems impose differing costs. Municipalities in developing countries may not be able to support construction of an underground drainage network that combines wastewater and storm water. End of pipe systems for treatment of wastewater besides exacerbating competition for freshwater (for example, through its use of flushing toilets) can increase per-capita costs that consumers must bear.

An important policy question is how to recover the above capital costs. Several combinations of institutional arrangements may be available to recover costs, such as commercial borrowing that employs instruments like bonds, sovereign guarantees and micro-finance. A range of management contracts entered into between government and the private sector could also facilitate recovery of capital investments: service management contracts, divesture and concessions are some examples.

Finally, tariff structures can vary depending on quantum of costs to be recovered and policy instruments that are available (Hanemann 2000). Flat rates are determined independent of quantity of water used while variable rates vary directly depending on water consumed or indirectly based on number and type of fixtures used. Variable rates could be uniform where amount paid per unit of consumption is same over all units consumed. In the case of block rates on the other hand, unit charge varies, either decreasing with amount consumed or increasing. Rates may also differ between utilities that charge different prices in different time periods depending on differences in season or peak load. Tariffs could also take the form of levies that support expansion of plant capacity through use of connection charges, facilities or capacity charge. Life-line rates offer low-income customers initial quantum of usage at reduced price and serve as an incentive to increase service coverage.

1.3.4 Co-production and Service Delivery

New Institutional Economics (NIE) has been instrumental in shifting the focus away from a world of only two possibilities – centralised/hierarchically organised public sector departments and privatisation of publicly owned assets with the aim of improving service delivery. NIE has been critical in shining the light on non-market institutions for management of common pool resources. Earlier on in the discussion while discussing prospects of combined and separate management of wastewater we pointed out that costs imposed by a combined system may be prohibitive for local authorities in developing countries. In this context 'co-production' involving partnerships between public, private sectors and civil society offers several benefits. Ostrom (1996) used the concept of co-production defined as 'a process through which inputs used to produce a good or service are contributed by individuals who are not "in" the same organization' to explain the delivery of sanitation services in Brazil. Her analysis of condominial systems – low-cost water-borne sewers – revealed three key lessons: (1) centralising infrastructure provision at the national level kept municipalities from access to decision-making responsibilities, (2) excessively high engineering standards set in a capital city were inadequate for bringing better services to poorer regions and neighbourhoods, and (3) citizens were themselves helpless to do anything about squalid conditions although they possessed resources like skills and time (ibid: 1074).[4] Co-production literature has also played an important role in discussing the role of social capital and in highlighting the important link between agency performance and access to basic services (Tendler 1998).

The co-production approach offers a way of effectively delivering services to the poor in a cost-effective way by emphasising the role of community participation in informing broad-based policy formulation and implementation. Since, secondary towns are experiencing the fastest rates of demographic change, being relatively under-developed from an infrastructure standpoint potential for simplified sewage is great. However, for simplified sewage design to take root, higher order institu-

[4] Here Watson's (1995) analysis of condominial sewers in Brazil led him to conclude that the system motivates residents by engaging them in discussions on service level, layout of trunk lines, maintenance arrangements and cost recovery mechanisms.

tional norms and rules require attention. At present in many parts of the developing world, central fiscal transfers constitute a large proportion of revenues of local authorities (municipalities or utilities). There is very little incentive for local plan preparation based on a deliberate search for opportunities for cost-reduction. Instead, central transfers encourage engineers and planners to prepare grander, more expensive plans. Local authorities constantly fear that a failure to develop plans and supporting budgets will translate into less or no central transfers the following year. A large proportion of central transfers actually support overheads like staff salaries and a smaller proportion of the remainder goes to infrastructure; often with no follow-up investment in maintenance. This is an important component of behaviour change required to ensure that capital investments in infrastructure are translated into tangible and continuous improvements in access to services, especially by the poor. In this connection, in Chapter 7, Björkman examines the political nature of budgeting processes and scope for results-based financing instruments of international agencies to effect a change in behaviour.

1.4 Approach Adopted by This Book

This book acknowledges at the outset that there are difficulties inherent in operationalising the MDG concept. A number of facile assumptions have been made about sustainable access to drinking water and connection to sewer networks. Chapter 2 highlights problems like whether it is safe to assume that the poorest of the poor reside in slums and use of terms like reliable versus adequate access. A distinction is seldom made between access to private versus shared water and sanitation services. Further, it has been assumed that sanitation is an 'individual and community level' challenge, which with some investment in awareness raising campaigns and social marketing can be wished away. However, in the absence of reliable information it becomes difficult to test claims of progress or a failure of institutions to deliver services to the poor. We also acknowledge the importance of improvements in assessment capacity: methods/instruments that guide decision-making in developing countries are woefully inadequate in confronting the challenges brought on by the process of urbanisation (Turral 1998). Take for example methods currently in use to measure groundwater recharge, use of cartographic maps to identify boundaries of human settlements or use of the income poverty line to target public programmes at the poor (Scott 1998; Saith 2005). Some have also criticised the MDGs because they are located within a neoliberal straitjacket that ignores issues of structural inequality that characterise relations between the developed and developing world. Of particular relevance to our discussion on water and sanitation services is the distinction between norms and prices. For a good part of the last decade, international development cooperation has been focused on 'getting the institutions right'. One noticeable feature of such a focus, albeit sometimes overblown has been an emphasis on 'getting the price right' to ensure recovery on capital investments. However, such an *arrangement focused view* of service delivery has failed to improve services and ensure compliance of consumers with agreed water tariffs. Sector reform projects the world over preceded on the mistaken belief that once institutions (understood as rules) were established, parties to the contract would comply with them and service delivery would be achieved. However, in many cases some of the behavioural assumptions that shaped a contractarian view of service delivery (such as rational action based on access to information) were misguided. By contrast a *realisation focused view* of service delivery also 'considers what emerges in society, including the kinds of lives that people can actually lead and other influences, including actual behavior/norms' that have a bearing on how institutions mediate service delivery (Sen 2009: 10). Devoid of attention to structural issues, the MDGs discussion has focused instead on furthering a simplistic vision of international development cooperation:

External assistance +
Technological fixes +
Good local governance
= Poverty reduction (Saith 2006: 1167)

1.4.1 Framework for Understanding Water Services

With the objective of outlining a framework that we will employ for a reading of this book, it may be useful to return to some of the questions that arose in the context of Ostrom's discussion of institutional change. 'All rules are nested in another set of rules that define how the first set of rules can be changed. Whenever one addresses questions about *institutional change* it is essential to recognise the following: (i) changes in rules used to order action at one level occur within a currently "fixed" set of rules at a deeper level and (ii) changes in deeper-level rules usually are more difficult and more costly to accomplish, thus increasing the stability of mutual expectations among individuals interacting according to a set of rules' (Ostrom 1990: 51–52). NIE theory emphasised three issues that are of particular relevance to our discussion of water services in developing countries: (1) the notion of change or reform, (2) mutual expectations, and (3) transaction cost of changing a given set of rules. For a long time orthodox theory has viewed policymaking and implementation as a technical problem. 'The implicit assumption is that once a policy that maximises or improves social welfare has been recommended, it will be implemented as designed, and the desired effects will follow' (Dixit 1979: 7). However, issues of reform and credible contracts forming the basis of mutual expectations are infused with political overtones that make policymaking and implementation that much less amenable to solutions that can be prescribed from a technical manual. Success is more likely to be productive when consensus is built gradually through a broad-based process of consultation and deliberation on service delivery options as emphasised by Kurian in Chapter 12.

1.4.2 Institutional Environment

The two behavioural assumptions on which New Institutional Economics is based are bounded rationality (essentially meaning that all complex contracts are unavoidably incomplete because of incomplete information available with rational actors) and opportunism (mere promise unsupported by credible commitments poses contractual hazards). NIE's major contribution has been to explore governance arrangements that mitigate contractual hazards that arise under conditions of bounded rationality and opportunism. Interestingly, the nature and magnitude of these hazards varies: (1) with the attributes of transactions and (2) condition of institutional environment (understood as a combination of formal rules of the game, such as constitutional law, property rights informal rules, customs, traditions, sanctions) (Eggertson 1991). Although NIE takes the institutional environment as given and examines governance with reference to fixed background conditions problems could arise with such a formulation because they overlook concerns as outlined below (Williamson 1996).

- How do investment and the organisation of economic activity change in response to shifts in the condition of the institutional environment? This situation is akin to the situation of the Dutch Water Boards in the aftermath of the war when new forms of wastewater management followed changes in constitutional and collective choice rules that influenced the constitution of water boards and financing of water infrastructure (Chapter 5).
- How can the institutional environment be re-shaped to affect a better micro-analytic outcome (Dorward et al. 2005)? Later on in this volume, Kurian describes how changes in property rights (from state ownership to private land titles) in Laos resulted in adoption of alternative soil and water conservation practices by farmers in the uplands of the Mekong river basin. Interestingly, the study found that the biggest loss produced by either run-off water or by accumulation of sediments outside the field was recorded in the conventional slash and burn system. However, although erosion rates were the highest under the conventional slash and burn system, crop yields were highest under this system. This study highlights a potential trade off between economic efficiency and political feasibility (will farmers adopt alternative practices if crop yields are lower)? Further, if there were flaws in the reform process, are institutional arrangements in place that could remedy them? This question highlights a second important issue of a reform process: credible commitment.

1.4.3 Contractual Hazards and Credible Commitment

Drawing heavily on theories of the state and the firm NIE theory highlighted the issue of credible commitment, which can play out in different ways depending on the institutional environment. Chapter 6 discusses the implications of national policy change on execution of water contracts involving international water companies in Malaysia. Others discussed the issue by referring to categorisation of institutional forms as follows (Ingram and Silverman 2002):

- Public centralised: Characterised by resort to laws, absence of market actors.
- Public but decentralised: Characterised by resort to persuasive power of culture by civil society actors.
- Private but centralised: Characterised by reliance on rules where the chief actor is an organisation (re-organised line department or utility) and where application of business principles applies.
- Private but decentralised: Characterised by presence of norms, the chief actor being social groups and preponderance of inter-organisational networks.

Williamson (1996) combines the discussion of state structures and bureaucratisation to develop a typology of nation states based on the condition of the economy (developing or developed) and condition of the polity (above or below thresholds). Polities are judged based on their capacity to deliver de-facto democratic outcomes reliably, where failures of democracy can take three forms: (1) polity does not possess requisite de-jure democratic features, (2) requisite de-jure features are present but conditions of informal institutional environment (e.g. customs) to support de-facto democracy are lacking, and (3) requisite de-jure and informal institutional environment are present but have been defeated by corruption. It is likely that opportunism can influence the start up of a process of reform but it is most likely to be preceded by a tipping point (examples include war, drought or bankruptcy) that in many cases concludes with a sharp and messy reversal or attempt at one. Witness in this connection the fate of credible commitment in such instances as privatisation of water utilities in Latin America (Savedoff and Spiller 1999). We hypothesise that the cause of credible commitment in situations characterised by incomplete information and opportunism is best furthered in polities with de-jure democratic features and presence of supporting informal institutions. International development cooperation can further the cause of credible commitment where de-jure democratic features are absent or, if present, the informal institutions serve as a drag. Kurian alludes to several of these issues while discussing the potential of aligning better public policymaking and implementation with signals sent out by electoral systems (in public domain) and price (domain of market). The chapter also attempts to distinguish between information gathering under different types of state structure (federal, unitary, coordinated or decentralised), executive governments (majoritarian or consensual), minister–civil servant relations (separate or politicised), and administrative culture (public interest or legalistic).

1.4.4 The Poor, Decision-Making and Path Dependence

An important message of this book is that information is critical to improving accountability of decision-making. Accountability would be enhanced when we have reliable information about the poor: moving away from simple head counts to measures of concentrations, inequalities, geographical distributions of poverty, asset distribution or heterogeneous effects of deprivation that are mediated by factors of class, age or gender (McGee 2004; Sen et al. 2009; Saith 2005; Walle and Gunewardena 2001).[5] 'The way poverty is measured and interpreted has great importance because in circumstances of mass poverty and "near poverty" small statistical variations have large consequences in the magnitudes displayed and implications for design of effective policies to reduce poverty' (Pugh 1997). It is also important to place the bounded nature of information available to decision-makers who are mulling over adoption of a new technology up for public deliberation. (see Chapter 11). Are particular decisions taken because of an absence of information of all available technical options or do decision-makers lack the capacity to decide between options that are presented to them (Mara et al. 2007)? We hypothesise that when decision-makers are not fully aware of all available options or cannot distinguish between them they tend to maintain *path dependence* choosing options that other municipalities or utilities are opting for. Very often, circular arguments may be contrived to conclude that local authorities cannot afford to adopt technical options without the support of fiscal transfers from central authorities (*ministries or line departments*) (Faguet 2004). Consequently, consensus for tariff and pricing models is likely to be low because choice of certain technologies may have been decided based on 'sectional interests' that characterise bureaucracies that thrive on clientelism (Batley 2004). Further, in the absence of a competitive local government system, fiscal transfers can foster dependence on central authorities without necessarily effecting an improvement in service delivery (Boyne 1996). It is therefore presumptive to inquire whether consumers lack the ability to pay when indeed they are unwilling to pay for unreliable services and do not meet standards of acceptable service quality.

1.4.5 Time, Space and Information

In a wide range of situations in developing countries, the state has consistently been unresponsive to the needs of its citizens for reliable, affordable and safe water services. The reasons for such failure are embedded in both formal and informal features of the institutional environment. In the case of countries emerging from colonial rule, public water services were operated by direct state or municipal administrations, subsidised on grounds of equity, but typically with the poorer sections of the population having least access and often having to resort to private markets for their supplies (Batley 2004: 36). The model of direct state provision of services poses strong barriers to reform because along the way a web of patronage relationships involving politicians, bureaucrats and agency staff was developed. Each of these

[5] For an interesting discussion of direct and indirect methods of economic and environmental valuation and their application in examining equity issues related to wastewater management, see Chapter 10.

groups gradually built up buffers of resistance to change: urban residents enjoying subsidised prices, services and employment, politicians with secure vote banks as a result and line departments with expenditure plans to support grandiose infrastructure projects. To challenge the direct state model of service provision is almost tantamount to challenging the very basis of the state. However, the emergence of a network of global cities supported by globalisation and the free flow of information and capital has begun to challenge the above paradigm of power and privilege built around state action. As a result it is now possible to articulate governance challenges from a historical-institutionalist perspective without being overly conscious of price and output considerations that guides new managerial thinking.

Cities experiencing rapid economic change often are part of a network of transnational corporations. Global cities are quickly emerging as critical nodes in the international production of services or manufacturing output (Taylor 1998). The more globalised and digitised operations of firms and markets become, the more their central management and coordination functions become strategic (Sassen 2006). This cross-border network of global cities however exacerbates the separation of power from local politics. Increasingly, the global stage shapes the basis of power in the city through speculation in the market for real estate property. Property prices in cities resonate with speculative impulses transmitted through the medium of the global production chain for services and manufactured output. More importantly, the global stage spurred on by real time information flow alters the speed of change in consumption behaviour through an increased legitimisation of the role of private service providers in sectors like water, health and education (Melchert 2005; Kurian et al. 2009). Unlike changes in consumption behaviour, which shapes the basis of power in the city, territory or space predominates in politics at city scale. One of the consequences of this separation of power and local politics is that reform in sub-national regulation and water management strategies tends to occur slowly and fails to meet rising citizen expectations of reliable service delivery.

The conventional discussion surrounding service delivery takes on new dimensions when viewed from the perspective of ‘a-territorialised’ practice of public administration. If the power of the global market is sharpening the separation of power from local politics, how is the scope of public policy choices of individual cities defined and what is the process by which they are translated into collective action at sub-national scale (Bulkeley 2005; Borja and Castells 1996)? With increasing influence of the global marketplace, are socially marginalised sections of the population becoming effectively disenfranchised in that the process of aggregation of political choices at the national scale overrides their political choices with regard to affordable service delivery? Scholars like Forrest suggested that re-drawing of electoral constituencies could serve to align better signals sent out by the electoral process with decisions related to budgetary allocations (Forrest 2005). In this connection how are voting patterns of the groups who benefited from greater integration of their city in the global production chain been shaped and to what extent are they divergent from a shared view of public welfare (Reich 2007)? ‘We must emphasise however, that while ballots have an important role for the expression of public reasoning, they are not the only thing that matters. The effectiveness of an electoral system depends crucially on processes that support the balloting process – free speech and access to information' (Sen 2009: 326–27).

1.4.6 From Development Aid to Cooperation

External aid to low-income countries as provided in explicit concessional resource allocations to increase welfare in those countries built up a veritable arsenal of instruments, strategies, goals and vision of which the MDGs are but one expression. Aid relationships are also an expression of both moral and political commitments: welfare and governance reform respectively. Some pointed out that a priori arguments exist for political conditionality, which includes an obligation that recipients use aid for purposes of reducing poverty (Gasper 1999: 11). However, heavy conditional lending in the past only resulted in disastrous developmental outcomes as is evident from: (1) structural adjustment programmes and (2) an emphasis on good governance, human rights and democracy as conditions for aid disbursement. The first wave of conditional lending based on structural adjustments led to a wave of water utility privatisations with adverse consequences for distribution of assets, employment, prices for services and access of the poor to critical services. Empirical evidence from UK, Russia and Czech Republic to Bolivia shows that privatisation resulted in adverse distributional effects (Birdsall and Nellis 2003). More recently, Sector Wide Approaches[6] and results-based financing strategies have begun emphasising institutional reform based on a view of development cooperation as co-determination involving donors and governments in poor countries (World Bank 2009). A serious attempt has been made in this connection to reduce *fungibility* ensuring that growth of other expenditures (e.g. overheads) or sectors does not increase because of aid transfers. From the point of view of improving service delivery, this approach addresses an important issue head on, the challenge of accountability in the budgetary process. This approach moves away from viewing development cooperation as engaged with infrastructure (of which it amounts to only a drop in an ocean of need) to one that focuses on people, organisations and building capacity for learning by doing.

There are important lessons to be drawn on reform processes that have been undertaken in the past. Structural adjustment lending set the course for shrinking budgets, staff cuts, higher tariffs, contracting out and privatisation. However, in the

[6] Sector Wide Approaches (SWAPs) are designed to establish a situation in which all public support (government or donor) to a sector is informed by a common vision and strategy, implemented by a common management framework with increasingly accountable and effective institutions, and based around a public expenditure programme (Gilling et al. 2001: 308). A prerequisite for an effective SWAP is a coherent Medium-Term Expenditure Framework (MTEF) that provides a basis for ensuring that government policies are consistent with fiscal policy, that resource allocation is informed by government priorities and that resources are used efficiently and effectively. At the same time, an effective MTEF establishes norms that encourage a sector to develop plans within financial limits that are closely aligned with policy objectives.

water sector the state was to have a continuing role in shaping the course of reform. This continuing role took two forms: radical reform involving transfer of assets to private sector and incremental reform within the public sector. In the latter case, sector administrators and professionals played a strong role in furthering reform or in halting it altogether (Batley 2004: 50). Radical reforms challenged the control of professional water supply engineers and public administrators, in favour of the private sector and financial managers. It is important to note here that two of the successful cases of radical reform in the water sector were politically driven. The newly elected President Carlos Menem pushed through the 30-year Buenos Aires water supply concession. Likewise, a newly elected President in the country also pushed through the famous Manila water supply reforms. Water professionals on the other hand often led incremental water sector reforms. These reform measures resulted in retention of existing professional (engineering) control while freeing agencies from constraints of having to report to government. For example, with support from The World Bank, the professional staff of the Department of Water Resources in Uganda successfully ensured that state water supply organisation was corporatised. However, a similar proposal to turn the Sri Lanka National Water Supply and Sewerage Board into a consumer-oriented, cost conscious organisation, with USAID support, floundered because of resistance of the engineers' lobby and politicians at the central government level. Nevertheless, the important point remains that the first wave of experience of reform did set the course for a second round of reforms that paid greater attention to principles of integration, subsidiarity and decentralisation. For example, the earlier round of utility privatisations in Argentina resulted in improved government capacity for negotiation leading to clearer contracts. With a view to overcoming opposition to private sector participation, Aguas Argentinas, the company that held the water supply concession, ensured early water concessions to previously excluded poorer populations by cross-subsidies from other water consumers. It also improved conditions of employment of staff transferred from the public sector water company, and worked with NGOs and small-scale providers to build infrastructure and extend services (see Chapter 2 for an illuminating discussion).

1.4.7 Service Delivery Reform in an Inter-connected World

What becomes clear from the above discussion is that international development cooperation played an important role in facilitating reform in service delivery. It is also important to note that reform either of the radical or incremental variety usually did not appeal to the popular imagination. Managerial reforms, decentralisation of internal management contracting out of functions rarely became sources of heated discussion or popular debate until they affected the distribution of benefits and costs among parties involved (Batley 2004). Discussions of reform design remained within the bureaucratic arena. In many cases reform design was actually achieved through the initiative of the president and key ministers, particularly ministers of finance with support from the core central agencies associated with the political leader such as the public service commission and head of the civil service. However, when it came to reform implementation, politicians outside the core executive, sector ministers and parliaments played a bigger role in furthering the speed of reform or in contesting its overall direction. It may appear from the above discussion that international development cooperation played an important role in facilitating reform of a top-down variety. However, it has not been limited to furthering top-down institutional reform. Bilateral donors like DFID also played a role in facilitating bottom up approaches to reform by addressing some of the tensions that exist between a universal and a particular view of basic social needs. For example, the DFID Peru office confronted a situation where the rights of self-determination of the collective, in this case of the nation, came into direct conflict with the rights of groups and individuals within that collective (Kabeer 1994: 20). The approach that DFID took was to reconcile its own agenda with that of the government by invoking internationally agreed conventions to which Britain and Peru were both signatories. By demonstrating a commitment to an international framework of ethics that applies to citizens and taxpayers in both donor and those of aid recipient countries, legitimacy for development cooperation can be considerably enhanced (see Chapter 2 for an interesting discussion of the trajectory of the development discourse).

One of the outcomes of development cooperation that focuses on supporting bottom-up incremental reform has been to highlight the gap that exists between formal citizenship (a status that confers rights on individuals based on membership in groups contained within boundaries of a nation state) and substantive citizenship (an egalitarian framework for social relations at all levels and recognition of the other as a subject bearer of valid rights and legitimate interest in improved delivery of public services (Kabeer 1994: 22). It has been realised that collective action in support of transformative processes can be organised by those whose exclusion in the first place occurs because of their lack of organisational power. In some cases, collective action may take the form of allies within nation-states who may act on their behalf. In others, it may take global forms of solidarity. Transnational municipal networks offer one example of global forms of solidarity. As part of the Climate Change Programme (CCP), municipalities within the CCP network undertake emissions monitoring and modelling in line with established protocols. They report on progress with targets and protocols, as well as benchmarks and rewards progress (Bulkeley 2005: 895). Through such practices a new authority for governing climate change has been established, which does not reside at any particular scale or in any particular territory. The governing practices of particular members of the network are not confined to the municipality within which they are initiated. For example, New Castle, Australia, established the CCP nationally and has since undertaken a number of initiatives addressing energy efficiency and green energy. Workshops, road shows and publications have been produced to assist in creating norms for local governments in climate protection in Australia. Another example is Denver, Colorado, which initiated the Green Fleets Program to reduce greenhouse gases from municipal vehicles. In February 2000, a representative of the Denver Green Fleets committee travelled to Bangkok to advise officials there as they developed their own programme. Other examples include those of Dutch and Canadian municipalities working in concert with their counterparts in developing countries to improve operations of water utilities. In all these examples, individual agency is exercised, strengthening in the process horizontal versus purely vertical forms of citizenship involving hierarchical relations between individuals and states. The example of Global City Indicators Facility (GCIF) that endeavours to encourage municipalities in both developed and developing countries to volunteer information on service delivery to create a cross-country comparative benchmark is also noteworthy in this connection (McCarney 2009).

1.4.8 Incremental Reform: Concluding Thoughts

The Harrod–Domar model that shaped aid flows in the 1970s highlighted two issues: (1) recipient countries had no incentive to save but to spend on infrastructure and (2) recipient countries had no incentive to improve returns on investment through periodic maintenance, increasing service coverage or improving service quality. The MDG challenge of improving access to water services is essentially focused on addressing the behavioural assumptions that guide much of the infrastructure spending and aid flows to developing countries. The assumptions relate to getting the institutions/prices right and enhancing efficiency of water utilities. Neither of these assumptions has proven useful in improving reliability, affordability or quality of water services, especially for the poor. The Lindblomian thesis of ‘incrementalism’ by distinguishing itself from the means/end rationality paradigm of public policymaking offers us a way out of this impasse in developing thinking (Gregory 1997). Lindblom emphasised that the selection of appropriate means (e.g. technology) for achieving policy objectives (e.g. connection to sewer or water supply source) does not proceed based on rational selection among available choices. Second, given the fact that policymaking involves a political process (*negotiation and bargaining*), one cannot expect that decision-makers will always make economically rational decisions (e.g. choosing technical options that offer the highest benefit-cost ratio), an issue that both Björkman (Chapter 7) and Reddy and Kurian (Chapter 10) allude to in their chapters. Lindblom argues that incremental politics is a suitable instrument for grappling with our policy problems by offering a way of ‘smuggling’ changes into the political system. In the context of our discussion, one change that merits particular attention relates to strategies for financing water infrastructure. At present norms the world over encourage continued dependence of inter-governmental and or aid flows without commensurate monitoring of service delivery outcomes[7] (Lindblom and Cohen 1979).

[7] Strategic objectives focused on monitoring service delivery outcomes could include modalities related to *information* (collection, sharing, analysis, decision-making and coordinated action), *plan prioritisation* (staffing, staff skills or fund allocation) and *mechanisms that reward local governments* (for making services more affordable or reliable).

A robust political process could go a long way in ensuring that policymaking remains a continuous process of adjusting the 'value system' to the 'reality system'. It then becomes more realistic to talk of policy goals not as problems to be solved once and for all, but as norms and standards that are maintained and modified over time (Gregory 1997: 188). This approach has several implications for our analysis: (1) decentralised planning is important to prioritise what proportion of resources will be employed to address what particular development challenge, (2) information is key in enhancing accountability of decision-making processes by placing for public debate/scrutiny the use of discretionary instruments[8], and (3) local level planning is an iterative process rather than a sequential one providing critical inputs to the process of public policy formulation, implementation and monitoring. In this sense, 'public policy is being formed as it is being executed, and executed as it is being formed (ibid 1997: 188). From a reading of this volume three possible reform pathways may be discernable:

- Radical donor assisted reform (e.g. *water privatisations of the* 1980s) in response to a national crisis
- Design of radical reform measures based on political mandate received during an election (e.g. *Buenos Aires and Manila water sector reforms*) that meets with resistance at implementation stage
- Gradual reform with possibility of capture by special interest groups (e.g. *water engineers lobby in Sri Lanka*)

The 'incremental' nature of reforms must not be examined narrowly by the success or failure of particular 'events' as outlined above but rather by whether the polity would accommodate a reconfiguration of political forces in support of the next generation of reform steps. In this regard an assessment of success or failure of intergovernmental/aid flows in facilitating incremental change in policy formulation and implementation would benefit from adopting a comparative framework (based on locally identified indicators of quality, affordability or service reliability) as opposed to an evaluation framework that is guided by transcendental policy goals (examples include: use of a dollar a day to identify poor households and norm of 10% community contribution towards capital costs of water projects) (Sen 2009). Real time information collected employing a comparative framework besides highlighting incremental reform processes within the public sector could also highlight processes involving citizens outside the reach of public programmes: what are their coping strategies in relation to other groups? What options exist for governments to intervene in the interest of providing affordable and reliable services to such groups? For it to influence policymaking, such an approach to information gathering must be multi-directional in nature (involving information flows between citizens and governments and vice versa) and is predicated on transparency of decision-making processes within the public sector (Mosse et al. 1998; Lane 2000).

[8] Lipsky argued that street level bureaucrats make policy in two respects: by exercising discretion in decisions about citizens and with whom to interact and, when examined in concert ,their individual action adds up to agency behaviour (Lipsky 1980).

1.5 Structure to the Message

Urban water supply coverage in developing countries expanded over the course of the last half a century. However, infrastructure coverage has not been matched by a growth in households connecting to water supply and sewer networks. Very often institutional factors made access to water supply connections by marginalised groups and households difficult. Growing recourse to private water supplies in cities ensured that wastewater generation continues to grow. However, wastewater collection, transport, treatment and disposal services, involving large capital investments remained firmly under governmental control. Forces of globalisation compounded the challenges facing the public sector in delivering water and sanitation services. An institutional vacuum emerged at the peri-urban interface that spells doom for large urban populations; even those relying on private water supplies are being threatened by contamination of water supply sources like rivers and groundwater.

Globalisation is a double-edged sword as is evident from the role that freer flow of information had in placing the spotlight on the widening gap between reform of sub-national regulation and water management strategies and rising citizen expectations of reliable service delivery. International development cooperation has demonstrated an ability to shape processes of institutional reform through support for incremental or gradual change of governance structures. International development cooperation can play a more important role in reconciling the apparent contradictions of a top-down process of planning and programme implementation through support for struggles of marginalised groups and individuals for improved service delivery. In this connection, this book argues that with coordinated investments in data collection, sharing, analysis, decision-making arrangements and mechanisms for coordinated action, international development cooperation could go a long way in enhancing accountability of decision-making processes.

This book addresses some of the challenges confronting such a project through analysis of case studies from Africa, Asia and South America. The first section of this book outlines a framework to examine environmental and developmental challenges that exist at the interface of large cities, smaller towns and the rural hinterland. Allen in Chapter 2 discusses the scope for co-production by critically analysing the category of public and private through examples of service provision by informal actors. The chapter by Rashid-Sally and van Rooijen examines the issue of inter-sectoral competition for freshwater resources from the perspective of the physical water cycle. The chapter examines the concept of the urban water footprint and explores potential for freshwater swaps through effective institutional interventions in pursuit of wastewater reuse and resource recovery. In Chapter 2, Dietz explores the links between climate risks and governance challenges of municipalities, with a focus on megacities, taking a global and comparative outlook. First the world's megacities are positioned in their geographical and economic contexts. With regard to geography contexts, three criteria are used: location vis-à-vis coasts, climate zones and national water stress. With regard to the economic context, two criteria are used: level of national income per capita and recent economic growth experiences.

The second section of the book addresses water and sanitation services from the point of view of infrastructure, policy and co-provision. Salomé's chapter in this section provides a useful contrast to institutional development for water and sanitation service delivery in The Netherlands. Kurian's Chapter 6 on financing the MDGs examines Dutch experience in financing urban sanitation interventions through recourse to the private sector. The important issues of building capacity for plan prioritisation are discussed and a case is made for behaviour change in city planning and donor financing of sanitation investments. In Chapter 7, Björkman reviews the theory and practice of budgeting and critically examines the role of donor-supported interventions aimed at supporting sector-wide approaches and budget support to local governments. Kurian examines the issue of information flows with the objective of exploring pathways for design of incentive systems that support processes of bottom up planning.

The final section of this book includes a collection of chapters that focus on assessment methods that support evidence-based decision-making. Written based on case studies of water supply and wastewater management in developing countries, the section discusses the challenges of formulating policy guidance under conditions where information is unavailable or at best unreliable. Reddy and Kurian review both direct and indirect methods of economic and environmental valuation that can be employed to guide decision-making on technology choice and to circumvent social and environmental externalities. Blokland examines the evolution of the concept of benchmarking and reviews the challenges of applying the same to monitor delivery of water services in developing countries. The section concludes with an introduction to planning clinics, an approach focused on developing a vision of reform, concrete development goals, action plans and performance indicators in support of tangible and sustained improvements in delivery of water and sanitation services.

References

Allen, A., Davila, J., & Hoffman, P. (2006). *Governance of water and sanitation services for the peri-urban poor: A framework for understanding and action in metropolitan regions*. London: University College London, Development Planning Unit.

Bartlett, S. (2003). Water, sanitation and urban children: the need to go beyond "improved" provision. *Environment and Urbanization, 15*, 57.

Batley, R. (2004). The politics of service delivery reform. *Development and Change, 35*(1), 31–56.

Bhagwati, J. (2010). Banned aid: why international assistance does not alleviate poverty. *Foreign Affairs, 89*(1), 120–125.

Birdsall, N., & Nellis, J. (2003). Winners and losers: assessing the distributional impact of privatization. *World Development, 31*(10), 1617–1633.

Borja, J., & Castells, M. (1996). *Local and global: Management of cities in the information age*. London: Earthscan.

Boyne, G. (1996). Competition and local government: a public choice perspective. *Urban Studies, 33*, 703–721.

Bromley, D. (1992). The commons: property and common property regimes. In D. Bromley (Ed.), *Making the commons work* (pp. 3–16). San Francisco, CA: Institute of Contemporary Studies.

Bryant, R. (1992). Political ecology: an emerging research agenda in third world studies. *Political Geography, 11*, 123–136.

Bulkeley, H. (2005). Reconfiguring environmental governance: towards a politics of scales and networks. *Political Geography, 24*, 875–902.

Dasgupta, S., Deichmann, U., Meisner, C., & Wheeler, D. (2005). Where is the poverty-environment nexus? Evidence from Cambodia, Lao PDR and Vietnam. *World Development, 33*(4), 617–638.

Dixit, A. (1979). A model of duopoly suggesting a theory of entry barriers. *Bell Journal of Economics, 10 (Spring)*, 20–32.

Dorward, A., Kydd, J., Morrison, J., & Poulton, C. (2005). Institutions, markets and economic coordination: linking development policy to theory and praxis. *Development and Change, 36*(1), 1–25.

Eggertsson, T. (1991). *Economic behaviour and institutions*. New York: Cambridge University Press.

Faguet, J. (2004). Does decentralization increase government responsiveness to local needs? Evidence from Bolivia. *Journal of Public Economics, 88*, 867–893.

Ferguson, B., & Navarrete, J. (2003). A financial framework for reducing slums: lessons from experience in Latin America. *Environment and Urbanization, 15*, 201.

Fischer, J., et. al. (2006). Learning from the Past- Delivery of Water and Sanitation Services to the Poor in 19th Century Britain, Background paper for WELL Briefing Note. 9, WELL Resource Centre, Loughborough University, U.K.

Forrest, B. (2005). Information sovereignty and GIS: the evolution of “communities of interest” in political redistricting. *Political Geography, 23*, 435–451.

Gasper, D. (1999). Ethics and the conduct of international development aid: charity and obligation. Working Paper No. 297. The Hague: Institute of Social Studies.

Giddens, A. (1999). *The consequences of modernity*. Cambridge/Oxford/Boston, MA: Polity Press.

Gilling, J., Jones, S., & Duncan, A. (2001). Sector approaches, sustainable livelihoods and rural poverty reduction. *Development Policy Review, 19*(3), 303–319.

GoI. (2006). Towards faster and more inclusive growth-an approach to the 11th five year plan, planning commission, Government of India (GoI), New Delhi.

Gregory, R. (1997). Political rationality or incrementalism? In M. Hill (Ed.), *The policy process: A reader* (pp. 175–191). Essex: Prentice Hall.

Hanemann, M. (2000). Price and rate structures. In D. D. Baumann, J. J. Boland, & W. M. Hanemann (Eds.), *Urban water demand, management and planning* (pp. 137–179). New York: McGraw-Hill.

Holling, C. (1986). The resilience of terrestrial ecosystems: local surprise and global change. In W. Clark & R. Munn (Eds.), *Sustainable development of the biosphere* (pp. 292–317). Cambridge: Cambridge University.

Ingram, P., & Silverman, B. (2002). *The new institutionalism in strategic management*. London: Elsevier Science.

IWMI. (2007). Understanding the Drivers of Wastewater Agriculture in Developing Countries: Results from a Global Assessment. Colombo. Comprehensive Assessment Research Report Series, International Water Management Institute

Iyer, P., et al. (2005). *Rural water supply, sanitation and budget support: Guidelines for task teams*. Washington, DC: The World Bank.

Kabeer, N. (1994). *Inclusive citizenship: Meanings and expressions*. New Delhi: Zubaan.

Keohane, R., & Ostrom, E. (1995). Introduction. In R. Keohane & E. Ostrom (Eds.), *Local commons and global interdependence: Heterogeneity and cooperation in two domains*. Thousand Oaks, CA: Sage.

Krishna, A. (2004). Escaping poverty and becoming poor: who gains, who loses and why? *World Development, 32*(1), 121–136.

Kurian, M., Reddy, V., Van Dijk, M., Dietz, T. & Brdjanovic, D. (2009). Adapting to climate variability: productive use of municipal wastewater as a risk management option in peri-urban regions. *Proceedings of Urban Research Forum.* Marseille: The World Bank, 28–30 June.

Lall, S., & Pietrobelli, C. (2002). *Failing to compete: Technology development and technology systems in Africa*. London, UK: Edward Elgar.

Lane, J.-E. (2000). *The public sector: Concepts, models and approaches*. London: Sage.

Lindblom, C. E., & Cohen, D. K. (1979). *Usable knowledge: Social science and social problem solving*. New Haven, CT: Yale University Press.

Lipsky, M. (1980). *Street level bureaucracy*. London: Sage.

Mara, D., Drangert, J., Anh, N., Tonderski, A., Gulyas, H., & Tonderski, K. (2007). Selection of sustainable sanitation arrangements. *Water Policy, 9*(2007), 305–318.

Markandaya, A., & Richardson, J. (Eds.). (1992). *The Earthscan reader in environmental economics*. London: Earthscan.

McCarney, P. (2009). Governance of city services: the global city indicators facility (GCIF). *Key Note Address.* Urban Research Forum. Marseille: The World Bank, 28–30 June.

McGee, R. (2004). Constructing poverty lines in Uganda: a multi-disciplinary perspective. *Development and Change, 35*(3), 499–523.

Mehrotra, S. (2002). International development targets and official development assistance. *Development and Change, 33*(3), 529–538.

Melchert, L. (2005). The age of environmental impasse? Globalization and environmental transformation of metropolitan cities. *Development and Change, 36*(5), 803–823.

Minogue, M. (1983). Theory and practice in public policy and administration. *Policy and Politics, 11*, 63–85.

Mosse, D., Farrington, J., & Rew, A. (1998). *Development as process: Concepts and methods for working with complexity*. London: Routledge.

Moyo, D. (2009). *Dead aid: Why aid is not working and how there is a better way for Africa*. New York: Farrrar, Straus & Giroux.

North, D. (1990). *Institutions, Institutional Change and Economic Performance: Political Economy of Institutions and Decisions*, Cambridge University Press.

Okun, D. (1988). The value of water supply and sanitation in development: an assessment. *American Journal of Public Health, 78*(11), 1463–1467.

Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. New York: Cambridge University Press.

Ostrom, E. (1996). Crossing the great divide: co-production, synergy and development. *World Development, 24*(6), 1073–1087.

Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. *Science, 325*(5939), 419–422. July.

Pollitt, C. & Bouckaert G. (2000). *Public Management Reform: A Comparative Analysis*. Oxford: Oxford University Press.

Pugh, C. (1997). Poverty and progress? Reflections on housing and urban policies in developing countries, 1976–96. *Urban Studies, 34*, 1547–1595.

Reich, R. (2007). *Supercapitalism: The transformation of business, democracy and everyday life*. New York: Knopf.

Rijsberman, F. (2004). Sanitation and access to clean water. In B. Lomborg (Ed.), *Global crises, global solutions*. New York: Cambridge University Press.

Saith, A. (2005). Poverty lines versus the poor: method versus meaning. *Economic and Political Weekly,* 22 October, 4601–4610.

Saith, A. (2006). From universal values to millennium development goals: lost in translation. *Development and Change, 37*(6).
Sassen, S. (2006). *Territory, authority and rights: From medieval to global assemblages*. Princeton, NJ: Princeton University Press.
Savedoff, W., & Spiller, P. (1999). *Spilled water: Institutional commitment in the provision of water services*. Washington, DC: Inter-American Development Bank.
Scoones, I. (1999). New ecology and the social sciences: what prospects for a fruitful engagement? *Annual Review of Anthropology, 28*, 479–507.
Scott, J.C. (1998). Seeing like a State : *How Certain Schemes to Improve the Human Condition have failed*, New Haven, CT: Yale University Press
Sen, A. (2009). *The idea of justice*. London: Penguin.
Sen, G., Iyer, A., & Mukherjee, C. (2009). A methodology to analyze the intersections of social inequalities in health. *Journal of Human Development and Capabilities, 10*(3), 397–415.
Taylor, P. (1998). Radical political geographies. In J. Agnew, K. Mitchell, & G. Toal (Eds.), *A companion to political geography*. NJ: Blackwell.
Tendler, J. (1998). *Good government in the tropics*. Baltimore, MD: John Hopkins University Press.
Turner, M. (1989). Landscape ecology: the effect of pattern on process. *Annual Review of Ecological Systems, 20*, 171–197.
Turral, H. (1998). *Hydro-logic: Reform in water resources management in developing countries with major agricultural water use: lessons for developing nations*. London: Overseas Development Institute.
UNDP. (2006). *Water scarcity and human development*. New York: Human development report, United Nations Development Program.
Walle, D., & Gunewardena, D. (2001). Does ignoring heterogeneity in impacts distort project appraisals? An experiment for irrigation in Vietnam. *The World Bank Economic Review, 15*(1), 141–64.
Watson, G. (1995). *Good Sewers Cheap? Agency- Customer Interactions in Low- Cost Urban Sanitation in Brazil.* Washington, DC: The World Bank, Water and Sanitation Division.
Wester, P., & Warner, J. (2002). River basin management reconsidered. In A. Turton & R. Henwood (Eds.), *Hydro-politics in the developing world: A Southern African perspective* (pp. 61–71). CIP: University of Pretoria.
Williamson, O. (1996). *The mechanisms of governance*. New York: Oxford University Press.
World Bank. (2004). *Making services work for the poor*. Washington, DC: World Development Report.
World Bank. (2009). *Output based aid: A compilation of lessons learned and best practice guidance*. Washington, DC: GPOBA and IDA-IFC Secretariat.

Chapter 2
Neither Rural nor Urban: Service Delivery Options That Work for the Peri-urban Poor

Adriana Allen

Abstract This chapter examines why it is necessary and relevant to overcome the rural–urban divide in order to obtain a better grasp of the water and sanitation (WATSAN) needs of the peri-urban poor. While explicit concern with the nature and impact of rural–urban linkages on people's livelihoods and quality of life is relatively recent, assumptions about the role of urban and rural areas and their relationship are implicit in almost all development theories. Aimed at taking the reader beyond the rural–urban dichotomy and public–private controversy, the discussion explores the multiple practices and arrangements by which the peri-urban poor actually access water and sanitation on the ground. The concept of 'service co-production' is presented in this context as a means to explore meaningful institutional mechanisms to support their multiple practices and arrangements and their role and rights as key agents of change. The chapter concludes with an examination of how the previously discussed conceptual developments and empirical evidence can aid the identification of service delivery options that work for the peri-urban poor.

2.1 Introduction[1]

It seems customary for discussions on the water and sanitation challenge to start by highlighting that the world is undergoing a dramatic urban transition. However, in the developing world, rural–urban migration and a rural–urban poverty shift

[1] This chapter draws on two previous documents produced by the author in collaboration with Pascale Hofmann and Hannah Griffiths entitled: *Rural–Urban Linkages for Poverty Reduction* (Allen et al. 2007) and *Moving down the ladder: Governance and sanitation that works for the urban poor* (Allen et al. 2008) and on the findings of a three year research project entitled 'Governance of

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(at least in population percentages) alone do not punctuate such transition. There is also significant transformation of the linkages between urban and rural areas, the way in which rural and urban households and individuals straddle between these two worlds and, the causes of poverty and ways out of it. The central argument of this chapter is that these processes require a reappraisal of how rural–urban linkages work for the peri-poor, and how they affect the task of meeting their water and sanitation needs in order to examine what policy revisions and initiatives are underway and might be necessary.

The empirical literature that supports the discussion is incipient but fast growing. Thus, the purpose is to highlight a number of case studies selected to aid the process of rethinking service delivery options and their governance implications in the peri-urban interface (PUI), where many changes in urban–rural flows materialise, leading to problems and opportunities for peri-urban communities and for the sustainable development of adjacent rural and urban systems.

Some estimate approximately 45% of the 1.4 billion people who will join the world urban population by 2020 will live in peri-urbanising areas (Webster 2004). Given that poverty rates are often higher in peri-urban areas than in core urban areas, the process of peri-urbanisation relates with the peri-urbanisation of poverty closely. Despite the importance of the PUI in poverty alleviation and reduction, the notion of peri-urban is elusive and still poorly captured in demographic statistics, which arbitrarily lump peri-urban dwellers as either rural or urban population, depending on the jurisdictional, population size or density variables applied in census surveys. In this chapter, we refer to the 'peri-urban interface', as a specific context where both rural and urban features co-exist, in physical, environmental, social, economic and institutional terms (Allen 2003; Dávila 2005; McGregor et al. 2006).

Typically, provision of vital environmental and socio-economic services in the PUI are neglected by government agencies because of overlapping jurisdictions along with poor clarity and coordination of management responsibilities. Rapid land use change, land speculation and uncertain land tenure coupled with a mismatch with growing population and infrastructure requirements are typical characteristics. Whether migrants seeking alternatives in light of declining agricultural employment is driving peri-urbanisation or it is induced by large public investments; or by outwards relocation of slum communities propelled from core urban areas by market forces, an influx of newcomers and long-term residents makes community building, consolidation and, negotiation with local government and formal utility more difficult than in urban or rural areas.

The rural–urban dichotomy, which often colours characterisations of the water needs of the poor, assumes that notions of urban and rural statistically and qualitatively

water and sanitation in the peri-urban interface (PUI) of metropolitan regions'. This project was conducted with Julio Dávila and Pascale Hofmann at the DPU in collaboration with: Faculty for Social Sciences (FLACSO) in Mexico City, Centre for Development Studies (CENDES) in Caracas; Citizens Alliance for Sustainable Living (SUSTAIN) in Chennai; University College of Lands and Architectural Studies (UCLAS) in Dar es Salaam and the Urban Studies and Training Institute (UTI) in Cairo. Sincere thanks to them and to the editors of this book for their valuable comments and suggestions. The author remains, of course, solely responsible for the outcome of this chapter.

explain the conditions of those who lack access to adequate provisions. Similarly, the dominant conception of governance of water and sanitation supply remains expressed in terms of the 'great public–private divide' (Ostrom 1996). Like the rural–urban dichotomy, this divide creates a conceptual trap that fits within disciplinary and professional boundaries but fails to capture the spectrum of practices and arrangements through which the peri-urban poor access basic services.

2.2 Zooming Out: Beyond the Rural–Urban Divide

Since the 1950s, the development debate oscillated between an urban and a rural bias and the hegemony of these biases has had a significant impact upon development policies and aid priorities (Jerve 2001). Despite the shift in focus over time from a spatial definition (assuming a central urban point surrounded by a de-densifying periphery) to a relational focus on the flows between rural and urban areas, recent developments in theory and real world contexts show the need to reassess the changing nature of the rural–urban divide. As Douglass (1998) puts it, 'While policy initiatives toward rural–urban linkages have remained attached to the simple urban diffusion and industrial growth pole models, the basic parameters of rural–urban relations and, by extension, the prospects for poverty alleviation have been fundamentally transformed by new forms of economic organisation, technological change and globalisation' (cited in Adell 1999: 3).

In the 1950s and 1960s, under the modernisation paradigm, the early work of Rostow (1960) and Lewis (1954, 1979) prescribed links between rural and urban areas or, more precisely, between rural-based agricultural production and urban-based industrialisation, as a necessary condition for development, suggesting that the former plays a key role in supporting the latter in the modernisation transition. This model of economic development portrays an extractive urban-biased relationship between city and countryside as a necessary condition for diffusion of economic modernisation throughout an entire country. Myint's (1964) dual economies theory, which distinguishes between Western capital-intensive production and backwards rural-based labour intensive sectors, presents a similar notion. Here the central assumption is that the modern urban sector is the engine for economic growth, which will eventually diffuse modernisation outwards from the core urban areas into the rural hinterland and beyond. This pro-metropolis, anti-rural hypothesis remains in contemporary policies that advocate development investments that target the urban and industrial sectors or, those productive sectors where the expected return is higher (Lynch 2005).

Numerous 'growth pole' policies[2] all over the developing world followed the modernisation paradigm in the 1950s and 1960s, focusing public investments on stimulating the industrialisation of designated urban centres. Little parallel attention

[2]'Growth pole' policies are concerned with encouraging multiplier effects around those areas where economic growth is concentrated, especially in regions of industrial decline or stagnation.

went towards promotion of rural development. Instead, national-led initiatives aimed at restructuring the organisation of the rural agriculture sector and its means of production (labour, land and capital) through policies concerned with land reform, village resettlement and reform of the rural production sector. By the late 1950s, failure of the expected trickle-down effect from industrialising urban areas failed to reach the rural peripheries, and disillusion with the modernisation paradigm led to a policy shift. Based partly on the core-periphery and spatial polarisation models, the emerging field of regional planning called for renewed attention to the rural-agricultural sector and to reverse 'parasitic' and exploitative relations in which the urban cores accrued benefits at the expense of rural areas, draining them of key human, natural and capital resources. This shift in development thinking and planning marks a crucial point in terms of gaining adherence to a negative view of urbanisation and of rural–urban linkages. As Douglass argues, from this perspective, 'Cities actively exploited rural areas, with rural poverty and rural–urban migration not emanating from the isolation of rural areas from urban areas, but rather from the tightening of rural and urban linkages' (2006: 125). In practical terms, this perspective led to renewed emphasis, national investments and aid on integrated rural development approaches (Lynch 2005).

None of the shifts in development thinking and practice described above was absolute. On the one hand, a positive view argued that the polarisation effects of urban-led growth on rural areas were only likely to be felt in the 'early stages of development', giving way to a more even distribution of development across national territories. Under this hypothesis, one might expect 'polarisation reversal' to occur in tandem with the development of more mature spatial systems (Williamson 1965). Lipton's influential thesis on the urban bias in rural development (Lipton 1977), which argues that the state acts on behalf of urban-based groups, benefiting them through investment, tax and pricing policies at the expense of their rural counterparts, represents the negative stand. The urban bias creates and expands disparities between the city and the countryside, perpetuates economic inefficiency and inhibits development. From this perspective, urban growth 'stands for a "perverse" stream of migration, sapping the economic strength of the hinterland without correspondingly large benefits to urban production. Instead of being a sign of development, urbanisation is a sign of economic illness' (Wellisz 1971: 42). Dependency theorists have elaborated on how global chains of economic power perpetuate not only rural poverty but also a reserve labour army of informal urban workers (Portes and Walton 1981; Portes 1985).

The shifts between urban and rural bias in development theory led to substantial separation between rural and urban planning. In the 1970s and 1980s, increased awareness about the need to bridge rural and urban development resulted in a number of influential approaches, which paid specific and explicit attention to rural–urban interactions. These included the 'urban functions in rural development' approach (UFRD) (Rondinelli 1979) and the 'agropolitan' approach (Friedmann and Douglass 1975). Rooted in central place theory, the UFRD approach focuses on promoting the growth of small towns as potential engines of regional economic growth. Several authors (Douglass 1998; Tacoli 2006) characterised these attempts as a disguised form of modernisation urban bias, arguing that mechanistic applications of central place theory have marginal effect on the promotion of reciprocal rural–urban linkages. This approach has been challenged most for assuming a direct correlation between town size, urban functional diversity and positive developmental effects on rural areas. The agropolitan approach also aimed at linking rural and urban development by strengthening horizontal relations at the local level through political and administrative decentralisation and democratisation in support of diversified agricultural production. Despite only partial, practical application, agropolitanism has influenced arguments for the need to promote decentralisation and democratisation in regional development planning.

Douglass (1998) revisited the question of how to promote two-way positive interactions between urban and rural development, arguing for a regional network/cluster approach. Unlike previous models, this approach aims at overcoming the dichotomisation of urban and rural planning and the aspatial and/or hierarchical prescriptions characteristic of the above approaches. Douglass' approach has three main characteristics. Horizontal and complementary promotion of relations within networks of villages, towns and cities allows many variations found in rural–urban linkages. Networks and clusters are not to be defined in the abstract, but identified and nurtured based on existing links and flows of goods and people. This approach favours a wider spatial scale and more complex and economically diverse network of settlements than the single town-hinterland relation often advocated under the growth pole model. At the core of this approach is a better understanding of the flows and linkages between rural and urban areas and of the potential for combining their positive impact by promoting reciprocal interactions.

2.3 Emerging Landscapes in the Rural–Urban Continuum

The developing world is facing a dramatic urban transition, but not necessarily a transition to full urban status in which urbanisation spreads transforming the countryside. Rather a process of intensification of mutual rural–urban interactions leading to still poorly understood spatial, socio-cultural, demographic, economic and environmental realities. Potter et al. (2004) argue that 'geographies of development' are about relationships between people, environment and places in different locations, but 'the nature and relative significance of these relationships are changing constantly, both through time and space, and are themselves determined to a large extent by complex movements and flows of people, commodities, finance, ideas and information' (319).

The rural–urban dichotomy appears unable to explain emerging territorial landscapes, where geographical borders of rural and urban intermingle to such a degree that distinguishing between them is difficult. Montgomery et al. (2004) highlight that current findings from demographic research remain inadequate to show the scope of urban transformation (including restructuring production, social and economic fragmentation and, spatial reorganisation) and to inform programmes and policies because of the limitations of urban–rural dichotomies.

2.3.1 Shifting Boundaries

The definitional difficulties increase when considering the activities in rural and urban areas and the people living within them. Notions such as 'place' and 'home' often carry ambiguous perceptions and multiple uses because people do not always consider where they live their home. Conventional distinctions between urban and rural generally assume reducibility of the livelihoods or their inhabitants to two main categories agriculture-based in rural areas, and manufacture and services in urban centres. In contrast, due to contemporary processes by which rural and agricultural do not necessarily overlap, today these associations appear weaker. A similar observation applies to the conflation between urban and industrial pointing to increased mixing of farming and non-farming activities among the urban and rural poor, with significant consequences for planned poverty interventions.

Both micro-level development studies of household strategies and macro-level geographical studies of urbanisation, development and rural–urban disparities point to an emerging, irregular and 'lumpy rural–urban continuum' ranging from 'clearly rural environments … through a variety of intermediate or peri-urban forms and on to dense built-up environments culminating in mega cities such as Jakarta and Mexico City'. Thus, the urbanisation process is being re-examined in light of emerging landscapes that challenge conventional definitions and perceptions of the city and the countryside regarding location, physical structure, functional relation, institutional context and cultural outlook.

2.3.2 Spatial Considerations and the Informational City

Many assume increases in land and housing prices and congestion in core areas of large cities together with revolutionary developments in telecommunications and the post-Fordist restructuring of economic activities lead to the spatial deconcentration of manufacturing and population, rendering space irrelevant. But the spatial expression and developmental impact of these trends in the developing world is less linear and evenly spread than predicted. This leads to scattered industrial sites, dormitory residential areas, spatially concentrated enclaves at transport nodes and, the expansion of the so-called informal city outside established boundaries as regards fragmented jurisdictions and low local government capacity to handle the infrastructure and service needs and demands of poor dwellers.

Some concepts originally coined to describe the rural–urban interface in North America or Europe are now used in analysis of the processes of change in the developing world. Meanwhile, discussion in the developed world has shifted to the edge-cities or post-suburban landscapes, where the emphasis is on not only flows of people but also of capital, commodities and information and their impact on a place-less periphery. The concept of the 'informational city' suggests, in the context of globalisation, information technology constitutes the most strategic commodity, dividing wealth within cities into the 'information rich' and the 'information poor' (Castells 1989). Based on the globalisation discourse, some academics propose applying the same conceptual tools in every context with evidence of accelerated integration into the world economy. Thus, the theoretical developments associated with ideas of 'edge-cities' and the 'post-Fordist city' have been applied to the Southeast Asian context and to the analysis of 'extended metropolitan regions' (Ginsburg et al. 1991). This implies acceptance of a general blurring of frontiers, not only between rural and urban, but also between the First and Third Worlds.

2.3.3 Peri-urbanisation: Trends in Africa, Latin America and Asia

Research findings reveal significant qualitative differences in the relationship between rural and urban in developing countries and in the developed world. While in the latter, many cities have become engines of economic growth; many developing countries, particularly the world's poorer nations, have higher dependence on agriculture, mining and fisheries; often assumed rural activities, which challenges the assumption that the developing world is likely to replicate the advantages associated with the urbanisation process in the North. Numerous studies also suggest that cities in the developing world rely on their own hinterlands more than do cities in the developed world. A comparison of urban ecological footprints in developing and developed countries reveals that the latter tend to draw on distant 'elsewhere's' to satisfy their food, energy and other demands bypassing their hinterland and missing opportunities for reciprocal rural–urban linkages within the same area and/or region.

Although difficult to generalise, a number of studies concerned with understanding the geography of rural–urban interactions suggest diverse processes and spatial configurations in different regions of the developing world, which do not fit neatly into urban and rural components but are distinctive for their rural–urban ambiguity. These range from better known processes of suburbanisation and peri-urbanisation around fast growing large cities to 'ruralopolises', a term coined by Qadeer (2000) to describe a 'fusion of rural economic and social systems with metropolitan spatial organisations'. They feature what Qadeer speculates will be 'the future forms of human habitat in large parts of Asia and Africa in the 21st Century' (1601).

Asia presents the greatest concentration of urban areas with one-third of the region's population living in cities. By 2025, the urban population in Asia will double (from about 1.1 to 2.5 billion) housing half of the world's urban population. Research particularly in East Asia and South-East Asia points to the emergence of high-density rural areas formed from the expansion and influence of metropolitan economies. McGee (1991) coined the term *desakota*[3] for this phenomenon, also

[3] The term *desakota* derived from the Indonesian words village (desa) and town or city (kota).

'extended metropolitan regions' (EMR) (Ginsburg et al. 1991). These terms reference a process of region-based urbanisation, opposed to city-based urbanisation and require understanding in relation to the changing international division of labour, international networks and regional spill over from one mega-urban region to another. The *desakota* constitutes the spatial by-product of hi-tech production from heavily congested metropolis (e.g. Jakarta, Manila and Bangkok) into nearby cheaper but still accessible rural areas. Physically the landscape still appears predominantly rural with vast areas devoted to cultivation while a large proportion of household income derives from non-agricultural activities. The emergence of EMRs and similar spatial phenomena from new articulations to the global economy 'are accompanied by rising incomes and improved quality of life for some groups of inhabitants, but often at the expense of the immiseration of others in both these new cores and peripheries'.

The Latin America and Caribbean (LAC) region is highly urbanised, some estimate three out of four persons live in urban areas. By 2000, LAC cities concentrated 75% of the region's population (about 330 million people) and generated more than 50% of the economic growth. However, inequality in income distribution is more pronounced than in any other region (World Bank 2003) and estimates are that five out of six additional poor people between 1986 and 1998 lived in urban and peri-urban areas (ibid). Several authors (Gilbert 1993; Aguilar and Ward 2003), argue that globalisation and associated forces also seem to be changing the structure of major Latin American cities (i.e. Buenos Aires, Lima, São Paulo and Mexico City) to a polycentric form. A form where much of the growth is outside the urban perimeter, in hot spots – smaller towns and secondary cities – within the wider metropolitan region (Armstrong and McGee 1985; Browder et al. 1995). In this context, 'urban archipelagos' are emerging with diffuse boundaries between urban and rural (McGregor et al. 2006).

In Africa, the population is growing almost twice as fast as any other region in the world and although urbanisation is relatively new in comparison to Latin America and Asia, more than one-third of the region's population live in cities and rural-to-urban migration is increasing rapidly. Some forecast such rapid urban development over the next 20 years that the number of cities in West Africa will increase from 2,500 in 1990 to 6,000 in 2020.

The uneven geography of rural–urban interactions is leading to distinctive processes ranging from the extended metropolitanisation of the Johannesburg-Pretoria region in South Africa (McGregor et al. 2006) to the so-called 'close-settle zones',[4] dense but extended areas in which high intensity farming systems evolved under local market conditions, supporting high population densities while maintaining soil fertility. The most distinctive feature is that partly with the exception of South Africa, urbanisation and peri-urbanisation in Africa appear decoupled from economic development, most African cities face global economic marginalisation

[4]Examples include Kano, Northern Nigeria (Mortimore 1993), the Mossi plateau in Burkina Faso and Machakos in Kenya (Tiffen 2003).

but continue to grow despite poor macro-economic performance and without significant direct foreign investment (Briggs and Mwamfupe 2000). In Namibia, Frayne (2005) refers to a process of 'reciprocal urbanisation' in which urbanisation accompanies rising poverty and persistent non-commercial agricultural production. This form of urbanisation, relevant to other contexts in the developing world, implies that flows of migrants, information, capital and food between urban and rural areas shows interdependency of rural and urban systems instead of a linear and unidirectional urbanisation process.

2.4 Neither Urban nor Rural: Understanding Change at the Peri-urban Interface

Attempts to conceptualise the emerging landscapes described above range from emphasis on rural–urban linkages as unhindered processes rapidly transforming territories, to the notion of the 'peri-urban' as a term qualifying areas with mixed rural and urban features. First, place seems less important than flows of people and materials, commodities, resources and waste. Second, either loss of 'rural' features (reduced soil fertility, degraded natural landscape) or a dearth of 'urban' attributes (low density, lack of accessibility, lack of services and infrastructure) often characterise peri-urban areas. The term peri-urban developed as a way of analysing the relationship between urban and non-urban areas, focusing on the area immediately surrounding cities. As rural areas develop links with different cities according to different needs, the heterogeneity of cities and the way they relate to their hinterlands and to sources of growth and sustenance farther afield should be in the analysis. Many intensive urban–rural interactions related to supply of resources or migration of people increasingly occur at distance and not within a confined city hinterland (Allen et al. 2006a).

2.4.1 Process of Change

The peri-urban interface constitutes an uneasy phenomenon usually characterised by the loss of rural values or the deficit of urban attributes. One could define such interface as a highly dynamic and complex system of land use, constituted by a singular mosaic of ecosystems (from high to low ecological productivity) and often affected by similar processes to those in the expansion of 'agrarian frontiers' (Morello 1995, cited in Allen et al. 1999), outlined in Box 2.1.

From an ecological perspective, the PUI is an interface or heterogeneous mosaic of natural, productive or agro-ecosystems and urban ecosystems, affected by material and energy flows demanded by urban and rural systems. This interface is distinctive because of its ecological features, socio-economic heterogeneity and fragmented institutional context. Socio-economically, the rural–urban interface is heterogeneous

Box 2.1 Environmental impacts affecting the rural–urban interface

- Increasing pressure over the biophysical support reflected in replacement of natural or semi-natural soil and vegetation with impermeable surfaces, and routing rainwater along drains and sewers altering natural hydrological networks; Urban expansion resulting in new economic opportunities (e.g. land speculation), often with high environmental costs, due to reduction in or cessation of essential ecological functions (e.g. recycling of nutrients, aquifers recharge).
- Emergence of informal activities, such as the use of raw organic wastes to increase vegetable production, mining and extractive activities for the construction industry, clandestine slaughter establishments, and deposition of toxic wastes and open-site dumping.
- New conflicts among actors in use and appropriation of environmental resources.
- Land use changes driven by decisions taken outside the system (promotion of freestanding industrial states or the construction of motorways or dams).
- Land values and ownership subject to rapid changes, resulting in clashes between indigenous and market land management systems.
- Disruption of natural management systems and intensification of extractive activities (forest, sand and quarries).
- Negative impacts on traditional productive activities affecting the livelihood of the poorest (e.g. declining open field horticulture due to decreasing soil quality affected by sediments produced by cement plants and power stations).
- Livelihood strategies of low-income households characterised by both natural and non-natural resource based activities, interlocking exchanges and support between rural and urban communities.

Source: Based on Allen et al. (1999)

and subject to rapid changes over time. Small farmers, step-wise migrants, informal settlers, industrial entrepreneurs and urban middle class commuters may all coexist in the same territory, but with different and often competing interests and practices. In institutional terms, a general lack of institutions capable of addressing the links between urban and rural activities characterises this interface reinforced by sectoral and overlapping institutions with different remits.

Several authors suggest that processes of social and environmental change in the peri-urban interface need to be considered in light of complex rural–urban interactions, which include consideration of flows of people, goods, income, capital, natural resources and waste (Douglass 1998; Tacoli 1998; 2006; Allen et al. 1999; Allen and Dávila 2002). These flows can be either rural or urban oriented and it is usually difficult to identify their source, as processes driven by factors and decisions at different levels might be cumulative and mutually reinforcing, converging on a single process. For example, deteriorating physical environments and restrictive political conditions for agricultural practices might promote rural to peri-urban migration. One might view this as a 'rural problem' but decreasing opportunities in rural areas can result from commercialisation of crop production driven by city-based demand. Often environmental and social changes in the PUI are not the result of either movement of rural households into ecologically vulnerable areas or a unidirectional spread of urbanisation into agricultural land alone.

Michael Douglass (1998) proposes an analytical framework to understand how rural–urban linkages or flows can be mutually reinforcing or truncated leading to different trajectories and reciprocal or opposite relationships between urban and rural development. Figure 2.1 presents a modified version of his framework, which suggests that rural and urban systems link through a set of flows (people, production, commodities, capital and information). We add to this framework the consideration of flows of natural resources and wastes, relevant to the analysis of environmental changes in the PUI.

The above framework focuses on processes rather than states and as such constitutes a more appropriate path to capture the shifting nature of the PUI, considering the broad and multidirectional processes affecting changes there. For instance, expansion of urban areas might not drive changes in land use but by the de-agrarianisation of rural areas or promotion of industrial decentralisation at the regional and national level. As Rakodi argues, 'conceptualising the peri-urban interface as a series of interconnected flows and changes over time helps to ensure that the system is represented as a dynamic one, *since the pace of change in the interface is rapid*, and the flows within and between production systems are significant' (Rakodi 1998: 9) (italics added).

2.4.2 Need for a Regional Planning Focus

However, rural–urban linkages and flows involve a wide set of phenomena, which explain the structural changes between functions of urban and rural areas that might go well beyond the PUI as a recognisable and specific biophysical system. Therefore, analysis of rural–urban linkages at the regional level provides a necessary framework to understanding the nature and speed of environmental and social change in the PUI, but remains too broad to provide a working definition for identifying specific characteristics (place) of the PUI as a spatial entity. Environmental conceptualisation of the peri-urban interface and processes of change that shape and reshape this interface helps capture its spatial manifestations in a number of ways.

First, the environmental perspective opens a new understanding and evaluation of the characteristic processes in the PUI, calling upon the articulation of social, economic and biophysical aspects. For instance, the processes of private appropriation of land, either through real estate speculation or through the spatial segregation and

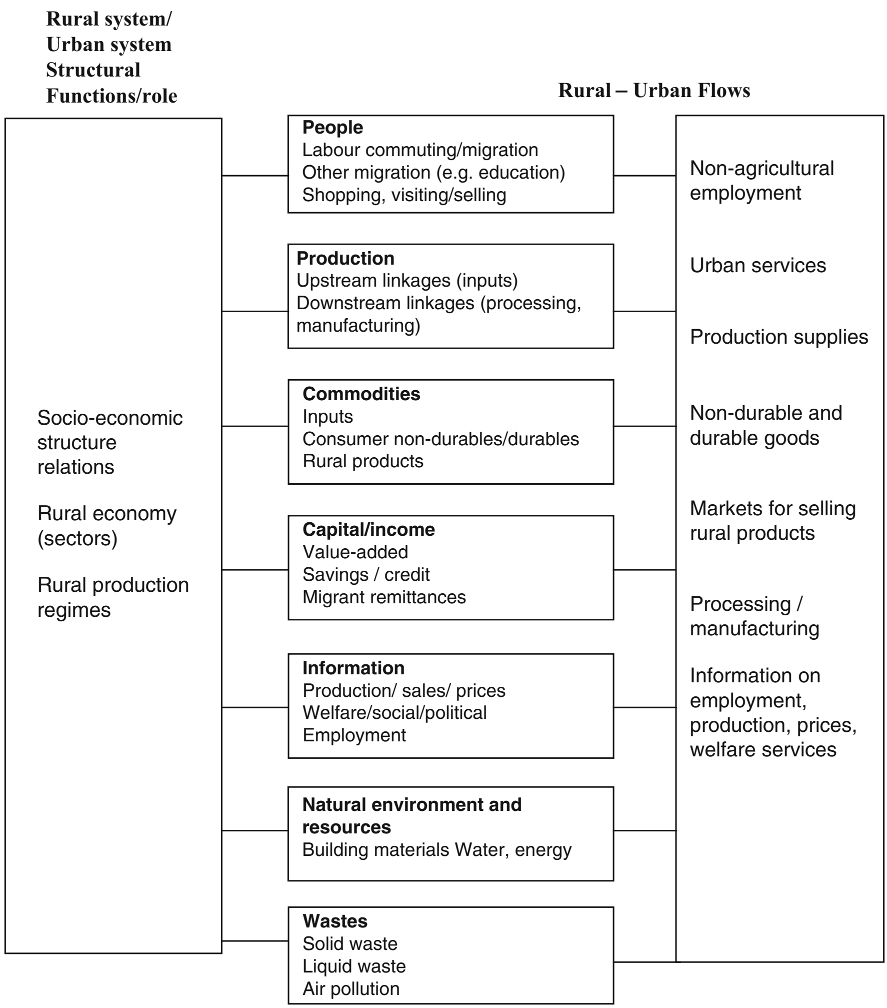

Fig. 2.1 Reciprocal rural–urban interactions. Source: Allen et al. (1999); based on Douglass (1998: 31)

direct marginalisation of certain groups by disparities in the distribution of public expenditure reinforce unequal environmental quality within society. Thus, lower income groups often inhabit areas of increased environmental hazards, while areas of high environmental quality constitute the epicentre of speculative mechanisms, taking these areas from the productive accumulation of previous dwellers or cancelling valuable ecological functions performed by natural systems.

Second, consideration of the carrying capacity of the territory (landscape quality, soil productivity, vulnerability to floods, availability of drinking water, etc.) poses more appropriate criteria for assessment of the environmental aptitude of the PUI than the conventional zoning criteria based on density, morphology, distance and, urban and rural uses of the territory. Conventional urban planning favours a centrifugal view from the urban to the non-urban space, inadequate to address the characteristics and functioning of the patchwork structure of the peri-urban interface, its attributes, uses, functions, values and strategies for occupation of the territory and the appropriation and transformation of its natural resources.

Third, an environmental perspective contributes to understanding how peri-urban systems are constituted and transformed, and of the long-term synergies and trade-offs established between environmental sustainability, economic productivity and social equity. Furthermore, the fact that the conventional distinction between urban and rural is unable to represent the daily reality of millions of people whose lives and income-earning activities straddle the rural and urban, means that such distinction is less useful as a component of planning and other attempts to guide expansion and service provision.

2.5 Living Between Two Worlds: The Peri-urbanisation of Poverty

Contemporary trends not only imply that most of the world will be living in cities, but that urbanisation does and will affect the way rural and urban households and individuals straddle these two worlds. The diffused power of the urbanisation process affects decisions about health, fertility, migration, production, service provision and others, not only spatially but through informational spill over and social networks. Thus mainstream definitions of ‘urban’, mostly based on population size, population density, economic function or, administrative-political boundaries, increasingly fail to identify specific conditions affecting the poor or to inform programmes and policies to their access to basic services.

Common problems with such definitions include: (1) census time-lag and variations among national definitions, making international comparison difficult and misleading (Satterthwaite 2000); (2) lack of disaggregated data at the local area unit and critical application of concepts from one context to another; (3) failure of statistic definitions and registration records to track people’s mobility between urban and rural areas and the emergence of fluid, fragmented and multi-location households (Rigg 1998); and (4) blurred geographical and spatial expressions in which urban and the rural physical boundaries become interlaced. All these aspects affect ability to keep pace with changes in the PUI. Satterthwaite argues (2000: 1), ‘Where you live and work influences whether or not you face deprivation and the nature of that deprivation’. In this sense, even when rural–urban interdependencies among the poor are likely to intensify in the urban transition, certain characteristics help differentiate poverty in the urban and peri-urban context. These include: (1) *greater reliance on livelihoods* from labour markets within non-agricultural production or making/selling goods or services; (2) *greater reliance on cash* for food, water, sanitation, employment, garbage disposal, and so on; (3) difficulty accessing *land for housing* due to commercialised housing and land markets; and (4) severe difficulties *accessing infrastructure and services* because of high prices. In many cases, the illegality of their dwellings prevents the urban and peri-urban poor from connecting to formal systems of service provision or from using their homes as collateral.

2.5.1 Differential Impacts on the Poor in Rural and Urban Areas

Following the sustainable livelihoods framework, Rakodi (1998) formulates a series of hypotheses on how 'urban influence' in the peri-urban interface affects the (mostly rural) poor. In general, the hypotheses assume a sort of 'peri-urbanisation of injustice': increasing urban influence is thought to increase differentiation between different social groups, as their capacity to benefit from proximity to urban areas demands access to resources or assets from the start. Rakodi suggests that the formulation of hypotheses that explain the characteristics and impact of poverty for people who live in and move through the peri-urban interface, demands the consideration of the complex processes of change underway in the PUI; especially those related 'to farming systems and land use, high levels of activity in the land market and the process of urban development, and opportunities for access to economic activities linked to the urban labour market' (op. cit.: 61).

Confronted with urban expansion, a number of problems and opportunities affect farming systems in the PUI, including opportunities for more fresh produce to meet urban demand; pressures towards subdivision and conversion of farm land for urban development and competition for labour between agricultural and non-agricultural activities. Farming systems may also suffer the adverse impact of dispersed urban development patterns reinforcing uncertainty over the future, increased constraints in accessing extension services, and effects of soil, air and water pollution. Therefore, opportunities and problems created by urban–rural linkages are likely to produce differential impacts on poor peri-urban households. Considering how the processes above might affect access to natural, physical, human and social capital, Rakodi proposes the following hypotheses.

> In the early stages of urban influence or the outer parts of the PUI the opportunities for farm enterprises exceed the threats. Those who benefit tend to be the larger farmers and those who are least able to take advantage of the opportunities are smaller farmers who lack capital and surplus land, leading to increased differentiation.
>
> In the later stages of urban influence or the urban fringe areas on the outskirts of the built up area, the threats to farm enterprises outweigh the opportunities, leading to increasing abandonment of farming. Those who benefit from this process are those who can either sell land to speculators or developers or have the capacity to develop it themselves, and those who lose are those who have little or no land, are dependent on wage or casual labour on other farms for all or part of their incomes and are unable to take advantage of alternative economic opportunities in the urban labour market, because households and their members lack labour power, skills, contacts, capital, or freedom of movement (op. cit.: 61–62).

2.5.2 Decision-Making, the Poor and the Political Process

This suggests that the influence of urban–rural interactions on peri-urban households might have multiple ramifications increasing or reducing access to capital at different stages and different impacts on women and men. Low-income groups dependent on natural resource activities may lose access to livelihood resources and might miss opportunities related to peri-urban changes. Those engaged in urban-based activities may face two inter-related processes. Development of urban influence (particularly land value changes and infrastructure) may confine them to new marginal environments (depending on their political influence) and, as Harvey says (1995), assuming that low-income areas are of low political resistance and in need of job opportunities, they will be sites for odious activities and conflicts.

One condition that sets the peri-urban poor apart from their rural and urban counterparts is that their living environments tend to be closely associated with marginal environments, sited in and/or around negative externalities, poor physical site conditions and complicated site layouts, where land is relatively cheap or where illegal occupation is less likely to be challenged. Limited access to water and sanitation is another typical constraint faced by peri-urban poor, who often face water poverty in a context of abundant water availability. Despite lack of services, governments' reluctance to make improvements and other deficiencies, settlement in the peri-urban interface remains a popular option for individuals, groups, entrepreneurs and government agencies because land acquisition is easy and informal providers are readily available to fill gaps in service provision. For the peri-urban poor, however, resorting to informal options may come at much higher unit costs than conventional systems, inadequate clandestine connections or unprotected, polluted water sources.

Considering the many uses for water in the PUI, limited access has both productive and reproductive implications, leading to major livelihood and environmental health problems. Peri-urban households often must set priorities that may compromise adequate levels of personal and domestic hygiene, which increases the transmission risk of excreta-related infections and threatens the public health. However, the rapid development and informal status of peri-urban settlements means, in the PUI public and private utility operators, already overwhelmed by the sheer number of unmet and more visible needs within inner urban areas often ignore the poor. Regulatory frameworks that define peri-urban settlements as illegal or irregular regarding the structural erosion of the political capital of the peri-urban poor, often disenfranchised from the decision-making process exacerbates supply of service restrictions in the PUI. The 'Zero Growth Pact' implemented in the Metropolitan Area of Mexico is a good example of how policies rationally designed to control metropolitan expansion in environmentally protected areas can reinforce unequal access to services, affecting the peri-urban poorest worst (Box 2.2). Thus, one could argue that water and sanitation poverty in the PUI is not only a technical or financial challenge but also the by-product of the closed right to the city, which exacerbates the peri-urbanisation of injustice.

Box 2.2 The Zero Growth Pact in the peri-urban interface of Mexico DF

The Metropolitan Area of Mexico comprises 38 natural protected areas occupying 76,714 ha. Urban expansion pressures put these areas, which are strategic for the sustainability of the metropolitan zone at risk. Within this context, Milpa Alta is the most rural district in the metropolitan area of Mexico City and considered a natural protected area due to the location of strategic environmental resources for the city, particularly its role in the recharge of the aquifers that supply the metropolitan area. In both physical and socio-economic terms, this area is experiencing high population growth, not least from migrant households relocating there from other parts of the metropolitan area.

The Federal District Government implemented several mechanisms to control metropolitan expansion over Milpa Alta. First, they divided the territory into two zones: towns and *parajes*, outside the towns. This stratified the population socio-economically since a dweller from outside the towns theoretically cannot access water and sanitation networks. Second, a census in the *parajes* in 1997 was used to divide the population into two groups: those recorded in the census and those who settled after the census. The Zero Growth Pact is an agreement between the delegation authorities and the *parajes* dwellers recorded in the census to stop new settlements. The pact establishes that only the registered population can have access to water provided by public tankers and taps. In return, those peri-urban dwellers included in the Pact police the area and denounce any new settlers, who may not receive public water supply.

This gives rise to a contradictory situation. On the one hand, the former, historical economic crisis of peasant subsistence in the area led long-term settlers to divide land formerly used for cultivation, selling it to individuals or real estate speculators. On the other, politicians intervene to ensure the supply of free water to those they see as their 'client' population who are outside the Zero Growth Pact. Thus, the law is not always applied equally. Informal settlements continue to be established in this area and their dwellers forced to resort to accessing water and sanitation through different mechanisms, often involving forms of illegality and at higher unit costs.

Source: Allen et al. (2006a: 41).

2.6 Service Provision at the Peri-urban Interface: Moving Beyond the Public–Private Divide

The seventh Millennium Development Goal (MDG) pertaining to water and sanitation did not address any new concerns. The 1980s were termed 'the water and sanitation decade' with the target of reaching universal service provision, but efforts failed to meet this ambitious target due to a focus on purely technical and financial aspects. Nevertheless, the effort achieved much, recognition of the right to basic services and of the need for legal systems to protect them. WHO estimates that, during the 1980s, an additional 1.3 billion people gained access to safe water and 960 million to basic sanitation (Jolly 2003). Access in urban areas increased from 75% to 95% in water supply and from 53% to 82% in sanitation (ibid).

2.6.1 Private Sector Participation and Access of the Poor to Services

Following the realisation that service improvements benefiting the poor require more accountable and responsive political structures, towards the end of the 1980s, donors started to fund capacity building in Water and Sanitation (WATSAN) institutions. In the 1990s, efforts shifted towards structural reform, with emphasis on privatisation of publicly run water and sanitation services. However, many recipient governments were reluctant to respond to external, donor-imposed adoption of 'good governance' and service privatisation, hindering implementation. The international debate became concerned with the question of whether these services were better run by the public or the private sector, which, McGranahan and Satterthwaite argue (2006: 1), 'presented an artificial choice, diverting attention from the real problem of how to reach the poor'.

While the above debate is silent about peri-urban poor, there now seems widespread agreement that in developing countries the State alone will be unable to meet the internationally agreed targets for reducing the number of urban dwellers with no access to clean water alone (Nunan and Satterthwaite 2001; Allen et al. 2007; World Bank 2003). This is a legacy of decades of supply-led engineering approaches with high operating costs and under-utilised investment, unrealistic standards of per capita service to formal urban areas and general disregard for the needs of unregulated or 'illegal' settlements. Recent attempts to involve private investors in water supply have not yielded the desired expanding network coverage to low-income urban and peri-urban settlements, regarded as less profitable than wealthier and more central areas of cities (Cook and Kirkpatrick 1988; Adam et al. 1992; Batley 1996). Due to lack of resources or capacity to manage large-scale privatised networks, in many countries local capital is largely excluded from this process so, foreign investors control divested public utilities and concessions. The recent collapse of large-scale contracts with multi-national companies in cities such as Buenos Aires, Dar es Salaam and Cochabamba compounded doubts about the capacity of the market to fill the gap.

Private sector participation (PSP) has become widespread in running urban water and sanitation utilities despite local unpopularity of and resistance to the forms of service governance promoted by international agencies. While the prevailing focus of these reforms is on urban areas, there is a persistent lack of recognition of the various actors involved in developing and servicing the peri-urban poor, such as CBOs, local contractors and small (often informal) service providers (Allen et al. 2006a).

2.6.2 A Fault Line

Dardenne argues (2006: 1), ‘No evidence can be found in the present situation in order to conclude whether the capacity to supply the poor is inherently linked to the private or public nature of the operator’. In other words, many barriers to service provision in poor settlements persist with both public and private water utilities. In practice, a fault line exists between the idea of the State as guarantor of basic service delivery, encompassing notions of social equity and basic rights to resources, and market-based approaches that focus on cost recovery and the financial sustainability of service supply. Figure 2.2 presents a model by the Asian Development Bank, which indicates that, often, the poor and moderately poor are best serviced by public/community partnerships. The model suggests that because of pricing issues, public–private partnerships are less effective in serving the poor.

The above implies that service provision can involve different (public–private and civic society) organisational arrangements. Governments might assume different responsibilities in the provision of these services. Direct provision or ‘production’ of a service involves the physical act of constructing, maintaining and delivering, while indirect provision involves ensuring that the service is available through decisions about policy and standards of service. In this case, governments may be responsible for coordinating, financing, enabling and regulating producers. Reference to the

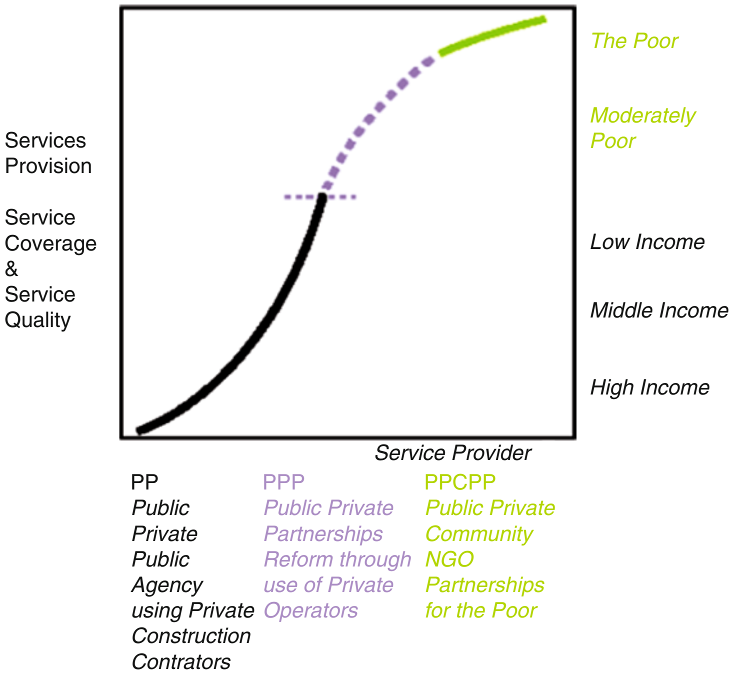

Fig. 2.2 Efficiency and participatory developments: Partnerships. Source: Banyard (2004: 24)

'regulator-provider-consumer triangle' is used to explain the basic roles and relations in water and sanitation delivery. However, there are significant differences in the peri-urban context, particularly between arrangements at the policy level and practices on the ground.

While decentralised service provision, for example, through condominium systems and on-site sanitation (pit latrines and septic tanks), appear most effective to deliver basic services for many peri-urban poor, and most of Africa, efforts by policymakers and bureaucrats still focus on network sewage and centr alised systems that do little to improve water and sanitation in low-income peri-urban areas (Schaub-Jones 2006; Calaguas and Roaf 2001). The question arises, who will serve the poor, whose lives straddle between the urban and the rural? This is a question about the governance of water and sanitation. Unfortunately, in the 1990s, the debate focused on the public–private controversy, missing this question almost entirely. The answer to the above question needs to move beyond such controversy and be examined in light of the wider, complex emergence of multi-level governance (Eckerberg and Joas 2004).

2.6.3 A Role for Municipalities and Local Governments

Considering the role of local governments, there is a large body of literature discussing the challenges associated with the increased role of municipalities as direct providers of water and sanitation. Authors like Hilda Herzer and Pedro Pirez (1989) described the processes of municipal decentralisation initiated in the late 1980s, as the 'decentralisation of the crisis', making reference to the frequent mismatch between increased responsibilities and decreasing resources. However, decentralisation has also played a positive role, bringing public agencies and service users closer together. A crucial aspect to enhance the capacity of local governments as direct service providers relies on building dialogue, exchanges and mutual support among municipalities. In Brazil, cooperation among municipalities allowed them to develop alternative public options to privatisation, reaching economies of scale in service delivery, while achieving universal access – treating and distributing 100% of the water and treating 100% of sewage collected – and strengthening participation and social control (Box 2.3). Often, municipal operators, such as the Service of Water Supply and Sanitation of Araraquara in São Paulo, successfully integrated the management of solid wastes and rainwater drainage.

2.7 Access to Basic Services on the Ground: A Wider Spectrum of Service Providers

In the peri-urban interface, aspects of the water and sanitation challenge discussed above present characteristics that often remain invisible or undifferentiated. It is important to examine these in light of specific institutional, ecological and socio-economic characteristics of the PUI.

Box 2.3 Building cooperation across municipalities in Brazil

Brazil has about 1,800 municipalities responsible for providing water and 4,000 municipalities operating sanitation services, with significant variation in population size and local government's technical and financial capacity. A recent evaluation by da Costa et al. (2006) examines 20 successful experiences of municipal public utility service of water supply and sanitation, which meet the principles of universal access, equity, integration across service sectors, quality of services, social control and municipal responsibility.

Araraquara and Guairá in São Paulo achieved universal coverage in water supply and sanitation, even with substantial and sustained population growth and urban sprawl. The specific priority municipal administrations give to basic sanitation regarding ambulatory health care and infrastructure development and maintenance drives this achievement as well as the contributions of administrative planning and continuity to universal service.

All successful experiences share one common denominator, emphasis on delivering services focussed on citizens. In Ituiutaba, 90 out of 153 workers from the Superintendence of Water and Sewage (SAE) are in direct relationships with service users. Monthly 'after service' surveys show, satisfaction rates of more than 90%. In Campinas, in 2001, the municipality defeated an attempt to privatise Sanasa, the city's public environmental sanitation company. Sanasa is open to social control and has been nationally recognised as a highly efficient public company for its achievements in reducing water losses and policies of monitoring and use rationalisation. Similarly, Jaboticabal in São Paulo resisted a private concession for wastewater treatment. Instead, the municipality created a special fund for construction of a wastewater treatment plant, interceptor lines and water supply works. Civil society entities audit the fund and the State of São Paulo University (UNESP) donated the land for the treatment plant, under condition that the local public authorities remain in control of WATSAN public management and development of associated research projects.

Several municipalities created consortia, to provide water supply and sanitation services to more than one municipality, serving rural, peri-urban and urban populations. Some municipalities and public bodies at the state/provincial level established similar consortia. The local government of Caxias do Sul, the second largest municipality in the state of Rio Grande do Sul, established a partnership with the Federal University of Rio Grande do Sul to develop an integrated sanitation and rainwater drainage solution, through a combined sewage collecting system covering 85% of the jurisdiction. Alagoinhas in Bahia achieved integration across services and sectors through adoption of a Municipal Plan for Environmental Sanitation, which links sanitation, health and environmental management.

Source: Based on da Costa et al. (2006).

As argued, *institutionally*, the PUI often captures a mix of urban and rural jurisdictions with important consequences to service provision due to significant differences regarding the responsible body and the pricing, as shown in the case of metropolitan Chennai below (Box 2.4).

Ecologically, the crucial role played by peri-urban ecosystems in supplying water and assimilating liquid wastes from adjacent rural areas requires attention. The PUI is often the location of water supply facilities, such as reservoirs, or areas that mainly replenish underground water sources because of the higher infiltration capacity of the system compared with urban areas where large areas of soil paved over by surfaces like concrete reduce infiltration. Urban growth leads to increasing demand for industrial and domestic uses, which conflict with agricultural demands, often intensified by shifting irrigation practices. Very often, urban-based demands

Box 2.4 Who is responsible for service provision in peri-urban Chennai?

Since 1978, in metropolitan areas of Chennai (India) the legal mandate for supplying water and providing sewerage and drainage services at affordable prices has been with the Chennai Metropolitan Water Supply and Sewerage Board (Metrowater). Due to severe policy, technical, financial and functional constraints, Metrowater is far from achieving its mission within the urban core of Chennai City, let alone the nearby peri-urban areas. Only recently, the jurisdiction of Metrowater has extended beyond the City of Chennai to include adjacent urban areas, including several peri-urban localities. Regarding water supply, many peri-urban areas excluded from Metrowater's jurisdiction are the responsibility of the Tamil Nadu Water Supply and Drainage Board and rely on rural schemes. Rural local authorities operate and maintain this scheme, which generally lack the human and financial resources for effective maintenance and service delivery.

However, in practice there are some incentives for peri-urban dwellers to remain under jurisdiction of rural local bodies despite inadequate capacity. First, the state Ministry of Rural Development offers significantly more funds than programmes administered by the Ministry of Urban Development. Second, under rural jurisdictions some services like water are free and charges for others (like electricity) are lower than in municipal areas. The duplicity of agencies for the provision of water and sanitation in the PUI of Chennai has resulted in confusion, with the poor suffering the most, particularly women and children. With the state government institutions and elected local bodies virtually failing to deliver the most basic services in the PUI, the alternative is to look at community and household initiatives and small independent providers.

Source: Allen et al. (2006a).

pre-empt resources previously used by peri-urban dwellers or essential to the health of valuable ecosystems. Water scarcity affects urban, peri-urban and surrounding rural areas, particularly for the poor with little or no access to infrastructure.

Socio-economically, although the PUI is highly heterogeneous, peri-urbanisation is closely associated with high poverty rates, which implies that addressing the MDGs requires understanding the changing nature and contemporary dynamics of the peri-urbanisation of poverty and the specific forms of service deprivation affecting the poor in this interface.

The World Bank identifies five main institutional options for service provision, (1) public ownership and operation (including contracting out); (2) public ownership and private operation; (3) private ownership and operation; (4) community or user provision; and (5) mixed (joint ventures between public and beneficiaries or public and private direct providers) (Batley 1996: 731). These options feature neatly within what one could call formal, 'policy-driven' mechanisms supported by institutional arrangements of the state. However, examining specific ways the peri-urban poor gain access to water and sanitation services one identifies a wider range of arrangements.

Different studies illuminate the potentials and limitations of each arrangement to reach the peri-urban poor. Common problems affecting many public utilities and municipal services in developing and transitional countries include poor financial management, low funding priority, political interference, little or no independent regulation and poor engagement with civil society, as WaterAid reports (Gutierrez et al. 2003; see also WUP 2003). The same report challenges the role of transnational corporations (TNCs) in the MDGs and concludes that local private agents, reformed public utilities and community-managed schemes are more likely to reach the poor. These arguments are particularly relevant in peri-urban areas. Thus, the peri-urban poor resort to a wide range of 'needs-driven' mechanisms to access water and sanitation effectively, often with little or no support from the state, its policies and resources.

The water and sanitation 'wheels' depicted in Figs. 2.3 and 2.4 represent mechanisms in the PUI. While policy-driven arrangements are clear from the perspective of production and provision, the arrangements identified on the right side of the wheels are best examined and understood from the perspective of access particularly, the viewpoint of localised strategies adopted by the peri-urban poor.

In contrast to the public–private-community linear spectrum that often characterises discussion of WASAN delivery options, the figures show the role of public, private and civic society in this service and the extent to which these roles are based on cooperative or competitive arrangements across these sectors. They also highlight the lack of homogeneity among these sectors. As the public sector might take the shape of highly centralised state agencies or of decentralised bodies; the private sector might involve transnational companies, medium-sized licensed operators, or informal small-scale independent providers in water vending, latrine construction or pit-emptying services; the community sector might involve relatively formalised arrangements, such as community schemes supported by the public sector or external NGOs (e.g. water kiosks and communal toilet facilities) and informal cooperative initiatives established among community members based on solidarity ties.

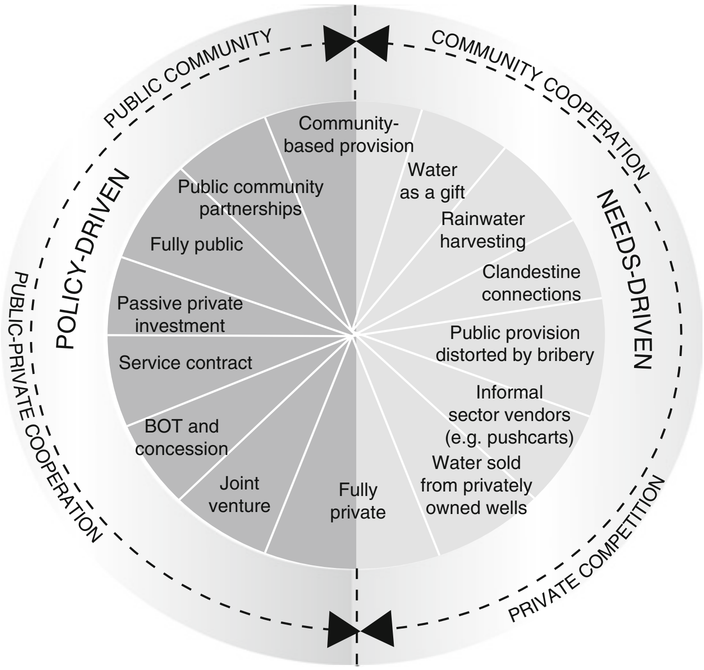

Fig. 2.3 The water wheel. Source: Published in Allen et al. (2006a: 50)

Like the urban poor, peri-urban dwellers rarely have access to formal facilities operated by the public or formal private sector, such as network water connections, waterborne sewerage or licensed pit emptying services. Small independent providers play a crucial role in serving the peri-urban poor, but they are still regarded with suspicion by the public sector both in quality and cost terms, and particularly resisted on the grounds that 'unorganised vendors are too many, too small and too dispersed' for effective regulation. Similarly, informal private pit-emptying services are common in urban and peri-urban low-income areas and often emerge to complement the shortfalls in the formal sector (see the case of Cairo in Allen et al. 2006a: 80).

A comparative study conducted in 10 peri-urban localities in the PUI of 5 metropolitan areas (Chennai, Mexico, Caracas, Dar es Salaam and Cairo) confirmed that 'the water poor in peri-urban areas are not necessarily restricted to low-income households, as often members of other income groups also lack access to adequate water and sanitation services. However, low-income peri-urban dwellers and home workers tend to be more vulnerable than higher income ones, as they often lack the financial and political means to improve their access to water and sanitation services in a manner that is not only affordable to them but also secure in the long term' (Allen et al. 2006: 243). A second distinctive feature is that despite evidence that public and private utility providers must devise specific arrangements that reach the urban poor;

Fig. 2.4 The sanitation wheel. Source: Allen et al. (2008); elaboration based on Tayler (2005)

in the PUI, the two sides of the wheels are rarely bridged. The same study revealed that plans to restructure service delivery options mostly failed to acknowledge and support the needs driven practices of the peri-urban poor, while operating on assumptions that ignored the specificity of such context (Allen et al. 2006).

2.7.1 Beyond International Private Sector Participation?

The case of Aguas Argentinas in metropolitan Buenos Aires provides some lessons on the lack of understanding by large international operators and public regulators alike on how to reach the peri-urban poor, even when explicitly included. When the Lyonnaise des Eaux group (today Suez) won a 30 year contract for the water and sewage concession in 1993, the concession perimeter included about 10 million inhabitants, one-fifth of whom live in deprived neighbourhoods. Within these, the contract obligation included only peri-urban settlements, excluding slums in inner urban areas. More than 15 years later, the outcome of the Aguas Argentinas experience in metropolitan Buenos Aires is poor, with only 25% of the peri-urban settlements inside the concession obtaining access to water supply and 100,000 to the sewerage network (Dardenne 2006).

One of the main setbacks during this process was the hefty infrastructure charges first aimed at collecting from new consumers to cover expansion, later replaced by a bimonthly fee levied on all customers. Dardenne argues (2006: 4), 'neither the contracting authority, nor the private operator, had, at the time of the takeover, any practical proposal on what should be effectively done in the peri-urban areas. The simple agreement on the need to integrate development programmes towards low-income dwellings into the operator's duties was not enough. The company committed itself to a new and complex field of activities. They could not propose a clear strategy leading to credible objectives, and could not avoid the pressure of goal inflation that surrounded contract negotiation. The negative conclusion to be drawn from the Buenos Aires experience is that it took more than 6 years to work out a methodology and an organization able to handle the peri-urban issues.'

2.7.2 A Future for Simplified Sewerage Systems?

In contrast with urban areas, the lower population densities and higher distance to centralised wastewater disposal systems that characterise the PUI mean that such centralised solutions demand high investments for collection and disposal, which prevent economies of scale and are unaffordable by the poor (Allen et al. 2006a). Conversely, most service delivery-options with the potential of filling in the gaps in peri-urban provision rely on decentralised systems. While conventional sewers are generally too expensive for use in the peri-urban context, condominial sewer system can be a cost-effective and flexible solution. Condominium sewers rely on the frequency of wastewater passing through the gravity-driven system, rather than on large quantities of flush water. Since the 1980s, Brazil successfully developed and applied examples of affordable sewer systems involving the community in construction and, with the utility, management responsibilities (Box 2.5 below) (Hogrewe et al. 1993; SIGUS 2003). Such systems depend on collaboration between the community and local government throughout the process.

Where individual facilities are not feasible, community toilets or latrines constitute an alternative both for the urban and peri-urban poor. The difference between public and community toilets is that the former 'serve the needs of whoever happens to be passing by, whether a local or a stranger' whereas the community controls the latter (Burra et al. 2003: 30). Treating poor communities as homogeneous, the approach taken by formal public and private service providers, neglects the different needs, practices and responsibilities regarding class, age, gender, ethnicity, and the relationship to rural and urban outlooks (Joshi and Morgan 2007). In contrast to most public toilet schemes, the involvement of civil society from the design stage ensures consideration and implementation of maintenance practicalities and the needs of different user groups into the plans from the start. Although community toilets built by civil society are often cheaper than the ones constructed by local authorities, users still must cover maintenance costs. Several experiences of community toilets across India involving the urban and peri-urban poor in their

Box 2.5 Condominial sewers in Brazil

The first condominial sewer system developed in Brazil was in Natal, a city in the northeast, to extend wastewater collection. The State water company (CAERN) and the World Bank contributed considerably to disseminating and legitimising this approach across Brazil (Watson 1995).Condominial sanitation systems can provide an affordable sewage system for the poor provided there is regular water supply, ideally with a connection to each plot (Mara 1998). Condominial sewer systems rely on a productive partnership between the service provider(s) and the community mediated by the municipal government. Community involvement is crucial for what Watson labels 'customized service approach' (1995: 21) that tailors the project to the residents' needs. Public agencies need to engage with communities throughout the process, which requires a substantial change in approach to provide services and in some cases necessitates the involvement of consultants with more experience with the urban poor and condominial systems (ibid). Often the community will participate in the operation and maintenance of the system. Empirical evidence reveals that customer involvement combined with political support from mayors and sewerage agencies are keys to the success of the system (ibid).

Agricultural practices might link into such systems by using the collected and treated effluents for irrigation and fertilisation of agricultural plots. However, creating this partnership is difficult requiring collaboration with more institutions and different jurisdictions (Neder and Nazareth 1998).

Source: Allen et al. (2008: 18).

construction and management changed the relationship between the city government and civil society leading to redefinition of roles and responsibilities in provision of affordable, safe and sustainable sanitation services (see Box 2.6 below).

Financial constraints often hamper scaling up of water and sanitation solutions that work for the poor. Box 2.7 illustrates an innovative approach to bridge the finance gap in community-led sanitation initiatives both in urban and peri-urban areas employed in three countries of the South. The community toilet approach of the Alliance in India started small, but was scaled-up across India and now more than 500,000 urban and peri-urban dwellers across 8 urban regions in India benefit (Burra et al. 2003). To sustain and scale up initiatives where services are largely provided informally, collaboration with the local government is essential (Fisher 2006).

2.7.3 Co-production Options: Hybridity and Informality

Absent affordable and sustained public or private formal service delivery options, the peri-urban poor access basic services at scale through multiple hybrid combinations. Water user associations, technical water fora and local water committees allow peri-urban dwellers to co-produce services with local governments. Co-production

Box 2.6 Community toilets as a form of service co-production in Mumbai, India

This initiative came in response to inadequate public facilities provided by the municipality. The UK charity Homeless International funded the first community toilets in India built and managed by the community to convince the government and donors to collaborate with organisations for the urban poor. Initial efforts of this alliance of the NGO SPARC, the women' savings group Mahila Milan and the National Slum Dwellers Federation (NSDF) to gain government and donors support for community-driven projects failed. After successful implementation of toilet block projects across India by the alliance, the municipal corporation in Mumbai began to appreciate involvement by the alliance towards improving sanitation in low-income areas.

The different actors involved in building and managing community toilets have clearly defined roles and responsibilities. The city government sets standards, provides the land and capital for the construction as well as connections to water and electricity. The community helps select the site, then designs, builds and manages the facilities. Although an NGO receives a contract, the success of community toilets rests upon active community involvement. This helps integrate the needs of a diverse community into the layout of the facilities and enhances their capacities and skills. User fees, mainly in the form of monthly family passes, pay for a full-time caretaker and maintenance costs. The experience with small-scale projects resulted in the Alliance's involvement in larger community toilet programmes in Pune and Mumbai and led to a form of service co-production between the community and the metropolitan government.

Source: Base d on Burra et al. (2003).

implies participation of users and communities in various stages of public services production (Ostrom 1973, 1996; Whitaker 1980; Percy 1984). While the benefits of service co-production apply to the peri-urban and urban poor, two hypotheses by Joshi and Moore (2004) are pertinent to address the challenges in the PUI. First, co-production seems the most effective way to reach many beneficiaries, addressing their different needs and circumstances and making the most of existing local networks. Second, great diversity exists in the standards, costs, technologies and other operational situations of service delivery and rapidly changing conditions, difficult to address under standardised solutions or responses.

Several additional arguments highlight the relevance of service co-production in the peri-urban context. It allows users and communities to supplement government provision where a particular service is not reaching certain groups or individuals. It can aid development of an effective interface between public/professional service providers and users/communities by creating a mechanism for interaction and feedback that allows reformulation of policy design and implementation to meet the needs and expectations of beneficiaries. It can empower citizens to exercise their rights and

Box 2.7 Scaling up sanitation in India through CLIFF

CLIFF is a macro-level finance facility funding the urban poor directly, to support community-led projects in partnership with local governments (Jack and Morris 2005). Homeless International (HI) manages CLIFF and Cities Alliance administers the project with DFID and Sida bridging the finance gap with revolving funds to construct facilities until revenues can be realised and further help to 'leverage and blend financial and other resources' with guarantees by the UK housing sector through HI (ibid: 5). It has helped fund knowledge exchanges within and between countries to build capacity of the urban poor and government officials and engineers.

Eligibility for CLIFF funding requires meeting certain criteria, including the need to 'Build on established local organisation by communities of the urban poor and their existing relationships with local authority and municipal officials, and have the potential to strengthen such city–community relationships' (Jack andMorris 2005: 4). It has proven particularly useful for replicating and scaling up small-scale solutions. By the end of 2006, CLIFF helped finance sanitation programmes in Pune and Mumbai, India benefiting around 260,000 families. Since 2005, CLIFF is also operating in Kenya and the Philippines.

Source: Allen et al. (2008: 21–22).

to become agents of change, fostering people-centric not producer-centric governance (Allen 2010). The above conditions appear in peri-urban Caracas, where introduction of water technical fora not only allowed the public utility to reach the peri-urban at scale, but to promote their involvement in the process of governing service delivery (and other public policies) while helping to reformulate citizens rights and responsibilities vis-à-vis the State (Box 2.8). It is important to stress co-responsibility, service co-production could otherwise be understood as only a fancy name for the more widely advocated public/private-community partnerships, where the poor are perceived as individuals, groups and even communities defined as clients with potential to proffer various resources and assets in the service delivery process.

2.8 Crossing the Public–Private Divide: Rethinking Service Delivery Options that Work for the Peri-urban Poor

This chapter endeavoured to present an exploration of issues and trends that emerge from examining water and sanitation challenges at the peri-urban interface. The PUI not only provides land, and often a source of livelihood, to a changing and highly heterogeneous population including a disproportionate number of poor households and producers, but also essential environmental services to urban regions acting for

Box 2.8 Citizen co-production in Caracas, Venezuela

In Venezuela, one must examine the emergence of an institutionalised platform for service co-production in light of the substantial changes introduced by the Chavez administration. In 1999, adoption of a new constitution began reorganisation of the State, marking a shift from representative to participatory democracy. Since then, government policy on poverty focused on a strategy of social and productive integration through active community participation. The 2001 Organic Drinking Water and Sanitation Service Act introduced a new institutional scheme separating policy, regulation and management functions. This transferred the service to municipalities and activated the organisation of Technical Water Fora (TWF), designed as a direct channel between grassroots community organisations and Hidrocapital, the public sector regional water supply company in the Caracas Metropolitan Region (CMR).

The new water regime does not allow private sector participation in the water extraction and production stages, since water is a public good and the State retains this activity. In this context, Hidrocapital and the National Superintendence of Water Service by the National Water Office regulate WATSAN and report to the Ministry of the Environment and Natural Resources. Hidrocapital undertook an organisational change to incorporate community participation into its operating procedures through a new Community Management Office, which has proved instrumental in expediting implementation of TWF throughout the CMR, helping create more than 200 TWF in the peri-urban areas alone (Cariola and Lacabana 2004).

Local community participation through the TWF takes place throughout the planning process. From the community water needs assessment and the elaboration of a joint diagnosis with Hidrocapital professionals, through project design for rehabilitation and\or expansion of the network, to monitoring the service provided; also, the state of the network and the use of water in a sensible way. The projects differ in technical difficulty, cost and complexity, ranging from small-scale water distribution systems to large-scale systems.

The project constitutes a key outcome for the community, representing a common vision and allowing the necessary organisation for implementation. The TWF in collaboration with state agencies, co-manage project finances and are responsible for regularising water tariffs within each community. The TWF improved coverage of WATSAN services and strengthened community solidarity ties, while providing examples of participatory democracy stressing not only rights but also duties. Although not easily attributable to the TWF alone, Venezuela met the MDGs of halving the population without access to water and sanitation by 2015 in 2005.

Source: Allen (forthcoming 2010); based on Cariola and Lacabana (2004).

instance as an ‘environmental sink’ for liquid and solid waste from the denser urban core requiring wider integrated water management interventions.

The peri-urban poor live in a conceptual and spatial grey area (Aguilar and Ward 2003). The identification of the water and sanitation needs is more complex in the PUI than in either urban or rural areas due to the particular mix of newcomers and long-established dwellers, and because farming, residential and industrial land uses often coexist. This calls for an institutional and technical response to this diversity and to the changing needs of peri-urban residents and enterprises. In addition, a wide range of spatial and non-spatial policies and a variety of agencies operating with overlapping and sometimes contradictory remits shape provision of basic services in the PUI. Some policies may point towards controlling peri-urban expansion of metropolitan areas, while others might aim in the opposite direction. For example, encouraging the relocation of manufacturing industries from the urban core to the periphery. Dávila argues (2006), an adequate framework for intervention requires better understanding of the impact of both spatial (for instance, a 'green belt' around metropolitan areas) and non-spatial policies (such as agricultural subsidies).

Peri-urban areas generally lie outside formal networked water and sanitation systems. This is partly because many peri-urban settlements develop outside existing formal regulations, affecting their formal right to these basic services. However, with installation of adequate land policies and control procedures, improving access to water and sanitation by the peri-urban poor should not require formal land or housing tenure, but focus on collective land rights and responsibilities for designing and managing these services. The is a gap between the current planning paradigm for formal urbanisation, which assumes that urbanisation begins with installation of basic urban services and the actual process of peri-urbanisation, which starts with development of informal settlements on marginal environments and un-served land. The peri-urbanisation of poverty challenges the urban–rural divide, demanding statistics that capture the reality and needs of peri-urban dwellers requiring a different paradigm that challenges the status quo in seeking enhancement of reciprocal relations between cities and their hinterland.

One important consideration in a context of rapid peri-urban population growth and environmental change and weak or inadequate official institutions, centralised network systems for water supply and sanitation services may never become the norm in poor peri-urban settlements (Allen et al. 2006a, b). Planners and decision-makers should be prepared to consider decentralised approaches involving greater user involvement with less capital-intensive solutions. Private players in the water and sanitation sector often seem synonymous of either large multinational companies or informal local providers filling the gaps left by deficient utilities. Between these two extremes, there is a much wider spectrum of local private operators in the PUI, which despite their ability to meet water and sanitation needs at scale, are either ignored or resisted. Small-scale commercial firms and not-for-profit operators may provide, with minimum official control, adequate, affordable and more sustainable services such as water from local sources or latrine-emptying services. In a flexible and responsive regulatory environment, such decentralised services may offer a solution more in keeping with the changing needs of local users. In this sense, much can be learned from implementation of 'locally based demand' (LBD) approaches embedded in service co-production platforms, such as water technical fora or water user associations. Such approaches derive from mutual provider-citizen 'learning processes' with potential to change the relationship between communities, institutions, and outside organisations. As Varley et al. (1996: iii) argue, 'There will always be "supply-side" factors that influence planning and resource allocation for environmental health investments and service improvements. Nonetheless, prioritization on the basis of LBD shifts the balance in this process toward well-informed choices by peri-urban residents about the improvements they would like and for which they are willing to pay'.

While governance in the peri-urban interface appears fragmented, with many agencies and no single organisation (either public or private) providing guidance or leadership, recent trends to 'un-bundle' service provisions exacerbate this institutional fragmentation. Analysis suggests that policy- and action-oriented approaches to governance of peri-urban water and sanitation need re-examination, unlocking approaches from the boundaries of prevailing orthodoxies. This chapter shows the public–private controversy dominating the debate since the 1990s has barely advanced the cause of better water and sanitation for the peri-urban poor. It is now perhaps more widely accepted that to be efficient it is insufficient to be private and to be equitable it is insufficient to be public.

Although increasingly questioned, the public–private controversy seems locked within the limits of new managerial thinking, assuming the failure of government-led service delivery systems and the need for a more efficient division of labour under unbundled systems. This perspective often refers to institutions (state, market and civic society) of Western representative democracies, favouring formal market mechanisms as most flexible and effective to expand service provisions, leaving areas where private provisions are seen as financially unviable either to the state or more often to communities themselves. Joshi and Moore argue (2002), this 'rationalist' perspective encompasses various prevailing approaches within public policy analysis, as opposed to an 'empiricist' perspective, concerned with the local-specific analysis of the empirical conditions under which the poor access basic services in the context of the developing world. There are problems with both perspectives. Rationalists often fail to account for the reality of how services operate on the ground, outside Western systems and their generalisations and policy prescriptions are therefore often impractical or irrelevant to the question of how to reach the poor. On the other hand, the empiricists provide plenty of interesting and relevant insights into the contextual conditions and diversity of practices the poor use to access services, but their findings remain under-theorised, to the extent that it becomes difficult to extrapolate general lessons in terms of organisational development and governance arrangements. However, this need not be. It is possible to identify regular patterns across the wealth of organisational arrangements found in the peri-urban context of the developing world and to confront rationalist predictions of what works and does not work with these real-world patterns.

This chapter identified a range of possible actions and types of organisation and management with potential to support universal access to water and sanitation in the PUI, in ways that ensure equity, quality and social control. The crucial task ahead for policymakers and planners lies in rethinking the water and sanitation challenge. Shifting from the usual route of policy-based evidence, to evidence-based policymaking, in which the latter acknowledges that the conventional distinction between urban and rural poor not only fails to capture the reality of a significant portion of the poor but also increases the gap between current efforts and any meaningful chance to meet the MDG. Any strategy to provide service delivery that works for the peri-urban poor depends on the participation of the poor themselves in the definition of priorities and in political decision-making, as a central component in fighting the peri-urbanisation of injustice that underlies water and sanitation poverty in the PUI.

References

Adam, C., Cavendish, W., & Mistry, P. (1992). *Adjusting privatization: case studies from developing countries*, James Curry, Ltd, London

Adell, G. (1999). Theories and models of the peri-urban interface: a changing conceptual landscape. Report prepared for the Research Project. *Strategic Environmental Planning and Management for the Peri-urban interface.* London: Development Planning Unit.

Aguilar, A. G., & Ward, P. (2003). Globalization, regional development and mega-city expansion in Latin America: analyzing Mexico City's peri-urban hinterland. *Cities, 20*(1), 3–21.

Allen, A. (forthcoming 2010). Service co-production and water management governance in the peri-urban interface: responsible citizenship in Venezuela. In Igor Vojnovic (Ed.), *Sustainability: a global urban context.* Lansing, MI: Michigan State University (MSU) Press.

Allen, A., Da Silva, N.A. & Corubolo, E. (1999). Environmental problems and opportunities of the peri-urban interface and their impact upon the poor. Document produced for the Research Project *Strategic Environmental Planning and Management for the Peri-urban Interface.* Development Planning Unit, University College London. www.ucl.ac.uk/dpu/pui.

Allen, A., & Dávila, J. (Eds.). (2002). Mind the gap: bridging the rural–urban divide. *Insights Development Research* (41), May. http://www.id21.org/insights/insights41/index.html.

Allen, A. (2003). Environmental planning and management of the peri-urban interface (PUI): perspectives on an emerging field. *Environment and Urbanization, 15*(1), 135–147.

Allen, A., Dávila, J. D., & Hofmann, P. (2006a). *Governance of water and sanitation for the peri-urban poor: a framework for understanding and action in metropolitan regions.* London: University College London, Development Planning Unit. www.ucl.ac.uk/dpu/pui/publications/DPU%20PUI%20WSS_Book.pdf.

Allen, A., Dávila, J. D., & Hofmann, P. (2006b). *So close the city, so far from the pipes.* London: University College London, Development Planning Unit. www.ucl.ac.uk/dpu/pui/publications/DPU%20PUI%20WSS%20Brochure.pdf.

Allen, A., Hofmann, P., & Griffiths, H. (2007). Rural–urban linkages for poverty reduction. Report commissioned by IDRC/UPE and UN-Habitat for the State of the World's Cities Report 2008: Creating Harmonious Cities.

Allen, A., Hofmann, P., & Griffiths, H. (2008). Moving down the ladder: governance and sanitation that works for the urban poor. Discussion paper commissioned by IRC for the Symposium: Sanitation for the Urban Poor Partnerships and Governance, Delft, The Netherlands, 19–21 Nov 2008.

Armstrong, W., & McGee, T. G. (1985). *Theatres of accumulation: studies in Latin American and Asian urbanisation*. London: Methuen.

Banyard, J. (2004). Water for the world – Why is it so difficult? Fifth Brunel International Lecture, Institution of Civil Engineers. www.ice.org.uk.

Batley, R. (1996). Public–private relationships and performance in service provision. *Urban Studies, 33*(4–5), 723–751.

Briggs, J., & Mwamfupe, D. (2000). Peri-urban development in an era of structural adjustment in Africa: the city of Dar es Salaam, Tanzania. *Urban Studies, 37*(4), 797–810.

Browder, J., Bohland, J. R., & Scarpaci, J. L. (1995). Patterns of development on the metropolitan fringe – urban fringe expansion in Bangkok, Jakarta and Santiago. *Journal of the American Planning Association, 61*(3), 310–327.

Burra, S., Patel, S., & Kerr, T. (2003). Community-designed, built and managed toilet blocks in Indian cities. *Environment and Urbanization, 15*(2), 11–32.

Calaguas, B., & Roaf, V. (2001). Access to water and sanitation by the urban poor. Paper presented to Development Studies Association Conference, Manchester, 10 Sept.

Cariola, C., & Lacabana, M. (2004). WSS practices and living conditions in the peri-urban interface of metropolitan Caracas: the cases of Bachaquero and Paso Real 2000. Unpublished report prepared for the Research Project Service Provision Governance in the peri-urban interface of metropolitan areas. Development Planning Unit, University College London.

Castells, M. (1989). *The informational city: information technology, economic restructuring and the urban-regional process*. Oxford: Basil Blackwell.

Cook, P., & Kirkpatrick, C. (1988). Privatization in less developed countries, Wheatsheaf, Brighton, UK.

da Costa, S., Campos Borja, S.P., Heller, L., & Santos Moraes, L.R. (2006). Successful municipal experiences in water supply and sanitation services in Brazil. Available online at http://www.tni.org/water-docs/dacosta.pdf.

Dardenne, B. (2006). The role of the private sector in peri-urban or rural water services in emerging countries, OECD Global Forum on Sustainable Development: Public–Private Partnerships in Water Supply and Sanitation – Recent Trends and New Opportunities, Paris, Nov 2006. http://aspa-utilities.com/Dardenne_OECD.pdf.

Douglass, M. (1998). A regional network strategy for reciprocal rural–urban linkages: an agenda for policy research with reference to Indonesia. *Third World Planning Review, 20*(1), 1–33.

Douglass, M. (2006). A regional network strategy for reciprocal rural–urban linkages: an agenda for policy research with reference to Indonesia. In C. Tacoli (Ed.), *Rural–urban linkages* (pp. 124–154). London: Earthscan.

Eckerberg, K., & Joas, M. (2004). Multi-level environmental governance: a concept under stress? *Local Environment, 9*(5), 405–412.

Fisher, J. (2006). Achieving sanitation at scale: Innovative approaches to rural and urban sanitation. WELL Briefing Note 18, Water and Engineering and Development Centre, Loughborough. http://www.lboro.ac.uk/well/resources/Publications/Briefing%20Notes/BN18%20Sanitation%20at%20scale.htm.

Frayne, B. (2005). Survival of the poorest: migration and food security in Namibia. In Luc J. A. Mougeot (Ed.), *AGROPOLIS: the social, political, and environmental dimensions of urban agriculture* (pp. 31–50). London: Earthscan/IDRC. http://www.idrc.ca/es/ev-85401-201-1-DO_TOPIC.html.

Friedmann, J., & Douglass, M. (1975). Agropolitan development: Towards a new strategy for regional planning in Asia, in United Nations Centre for Regional Development. *Growth pole strategy and regional development planning in Asia* (pp. 333–387). Nagoya: The Asian Experience.

Gilbert, A. (1993). Third world cities: the changing national settlement system. *Urban Studies, 30*(4/5), 721–740.

Ginsburg, N., Koppel, B., & McGee, T. (Eds.). (1991). *The extended metropolis: settlement transition in Asia*. Honolulu, Hawaii: Hawaii University Press.

Gutierrez, E., Calaguas, B., Green, J., & Roaf, V. (2003). New rules, new roles: does Private Sector Participation (PSP) benefit the poor? *Synthesis report*. London: WaterAid and Tearfund.

Harvey, D. (1995). The environment of justice. In A. Merrifield & E. Swyngedouw (Eds.), *The urbanization of injustice* (pp. 65–99). London: Lawrence and Wishart.

Herzer, H., & Pirez, P. (1989). Municipio y participación popular en America Latina, *Desarrollo Económico*, *29*(114), 187–205 (July–Sept).

Hogrewe, William, Joyce, Steven D. & Perez, Eduardo A. (1993). The unique challenge of improving peri-urban sanitation. *Voices from the city. Newsletter of the peri-urban network on water supply and environmental sanitation,* Vol 2. WASH Project.

Jack, M., & Morris, R. (2005). The community led infrastructure finance facility (CLIFF), *International Association of Local and Regional Development Funds in Emerging Markets*. Available online at http://www.citiesalliance.org/doc/resources/financing/cliff/articleIADF(FullVersionFinal)_Jun05.pdf.

Jerve, A. M. (2001). Rural–urban linkages and poverty analysis. In A. Grinspun et al. (Eds.), *Choices for the poor: lessons from national poverty strategies* (pp. 89–120). Bergen and New York: CMI/UNDP.

Jolly, R. (2003). Water and sanitation goals: is progress in the pipeline? *id21 Research Highlight*: 10 Mar 2003.

Joshi, A., & Moore, M. (2002). Organisations that reach the poor: why co-production matters. Paper prepared and presented at the Making Services Work for Poor People, World Development Report (WDR) 2003/04 Workshop, Oxford, 4–5 Nov.

Joshi, A., & Moore, M. (2004). Institutionalized coproduction: unorthodox public service delivery in challenging environments. *Journal of Development Studies, 40*(4), 31–49.

Joshi, D., & Morgan, J. (2007). Pavement dwellers' sanitation activities: visible but ignored. *Water Lines, 25*(3), 19–22.

Lewis, W. A. (1954). Economic development with unlimited supplies of labour. *The Manchester School, 22*, 139–191.

Lewis, W. A. (1979). The dual economy revisited. *The Manchester School, 47*, 211–229.

Lipton, M. (1977). *Why poor people stay poor: a study of urban bias in world development*. Cambridge: Harvard University Press.

Lynch, K. (2005). *Rural–urban interaction in the developing world*. London: Routledge.

Mara, D. (1998). Low-cost sewerage, Sanitation Promotion, WSSCC Working Group on Promotion of Sanitation, WHO, Geneva. Available online at http://www.efm.leeds.ac.uk/CIVE/Sewerage/articles/WHO_EOS_98.5_pp249-262.pdf

McGee, T. G. (1991). The emergence of the desakota regions in Asia: expanding a hypothesis. In N. Ginsberg, B. Poppel, & T. G. McGee (Eds.), *The extended metropolis* (pp. 3–25). Honolulu, HI: University of Hawaii Press.

McGranahan, G., & Satterthwaite, D. (2006). Governance and getting the private sector to provide better water and sanitation services to the urban poor. IIED human settlements discussion paper series, theme: Water-2. London: International Institute for Environment and Development.

McGregor, D., Simon, D., & Thompson, D. (2006). *The peri–urban interface. Approaches to sustainable natural and human resource use*. London: Earthscan.

Montgomery, M., Stren, R., Cohen, B., & Reed, H. E. (Eds.). (2004). *Cities transformed: demographic change and its implications in the developing world*. London: Earthscan.

Mortimore, M. (1993). The intensification of peri-urban agriculture: the Kano close-settled zone, 1964–1986. In B. L. Turner, R. W. Kates, & G. Hyden (Eds.), *Population growth and agricultural change in Africa*. Florida: University Press of Florida.

Myint, H. (1964). *The economics of developing countries*. London: Hutchinson.

Neder, K. D., & Nazareth, P. (1998). Condominial sewerage systems for the federal district of Brazil. CAESB – Water and Sewerage Company of Brasília. http://www.efm.leeds.ac.uk/CIVE/Sewerage/.

Nunan, F., & Satterthwaite, D. (2001). The influence of governance on the provision of urban environmental infrastructure and services for low-income groups. *International Planning Studies, 6*(4), 409–426.

Ostrom, E. (1973). *Community organisation and the provision of police services*. Woodland Hills, CA: Sage Publications.

Ostrom, E. (1996). Crossing the great divide: co-production, synergy and development. *World Development, 24*(6), 1073–1087.

Percy, S. L. (1984). Citizen participation in the co-production of urban services'. *Urban Affairs Review, 19*(4), 431–446.

Portes, A. (1985). The informal sector and the world-economy: notes on the structure of subsidized labor. In M. Timberlake (Ed.), *Urbanization in the world-economy* (pp. 53–62). Orlando, FL: Academic Press.

Portes, A., & Walton, J. (1981). *Labor, class, and the international system*. New York: Academic Press.
Potter, R., Binns, T., Elliott, J., & Smith, D. (2004). *Geographies of development*. Harlow: Pearson (Second edition).
Qadeer, M. A. (2000). Ruralopolises: the spatial organisations of residential land economy of high density rural regions in South Asia. *Urban Studies, 37*(9), 1583–603.
Rakodi, C. (1998). Review of the poverty relevance of the peri-urban interface production system research. Report for the DFID natural resources systems research programme (PD70/ZE0091), Second Draft, Sept.
Rigg, J. (1998). Rural–urban interactions, agriculture and wealth: a southeast Asian perspective. *Progress in Human Geography, 22*(4), 497–522.
Rondinelli, D. (1979). Applied policy analysis for integrated regional development planning in the Philippines. *Third World Planning Review, 1*(2), 151–178.
Rostow, W. W. (1960). *The stages of economic growth: a non-communist manifesto*. Cambridge: Cambridge University Press.
Satterthwaite, D. (2000). Seeking an understanding of poverty that recognizes rural–urban differences and rural–urban linkages. Paper commissioned by the World Bank, first draft presented at the World Bank's Urban forum on urban poverty reduction in the 21st century, April 2000.
Schaub-Jones, D. (2006). Sanitation partnerships: can partnership make a difference to the urban sanitation challenge? BPD Sanitation Series, Feb 2006.
SIGUS (2003). Providing sanitation services, in *Water and sanitation for all: a practitioners companion*. http://web.mit.edu/urbanupgrading/waterandsanitation/levels/provide-san-serv.html#household-latrine-pit-septic.
Tacoli, C. (1998). Rural–urban interactions: a guide to the literature. *Environment and Urbanization, 10*(1), 147–166.
Tacoli, C. (Ed.). (2006). *The Earthscan reader in rural–urban linkages*. London: Earthscan.
Tayler, K. (2005). *Notes on sanitation and wastewater disposal. Prepared for the Research Project Service Provision Governance in the Peri-urban interface of Metropolitan Areas*. London: Development Planning Unit.
Tiffen, M. (2003). Transitions in sub-Saharan Africa: agriculture, urbanisation and income growth, *World Development*, *31*(8): 1343–1366. Reprinted in C. Tacoli (Ed.) (2006). *The Earthscan reader in rural–urban linkages* (pp. 91–123). London: Earthscan.
Varley, R. C. G., Yacoob, M., & Smith, S. (1996). *Beyond participation: locally based demand for environmental health in peri-urban areas.* USAID. http://pdf.dec.org/pdf_docs/pnabz936.pdf.
Watson, G. (1995). *Good sewers cheap? Agency–customer interactions in low-cost urban sanitation in Brazil. Water and sanitation currents*. Washington, DC: World Bank.
Webster, D. (2004). *Summary of peri-urbanisation: the new global frontier*. Enschede, Netherlands: International Institute for Geo-Information Science and Earth Observation.
Wellisz, S. (1971). Economic development and urbanization. In L. Jakobson & V. Prakash (Eds.), *Urbanization and national development* (pp. 39–55). Woodland Hills, CA: Sage Publications.
Whitaker, G. (1980). Co-production: citizen participation in service delivery. *Public Administration Review, 40*, 240–246.
Williamson, J. (1965). Regional inequality and the process of national development: a description of patterns. *Economic Development and Cultural Change, 13*(4), 3–45.
World Bank. (2003). *World development indicators*. Washington, DC: World Bank.
WUP (Water Utility Partnership for Capacity Building) Africa. (2003). *Better water and sanitation for the urban poor. Good practice from sub-Saharan Africa*. Nairobi: European Communities and Water Utility Partnership.

Chapter 3
Prospects for Resource Recovery Through Wastewater Reuse

Liqa Raschid-Sally and Daniel J. van Rooijen

Abstract This chapter attempts to show the inter-related nature of the water cycle and its uses, which in turn highlights its cross-sectoral character. It examines the concept of the water footprint and how urbanisation through creating a demand, leaves a mark on the hydrological cycle, via pollution of the environment through unmanaged/untreated wastewater flows. It includes a variety of concepts and approaches that explain the recent thinking behind water allocation and how this then relates both to the sanitation and agricultural sectors. The chapter argues how wastewater may be a feasible alternative for freshwater especially for irrigation in proximity to the city. Additionally, it is important not to overlook its value as a potential nutrient source, as this could enhance its overall resource worth, but this has to be accounted for, within the water management framework, and incorporated into the design of water systems from the conceptual stages. The chapter concludes by examining the typology of different reuse practices to assess the consequences and identify solutions. In this context the Design for Use paradigm that is gaining support, encourages source control of pollution, views wastewater as a resource, and designs systems for re-use with the potential for generating economic benefits, which can in turn be used in part to maintain the systems.

3.1 Water Scarcity and the Need for Allocation

Water allocation: why is it necessary and why can water not be made available for all uses? Over the past two decades, these questions appear with increasing frequency and are becoming more critical due to the finite nature of water resources and

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threats from pollution. Rising demand and shrinking supply as well as agricultural, industrial and urban uses coupled with the need to reserve sufficient supply to accommodate environmental requirements are leading to competition and over allocation. In many countries the available freshwater resources are already committed and often, overcommitted (Molle et al. 2007).

To understand the need for water allocation the following concepts are useful.

Physical water scarcity occurs when available water resources are insufficient to meet all human demands, including minimum environmental flow requirements due to the over-allocation and over-development of water resources, leaving no water available to meet new demands except through inter-basin transfers (Fig. 3.1). Severe environmental degradation such as river desiccation and pollution; declining groundwater tables; water allocation disputes; and failure to meet the needs of all users equitably, are symptomatic of physical water scarcity. Some 1.2 billion people live in river basins with an absolute physical scarcity of water (human water use has surpassed sustainable limits). Another 500 million people live in river basins approaching this condition rapidly.

Economic water scarcity occurs when investments needed to keep up with growing water demand are constrained by financial, human or institutional capacity. Symptoms of economic water scarcity include inadequate infrastructure development, insufficient water for agriculture and domestic purposes; high vulnerability to seasonal water fluctuations, including floods and long- and short-term drought; and inequitable distribution of water despite adequate infrastructure. In many cases, much of the scarcity can be attributed to the way institutions function – favouring one group over another, and not listening to the voices of women and disadvantaged

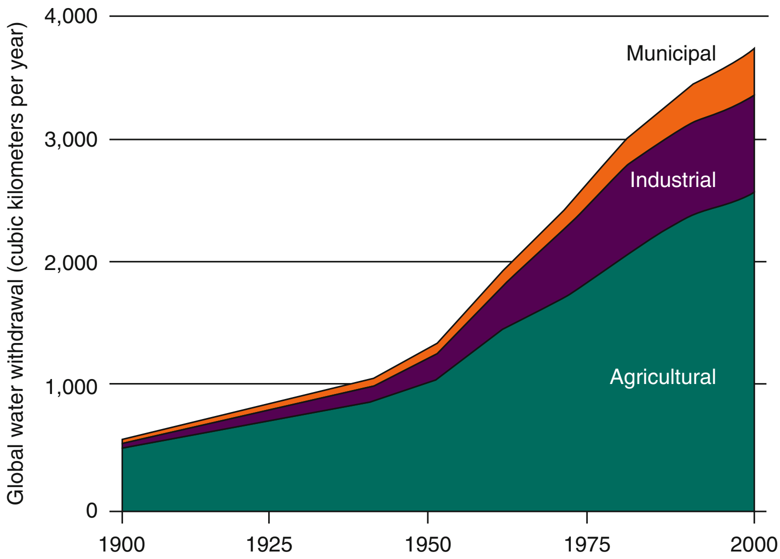

Fig. 3.1 Increasing sectoral competition for blue water withdrawals for human use

groups. Much of Sub-Saharan Africa experiences economic water scarcity and in many pockets across the globe, water resources are inequitably distributed.

According to the UN medium term projection, world population figures will reach seven billion by the year 2025, a 38% increase over present levels. The International Water Management Institute (IWMI) relative water scarcity index reveals from a data analysis of countries covering 93% of the world population, that 8% of the study population live in a physically water scarce situation, which means that they do not have enough water to meet their growing needs. Eighty per cent live in economically water scarce countries, which have potentially sufficient water to meet their requirements until 2025, but may not be able to make the investments required to harness this resource (Seckler et al. 1998). While domestic water consumption figures are small (assuming around 100 l/capita/day (lpcd) at the lower end of consumption), total withdrawals for human use (all uses including irrigation) are approximately 3,800 km^3 (water diverted from its natural courses) today. Of this a staggering 2,500 km^3 is already diverted for food production (Molden et al. 2001), but it is estimated that 40% more food grains with concomitant water requirements, will be required to feed this population in 2025.

Green and blue water use in agriculture occurs through evapo-transpiration or transpiration by plants and evaporation from soils. One may draw a distinction between the withdrawal of water from rivers, and soil (green water) and those measured and managed freshwater resources (blue water). Blue water is the component used to meet domestic, industrial and hydropower demands as well as, to sustain aquatic ecosystems in rivers and lakes (Molden et al. 2007).

If one analyses global water needs, global blue water withdrawals are at an estimated 3,830 km^3, of which about 1,000 km^3 (25–30%) is from ground water, mainly for drinking and irrigation. Of blue water 2,664 km^3 (70% including losses) is used for irrigated agriculture, with the net evapo-transpiration from irrigation being 1,570 km^3. The total water for rain fed and irrigated agriculture amounts to 7,130 km^3. Municipal and industrial demand for blue water, including for energy generation, is growing relative to demand for agriculture. As competition for water from these sectors intensifies, agriculture can expect to receive a decreasing share of developed freshwater resources (Shiklomanov 2000).

Basin closure: As societies develop, water resources within a given basin become diverted and controlled for accounted uses like water supply, energy generation, irrigation and others. There are also non-accounted downstream uses of water like flushing out sediments (e.g. Yellow River in China), diluting polluted water (e.g. Chao Phraya River in Thailand), controlling salinity intrusion (many deltas), and sustaining estuarine and coastal ecosystems and outflow to the sea. When river discharges fall short of such commitments during part of or all of the year, basins (or sub-basins) are termed, closing or closed (Fig. 3.2).

Basin closure is a human-induced process with many forces working to produce developed and often-overbuilt basins. While supply oriented strategies with disregard for demand management and the environment, are major contributory causes to over-development of river basins, the main reason is the development of infrastructure with a potential demand for water that outstrips basin resources and ecosystem resilience.

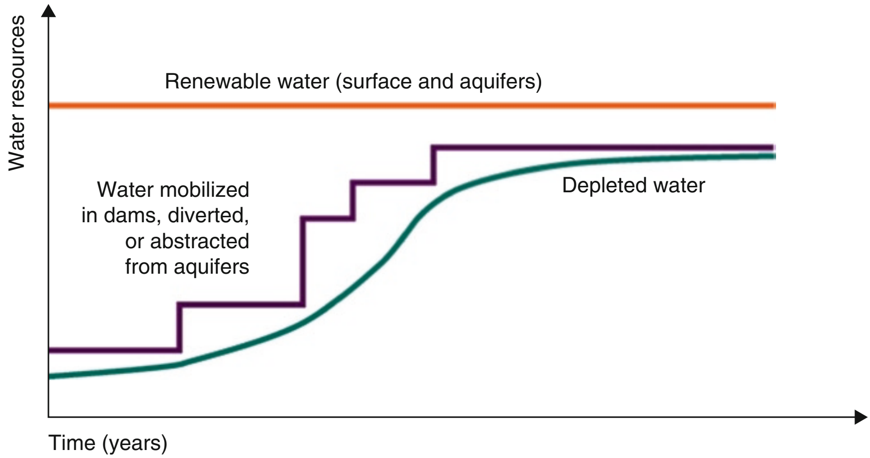

Fig. 3.2 Development of water resources can lead to basin closure

As basin water resources are committed, challenges posed by water quality and scarcity arise. Societies respond to basin closure in many ways, at the individual, community and state levels.

During basin closure, conflict situations that arise often relate to:

- Unfair allocation: during times of water constraints, water is often diverted from less profitable uses (often rural), and away from minority (or less powerful) groups
- Ignorance of upstream/downstream interactions: water can be removed or polluted upstream, leading to downstream reduced or polluted supply, requiring negotiation between upstream and downstream users

When this happens, three types of responses are possible:

1. Augment the supply from existing sources (foremost, increasing the quantity of controlled water), as well as tapping additional water.
2. Conservation or improving the efficiency of use of already controlled water resources without increasing supply.
3. Reallocate water from one user to another either within the same sector (for example, within or between irrigation schemes) or across sectors. This reallocation may be justified by a concern for increasing water productivity, but other objectives like enhancing food security, redressing inequities or restoring natural river flows may also prevail.

3.2 Water as an Economic Good

Social change, including changes in and increased understanding of the distribution of goods, produced new issues in water allocation. Population growth in many countries made water scarcity and water pollution a major but certainly not a recent problem. Traditionally, the state played a dominant role in managing water resources, but inefficient use of water, poor cost recovery for operating and maintenance expenses, the mounting cost of developing new water sources, and problems with the quality of service in agency-managed systems led to a search for alternatives that make water allocation and management more efficient (Dinar et al. 1997). This efficiency is a result of treating water as an economic good and allocating it among the sectors based on *value of use*. Actual mechanisms used for allocating water however may vary and include, marginal cost pricing, social planning, user-based allocation, and water markets. No single approach is suitable for all situations. Clearly, the state must play an important regulatory role, for example, but how effectively it does so depends on the relative political influence of various stakeholders and segments of society. User-based allocation is generally more flexible than state allocation, but collective action is not equally effective everywhere; it is most likely to emerge where there is strong demand for water and a history of cooperation. The outcome of market allocation depends on the economic value of water for various uses, but moving towards tradable property rights in water may ease the process of inter-sectoral reallocation by compensating the losers and creating incentives for efficient water use in all sectors.

However, one must remember that water is an unusual economic good with many different uses (Batten 2007):

- Water is renewable and fugitive, that is, water flows in a cycle, with little of the total water in storage.
- Many water bodies are common pool resources from which it is difficult to exclude users.
- Water typically has a very high value-in-use (i.e. is very useful), but a very low value-in-exchange (i.e. the price is low), sometimes making economic valuation and market mechanisms problematic.

Throughout history, societies have invested capital in infrastructure to maintain resource allocation based on social criteria or maintaining the community by ensuring that water is available for human consumption, for sanitation and food production. This prioritisation seems to continue across countries, with cities receiving water as resources become scarce, to the detriment of agriculture (Molle and Berkoff 2006). The four examples below, China, Tunisia, Jordan and India illustrate how countries try to deal with the transfer of water from low value users (agriculture) to higher value users (cities, industry, energy) under conditions of water scarcity/basin closure, giving rise in some instances to conflict. In some situations of water scarcity that affects agriculture, and where the conditions for transfer are right, recycling of wastewater is a possible compensatory measure to sustain agriculture.

China: Over the past 50 years, agricultural withdrawals as a proportion of total water withdrawals decreased from a high of 97% in 1949 to 69% in 1998, and are expected to reduce to 54% by 2050 (Jin and Young 2001). In part, this reflects the completion of irrigation development as irrigable land has run out. However, on China's northern plains, one of the most severely water-stressed areas in the world, it has also been associated, with an absolute decline in agricultural water withdrawals. In contrast, domestic and industrial water use has continued to increase at an annual rate of 12% and 5% respectively, over the past two decades. This impressive re-balancing derives from centralised policy and allocation mechanisms.

Tunisia: The concept of inter-regional solidarity and equity forms the basis of water policy. Regions are partly inter-connected through a network of pipes that re-distributes water from water-rich (mostly the north) to water-poor regions, and from agriculture to cities/tourist resorts, and sometimes back again to agriculture (use of wastewater for agriculture near Tunis). Out of concern for equity, Tunisia instituted a policy of pricing urban water on a homogenised average. In such a system, reservoirs in the north, initially constructed for irrigation purposes have gradually shifted to urban supply. The development of groundwater compensates for part of the shortfall. Irrigation use still amounts to 80% of total use, but groundwater accounts for 60% of the water used in agriculture (Treyer 2002). In the case of Tunisia, therefore, urban supply has clear priority with imposition and central management of reallocation.

Jordan: Domestic water supply in Amman, Jordan, is intermittent and the city has a long history of water shortages. The King Abdullah Canal in the Jordan Valley was initially constructed for irrigation and diverts an average of 150 mm^3/year from the Yarmouk to the Jordan Valley. The Deir Allah pipeline was constructed in the mid-1980s to lift 45 mm^3/year from the canal to Amman. Part of the return flow from the city is treated and sent back to the valley in compensation.

India: The Krishna Basin, in southern India, faces strong inter-seasonal and spatial rainfall variation (Biggs et al. 2007), which can cause acute scarcity and competition during dry years. Water availability varies considerably by sub-basin, and large projects built to increase water storage capacity fuelled disputes among the three basin states, Karnataka, Andhra Pradesh and Maharashtra. Rapid irrigation development, industrialisation, urbanisation and water pollution contribute to water scarcity and increased probability of conflicts. Tensions between farmers and state water authorities emerged when additional water, originally intended for irrigation, was diverted for the city of Hyderabad. Clearly, in India although overall urban growth rates are expected to decrease (from 1.4% to 0.9% between 2006 and 2025, Government of India 2006); securing sufficient and reliable water supplies for cities is becoming a significant challenge, due to increased water demand for industrial uses and energy production, and pollution due to unrestricted urban and industrial wastewater disposal (Centre for Science and Environment 2004). Modelling scenarios of water use for 50% and 75% dependable flow volumes for the period 2001–2030, provides some interesting perspectives (van Rooijen et al. 2009). Water use by non-irrigation sectors is estimated at 34% in 2030, roughly one-third of basin available water. This has profound implications for agriculture 1 year in 4, given that all urban and industrial demands will inevitably assume priority and offer minimal opportunities for conservation. Therefore, irrespective of the development of wastewater reuse, which can contribute to reducing water scarcity; contingency plans will need to respond to the increasingly variable water supply to agriculture.

3.3 Urban Water Use, Sanitation and Wastewater Disposal

In the next quarter century, the population explosion that characterised much of the twentieth century will witness another dramatic demographic transformation: urban population growth of an unprecedented scale. The urban population in the developing world will likely double to four billion by 2025, accounting for about 90% of global population growth. In contrast, rural population will probably grow slowly at only 0.1% and remain nearly stable at about three billion. China and India epitomise these shifts. China, now two-thirds rural, will become predominantly urban in the next 25 years, and the 600 million people projected to live in urban India by 2025 will approximate the combined total population of the United States, Russia and Japan.

Urbanisation carries in its wake a number of water supply and sanitation related problems particularly in the context of emerging economies. In many instances, failure to meet the supply-demand gap is not because of physical water scarcity but due to economic water scarcity although the former may compound the latter. All city dwellers have access to water in some way since no one can live without it. The issue is not whether they have access to water but whether the supplies are safe, equitable and sufficient for their needs and easily accessed at a price they can afford.

Analysing urban water use, one sees that bathing/showers and flushing toilets consumes the largest proportion of water. In India at the household level, bathing water accounts for 28% of total consumption in a study of seven cities. This is followed by consumption in toilets (20%), washing clothes (18.6%) and washing utensils (16.3%). On average, less than 10% of the total water in a household is used for drinking and cooking (Shaban and Sharma 2007). Water consumption figures from private households in the city of Qingdao, China (109 lpcd on average), showed similar high usage for bathing, flushing toilets, and washing dishes and clothes, amounting to a significant amount (30% each). In contrast, in a city like Queensland, Australia, domestic use is 627 lpcd of which 20% goes to flush toilets, 34% for bathing and 14% for laundry (Cornel et al. 2007).

3.3.1 Urban Water Footprint

The footprint is an interesting concept that contributes to understanding the impact of cities, and the city's links to the rural areas and beyond. Rapid urbanisation today is depleting natural resources and in the case of water, this could be due either to consumption or to downstream pollution. The water footprint tries to encapsulate this notion and in an urban context, can extend further to include the water needed for a city (Box 3.1).

The concept originated with the 'ecological footprint', introduced in 1994 by Rees and Wackernagel to describe the impact of growth of human society particularly

Box 3.1 The urban water footprint as virtual water flow into cities through food

Cities are the hub of economic and political activity and this translates into better facilities for cities, contributing to rural-urban migration. As cities attract more people, they have to assemble and provide the goods and amenities that these people need and want. Foremost among these is food.

A city of 10 million people may need at least 6,000 t of food per day. If you compare the daily per capita domestic water use with water for growing and processing food:

- People need 50 l of water per capita for drinking, cooking, washing, bathing and other domestic uses. Water for people is blue water.
- Growing a kilo of cereal grains uses between 500 and 2,000 l.
- A healthy, balanced diet requires 2,000–5,000 lpcd, depending on how much meat is included.

Providing a balanced diet requires 70 times as much water as domestic use.

urban societies, on natural resources notably land and water. The water footprint is an indicator of water use that examines both direct and indirect water use. The water footprint of a product (goods or service) is the sum of the volume of fresh water used to produce the product, at each step of production. A footprint can be defined similarly for the consumer, for a business or, for any product or activity as well as for any well-defined group of consumers (e.g. an individual or family, or the inhabitants of a village, city, province, state or nation), or producers (e.g. a public organisation, private enterprise or an entire economic sector). It goes beyond the total water volume used; and specifically includes the type, where and when the water is used.

Water use is measured in terms of water volume consumed (evaporated) and/or polluted. The water footprint in general includes three components: consumptive use of rainwater (green water), groundwater or surface water (blue water) and pollution of water (grey water/wastewater) (adapted from definitions, Hoekstra 2008). Depending on the patterns of disposal, one can extend the notion to include a spatial dimension, extending into rural areas. An example is the Musi River in Hyderabad, which receives city wastewater, and the pollution impacts appear up to 40 km downstream in the rural area (Ensink et al. 2006). When the footprint of cities is analysed in a basin context, such pollution may even be continuous with the various discharges from urban settlements within the basin.

The national water footprint (Chapagain and Hoekstra 2004; Drechsel et al. 2007) is a possible basis for comparison between countries. A particular urban challenge is the consideration of water quality in both the virtual water and urban water footprint concepts. Although water recycling (domestic return flow into the natural system) reduces the urban water footprint volumetrically, this amount remains marginal compared to the additional environmental water requirements to dilute its contamination load where wastewater treatment systems are inadequate (Hoekstra and Chapagain 2007). Thus for cities like Accra or Kumasi in Ghana, where streams passing the cities have faecal coliform loads of at least 10^5–10^6/100 millilitres (ml) due to discharge of wastewater; Drechsel et al. (2007) show that every litre of domestic return flow requires 1,000 l of clean water to dilute its pollution load to acceptable levels (below the World Health Organization, WHO 1989 coliform threshold of 10^3/100 ml, for reuse via irrigation). They also examine the urban water footprint from the interesting perspective of number of basins serving a given city. In the case of Accra, while piped water supply comes from only two basins; 80% of the food-related virtual water comes from four sub-regional basins and 20% (mostly processed and frozen food) comes from 38 basins worldwide, showing Accra's extensive geographical footprint to satisfy urban demands.

When a water footprint is reduced as much as is reasonably possible, and the negative externalities of the remaining footprint have been offset by making a reasonable investment in establishing or supporting projects aimed at the sustainable and equitable use of water; we speak of water neutrality.

3.3.2 Water Stress in Cities: Upstream and Downstream Implications of Sanitation Provision

In many developing cities with a preponderance of low-income areas, achieving the sanitation MDGs with improved systems (except if they are water saving or dry toilets), will require more water because the so-called improved systems usually require more water, for flushing and for carrying away the waste within the disposal system. Such is the situation in Accra, Ghana, where in addition a 6% economic growth rate is expected to be accompanied by more water consumption. Water intensive scenarios could thus lead to a shortfall of water for uses other then sanitation, in the absence of additional supply, leading to urban water stress; or put further pressure on upstream water resources to supply the city. Unless current designs of flush toilets become more water efficient, they will continue to take the biggest share in total water demand (Van Rooijen and Drechsel 2008). Rapid increase in urban water stress necessitates exploration of ways to save or recycle water and of alternative water sources. Flushing toilets using roof water or increased water recycling can help reduce urban water stress.

Sanitation service provision is a function of income levels in cities and shows a continuum between very high quality (high income) to very low quality (low income) (Box 3.2). The implications for surface (and ground) water resources within the city and downstream, and for public health are manifold.

A study in Accra, Ghana (Labite 2008; Drechsel 2009) comparing the burden of disease via different exposure pathways (drinking contaminated water, food borne, other contact with polluted water, etc.) showed that exposure of children

Box 3.2 Economic development and sanitation service provision

There are three levels of provision with attendant challenges.

1. In *high-income countries*, there is nearly universal provision of advanced water and sanitation facilities, most of which are provided by public sector utilities, although private sector provisions have gained market share. The main challenges are prevention of microbial and chemical contamination of water distribution systems, optimising the efficiency of utility operation both in economic and in ecological terms, issues of asset renewal and management of residuals from water treatment, and ensuring that the impact of effluents from wastewater discharges on receiving waters remains within acceptable levels.
2. In *middle-income countries*, significant water and sanitation infrastructure exists but often in poor condition. The service delivery systems are frequently under-funded, poorly managed and in poor repair with high levels of leakage, and inadequate wastewater treatment. Here the most pressing issues relate to improving efficiency, infrastructure maintenance, renewal and extension, pricing and revenue collection, and more effective supervision and enforcement of regulations on industrial pollutants. Governments are beginning to address these issues, especially in larger cities.
3. *Lower-income countries* have particularly difficult problems. They have less water and sanitation infrastructure than high- and middle-income countries. Likewise, their institutions and management systems are generally underdeveloped, and their overall capacity to deliver reasonable water and sanitation service is low. Big cities generally have some water and sanitation infrastructure in their central areas and in many cases, the introduction of private concessionaires or improved public utility operations is improving and expanding coverage. However, in many areas of large cities and in most smaller urban centres, water and sanitation infrastructure remains limited, and there are problems with industrial pollution. The overall result is widespread microbial and chemical pollution of water sources in and around the cities.

to open drains carrying wastewater contributed most to the disease burden of the city expressed in DALYs[1] (Fig. 3.3). Episodes of flooding due to overflow from storm water networks carrying wastewater either by accident or by design can also spread disease. This compromises the widespread phenomenon in developing countries of using these sources for livelihood purposes like urban and peri-urban

[1]DALYs (Disability Adjusted Life Years) is a measure of the relative public health and emphasises the real health weight and (cost) of disease, sometimes leading to death and/or long-term damage.

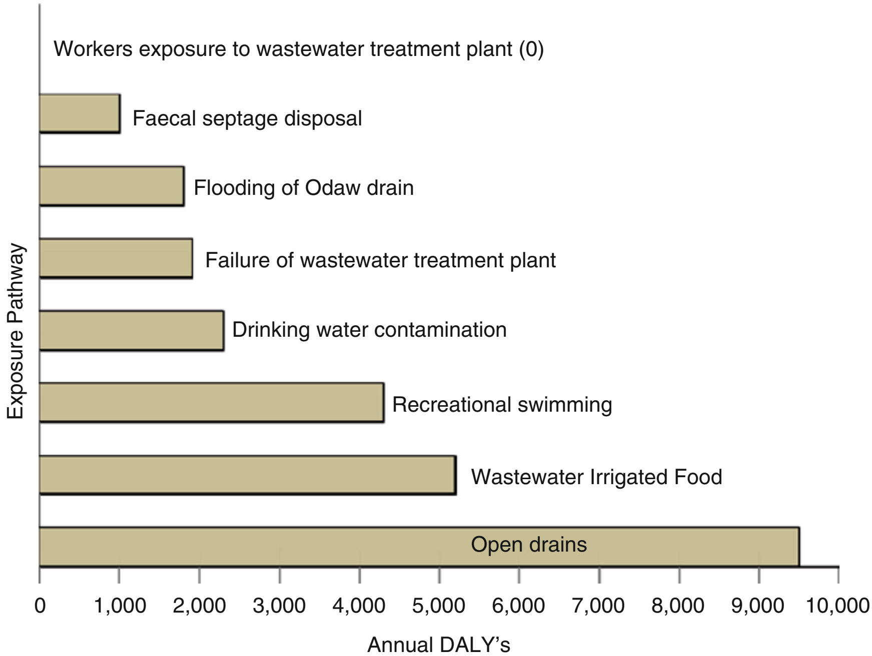

Fig. 3.3 Hazard comparison for Accra, Ghana, via different exposure pathways. DALY: Disability Adjusted Life Years (WHO 2006). Source: Labite (2008) and Drechsel (2009)

agriculture, leading to contaminated supplies of perishable fresh vegetables to cities. The environmental implications are loss of diversity and in some cases, downstream stretches of water are no better than open sewers.

From a health perspective, 2.1 million people globally, mostly children die of diarrhoea each year through exposure to waterborne pathogens. Inadequate water supply, sanitation and hygiene result in a global disease burden of 52.7 million DALYs a year.

3.3.3 Sanitation and Waste Disposal Infrastructure in Cities

A recent survey of 53 cities (Raschid-Sally and Jayakody 2008) shows that although the coverage for urban water supply seems high, water supply is only intermittent in many cities implying low overall service levels (see also Box 3.2). People cope with this situation through storing it in-house on days they receive supply. In some cities, this rotation serves the hidden purpose of managing water losses as well. With poorly maintained infrastructure in cities where losses due to leakage may be up to 30–35%, maintaining 24-h supply would entail huge water losses. In Chennai, India reportedly, if supply increased from current levels of 2–12 h/day, at 10 m pressure, leaks would amount to about 900 million l/day, or about 3 times the current total supply (as reported in Molle and Berkoff 2006).

From a sanitation and waste disposal perspective, it is surprising that in at least 60% of the cities, a large percentage of the urban populations (between 30% and 100% in some cases) still get service from some form of onsite sanitation. Nearly half these cities have populations of more than one million. Under urban densification, due to space restrictions, the efficient functioning of on-site systems is compromised, leading to septage disposal problems. Unfortunately, the treatment and disposal infrastructure for both this form and the centralised sewerage form are unavailable.

The same survey showed that out of 27 cities; only eight treated all their collected wastewater, but the collected wastewater did not always represent the total volume of wastewater generated. More than half of these cities treated less than 50% of wastewater collected mostly to primary treatment level and some to secondary level using stabilisation ponds or other biological processes. More than half these cases even had overloaded and/or malfunctioning treatment plants, leading to surface water pollution through discharge of untreated wastewater. Many cities exhibit groundwater contamination from point sources (leachate from garbage dumps) and non-point sources (overflows from septic tanks). Sewer overflows due to increased volume and frequency of rainfall, are often the cause of urban flooding.

Less developed economies have fewer resources for treatment and direct discharge results in significant spoilage of freshwater for many purposes including irrigation. In New Delhi, India, in 2000, more than 50% of city sewage emptied into the river, used downstream for various purposes including agriculture. Even if New Delhi tripled its then sewage treatment capacity at a cost of 7.5 billion US$, this will still be below safe disposal levels (Agarwal and Narain, 2002).

3.4 Valuing Wastewater as a Resource

As can be understood from the earlier discussion, while allocation issues can create tensions even within a sector (e.g. different urban users), the real issue often is the inter-sectoral allocation or competition between urban use, hydropower and irrigation/agriculture. Here we consider the competition between agriculture and cities (urban uses) and the synergies possible at the agriculture-water-sanitation nexus. Although urban use represents less than 10% of withdrawals, it is often accused of taking water away from agriculture; a contention that is relatively true in some instances. The good news however is that the return flows from cities (wastewater) can contribute to offsetting this agricultural loss (albeit perhaps not in the same location), since nearly 70–80% of urban consumption returns as waste. Wastewater reuse is an integral part of managing the urban water cycle thus; it is important to handle it sustainably and discuss ways to meet that goal.

Dense human settlements absorb large volumes of clean water and food and convert them into wastewater containing organic matter and nutrients. Managing this wastewater and eventually making an asset out of an otherwise waste product, relies on the following arguments.

Health and welfare of people: Not only those within the city but those downstream have exposure to the hazards of current disposal arrangements. Inadequate wastewater disposal is a contributory factor to the global burden of diarrhoeal disease of nearly 52.7 million DALYs/year.

Environmental wellbeing: Disposal without treatment as in most cities in developing countries is ruining natural ecosystems that sustain human livelihoods.

Recycling essential nutrients: The current global phosphorus crisis makes it imperative to recover as much of this nutrient as possible (Rosemarin 2004). Every 1,000 m^3 of municipal wastewater that irrigates one hectare can contribute 16–62 kg total nitrogen, 4–24 kg phosphorus, 2–69 kg potassium, 18–208 kg calcium, 9–110 kg magnesium, and 27–182 kg sodium (from Keraita et al. 2008).

Economic cost of ill-managed wastewater: All of the above have economic costs linked to health, loss of ecosystem values, and energy and fertiliser needs.

Water scarcity and climate change: Finally, the issues of water scarcity and allocation discussed above make it imperative to use wastewater to the maximum extent possible. This is substantiated further by arguments of climate change impacts.

Reuse of wastewater dates as far back as 1700 BCE to Crete, where brick-lined conduits transported wastewater to agricultural lands to irrigate and fertilise crops and fruit orchards. As late as the nineteenth century, in Berlin, Germany, and in Paris, France; wastewater was still being used for sewage farming, sometimes only with partial treatment (Asano et al. 2007). In China, Mexico, Peru, Egypt, Lebanon, Morocco, India and Vietnam, wastewater is an historic source of fertiliser (Shuval et al. 1986; Jiménez and Asano 2008). Thus, untreated wastewater has ancient agricultural applications for both environmental protection through land application and crop production (Keraita et al. 2008). However, developed countries, with increasing knowledge of science and improved technology, have moved away from the practice. Yet, developing countries continue to use untreated wastewater, for many reasons and often involuntarily.

In general, when we speak of reuse we tend to think of it first as a planned or engineered process. As such, the inclusion of planned water reclamation, recycling and reuse in a water resource system usually reflects the increasing scarcity of water sources to meet societal demands, technological advancement, public acceptance and improved understanding of public health risks.

The last decade saw increased interest towards responding to untreated wastewater use in agriculture (and aquaculture) when practitioners realised the extent of the practice and the potential extensive health impacts to users and consumers of the produce.

3.4.1 Definitions of Wastewater and Typology

Various reports and textbooks provide definitions of wastewater (Metcalf and Eddy 1995; Westcot 1997; Asano and Levine 1998). Consolidating and summarising this information, urban wastewater may be described as a combination of some or all of the following:

- Domestic effluent consisting of blackwater (excreta, urine and associated sludge) and grey water (kitchen and bathroom wastewater)
- Water from commercial establishments and institutions, including hospitals
- Industrial effluent
- Storm water and other urban runoff

The proportion of each constituent within any given urban sewage load will vary due to spatial and temporal differences. For instance, monsoon climatic patterns will have a marked effect by washing waste into sewers and drains, but also by diluting wastewater during heavy rains, with the converse effect during hot and dry summers with more evaporation.

The term *Marginal Quality Water* provides a larger umbrella as it can refer to wastewater, but also to agricultural drainage water or other water (e.g. with a high salt or silt content), which reduces its quality for agriculture and other uses (Qadir et al. 2007).

A typology captures the characteristics of the different ways wastewater is used. Various authors attempted to provide typologies for wastewater recycling and use (Cornish and Kielen 2004; Van der Hoek 2004), but none of these have been taken up universally or been standardised. A comprehensive set of definitions, terminology and typology of wastewater appears in Jiménez and Asano (2008). In relation to use, recurring frequently in literature and sometimes in combination are the terms, *treated, untreated, or partially treated*, *raw* and *diluted,* as well as *direct, indirect, planned* and *unplanned, formal* and *informal* use. Additionally, *reclaimed water, reuse* and *recycling* are important terms.

Reclaimed water has a connotation of quality such as wastewater *treated* until safe for reuse.

Recycling is utilisation of *treated* or *untreated* wastewater for the same purpose that generated it (e.g. recycling effluents within the industry), whereas *reuse* is for a purpose other than the one that generated it (e.g. municipal wastewater used for agriculture).

Direct and *indirect* use can refer to both treated and untreated wastewater, and the difference is in the degree of 'dilution' of the wastewater. Direct use of treated wastewater is planned and control exists over the conveyance from treatment works to a controlled area used for irrigation. Various treatment technologies are possible, with lower level of treatment required for agricultural purposes and more advanced treatment if direct or indirect potable reuse is expected (Brissaud 2002, 2008; Asano et al. 2007; Lazarova and Bahri 2005; Libhaber 2007). If such use is indirect, it implies that the treated wastewater was first 'diluted' in a water body before it was extracted for use.

When untreated wastewater is directly used, it may be via a formal irrigation conveyance system as in Haroonabad, Pakistan, where it is used for vegetable production (van der Hoek et al. 2002). Alternatively, numerous informal irrigators may extract and use it individually, as in Accra, Ghana or in Nairobi, Kenya, where farmers block or break sewers deliberately to access water for irrigation in urban areas.

With indirect use, if the dilution is not adequate, the resulting water may be of very poor quality. There is no control over the use of water for irrigation or domestic

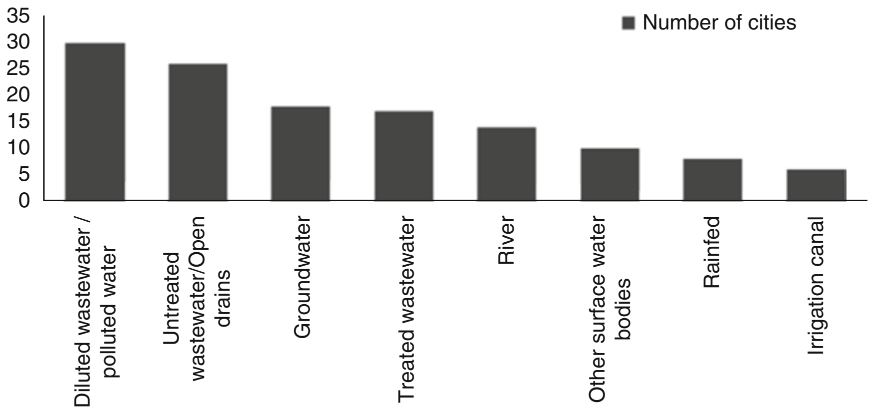

Fig. 3.4 Water sources for use in irrigated agriculture. Source: Raschid-Sally and Jayakody (2008)

consumption downstream of the urban centre. Many urban farmers indirectly use marginal quality water of unknown composition from points downstream of an urban centre (Drechsel et al. 2006). This reflects inadequate waste disposal practices in urban areas. For example the city of Beijing, despite massive investments in wastewater treatment, is only able to treat about half of the wastewater generated, and untreated wastewater discharges to waterways, which farmers use downstream (Yang and Abbaspour 2007). Some Middle Eastern examples are Lebanon and Palestine, where most of the wastewater collected from sewers discharges into nearby rivers, wadis and the sea, on open land or underground with little or no treatment (Post 2006). Sometimes, irrigation infrastructure originally built to transport freshwater has switched to use wastewater, at least during certain periods, to supplement irrigation water. For instance in Vietnam, wastewater from Hanoi and other cities along the Red River Delta is used in this way (Raschid-Sally et al. 2004).

In Fig. 3.4, direct and indirect use of untreated wastewater, represented by the columns 'diluted wastewater' and 'untreated wastewater' are the most frequently used water sources.

Distinction between formal and informal use refers to the presence of an irrigation infrastructure or to a certain level of permission and control by state agencies. With informal use, abstraction is at scattered points and there is no control. Such use provides livelihood opportunities to many poor farmers in urban and peri-urban locations.

3.4.2 Overview of Planned and Unplanned Use in Agriculture

There is no comprehensive global inventory on the extent of wastewater used for irrigation and the level of treatment. Various criteria describe the extents of wastewater use, such as number of countries using, areas irrigated, volume used, and number of farmers, etc. Based on information from the countries providing data on irrigated areas, it is estimated that more than 4.5 million ha use *waste* or *polluted* water. A separate estimate indicates 20 million ha; an area nearly equivalent to 10% of the total irrigated land globally (Jiménez and Asano 2008; Keraita et al. 2008; LeBlanc et al. 2008; Scott et al. 2004). In contrast, the area reported irrigated with *treated* wastewater amounts to only 10% of this value. In practice, due to under-reporting of areas using polluted water, the difference may be much higher.

WHO (1989) estimated, almost 20 years ago that the area using raw wastewater or polluted water was three million ha, showing that in 20 years, the estimated area has increased by 6 times, which indicates at least that reporting is better due to increased awareness of this phenomenon. Every four out of five cities (80%) in the developing world use wastewater irrigation and up to 200 million farmers across Asia, Sub-Saharan Africa, and Latin America harvest grains and vegetables from fields using polluted water sources (Raschid-Sally and Jayakody 2008). Similar results were reported using data from 46 of 62 countries investigated (74%), which reported the use of polluted water to irrigate (Jiménez and Asano 2008; LeBlanc et al. 2008). Much of this use is unintentional, and is the consequence of polluted water sources from poor urban sanitation and waste disposal practices. Jiménez and Asano (2008) have compiled the most comprehensive volume on the subject, citing many, global case studies.

Reuse of wastewater is usually directed towards the sector using the most amount of water. In Pakistan and Tunisia, this is agriculture, with water use of 96% and 86% respectively, and both reuse much of their wastewater for irrigation, in the former mostly untreated and in the latter treated. Namibia and Singapore, use 29% and 45% of total water extracted for municipal purposes respectively, and run big reclamation projects on treated wastewater for human consumption. In the USA, Singapore and Germany, where 45%, 51% and 69% of water is used for industrial purposes respectively, there are many recycling and reuse projects across industries.

In general use in aquaculture is limited, but Vietnam, China and India are popular examples. (Edwards 2000). In Vietnam, the practice remains extensive in rural areas with each household having their own pond, as well as in urbanised areas, especially on the outskirts, where the terrain and the climate permit extensive ponds. The Calcutta wetlands are famous for sewage aquaculture for the past 70 years, but urbanisation has taken its toll and the area is now reduced.

Contrasting examples of reuse, from Tunisia, Ghana and Ethiopia, are in Box 3.3 Tunisia has a longstanding programme of planned reuse of treated water, whereas Ghana and Ethiopia, have experience of indirect and uncontrolled use of untreated wastewater.

3.4.3 Drivers, Benefits, and Risks of Wastewater Agriculture

3.4.3.1 Drivers

A study commissioned by the Comprehensive Assessment of Water Management in Agriculture showed that across 53 cities in the developing world the main drivers

Box 3.3 Planned reuse (Tunisia) versus unplanned reuse (Ethiopia and Ghana)

Wastewater reuse in Tunisia
In Tunisia, the sanitation coverage in large urban centres is more than adequate (97%) and industries have to meet compliance standards. Of the 287 Mm^3 (million cubic metres) of wastewater collected annually, 224 Mm^3 (78%) are treated in 98 treatment plants (mainly secondary biological treatment). Tunisia launched its national water reuse programme in the early 1980s, such that the planning stage allows consideration and combination of treatment and reuse needs. More recently, they drafted a water reuse strategy, which considers reclaimed water as a resource. About 30–43% of the treated wastewater is for agricultural and landscape irrigation. Reclaimed water irrigates 8,100 ha of industrial and fodder crops, cereals, vineyards, citrus and other fruit trees. Regulations allow secondary-treated effluent use on all crops except vegetables, whether eaten raw or cooked. Reuse provides a way to increase water resources, provide supplemental nutrients, and protect coastal areas, water resources and sensitive receiving water bodies. Tunisia has achieved this through inter-departmental coordination and follow-up commissions at national and regional levels, which bridge the gaps between the needs of different parties, ensure the achievement of development objectives and preserve the human and natural environment (Bahri 2009).

Wastewater reuse in Addis Ababa (Ethiopia)
About 49 Mm^3 of wastewater is generated in the city of Addis Ababa annually of mainly domestic origin with about 13% industrial. Akaki River serves as the sink for this wastewater. Farmers have been producing vegetables using Akaki River water for the last 50 years with 1,240 ha irrigated, mostly by gravity using furrow or flood irrigation. Urban agriculture, mainly irrigated with wastewater, provides 61% of the vegetables consumed in Addis Ababa (lettuce, Swiss chard, cabbage, spring onion, potato, beet root, etc.) (Bayrau 2008).

Wastewater livelihoods, in Accra, Ghana
In Accra, about 53% of the population dispose of their grey water directly into gutters and storm drains. All this grey water supplemented by direct discharges from septic tanks and public toilets in low-income areas, empties into the local stream and river network that provides water for irrigated urban vegetable production. Annually, an estimated 4.4 Mm^3 of wastewater irrigate urban farms (Abraham et al. 2007). From this, 800–1,000 farmers earn an income (Obuobie et al. 2006).

Raschid-Sally and Jayakody 2008, suggest that the use of wastewater in agriculture is driven by a combination of the following factors:

- Limited capacity of cities to treat their wastewater, causing pollution of water bodies and traditional irrigation sources

- Lack of alternative (cheaper, similarly reliable, available or safer) water sources in the physical environment
- Urban food demand and market incentives favouring food production in city proximity where water sources are usually polluted

Jiménez (2006) points in addition, to the influence of socio-economic factors at the household level, like poverty and low education. In developing countries, where lack of job opportunities encounters a limited awareness of health risks, wastewater reuse represents a promising opportunity to improve food supply or for cash crop production. Once it is in place and the population gauges the advantages, it is difficult to change behaviour especially if changes have an associated cost or link to historical water rights. Reduced availability of freshwater resources (influenced by climate change, and salinisation in some places) may compound this reality. Farmers recognise the inherent nutrient value in wastewater and sludge, another factor driving use.

However, in developed countries recycling treated wastewater is increasingly a response to physical water scarcity (climate change and drought management), water reallocation from agriculture to other uses, and as an economic response to costly inter-basin transfers. Another factor influencing recycling is stringent environmental standards that make land application of wastewater and sludge both unavoidable and economically feasible.

3.4.3.2 Benefits

For small farmers in developing countries, wastewater serves as a reliable source all year round permitting multiple cropping seasons, higher yields, and a larger variety of crops that require irrigation (Keraita et al. 2008; Raschid-Sally et al. 2005). Studies conducted in Hubli-Dharwad showed that wastewater allowed farming in the dry season, when produce can fetch 3–5 times the kharif (monsoon) season prices (Huibers et al. 2004). In Haroonabad, Pakistan, the reliability and flexibility of wastewater supplies allows farmers to cultivate high-value short cycle crops (Van der Hoek et al. 2002), and in Ghana, it aids vegetable production. Similarly, in Dakar, Senegal, wastewater allows 8–12 harvests per year compared to 5–6 harvests per year before farmers had access to wastewater (Gaye and Niang 2002).

Income benefits translate into indirect benefits of education and improved health conditions for farmers and family although the latter is more difficult to prove. Where vegetables are the main commodity produced with wastewater, there can be a significant aggregate benefit for society in terms of a more balanced diet. In Accra, every day more than 200,000 people eat vegetables produced with wastewater (Amoah et al. 2007). However, this group is also at risk, from clearly adverse health effects (WHO 2006).

The nutrient content, especially in untreated wastewater, contributes to economic gains by reducing demand for chemical fertilisers. On the other hand, excessive concentrations of nitrogen in wastewater can lead to over-fertilisation and/or

Table 3.1 Income generated from wastewater irrigated agriculture in selected cities

City	Annual income per hectare (US$)	Annual GNI[a] per capita (US$)[b]
Nairobi, Kenya	1,770	645
Dakar, Senegal	2,234	773
Kumasi, Ghana	420–1,920	522
Hyderabad, India	830–2,800	771
Haroonabad, Pakistan	840	931
Guanajuato, Mexico	1,935	7,755

Source: Keraita et al. (2008).

[a] GNI = General National Income; Source: UN Statistics for countries for 2006.

[b] Actual farm sizes are usually smaller, ranging for example in West Africa's cities between 0.02 and 0.3 ha.

salinisation (Pescod 1992; Jiménez 2006) and farmers are unable to control the dosage of fertiliser as the nutrient content in wastewater varies and is difficult to evaluate.

Few studies quantify the economic gains from nutrients in wastewater under field conditions (Table 3.1). In Guanajuato, Mexico, the estimated savings of using wastewater to add nitrogen and phosphorus is US$135/ha (Keraita et al. 2008). A study comparing vegetable production using freshwater and untreated wastewater in Haroonabad, Pakistan, found that the gross margins with wastewater were significantly higher (US$150/ha), because farmers achieved higher yields but spent less on fertiliser (Van der Hoek et al. 2002). In Ghana, the greatest factor influencing farmers' profits is not the yield, but the ability to produce high-demand crops at the right time, which could sell consistently above average prices (Cornish and Lawrence 2001).

In El Mezquital Valley, Mexico, irrigating with wastewater instead of freshwater increased rents from US$170 to between US$ 350–950/year (Jiménez 2005), and reflects the profitability. In Quetta, Pakistan, farmers paid 2.5 times more for wastewater than for freshwater (Ensink et al. 2004).

While farmers and their families are direct beneficiaries, there are also indirect beneficiaries along the supply chain including farm labourers, transporters, vendors, processors, input suppliers and consumers (Buechler et al. 2002). With low investments and quick returns, this lucrative practice enables many farmers to escape poverty (Danso et al. 2002; Faruqui et al. 2004). Finally, agricultural use of wastewater constitutes a low-cost disposal method that if controlled can be safe. Wastewater use can recharge aquifers through infiltration or reduce effects on surface water bodies, as wastewater treatment happens in the soil (Jimenez 2003).

3.4.3.3 Health Risks

Health risks from pathogens associated with untreated wastewater are much higher than with treated (Box 3.4) (WHO 2006; Hamilton et al. 2007; Keraita et al. 2008). Three important considerations to keep in mind are:

1. Disease is a function of the nature of the pathogen in the wastewater and thus show local variations depending on the local public health pattern.

Box 3.4 Diseases most commonly associated with wastewater

- Helminthiases: caused by intestinal infestation of parasitic worms, which often lead to severe consequences, such as cognitive impairment, dysentery, or anaemia. Children under 15 may suffer stunted growth and/or impaired fitness.
- Cholera, caused by Vibrio cholera, has caused not only epidemics several pandemics. Cholera relates strongly to the use of polluted water for irrigation. Major risks occur where there are large concentrations of people and hygiene is poor (as in refugee camps and urban slums).
- Salmonellosis, typhoid, shigellosis, gastric ulcers (caused by Helicobacter pylori), giardiasis and amebiasis (Blumenthal and Peasey 2002).
- Skin diseases are associated with contact with untreated water. Nail problems (koilonychias) characterised by spoon-formed nails have also been reported, associated with the anaemia produced by hookworm infections, which cause iron deficiency (van der Hoek et al. 2002). Studies from Vietnam and Cambodia associate skin diseases such as dermatitis (eczema) with contact with untreated wastewater. In the Katmandu Valley, a study found more than half of 110 farmers using wastewater experienced skin problems including blisters and itching on the hands and feet. Rice farmers along the Musi River in Hyderabad, Pakistan and urban vegetable farmers using wastewater in Ghana report similar problems (excerpted from Keraita et al. 2008).

2. Risks are not limited to farmers, but affect four groups – agricultural workers and their families; crop handlers; consumers of crops or meat and milk coming from cattle grazing on polluted fodder; and those living in or near the areas where wastewater, sludge or excreta is used. Within these groups, the most vulnerable sections of the population are children and the elderly.
3. Observed responses may vary between developing and developed countries (Jiménez 2007; Jiménez and Wang 2006) because pathogen distributions and concentrations, to which these groups are exposed, are very different, as are living conditions and the level of resistance to disease. Furthermore, statistics on food safety used to calculate risks are unreliable because laboratory standards are so low in most developing countries it is impossible to guarantee accurate results.

Two types of health risks are associated with wastewater reuse, particularly untreated.

Consumption-related health risks: the primary concern is consumption of raw vegetables. As Keraita et al. (2008) indicate, several studies, including a prospective cohort study (Peasey 2000), an analytical descriptive study (Cifuentes 1998) and several descriptive studies show higher Ascaris (worm) infections for both adults and children consuming uncooked vegetables irrigated with wastewater.

Occupation-related risks: Helminth infections, especially Ascaris and hookworm, have higher importance in an occupational sense compared to bacterial, viral and protozoan infections. This affects farm workers most, due to the long exposure to wastewater and contaminated soils. Indian and Pakistani sewage farmers show higher risk of infection from hookworms (Ensink 2006); and in Pakistan, prevalence rates for hookworm infections as high as 80% have been reported for male adult farmers using untreated wastewater (Van der Hoek et al. 2002). Skin diseases are the other clear health risk associated with wastewater when farmers have direct skin contact with untreated wastewater.

It is important to remember that there is no comprehensive study in developing countries with various disease exposure pathways, of the comparative risk contribution from wastewater irrigation and contaminated crops. Quantitative Microbial Risk Assessment (QMRA) methodologies can and should be effective for this purpose, in order to have a realistic perspective of the situation. Pathogens contaminate crops mainly via direct contact, although some cases of uptake by plants have been recorded (Hamilton et al. 2007).

3.4.3.4 Other Risks

Beside pathogens, wastewater can also be a source of high levels of heavy metals and toxic organic compounds (Hamilton et al. 2007; Abaidoo et al. 2009). Most metals and some organic chemicals are absorbed directly from the soil. Location (possible contamination sources), environmental and soil conditions, bioavailability, crop types and agricultural practices (quantity of water applied and irrigation method) are some important factors influencing uptake of pollutants and contamination (Pescod 1992; Jiménez 2006). However, in developed and developing countries, the heavy metals content of wastewater from domestic sources is typically low enough to permit their use as fertilisers (WHO 2006).

Experts recommend banning this practice as unsafe, and treating all wastewater. Such recommendations, besides the social and economic implications, would be nearly impossible to implement in many developing countries and would prevent nutrient recovery from wastewater. A practical trade-off is necessary. It is vital to make the practice sustainable within various contexts. Theoretically, there are many ways to do this but practically, application of these methods remains rudimentary (Drechsel et al. 2010).

3.5 Sustainable Approaches to Sanitation and Wastewater Management

It is important to view urban wastewater recycling as one part of a much larger picture of integrated water planning. For successful wastewater recycling, centralised strategies work in some countries, but in emerging economies decentralised strategies for water collection, use and treatment, may be more successful, because they rely on principles of integration, prevention and resource recovery, rather than treatment and disposal. By first seeking more local opportunities both at the site of water use and at the point of discharge, and tailoring water quality to the end use, we may find ecological and low-entropy possibilities for reducing water demand and treating effluents in more ecologically effective ways. This concept of integrated source- and site-based water planning has been the basis for developing a number of ecologically sensitive approaches. Here are brief explanations of two such approaches, the Design for Service (DFS) approach and the Ecological Sanitation approach.

3.5.1 Design for Service Planning Approach

This planning approach combines elements of sustainability in a logical planning framework applicable to wastewater reuse (Murray and Buckley 2010). First tested in China, it requires further field application to confirm applicability. The approach is an effort to broaden the societal anchor of the sanitation sector as an active contributor to local economies by linking sanitation service providers, communities, and the private sector. This in turn could leverage finances for operation and maintenance (O&M) of the system, which is one of the primary factors leading to breakdown and malfunction of treatment systems.

DFS is a market-oriented approach that puts back-end-users, people who exert demand for wastewater (WW), effluent or faecal sludge (FS) for irrigation, aquaculture, fertiliser or fuel at the centre of the planning process to achieve urban sanitation objectives and to capture and allocate the local economic and social value of WW, FS and treatment by-products simultaneously. Back-end users will be formally incorporated into the financial and O&M model of each target treatment facility and, in exchange for direct payment and/or in-kind labour (maintenance) at the treatment plant, they obtain their specific output requirements. This additional revenue and/or labour will ease the burden of financing WW and FS treatment on households and government and improve the incentives and financial capacity for long-term operation.

3.5.2 Ecological Sanitation

The introduction of concepts of ecological sanitation came in response to the increasing criticism of conventional forms of centralised sanitation, and their negative environmental impact (IRC 2006; SIDA 1998; SEI 2004; UNESCO/IHP & GTZ 2006; Schertenleib 2005). High water consumption, huge operating and maintenance costs, and enormous initial investments involved, make these unsuitable as a blanket solution for developing countries especially in arid climatic zones. Moreover, these usually deprive agriculture, and consequently food production, of the valuable nutrients contained in human excrement. The concepts referred to as ecological sanitation offer a more holistic approach towards sustainable sanitation. The key objective of this approach is not to promote particular technologies, but a new philosophy of dealing with wastewater. It is based on the systematic implementation of a material-flow-oriented recycling process as a holistic alternative to conventional solutions (ECOSAN, SuSanA websites[2]). Ideally, ecological sanitation systems enable the complete recovery of all nutrients from faeces, urine and grey water to the benefit of agriculture, and the minimisation of water pollution, while ensuring that water is used economically and is reused to the greatest possible extent, particularly for irrigation purposes.

3.6 Conclusions

Cities receive priority in water allocation, due to their socio-political construct. The transfer of water from low value (agriculture) to high value (urban/industrial) uses necessitates reflection on how to accommodate this loss of water to the agricultural sector. Urbanisation on the other hand creates demand, and leaves a mark on the hydrological cycle, via its water footprint.

The fact that almost 80% of urban water use constitutes return flow of wastewater to the environment, begs thinking that this otherwise useless nuisance, which furthermore pollutes freshwater sources, could be harnessed for beneficial use, in either agriculture or related activities like aquaculture. Indeed, wastewater is already used for these purposes worldwide with proven economic benefits but with little concern for potential health impacts.

Beneficial use would require a paradigm shift, in the design and maintenance of systems for re-users. Re-use should be an integral part of managing the urban water cycle. Associating beneficiaries and adopting a market-oriented value chain approach that benefits the users, will lead to more sustainable wastewater management and healthier populations.

References

Abaidoo, R., Keraita, B., Drechsel, P., Dissanayake, P., & Maxwell, A. (2009). Soil and crop contamination through wastewater irrigation and options for risk reduction in developing countries. In P. Dion (Ed.), *Soil biology and agriculture in the tropics*. Heidelberg: Springer Verlag.

Abraham, E. M., Van Rooijen, D., Cofie, O., & Raschid-Sally, L. (2007). *Planning urban water – dependent livelihood opportunities for the poor in Accra, Ghana*. Birmingham: Switch First Scientific Meeting.

[2] Ecological Sanitation available online at http://www2.gtz.de/ecosanienglish/subject,htm. SuSanA website – Sustainable Sanitation Alliance http://www.susana.org/.

Agarwal, A., & Narain, S., (2002). Private sector cannot solve India's water and sanitation problems, *Water and Wastewater International*, *17*(2) April 2002.

Amoah, P., Drechsel, P., Abaidoo, R. C., & Henseler, M. (2007). Irrigated urban vegetable production in Ghana: microbiological contamination in farms and markets and associated consumer risk groups. *Journal of Water and Health, 5*(3), 455–466.

Asano, T., Burton, F., Leverenz, H., Tsuchihashi, R., & Tchobanoglous, G. (2007). *Water reuse: Issues, technologies, and applications*. New York: McGraw-Hill.

Asano, T., & Levine, A. D. (1998). Wastewater reclamation, recycling, and reuse: an introduction. In T. Asano (Ed.), *Wastewater reclamation and reuse*. Boca Raton, FL: Water Quality Management Library, CRC Press.

Bahri, A. (2009). Managing the other side of the water cycle: Making wastewater an asset. TEC Background Papers No. 13. Global Water Partnership. Elanders, Molynlycke, Sweden.

Batten, D. (2007). Can economists value water's multiple benefits? *Water Policy, 9*, 345–362.

Bayrau, A. W. (2008). Economic analysis and policy implications of wastewater use in agriculture in the central region of Ethiopia. Ph.D. dissertation, Institute of Farm Management. Germany: University of Hohenheim, p. 91.

Biggs, T., Gaur, A., Scott, C., Rao, G., Krishna-Gumma, M., & Turral, H. (2007). Closing of the Krishna Basin: irrigation development, streamflow depletion, and macroscale hydrology. Colombo. Sri Lanka: International Water Management Institute, IWMI Research Report 111.

Blumenthal, U. J., & Peasey, A. (2002). *Critical reviews of epidemiological evidence of health effects of wastewater and excreta in agriculture, Background paper for WHO guidelines for the safe use of wastewater and excreta in agriculture*. Geneva: World Health Organization.

Brissaud, F. (2002). Extensive reclamation technologies for irrigation reuse. Proceedings of IWA regional symposium on water recycling in Mediterranean region, Iraklio, Greece.

Brissaud, F. (2008). Technologies for water regeneration and integrated management of water resources. Water scarcity and management under the Mediterranean climate. Girona, 24–25 November.

Buechler, S., Devi, G., & Raschid-Sally, L. (2002). Livelihoods and wastewater irrigated agriculture along the Musi River in Hyderabad City, Andhra Pradesh, India. *Urban Agriculture Magazine, 8*(14–17).

Chapagain, A. K., & Hoekstra, A. Y. (2004). Water footprints of nations, Value of Water Research Report Series No. 16. Delft, the Netherlands: UNESCO-IHE.

Cifuentes, E. (1998). The epidemiology of enteric infections in agricultural communities exposed to wastewater irrigation: perspectives for risk control. *International Journal of Environmental Health Research, 8*, 203–13.

Cornel, P., Wagner, M., & Chang, Y. (2007). Semi centralized supply and treatment systems for urban areas. In Hans G. Huber (Ed.), *Proceedings of the international symposium on water supply and sanitation for all – obligation of the water professionals for our common future*, 27–28 Sept.

Cornish, G. A., & Kielen, N. C. (2004). Wastewater irrigation – hazard or lifeline? Empirical results from Nairobi, Kenya and Kumasi, Ghana. In C. A. Scott, N. I. Faruqui, & L. Raschid-Sally (Eds.), *Wastewater use in irrigated agriculture: confronting the livelihood and environmental realities* (pp. 69–79). Wallingford, UK: CABI.

Cornish, G., & Lawrence, P. (2001). Informal irrigation in peri-urban areas: a summary of findings and recommendations, Report OD/TN 144, Nov. 2001. Wallingford, UK: HR Wallingford Ltd.

Danso, G., Drechsel, P., Wiafe-Antwi, T., & Gyiele, L. (2002). Income of farming systems in around Kumasi. *Urban Agriculture Magazine, 7*, 5–6.

Dinar, A., Rosegrant, M. W., & Meinzen-Dick, R. (1997). Water allocation mechanisms – principles and examples. Research working paper No. WPS 1779. Washington DC: World Bank.

Drechsel, P. (2009). Wastewater irrigation and public health: From research to impact – a road map for Ghana. Report prepared for Google.org on Grant Agreement # 13-2008.

Drechsel, P., Graefe, S., & Fink, M. (2007). Rural–urban food, nutrient and virtual water flows in selected West African cities, IWMI Report 115. Colombo, Sri Lanka: International Water Management Institute.

Drechsel, P., Graefe, S., Sonou, M., & Cofie, O. (2006). Informal irrigation in urban West Africa: an overview, Research Report 102. Colombo, Sri Lanka: International Water Management Institute.

Drechsel, P., Scott, C., Raschid-Sally, L., Redwood, M., & Bahri, A. (Eds.). (2010). *Wastewater irrigation and health: assessing and mitigating risk in low income countries*. London: Earthscan. ISBN 978184477960.

Edwards, P. (2000). Wastewater-fed aquaculture: state of the art. In B. B. Jana, R. D. Banerjee, B. Guterstam, & J. Heeb (Eds.), *Waste recycling and resource management in the developing world* (pp. 37–49). Switzerland: University of Kalyani, India and International Ecological Engineering Society.

Ensink, J. (2006). Water quality and the risk of hookworm infection in Pakistani and Indian sewage farmers. Ph.D. Thesis. UK: London School of Hygiene and Tropical Medicine, University of London

Ensink, J. H. J., Brooker, S., Caincross, S., & Scott C. A. (2006). Wastewater use in India: the impact of irrigation weirs on water quality and farmer health. In Proceedings of the 32nd WEDC International Conference. Colombo, Sri Lanka: 2006 on Sustainable Development Of Water Resources, Water Supply And Environmental Sanitation.

Ensink, J., Mehmood, T., Van der Hoek, W., Raschid-Sally, L., & Amerasinghe, F. (2004). A nationwide assessment of wastewater use in Pakistan: an obscure activity or a vitally important one? *Water Policy, 6*, 197–206.

Faruqui N., Niang S., & Redwood, M. (2004). Untreated wastewater reuse in market gardens: a case study of Dakar, Senegal. In C. Scott, N. I. Faruqui, & L. Raschid (Eds.), *Wastewater use in irrigated agriculture: confronting the livelihood and environmental realities* (pp. 113–125). Ottawa, Canada: Commonwealth Agricultural Bureau International, Orient-Longman and International Development Research Centre.

Gaye, M., & Niang, S. (2002). Epuration des eaux usées et l'agriculture urbaine. *Etudes et Recherches.* Dakar, Senegal: ENDA-TM.

Hamilton, A. J., Stagnitti, F., Xiong, X., Kreidl, S. L., Benke, K. K., & Maher, P. (2007). Wastewater irrigation the state of play. *Vadose Zone Journal, 6*(4), 823–40.

Hoekstra, A. Y. (2008). Water neutral, reducing and offsetting the impacts of water footprints, UNESCO-IHE Value of Water Research Report Series No 28. Delft, The Netherlands.

Hoekstra, A. Y., & Chapagain, A. K. (2007). Water footprints of nations: water use by people as a function of their consumption pattern. *Water Resources Management, 21*(1), 35–48.

Huibers, F., Moscoso, O., Duran, A., & Van Lier, J. (2004). The use of wastewater in Cochobamba, Bolivia: a degrading environment. In C. Scott, N. I. Faruqui, & L. Raschid (Eds.), *Wastewater use in irrigated agriculture: confronting the livelihood and environmental realities* (pp. 135–144). Ottawa, Canada: Commonwealth Agricultural Bureau International, Orient-Longman and International Development Research Centre.

SIDA (Swedish International Development Cooperation) (1998). *Ecological sanitation*. Stockholm: 100.

Jimenez, B. (2003). Health risks in aquifer recharge with recycle. In R. Aetgeerts & A. Angelakis (Eds.), *State of the art report in aquifer recharge using reclaimed water* (pp. 54–172). Copenhagen, Denmark: WHO Regional Office for Europe.

Jiménez, B. (2005). Treatment technology and standards for agricultural wastewater reuse: a case study in Mexico. *Irrigation and Drainage, 54*(1), 22–33.

Jiménez, B. (2006). Irrigation in developing countries using wastewater. *International Review for Environmental Strategies, 6*(2), 229–250.

Jiménez, B. (2007). Helminth ova control in sludge: a review. *Water Science and Technology, 56*(9), 147–155.

Jiménez, B., & Asano, T. (2008). Water reclamation and reuse around the world. In B. Jimenez & T. Asano (Eds.), *Water reuse: an international survey of current practice, issues and needs*. London, UK: IWA Publishing.

Jiménez, B., & Wang, L. (2006). Sludge treatment and management. In Z. Ujang & M. Henze (Eds.), *Municipal wastewater management in developing countries: principles and engineering* (pp. 237–292). London, UK: IWA Publishing.

Jin, L., & Young, W. (2001). Water use in agriculture in China: importance, challenges, and implications for policy. *Water Policy, 3*, 215–228.

Keraita, B., Jiménez, B., & Drechsel, P. (2008). Extent and implications of agricultural reuse of untreated, partly treated and diluted wastewater in developing countries. *CAB reviews: Perspectives in agriculture, veterinary science, nutrition and natural resources,* 3 (58), 15.

Labite, H. (2008). Analysis of health benefits versus costs of interventions in the urban water system in Accra, using quantitative microbial risk assessment. Master of Science Thesis. , Delft, the Netherlands: UNESCO-IHE Institute for Water Education.

Lazarova, V., & Bahri, A. (Eds.). (2005). *Water reuse for irrigation: agriculture, landscapes, and turf grass*. Boca Raton, FL: CRC Press.

LeBlanc, R., Matthews, P., & Roland, P. (Eds.). (2008). *Global atlas of excreta, wastewater sludge, and biosolids management. Moving forward the sustainable and welcome uses of a global resource*. Nairobi: United Nations Human Settlements Programme.

Libhaber, M. (2007). Appropriate technology for wastewater treatment and reuse in developing countries. Hans G. Huber (Ed.), *Proceedings of the international symposium on water supply and sanitation for all: obligation of the water professionals for our common future*. Birching, Germany, 27–28 Sept.

Metcalf and Eddy Inc. (Ed.). (1995). *Wastewater engineering: treatment, disposal and reuse*. New York: McGraw-Hill.

Molden, D., Frenken, K., Barker, R., de Fraiture, C., Mati, B., Svendsen, M., et al. (2007). Trends in water and agricultural development. In D. Molden (Ed.), *Water for food, water for life. A comprehensive assessment of water management in agriculture* (pp. 57–89). London, Colombo: Earthscan, International Water Management Institute.

Molden, D., Rijsberman, F., Matsuno, Y., & Amarasinghe, U. A. (2001). Increasing productivity of water: a requirement for food and environmental security. Dialogue Working Paper 1. Colombo, Sri Lanka: International Water Management Institute.

Molle, F., & Berkoff, J. (2006). Cities vs. agriculture. Revisiting intersectoral water transfers, potential gains and conflicts, Comprehensive Assessment Research Report 10. Colombo, Sri Lanka: International Water Management Institute.

Molle, F., Wester, P., & Hirsch, P. (2007). River basin development and management. In D. Molden (Ed.), *Water for food, water for life. A comprehensive assessment of water management in agriculture* (pp. 585–624). London, Colombo: Earthscan, International Water Management Institute.

Murray, A., & Buckley, C. (2010). Designing reuse-oriented sanitation infrastructure: the design for service planning approach. In P. Drechsel, C. A. Scott, L. Raschid-Sally, M. Redwood, & A. Bahri (Eds.), *Wastewater irrigation and health: assessing and mitigation risks in low-income countries* (pp. 585–624). UK: Earthscan, IDRC, IWMI.

Obuobie, E., Keraita, B., Danso, G., Amoah, P., Cofie, O. O., Raschid-Sally, L., et al. (2006). *Irrigated urban production in Ghana: characteristics, benefits and risks*. Accra, Ghana: IWMI, RUAF, CPWF.

Peasey, A. (2000). Human exposure to ascaris infection through wastewater reuse in irrigation and its public health significance. Ph.D. Thesis. London, UK: University of London.

Pescod, M. B. (1992). Wastewater treatment and use in agriculture. FAO irrigation and drainage paper 47. Rome: Food and Agriculture Organization of the United Nations.

Post, J. (2006). Wastewater treatment and reuse in eastern Mediterranean region. *Water, 2*, 36–41.

Qadir, M., Wichelns, D., Raschid-Sally, L., Singh Minhas, P., Drechsel, P., Bahri, A., et al. (2007). Agricultural use of marginal-quality water - opportunities and challenges. In D. Molden (Ed.), *Water for food, water for life. A comprehensive assessment of water management in agriculture* (pp. 425–457). London, Colombo: Earthscan, International Water Management Institute.

Raschid-Sally, L., Carr, R., & Buechler, S. (2005). Managing wastewater agriculture to improve livelihoods and environmental quality in poor countries. *Irrigation and Drainage, 54*(1), 11–22.

Raschid-Sally, L., & Jayakody, P. (2008). Drivers and characteristics of wastewater agriculture in developing countries: Results from a global assessment, IWMI Research Report 127. Colombo, Sri Lanka: International Water Management Institute.

Raschid-Sally, L., Tuan, D. D., & Abayawardana, S. (2004). National assessments on wastewater use in agriculture and an emerging typology: the Vietnam case study. In C. Scott, N. I. Faruqui, & L. Raschid (Eds.), *Wastewater use in irrigated agriculture: confronting the livelihood and environmental realities* (pp. 81–90). Ottawa, Canada: Commonwealth Agricultural Bureau International and International, Orient Longman and International Development Research Center IDRC.

Rees, W. E., & Wackernagel, M. (1994). Ecological footprints and appropriated carrying capacity: measuring the natural capital requirements of the human economy. In A. M. Jansson, M. Hammer, C. Folke, & R. Costanza (Eds.), *Investing in natural capital: The ecological economics approach to sustainability* (pp. 362–390). Washington, DC: Island Press.

Rosemarin, A. (2004). The precarious geopolitics of phosphorous. *Down to Earth, 30*(June), 27–34.

IRC (International Water and Sanitation Centre) (2006). The value of environmental sanitation. Delft, p. 134.

Schertenleib, R. (2005). From conventional to advanced environmental sanitation. *Water Science and Technology, 51*(10), 7–14.

Scott, C., Faruqui, N. I., & Raschid, L. (2004). *Wastewater use in irrigated agriculture. Confronting the livelihood and environmental realities*. UK: CABI, IWMI, IDRC.

Seckler, D., Amarasinghe, U., Molden, D., de Silva, R., & Barker, R. (1998). World water demand and supply, 1990 to 2025: scenarios and issues, Research Report 19. Colombo, Sri Lanka: International Water Management Institute.

SEI (Stockholm Environment Institute). (2004). *Ecological sanitation* (Revised and enlargedth ed.). Stockholm: Stockholm Environment Institute.

Shaban, A., & Sharma, R. N. (2007). Water consumption patterns in domestic households in major cities. *Economic and Political Weekly*, *9*(June).

Shiklomanov, I. A. (2000). Appraisal and assessment of world water resources. *Water International, 25*(1), 11–32.

Shuval, H. I., Adin, A., Fattal, B., Rawitz, E., & Yekutiel, P. (1986). Wastewater irrigation in developing countries: Health effects and technical solutions. World Bank technical paper No. 51. Washington, DC: World Bank.

UNESCO/GTZ (United Nations Educational Scientific and Cultural Organisation/Deutsche Gesellschaft für Technische Zusammenarbeit) (2006). Capacity building for ecological sanitation. *Concepts for ecologically sustainable sanitation in formal and continuing education*. Paris, Eschborn: 166.

Treyer, S. (2002). Analyse des strategies et prospectives de l'eau en Tunisie. *Sophia Antipolis*. France: Plan Bleu.

van der Hoek W. (2004). A framework for a global assessment of the extent of wastewater irrigation: The need for a common wastewater typology. In C. A. Scoot, N. I. Faruquri & L. Raschid-sally (Eds.), *Wastewater use in irrigated agriculture: confronting the livelihood and environmental realities* (pp. 11–24). Wallingford, UK: CABI.

van der Hoek, W., Ul-Hassan, M., Ensink, J., Feenstra, S., Raschid-Sally, L., & Munir, S. (2002). Urban wastewater: a valuable resource for agriculture, International Water Management Institute Research Report 63. Colombo, Sri Lanka.

van Rooijen, D. J., & Drechsel, P. (2008). Exploring implications of urban growth scenarios and investments for water supply, sanitation, wastewater generation and use in Accra, Ghana. 33rd WEDC International Conference, Accra, Ghana.

van Rooijen, D. J., Turral, H., & Biggs, T. W. (2009). Urban and industrial water use in the Krishna Basin, India. *Irrigation and Drainage, 58*, 406–428.

Westcot, D. W. (1997). Quality control of wastewater for irrigated crop production, FAO Water Report No. 10. Rome.

WHO (World Health Organization). (1989). *Guidelines for the safe use of wastewater in agriculture*. Geneva: WHO.

WHO (World Health Organization). (2006). *Guidelines of the safe use of wastewater, excreta and grey water, Vol. 2. Wastewater use in agriculture*. Geneva: WHO-FAO-UNEP, World Health Organization.

Yang, H., & Abbaspour, K. (2007). Analysis of wastewater reuse potential in Beijing. *Desalination, 212*, 238–250.

Chapter 4
Climate-Based Risks in Cities

Ton Dietz

Abstract This chapter explores the links between climate risks and governance challenges of municipalities, with a focus on megacities, taking a global and comparative outlook. First the world's megacities are positioned in their geographical and economic contexts. With regard to geography contexts, three criteria are used: location vis-à-vis coasts, climate zones and national water stress. With regard to the economic context, two criteria are used: level of national income per capita; and recent economic growth experiences. After a brief section about the link between the global urbanisation process and climate change, the various climate risks are explored for megacity populations in different geographical situations. Some background information is provided about the various ways, municipalities are coping with challenges related to climate change. In two sections, these challenges are explored further with regard to urban-rural interfaces, and with regard to coping with flood and drought risks.

4.1 Introduction: Megacities and Climate Risks

The majority of the world's population now lives in cities. Many of them even live in megacities, in conurbations of up to 33 million inhabitants, as in the cases of Tokyo-Yokohama (33 million), New York, Seoul-Inchon and Mexico City (all with 20 million), Sao Paolo and Mumbai (both with 18 million). In the *Metropolitan World Atlas* (Van Susteren 2007) these figures are based on assessments for the year 2000, and, like many other sources, this atlas shows a rapid and ongoing growth of megacities and of the process of urbanisation. In 2000, the ten largest conurbations

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in the world had between 14 and 33 million inhabitants each; in 1950, the ten largest conurbations (only two of them the same) had between 4.8 and 12 million inhabitants; in 1900, they had between 1.4 and 6.5 million inhabitants (5 were the same as in 1950), and in 1800, between 0.4 and 1.1 million (only three the same as in 1900). It really is an amazing development. See Table 4.1 for an overview.

The 50 largest megacities in 2000 had about 20% of all urban people in the world (almost 600 million), and 10% of the total global population. This of course only gives the top of the urbanisation pyramid. There are many people living in urban areas, which do not belong to the top-50 urban conurbations, and many urbanites are in fact living in small and medium-scale cities, with often less demanding governance tasks. However, for all other urban centres the data is far less reliable than that which is available for the megacities, so we will focus our attention on these megacities, by way of highlighting the extremes.

The majority of the megacities covered here are at or near the coasts (respectively 24 and 10 of the 56 cases included here), and hence face risks of sea-board climates, of which storms, hurricanes and cyclones are the most prominent, and rising sea levels provide a 'slow threat'. In addition, three inland megacities are near major lakes, also with storm risks. Fifteen megacities are located close to major river systems, some of those also near or at the coasts. River floods are basic threats there. Eleven megacities are inland cities without a major river.

The location of these megacities in very diverse climate zones adds additional variety in terms of basic risks and opportunities; see Tables 4.1 and 4.2.

- Megacities in tropical wet climates, including those with monsoon and seasonal wet periods, combine threats of torrential rain with peak river discharge after heavy rains in catchment areas. Thirteen megacities have these characteristics, six located at the coast.
- Tropical and subtropical dry climates, and particularly those with dry periods and without access to major dependable river systems, often face major water shortages in the driest months, and generally have to cope with heat and high levels of evaporation of the little water available. Five megacities have these characteristics.
- Many megacities are located in humid subtropical climates: 14 in total, of which seven are located on coastlines and another five near coasts. Downpours, peak river discharge and coastal storms are threats to these places, while summer heat and occasional droughts can cause water stress conditions.
- Four megacities can be found in Mediterranean conditions, all on coastlines, with risks of winter flooding, storms and (sometimes), severe water stress in summer.
- In five cases, megacities are located in temperate sea climates, often at or near the sea, and with occasional flood risks from both sides.
- In 12 cases, megacities are in temperate climate zones, with a 'land climate', often with (severe) frost risks in winter and droughts in summer, particularly in so-called temperate steppe conditions.

Of course, what also matters is the economic context of these megacities. Namely, whether governments are in a position to organise and finance an adequate system of water and sanitation conditions, of flood and drought protection, and adaptation.

Table 4.1 Megacities: 1800, 1900, 1950 and 2000. Number of inhabitants in millions in the 50 largest megacities of the world in 2000, and in the ten largest megacities of the world in 1950, 1900, 1800 and 1500 (and for 2000 in all other cities mentioned, between brackets)

Megacity	GEO	CLI	1800	1900	1950	2000
Tokyo (Yokohama), Japan	C	Cfa	0.7	1.5	7.0	33.2
New York, USA	C	Dfa	–	4.2	12.5	20.3
Seoul-Inchon South Korea	C	Dwa	–	–	–	19.9
Mexico City, Mexico	I	H	–	–	–	19.6
São Paolo, Brazil	c	Cfa	–	–	–	17.7
Mumbai, India	C	Aw	–	–	–	17.6
Osaka-Kobe-Kyoto, Japan	C	Cfa	0.4 + 0.4	–	–	16.9
Los Angeles, USA	C	Cs	–	–	–	16.2
Manila, Philippines	C	Aw	–	–	–	14.1
Cairo, Egypt	IR	BWh	–	–	–	14.0
London, UK	cR	Cfb	0.9	6.5	8.9	13.9
Calcutta, India	cR	Aw	–	–	4.8	13.9
New Delhi, India	IR	Cwa	–	–	–	13.7
Shanghai, China	cR	Cfa	–	–	5.4	13.6
Buenos Aires, Argentina	CR	Cfa	–	–	5.0	13.4
Jakarta, Indonesia	C	Af	–	–	–	13.3
Beijing, China	I	Dwa/BSk	1.1	–	–	13.2
Moscow, Russia	I	Dfb	–	–	5.1	13.1
Rhine-Ruhr, Germany	IR	Cfb	–	–	4.9	11.1
Karachi, Pakistan	C	BWh	–	–	–	11.1
Rio de Janeiro, Brazil	C	Af	–	–	–	10.8
Tehran, Iran	I	BSh	–	–	–	10.7
Paris, France	IR	Cfb	0.5	3.3	5.9	10.6
Istanbul, Turkey	C	Cs	0.6	–	–	10.4
Lagos, Nigeria	C	Af	–	–	–	10.0
Tianjin, China	c	BSk	–	–	–	9.9
Chicago, USA	IL	Dfa	–	1.7	4.9	9.5
Hong Kong, China	C	Cfa	–	–	–	9.2
Nagoya, Japan	C	Cfa	–	–	–	8.8
Dhaka, Bangladesh	I	Am	–	–	–	8.6
Washington-Baltimore, USA	C	Cfa	–	–	–	7.9
Lima, Peru	C	BWh	–	–	–	7.4
Taipei, Taiwan	c	Cfa	–	–	–	7.3
Bangkok, Thailand	cR	Aw	–	–	–	7.3
San Francisco-Oakland, USA	C	Cs	–	–	–	7.2
Bogotá, Colombia	IR	Af	–	–	–	7.0
Chennai, India	C	Aw	–	–	–	6.7
Randstad Holland, The Netherlands	CR	Cfb	–	–	–	6.6
Hyderabad, India	I	Aw	–	–	–	6.4
Santiago de Chile, Chile	I	BSk	–	–	–	6.1
Philadelphia, USA	c	Cfa	–	1.4	–	6.0
Lahore, Pakistan	I	BSh	–	–	–	5.9
Boston, USA	C	Dfa	–	–	–	5.8

(continued)

Table 4.1 (continued)

Megacity	GEO	CLI	1800	1900	1950	2000
Dallas-Fort Worth, USA	I	Cfa	–	–	–	5.8
Kinshasa, DRCongo	IR	Aw	–	–	–	5.8
Bangalore, India	I	Aw	–	–	–	5.7
Johannesburg, South Africa	I	Cwb	–	–	–	5.5
Toronto, Canada	IL	Dfb	–	–	–	5.5
Detroit, USA	IL	Dfa	–	–	–	5.4
St. Petersburg, Russia	C	Dfb	–	1.4	–	5.4
Berlin, Germany	I	Dfb	–	2.7	–	(4.1)
Vienna, Austria	IR	Dfb	–	1.7	–	(2.3)
Manchester, UK	c	Cfb	–	1.4	–	(2.2)
Guangzhou, China	cR	Cwa	0.8	–	–	(8.5)
Naples, Italy	C	Cs	0.4	–	–	(3.1)
Hangzhou, China	C	Cfa	0.4	–	–	(3.9)

Van Susteren (2007)
GEO:
C = directly situated along the coast
c = not directly situated along the coast, but within 50 km distance from the coastline
I = inland; > 50 km from the coastline
R = major river within the metropolitan area (on the introductory maps of the regional chapters in Rowntree et al. 2003)
L = near major lake
CLI (according to the Köppen system; as in Rowntree et al. 2003):
Af = Tropical, rainy (n = 4); climate risks (CR): torrential rain, heat; if R: peak river discharge
Am = Tropical, monsoon (n = 1); CR: heat; if C and c: cyclones, and coastal inundations
Aw = Tropical, wet and dry (n = 8); CR: heat; if C and c: cyclones; if R: peak river discharge; riverine inundations
BSh = Steppe, tropical and subtropical (n = 2); CR: heat, drought
BSk = Steppe, mid-latitude (n = 2.5); CR: drought
BWh = Desert, tropical and subtropical (n = 3); CR: heat; drought
Cfa = Humid subtropical, without dry season, hot summers (n = 12); CR: if C and c: summer storms, smog; coastal inundations; if R: peak river discharge; riverine inundations
Cfb = Marine west coast, without dry season, warm to cool summers (n = 5); CR: if R and C: riverine and coastal inundations
Cs = Mediterranean, with dry summers (n = 4); CR: summer drought
Cwa = Humid subtropical, with dry season, hot summers (n = 2); CR: summer drought; smog
Cwb = Marine west coast, with dry season, warm to cool summers (n = 1); CR: seasonal drought
Dfa = Humid continental, with warm summers (n = 4); CR: winter frost; summer drought
Dfb = Humid continental, with cool summers (n = 5); CR: winter frost
Dwa = Humid continental, with dry winter, warm summer (n = 1.5); CR: occasional droughts
H = Complex mountain climate (n = 1); CR: various

Table 4.3 gives an overview of the economic strength of countries (as of 2000) for the 56 megacities discussed here, and of the economic dynamics for the 1990s and 2000s of all countries with megacities. It matters whether megacities are situated in countries with a relatively rich population, and with government budgets, which can adequately support water and sanitation demands, and crises during and after floods, storms, frost and droughts; and it matters if countries experience steady or even fast economic growth conditions. Boston and Kinshasa, both with 5.8 million inhabit-

Table 4.2 Location and climate of 56 megacities

CLI	C	CR	c	cR	I	IR	IL	Total
Af	Jak Rio Lag	–	–	–	–	Bog	–	4
Am	–	–	–	–	Dha	–	–	1
Aw	Mum Man Che	–	–	Bko Cal	Hyd Ban	Kin	–	8
BSh	–	–	–	–	Teh Lah	–	–	2
BSk	–	–	Tia	–	Bei½ SdC	–	–	2.5
BWh	Kar Lim	–	–	–	–	Cai	–	3
Cfa	Tok Osa Hko Nag Was Han	BAi	SPa Tai Phi	Sha	Dal	–	–	12
Cfb	–	Hol	Mch	Lon	–	Rru Par	–	5
Cs	LAn Ist SFr Nap	–	–	–	–	–	–	4
Cwa	–	–	–	Gua	–	NDe	–	2
Cwb	–	–	–	–	Joh	–	–	1
Dfa	NYo Bos	–	–	–	–	–	Chi Det	4
Dfb	StP	–	–	–	Ber	Mos Vie	Tor	5
Dwa	Seo	–	–	–	Bei½	–	–	1.5
H	–	–	–	–	Mex	–	–	1
Total	22	2	5	5	11	8	3	56

See Table 4.1

ants, are at opposite ends of the spectrum when it comes to ability to deal with climate stress in megacities. Of course, tensions between supply and demand of water in a country (so-called severe water stress) are an important context for water and sanitation management, for the country as a whole, but also in its megacities.

The following overviews offer a summary of two climate regions: (1) tropical humid areas and (2) the drylands. General and specific climate risks are indicated, as well as information about the context – Gross Domestic Product (GDP)/capita in 2000 (×1000 US$, Purchasing Power Parity (PPP)); the annual economic growth of GDP/capita in the 1990s and in the 2000s, and finally the water stress assessment for the country as a whole.

Table 4.3 Megacities and economic context, from rich to poor; and severe water stress

Country	GNI/cap PPP, int $ × 1000, 1999	Average annual growth GDP/cap. 1990–1999 (%)	Idem, 2000–2006 (%)	50 largest Megacities	Severe water stress in a country (%)
USA	32	2	2	Washington, Philadelphia, Dallas, Los Angeles, San Francisco, New York, Chicago, Boston, Detroit	37
Canada	25	2	2	Toronto	1
Japan	25	1	2	Tokyo, Osaka, Nagoya	10
Germany	24	1	1	Rhein-Ruhr	1
The Netherlands	24	2	1	Randstad Holland	36
France	23	1	1	Paris	19
Hong Kong-China	23	2	5	Hong Kong	?
UK	22	2	2	London	21
S. Korea	16	5	5	Seoul	50
Taiwan	16	6	?	Taipei	?
Argentina	12	4	2	Buenos Aires	23
S. Africa	9	–0	3	Johannesburg	69
Mexico	8	1	2	Mexico City	44
Chile	8	6	3	Santiago de Chile	41
Russia	7	–6	7	Moscow, Saint Petersburg	4
Brazil	7	2	2	Rio de Janeiro, Sao Paolo	0
Turkey	6	2	4	Istanbul	62
Thailand	6	4	4	Bangkok	1
Colombia	6	1	2	Bogota	1
Iran	5	2	4	Tehran	88
Peru	4	3	3	Lima	24
Philippines	4	1	3	Manila	10

China	4	10	9	Tianjin, Beijing, Shanghai, Guangzhou	45
Indonesia	3	3	4	Jakarta	1
Egypt	3	2	3	Cairo	88
India	2	4	5	Mumbai, Chennai, Calcutta, Hyderabad, Bangalore, New Delhi	80
Pakistan	2	3	3	Lahore, Karachi	76
Bangladesh	2	3	4	Dhaka	22
Nigeria	1	–1	3	Lagos	18
DR Congo	0.5	–3	–0	Kinshasa	0

Rowntree et al. (2003); and for average annual growth rates GDP/cap 2000–2006: http://earthtrends.wri.org, based on World Bank, World Development Indicators Online 2008. The data about water stress are from http://www.nationmaster.com/graph/env_wat_sev_wat_str-environment-water-severe-stress, and are derived from the Centre for Environmental Systems Research of the University of Kassel, Germany. It indicates the percentage of a national territory that has to cope with severe water stress, defined as actual water consumption in a certain grid cell, which is more than 40% of the available water in that grid cell

Table 4.4 Megacities, climate and geographical conditions and specific climate risks in Tropical Humid and in Dryland Zones

Climate zone	Geographical condition	Specific climate risk	Megacities
Tropical			
Af (rainy all year)	At the coast	Coastal storms	Jakarta
		Floods	Rio de Janeiro
		Coastal inundations	Lagos
	Inland; major river	Riverine inundations	Bogota
Am (monsoon)	Inland	Dry spells	Dhaka
Aw (wet and dry)	At the Coast	Coastal storms	Mumbai
		Floods	Chennai
			Manila
	Near the Coast; major river	Riverine inundations	Bangkok
			Calcutta
	Inland; major river	Riverine inundations	Kinshasa
			Hyderabad
	Inland	Dry spells	Bangalore
Drylands			
BSh (tropical and subtropical steppes)	Inland	Heat	Tehran
			Lahore
BSk (mid-latitude steppes)	Near Coast	Storms	Tianjin
	Inland	Dust storms	Santiago de Chile
			Beijing (also Dwa climate zone)
BWh	Coast	Storms	Karachi
		Heat	Lima
	Inland; major river	Inundations	Cairo
		Heat	

In terms of urban management challenges, one may formulate a few general hypotheses:

- Growing climate risks can be countered better if countries are richer, and if they have experienced two recent decades of relatively fast economic growth (at least ++).
- Growing drought risks in megacities can be countered better if countries as a whole have relatively low water stress levels (see Tables 4.4 and 4.5).

4.1.1 Climate-Induced Urbanisation

Most urbanisation processes in the world have been and are fuelled by disparities between life chances in rural and in urban areas. During the twentieth century, world urbanisation rates increased from only 13% of 1.7 billion people in 1900, to

Table 4.5 Megacities in Tropical Humid and in Dryland Regions: Economic context and water stress conditions

Climate zone[a]	Megacity	GNI/capita (Int$, PPP × 1000)	Economic growth 1990s[b]	Economic growth 2000s[b]	Waterstress[c]
Af	Jakarta	3	++	++	0
	Rio de Janeiro	7	+	+	0
	Lagos	1	–	–	0
	Bogota	6	+	+	0
Am	Dhaka	2	++	++	s
Aw	Mumbai	2	++	+++	S
	Chennai	2	++	+++	S
	Manila	4	+	++	0
	Bangkok	6	++	++	0
	Calcutta	2	++	+++	S
	Kinshasa	1	–	–	0
	Hyderabad	2	++	+++	S
	Bangalore	2	++	+++	S
BSh	Teheran	5	+	++	S
	Lahore	2	++	++	S
BSk	Tianjin	4	+++	+++	S
	Santiago	8	+++	++	S
BSk/Dwa	Beijing	4	+++	+++	S
BWh	Karachi	2	++	++	S
	Lima	4	++	++	s
	Cairo	3	+	++	S

[a]Tropical: Af = rainy all year; Am = monsoon; Aw = wet and dry; Dryland: BSh = Steppe, tropical and subtropical; BSk = Steppe, mid-latitude; BWh = Desert, tropical and subtropical
[b]– = negative growth; + = average annual growth between 0% and 2%; ++ = average annual growth between 3% and 4%; +++ = average growth 5% or more
[c]0 = <20%; s = 20–40%; S = >40%
See Table 4.3

almost 50% of more than 6 billion people in 2000[1]; that is, from 220 million urbanites 100 years ago to 3.3 billion at the moment. Higher employment and income opportunities in cities compared to rural areas, the 'lure of the city', and an education and communication explosion, which led to urban cultural orientations, can be seen as the most important factors behind this enormous growth.

However, in some areas, most often Africa, climate events also played a role. For many Africans, migration to a city (or a chain migration towards ever-bigger cities) was an escape from rural poverty and misery during and after droughts and floods. The Sahelian drought of the 1970s and 1980s is often portrayed as a major catalyst of rural–urban disaster migration. Nouakchott in Mauritania increased from 20,000 people in 1960 to more than 600,000 in 2000; and Mauritania's urban population from a mere 5% to more than 50% during these 40 years. Bamako and

[1]For more information, see http://www.un.org/esa/population/publications/WUP2005/2005wup.htm

Ouagadougou had annual population growth rates of more than 10% in the drought years between 1976 and 1983. In only a few years, Bamako had a quarter of a million new inhabitants, all of them poor and many desperate (Dietz and Zaal 2001). The recent framing of this development, linked as it is to debates about the impact of climate change, is talking in terms of ‘climate refugees’, as part of a wider category of ‘environmental refugees’ (see Myers 1997, 2005). This has its merits (it clearly catches a world audience), but also its dangers, as a lot of rural–urban migration is framed as climate- or environment-driven, while in reality it is a result of many different push and pull factors. It also suggests a one-directional movement: from a drought- or flood-devastated rural area to rescue zones in cities, although often in the slum areas there (and sometimes to refugee camps, with population numbers that can also be called ‘urban’; examples are Goma in Democratic Republic of the Congo (DRC) and Dadaab in Kenya). Of course, drought and floods create migration waves away from disaster zones, and often the flood of people is directed to cities, but the new urbanites often maintain links with their zones of origin, and tend to migrate back and forth. In a number of African countries, cities have become disaster zones, and in some cases, people have been flocking back to the rural areas. Zambia’s ruralisation history of the last 30 years, and the depopulation of some of its former copper mining towns, is a telling example.

4.1.2 Climate Risks for City Populations and Climate Change

In both popular and policy discourse on ‘climate risks’, there is a lot of confusion. Climate risks have always existed. The most prominent climate risks are:

- Risks related to peak rainfall (a high volume of rainfall in short periods, and often with high rainfall energy) and to rain-induced landslides
- Risks related to peak river discharge, often following peak rainfall in river catchment areas
- Risks related to severe storms, often near sea (and major lake) coasts; part of monsoon periods, or of hurricane and cyclone seasons
- Risks related to heat (relative heat waves)
- Risks related to droughts (‘normal’ dry seasons, dry spells in ‘normal’ wet seasons, or failing rainy seasons)
- Risks related to frost, particularly if unexpected (e.g. early in autumn, or late in spring seasons)

Faulty physical urban planning has frequently made these risks more severe. There can be a lack of places for excess water storage. There can be inadequate drainage infrastructure in general. There are growing numbers of (poor) people and (faulty) structures in flood-prone zones. Inadequate building materials and low building standards to cope with floods, storms or frost can result in major disasters. Upstream, peri-urban and inner city canalisation of riverbeds have also increased flood risks.

Weather is variable by definition. ‘Normal’ weather variability and seasonality is part of life, and people adjust their livelihoods and their physical and social environments to ‘normal’ weather patterns (or ‘climate’ as a weather pattern over a longer period of time, often a 30-year average). During the last decade, ‘climate risks’ have entered popular and policy debates (as well as the scientific world far beyond climatologists) with another meaning: the risk that the climate is changing, that ‘normal’ weather patterns and ‘normal’ seasonality are shifting. This may mean higher temperatures, and hence higher evaporation rates, and higher heat risks (and lower frost risks). It may mean changing rainfall patterns: often more rain, and hence more flood risks. However, it can also mean greater variability and unpredictability, with a combination of more flood risks in some periods or in some places; and more drought risks in other periods, or other places. Climate change may also mean rising sea levels, and if combined with more severe coastal storms, higher risks of physical damage, human death and injuries during cyclones, hurricanes and storms. Finally, in some areas climate change means melting ice in upper catchments of major rivers, leading to faster and higher river water discharge, which threatens downstream cities. However, part of that threat is forest destruction in upstream catchment areas of these same rivers. Dams may burst under increased water pressure after peak discharge periods, and if that happens, downstream cities are in serious danger. If parts of cities become flooded, this has serious consequences for sanitation and for human health, as sanitation structures and institutions, as well as health behaviour and health institutions cannot cope with these, often sudden, disaster situations (see Fig. 4.1).

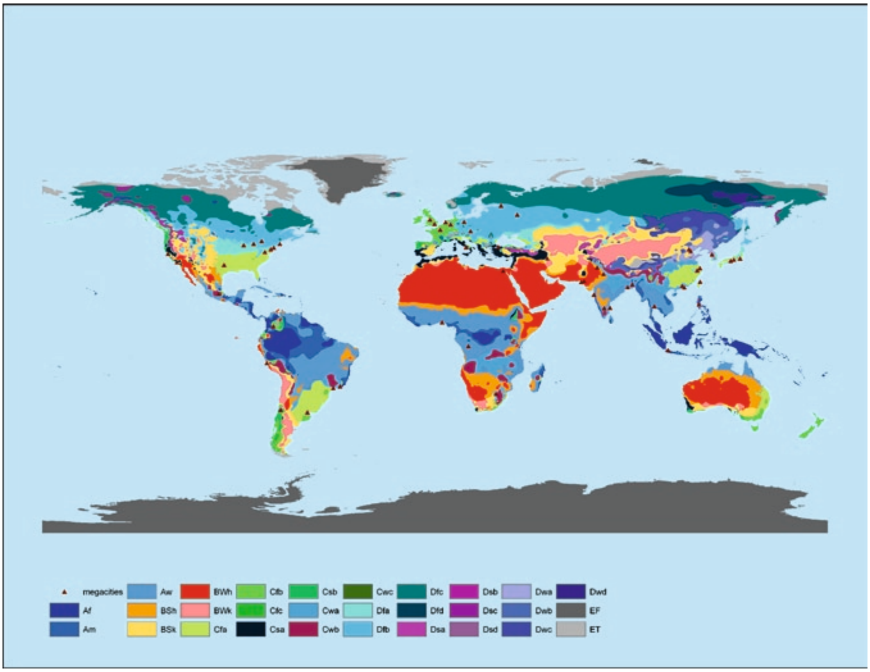

Fig. 4.1 World climate and megacities (compiled by Els Veldhuizen, GIS-Department of Geography, Planning and International Development Studies University of Amsterdam)

4.2 Responses of Municipalities to Climate Risks

4.2.1 Municipalities, Climate Risks, Water and Sanitation

In their study *Beyond 2015*, the Netherlands Environmental Assessment Agency summarises the impact of greater climate risks as a result of climate change, both in the Netherlands and elsewhere in the world.

> A range of water resources management problems are recognised that could become worse because of climate change. The two most often mentioned are increased pollution of water supplies as a result of increased and more frequent flooding; and reduced water supplies and increased costs associated with silting resulting from lower flows and higher evaporation rates. (NEAA 2009)

They add, 'Integrated water resources management (supply and demand management) will be necessary, together with good governance at regional (river basin), national and local levels' (ibid).

To cope with these challenges, municipalities need their own municipal policy to deal with water and sanitation problems, embedded within inter-municipality river basin arrangements, and often further embedded in national government institutions. In cases where river basins cover more than one national legal and institutional framework (e.g. for Randstad Holland: Germany, Switzerland, Belgium, and France; for Cairo: Uganda, Sudan, and Ethiopia; for Dhaka: India and Nepal), there is a need for adequate integration (and this is often lacking).

There are numerous initiatives by municipalities to become more 'emission neutral' and speed up mitigation measures, like 'clean energy', energy saving, transport rearrangements, carbon sequestration and underground storage (see Bulkeley 2003 for the early experiences, many of those in the USA). In 2002, Coenen and Menkveld (2002) pleaded for a major role for local authorities to transition towards a climate-neutral society, while in 2004, Lindseth (2004) wrote about the experiences with the so-called 'Cities for Climate Protection Campaign', showing that the 'framing' of the problem as 'global-AND-local' and of 'protection-AND-reduction' is important to avoid creating one-sided, unrealistic policies.

World business discovered that there is a future (and a niche as well as pioneer profits) in a more pro-active stance, resulting in numerous initiatives by companies (and public–private partnerships), and with sometimes surprising collaborations between companies and NGOs. The chorus of socially responsible businesses gives a strong voice to environmental sustainability, and to being wise protectors of Earth's atmosphere, and by implication of humankind. Economists now play a more prominent role in convincing world leaders about possible win–win scenarios (e.g. by calculating the costs of climate change mitigation against the benefits of saving on adaptation, or on lower health costs (Mitchell and Parson 2001). Some governments and cities now even go so far as to declare their goal to become completely 'climate neutral'. Norway and tiny Costa Rica did just that. Within Norway, the small city of Arendal took the lead in 2007 to declare its goal of becoming a fully climate neutral city,[2] and many cities now follow suit. In early September 2009, the entry ‘climate neutral cities’ on Google showed 355,000 hits, partly related to a major international conference in Geneva later that month.[3] The European Union has taken the lead in formulating more serious mitigation targets now, and in preparing more serious targets and implementation mechanisms for the decades to come. These are promising signs, but they are late, maybe too late, and compared to the fast action with regard to CFCs and the ozone layer, GHG mitigation appears to be a much more complicated ‘portfolio’, as the causes and impacts are geographically so diverse (Dietz 2009).

Experts with a civil engineering, architecture, spatial planning and public administration background have started to experiment with possible solutions for a variety of adaptations to sea level rise and coastal storm threats. However, what happens in areas with less experience? Even the United States had to be hit by a disaster the magnitude of Katrina in New Orleans (causing 1,836 victims, and USD 81.2 billion worth of damage in 2005) before it realised the vulnerability of its cities in coastal zones. Public opinion was confronted with the obvious fact that the poor are the ones who are hit hardest, as they are generally in the most vulnerable locations, and often do not have the insurance and recovery capabilities the rich have (even if some of the rich lost more assets in absolute terms). Compared to a century ago, both in absolute and relative terms, more people now live in vulnerable coastal areas, which have become the most sought after human space in many countries. Massive migration, movements of people towards coastal areas, where most perceive that economic prospects are generally better, compared to isolated inland areas has supplemented the global population explosion. West Africa is an interesting example. Between 1960 and 1994, almost everywhere the coastal population increased at least fourfold (Dietz and Veldhuizen 2004). Many more people than before live in extremely vulnerable coastal cities, often with chaotic and incompetent municipal administrations. Lagos is one of the many nightmares that come to mind (Mehrotra et al. 2009).

4.2.2 Floods, Pollution and Health Risks

In a recent study about the Netherlands, Gupta et al. (2007) indicate that flexible national arrangements to enable local climate policy indeed result in major differences between municipalities. Often the mitigation measures dominate, but adaptation gradually becomes more important. For instance, as part of the Clinton Climate Initiative (with a worldwide involvement of 54 cities now, started in 2006), the municipality of Rotterdam began an ambitious programme to make the city more flood proof, combining national programmes to ‘make room for the river’ with local initiatives to separate sewage from rainwater, and reducing pollution risks in

[2] www.livskraftig.no/0802UNEP_intro_8RDXE.pdf.file

[3] www.Climate-L.org

case of floods. Although the Clinton Climate Initiative focuses on mitigation (energy efficiency, clean energy and forest protection), its 'cultural capital' has created many opportunities for a combination of mitigation and adaptation, both in the global North (30 'Clinton cities') and in the global South (24 'Clinton cities'). The majority of these participating municipalities are in the category of megacities, as indicated earlier in this chapter.[4] Forty of these cities have formed the C40 group, with its own information exchange mechanisms.[5] On its website, the C40 group accepts the fact that cities are responsible for 75% of GHG emissions in the world, although they cover less than 1% of the world's land surface. Cities are also vulnerable for the impact of climate change.

> The effects of climate change are often more keenly felt in cities, e.g. the Urban Heat Island effect. Since many of the world's major cities are very close to the sea, rising sea levels are a major threat. The concentration of resources in cities can be a useful weapon in fighting climate change. Cities are often centres of new thinking and policy innovation – cities are in a great position to lead the way for others to follow. Novel approaches can be developed that if successful can be rolled out to other cities' (http://www.c40cities.org/climatechange.jsp).

In a prestigious study by the World Health Organization, Githeko and Woodward summarise the links between climate change and increased health risks:

> Any increase in frequency of extreme events such as storms, floods, droughts and cyclones would harm human health through a variety of pathways. These natural hazards can cause direct loss of life and injury and affect health indirectly through loss of shelter; population displacement; contamination of water supplies; loss of food production …; increased risk of infectious disease epidemics (including diarrhoeal and respiratory diseases; and damage to infrastructure for provision of health services…devastating impacts, particularly in densely settled populations with inadequate resources. Over recent years climate-related disasters have caused hundreds of thousands of deaths in countries such as China, Bangladesh, Venezuela and Mozambique (2003: 48).

The WHO study summarises recent evidence of climate-change induced health problems, and these have a major impact on megacities. Its regionally specific examples include the effects of El Niño events in 1997–1998, causing major malaria epidemics in Africa, and a strong increase in rift valley fever in livestock. In Peru, there is ample evidence of cholera risks during El Niño periods. Both in Africa and in Mexico, floods caused outbreaks of the plague, because of the explosion of the populations of rodents and fleas, while Leptospirosis outbreaks have been documented after floods in Portugal in 1967, and in Ukraine and the Czech Republic in 1997. In Asia, various causes of Salmonellosis have been documented after floods (ibid).

Although the WHO study acknowledges the fact that the relationship between human health and water quality, water quantity, sanitation and hygiene is complex, the most obvious risk of floods and heavy rainfall events is the transportation of terrestrial microbiological agents into drinking water sources. This can result in an increase in bacteriological diseases like cholera and typhoid, and in parasitic diseases like amoebiasis, giardiasis and crytosporidiosis. Microbiological agents not

[4] See http://www.clintonfoundation.org/explore-our-work/#/clinton-climate-initiative

[5] See http://www.c40cities.org

only contaminate open water bodies, but also public water supplies, and it can take a long time to clean these supplies (ibid). Due to population concentrations health problems like these tend to be severe in megacities, if disasters happen.

That WHO study appeared in 2003, prior to Hurricane Katrina and its devastating impact on New Orleans. After the breach of the levees that protected the city floodwaters from Lake Pontchartrain, 80% of the city was inundated. Soon afterwards, chemists established the level of contamination and concluded that indeed numerous environmental contaminants were present, of which concentrations of aldrin, arsenic, lead and seven semi-volatile organic compounds were above the thresholds of the US Environmental Protection Agency. Various types of coliform bacteria were also present in dangerous numbers. Next to the death and destruction (and the psychological stress caused by the disaster itself and the inadequacy of rescue and support mechanisms), water-related health risks appeared important as well (Presley et al. 2006). Modern history in Northern megacities shows that health epidemics have often triggered water and sanitation improvements, and more proactive municipal government planning for improving conditions in its slum areas, and for the poor. Health reasons have often convinced high and middle classes to support those measures politically. It is quite likely that Southern megacities follow the same pattern. The connection between the risk of health epidemics and climate change is a powerful one to mobilise public and political support for more robust climate policy.

4.2.3 Reduced Water Supplies and Temperature

Droughts, particularly those in water-stressed zones, have various adverse consequences for urban water supply and sanitation. Not only can the provision of water to urban consumers be negatively affected (resulting in high costs of water provision, reductions in water supply, expensive back-up systems, and restrictions in water use), but the quality of the water that reaches urban households may be negatively affected as well. During a drought, the limited water supplies can have a higher concentration of pathogens, and hence higher risks of water-borne diseases, but low supplies affect personal hygiene and result in skin infections (Githeko and Woodward 2003).

Cities, and particularly megacities, often depend on the aquifers fed by a major hinterland area for their urban water provision, and when megacities grow, the area of their water provisioning tends to grow as well. There is growing interdependence of water sources, and cities are ever more dependent on multiple sources of water supply (see Schmidt 2008 for a historical analysis of Johannesburg and South Africa).When megacities are located in relatively dry areas, the 'normal' provisioning of water is already quite a challenge. During dry seasons and droughts, the situation can indeed become desperate.

Ouagadougou, capital city of Burkina Faso (Dietz and Zaal 2001, based in part on work by Rouers and van den Bosch 1999), is an African city with a semi-arid, inland position, which has grown tremendously during the last 50 years: from 59,000 at Independence in 1960 to more than one million inhabitants now. The surrounding area has a structural deficit of rainfall as compared to potential evaporation. Urban water demand clearly competes with increasing demands for people, crops, livestock and wood production in the rapidly changing watershed area around Ouagadougou. In 1996, it was estimated that 70% of urban households were in one way or another connected to a clean water source. Water mainly came from dams and wells north of the city. It provided the city with 15 million m^3 in a normal year, but only 10 million m^3 in a drought year, while the 'normal' demand in the mid-1990s was estimated to be at least 16 million m^3. In 2010, the demand was predicted to be 52 million m^3. Water consumption per capita has strongly decreased, reflecting increasing scarcity: from 57 l daily in 1978 to 39 l daily in 1986 and 26 l daily in 1993. Two planned developments were to counter this trend: a major new water dam in an area 50 km northeast of the city, and considerable effort was put into various forms of rainwater catchments.[6] However, the growing water needs of farmers near the town clearly pose a problem, as many of them irrigate their crops.

Liberalisation and commercialisation of water provision led to major price increases, and to strong competition between relatively rich and relatively poor inhabitants. The urban poor must use often-polluted water sources and public health may be at risk. Most of the wells they use are dry between March and June, when needs are highest. The government of Burkina Faso and the municipal authorities are now caught between a rock and a hard place: should they provide cheap and reliable water to the urban poor, at subsidised prices, and with a strong public health motivation, or should they maintain a distance to water provisioning and only provide a legal and incentive structure for a commercial system? One may expect that a new major drought period in the Sahel causes an urban water crisis, and that a public health crisis may follow suit. Popular demand would then most probably force 'populist' measures, by (again) an authoritarian government, if it survives the turmoil caused by climate stress. However, one never knows. Climate variability might also result in occasional major floods, even in a city like Ouagadougou (like in early September 2009).

Higher temperatures in areas with already high summer temperatures will lead to growing water stress among people. In some areas, it will probably lead to depopulation (as is currently happening in inner Spain). It may also undermine tourism, as some of these summer holiday areas are already seen as becoming intolerably hot, despite the growing (and ever more expensive) use of air conditioners. Heat waves (like the one in Nanjing and Tokyo in 1988, and in Paris and London in 2005; Githeko and Woodward 2003) already caused alarming numbers of additional deaths during the summer months, in areas, which used to be seen as temperate zones. This increased 'thermal stress', next to the health impact of extreme weather events, increased infectious diseases, the indirect effects of food scarcity

[6]See http://www.irc.nl/page/10369.

and hunger, and of the general disruption related to climate change disorder, is one of the major risks related to climate change mentioned in an influential article in *The Lancet*, by McMichael et al. (2006). Health risks are moving geographically as well, with ecozones for the malaria mosquito and the tick moving northward (see Martens and Moser 2001). Heat and drought pose a major fire risk, and hence a risk for built structures, and for human life in or near cities. Forest fires in California and the Mediterranean receive a lot of publicity, frequently connecting them to climate change. Meanwhile, forest fires in Kalimantan have caused a significant amount of smog in cities like Singapore.

In colder areas, higher average temperatures create the opposite: better habitats for humans, with more options for outdoor activities, and lower energy bills. As with many aspects of the dynamics in the relationship between men and his environment, climate change has winners and losers. One may expect that many of the winners can be found in the North (with cases like the Netherlands requiring massive investments to continue being part of those 'winners'), and many of the losers in the Tropics, particularly among the poor in the most vulnerable human spaces in the low-latitude and low-prosperity areas of the world. Risky places are home to the most vulnerable people, least able to afford those risks. An interesting example are the 'informal settlements' of Mitchell Plain and Khayelitsha in South Africa's Cape Province (near Cape Town), which provide not even the bare minimum of human space, with severe risks involved for its occupants, both with regard to (rain)storms, inundations and with regard to human predatory behaviour. The shacks of a million poverty-stricken people are not built on solid rock, but on sand and in marshlands, and close to the smell of Cape Town's water treatment plant. Here, the poor occupy the most risky and least attractive places in an otherwise attractive environment.

4.2.4 Climate Change and Rural–Urban Interfaces

Two aspects deserve further attention. Many cities get much of their urban water supply from their hinterland zones of influence, and sometimes from quite far away. As described in Tobias Schmitz's recent Ph.D. dissertation about the water provision of the Johannesburg area in South Africa (Schmidt 2008), hydrological histories are often marked by ever-wider circles of water provision, and ever more integrated water supply systems. However, this also means that urban water demand in particular metropoles directly competes with other urban areas, and with rural and energy demands (rural mainly for irrigation; energy mainly for the creation of hydropower). Moreover, within metropolitan areas, there is direct competition between the water needs of urban households and public services on the one hand, and the private needs of industries, particularly if they need huge amounts of cooling water. In these circumstances, water becomes a geopolitical entity and 'entitlements to water' an element of political struggle between and within geographical entities (Dietz 1996). The struggle takes on class, racial and ethnic overtones, when white rich people water their lawns at low cost and poor black people have to make do with irregular and expensive visits by water trucks or with long and arduous trips to unhealthy water sources.

The other rural–urban link is the use made of wastewater. As analysed by Kurian et al. (2009) for Andhra Pradesh in India, ever more attempts are being made to reuse urban wastewater, by separating ‘black water’ (from toilets) and ‘grey water’ (from bathrooms). Black water is reusable in urban and peri-urban agriculture as manure (‘wastewater farming’), with the side effect being the reduction of downstream river water pollution. However, the risks are also considerable. If concentrated wastewater mixes with storm water drains and inundates low-lying areas (often slums), concentrated pollution may indirectly threaten the lives of slum inhabitants. In addition, uncontrolled use of wastewater in urban and peri-urban agriculture may create health risks, one reason for many urban health agencies reluctance to support wastewater agriculture. Global warming and climate change provokes questions of global environmental justice, as well as questions of geopolitics and international law (Adger 2001). Redistribution of wealth, and a global system of insurance against the risks posed by the variety of impacts of climate change, should be high on the agenda of global governance institutions, and this combines the concerns of environmentalists and the ‘development industry’.

4.3 Conclusion

Higher climate risks mean higher vulnerability, more variability and less predictability (IPCC 1995; 2007), and these result in major policy challenges for areas of high population densities, like megacities. Thus, municipalities need to have more robust disaster-prevention measures, both against flood and storm risks and against drought, heat waves and dust storms. This would allow for greater flexibility and an earlier warning capability. If a disaster were to strike, these measures would offer a better chance of recovery and would provide higher resilience.

Municipalities are increasingly formulating their own policies in a bid to become less dependent on their national states (if these tend to move too slowly). We also see signs of municipalities developing ‘special linkages’ with municipalities elsewhere. Instead of relying on international aid through their national governments, Southern municipal governments, civil society and the corporate world (quite often in partnership) link up with Northern governments, civil society and/or businesses (Sassen 2006). Often this is no longer portrayed as an aid relationship, but as a relationship of mutual support and sharing experiences, and sometimes as a claim to compensation and a form of ‘global insurance mechanisms’ in the making.

In this chapter a plea has been made to look at climate-change induced risks for megacities with an eye for geographical specificity, and to combine information about climate zones, geographical location, economic strength and water stress contexts. This approach gives a framework to study differences in exposure to climate risks and differences in adaptation capabilities. However, it also gives tools to compare cases in different parts of the world, and to share lessons learned in ways that make sense and go beyond sweeping statements (Bast 2008).

References

Adger, W. N. (2001). Scales of governance and environmental justice for adaptation and mitigation of climate change. *Journal of International Development, 13*(7), 921–931.

Bast, J. L. (2008). *Opening remarks. The 2008 International Conference on Climate Change*, March 2–4, New York, USA, sponsored by the Heartland Institute.

Bulkeley, H. (2003). *Cities and climate change: urban sustainability and global environmental governance*. London/New York: Routledge.

Coenen, F. M., & Menkveld, M. (2002). The role of local authorities in a transition towards a climate-neutral society. In M. T. J. Kok, W. J. W. Vermeulen, A. P. C. Faaij, & D. de Jager (Eds.), *Global warming & social innovation. The challenge of a climate-neutral society* (pp. 107–125). London: Earthscan.

Dietz, T. (1996). *Entitlements to natural resources*. Utrecht: Uitgeverij Jan van Arkel.

Dietz, T. (2009). Ecospace, human space and climate change. In M. A. Mohamed Salih (Ed.), *Climate change and sustainable development: New challenges for poverty reduction* (pp. 47–58). Cheltenham/Northampton: Edward Elgar.

Dietz, T. & Zaal, F. (2001). The provisioning of African cities, with Ouagadougou as a case study. In I. Baud, et al. (Eds.), *Realigning government, civil society and the market. New challenges in urban and regional development* (pp. 309–328). Amsterdam: AGIDS.

Dietz, A. J., & Veldhuizen, E. (2004). Population dynamics. An important intervening variable. In A. J. Dietz, R. Ruben, & J. Verhagen (Eds.), *The impact of climate change on drylands, with a focus on West Africa* (pp. 79–82). Dordrecht: Kluwer.

Githeko, A. K., & Woodward, A. (2003). International consensus on the science of climate and health: The IPCC Third Assessment Report. In A. J. McMichael et al. (Eds.), *Climate change and human health, risks and responses* (pp. 43–60). Geneva: WHO.

Gupta, J., Lasage, R., & Stam, T. (2007). National efforts to enhance local climate policy in the Netherlands. *Journal of Integrative Environmental Sciences, 4*(3), 171–182.

IPCC. (1995). *Climate change 1995. Second assessment report*. Cambridge: Cambridge University Press.

IPCC (2007). *Climate change 2007: The physical science basis; summary for policy makers*. Available online at http://www.ipcc.ch/SPM2feb07.pdf

Kurian, M., Reddy, V., Van Dijk, M., Dietz, T., & Brdjanovic, D. (2009). Adapting to climate variability: productive use of municipal wastewater as a risk management option in peri-urban regions, *Proceedings of Urban Research Forum.* Marseille: The World Bank, 28–30 June.

Lindseth, G. (2004). The Cities for Climate Protection Campaign (CCPC) and the framing of local climate policy. *Local Environment, 9*(4), 325–336.

Martens, P., & Moser, S. C. (2001). Health impacts of climate change. *Science, 292*(5519), 1065–1066.

McMichael, A., Woodruff, R., & Hales, S. (2006). Climate change and human health: present and future risks. *The Lancet, 367*(9513), 859–869.

Mehrotra, S., et al. (2009). *Framework for Climate Risk Assessment: Buenos Aires, Delhi, Lagos and New York*. New York: Columbia University.

Myers, N. (1997). Environmental refugees. *Population and Environment, 19*(2), 167–182.

Myers, N. (2005). *Environmental refugees: an emergent security issue*. Prague, OSCE: Economic Forum. 13.

Mitchell, R. B., & Parson, E. A. (2001). Implementing the climate change regime's Clean Development Mechanism. *The Journal of Environment and Development, 10*(2), 125–146.

Netherlands Environmental Assessment Agency. (2009). *Beyond 2015: long-term development and the Millennium Development Goals*. Bilthoven: NEAA.

Presley, S. M., et al. (2006). Assessment of pathogens and toxicants in New Orleans, LA, following Hurricane Katrina. *Environmental Science and Technology, 40*(2), 468–474.

Rouers, F., & van den Bosch, L. (1999). *Etude de cas de la cellule de Ouagadougou*. Amsterdam: AGIDS (not published).

Rowntree, L., Lewis, M., Price, M., & Wyckoff, W. (2003). *Diversity amid globalization* (2nd ed.). Upper Saddle River, NJ: Prentice Hall.

Sassen, S. (2006). *Territory, authority and rights. From medieval to global assemblages*. Princeton, NJ: Princeton University Press.

Schmidt, T. T. (2008) *Catching the crocodile: Organisational responses to water scarcity in South Africa's Crocodile River catchment*. Dissertation, Nijmegen.

Van Susteren, A. (2007). *Metropolitan World Atlas*. Rotterdam: 010 Publishers.

Chapter 5
Wastewater Management Under the Dutch Water Boards: Any Lessons for Developing Countries?

Ir. Adry Abraham Salomé

Abstract This chapter has been written with the purpose to provide a contrast to the discussion on water and sanitation services from the perspective of the MDGs. A number of characteristics of improper sanitation and hygiene practices that are prevalent in the developing world today were present in Europe a century ago. Interestingly, institutional reform reflected in emergence in constitutional, collective and operational rules was incremental and gradual at best. Water boards are independent regional authorities who control and manage water quantity, quality and treatment of wastewater. They are public regional authorities with limited legally defined tasks, elected boards and allowed to raise taxes. This chapter examines the evolution of the Water Boards and emergence of accompanying policy and legal framework at both national and European levels. The reasoning behind benchmarking of water services and the processes that underlie such a project are described in this chapter.

5.1 Introduction

Water boards are independent regional authorities who control and manage water quantity, quality and treatment of wastewater. They are public regional authorities with limited legally defined tasks, elected boards and allowed to raise taxes. Water boards alone have water management tasks, unlike other local municipalities, regional Provinces and the National Government, who have to deal with all public aspects (see Table 5.1). These water tasks are[1]:

- Flood protection
- Surface water quantity

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[1]The majority of material in this chapter comes from Salomé (2008) UNESCO-IHE lecture notes; the author's personal archives and the various Dutch Water Boards (online and print).

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- Surface water quality
- Urban wastewater treatment
- Operational groundwater management (since 1 January 2009)[2]

Table 5.1 Dutch water boards key figures

Number of water boards (2009)	26
Number of employees	11.000
Tax revenues	2.2 € billion/year
Main dykes	3.000 km
Waterways	55.000 km
Number of waste water treatment plants	390
Capacity waste water treatment plants	33 million population equivalents
Treated waste water	27 million population equivalents

Salomé (2008), UNESCO-IHE lecture notes

The history of the Dutch water boards started more than 900 years ago. In the eleventh century, they took the first steps into water management. The twelfth and thirteenth centuries saw the organisation obtain greater stability giving birth to one of the oldest blueprints of democracy. It would take more than 500 years to change from local, more aristocratic directive organisations into the real democratic form known since the nineteenth century.

Water boards form the oldest layer of government in the Netherlands and early communities (known as *buurschap*, or 'neighbour shelf' meaning a collaboration of neighbours) played an important role in their creation. These communities elected administrators to represent the interests of the local population, with water management as one of their responsibilities. The farmers and landowners were responsible for maintaining local civil engineering works such as dikes, embankments, waterways and roads. Over the years, larger regional alliances arose, resulting in the first district water boards. These operated on a similarly democratic basis, with local communities having a say in their management.

Although wastewater treatment started about 100 years ago, the major role of water boards in wastewater management was established roughly 40–50 years ago. Before that, it was mainly the concern of each individual municipality and later the Provinces. The Netherlands is divided into 12 provinces. The 26 water boards do not have contiguous boundaries, as such; water boards have to deal with different provinces in one area.

5.2 Wastewater Treatment in the Netherlands

In order to understand the necessity of wastewater treatment, we must look at The Netherlands from the following perspectives. The Netherlands is the major delta of the large European rivers. Its deepest point is nearly seven metres below sea level

[2]You can find information on Dutch Water Boards via Internet search engine.

with 50% of the Netherlands below sea level. This has a major impact on earnings as 65% of the National Income in the Netherlands is earned below sea level.

5.2.1 Historical Development

The history of wastewater treatment in the Netherlands is compared to the other responsibilities of flood protection and later water quantity regulation. The quality of most surface waters in the Netherlands around 1,800 was generally quite good, with the exception of water in the cities. Even 50 years later, salmon was still the customary food for everyone; such was the high quality of the water.

In the Middle Ages, the city canals were more like open sewers. Dead animals, waste from slaughterhouses, manure, and more, including garbage from households and local industry, were all thrown into the water. In the summer, the smell was unbearable. Therefore, the city of Amsterdam issued the first prohibitive regulation in 1413.

By the nineteenth century, many Dutch cities situated special rainwater tanks for the poor. However, during dry periods there was no water at all, so they were forced to use the polluted water from the canals. Not surprisingly, many people became ill or died, often at young ages, of cholera, typhoid, tuberculosis and other contagious diseases. Slowly people became aware that special measures were necessary, but due to the high cost, lack of space, soil conditions and the idea of using expensive drinking water for flushing toilets, it took a long time before a serious large-scale effort was made (see Fig. 5.1).

Because of the industrial revolution and the growth of cities, the health situation at the dawn of the twentieth century was dramatically worse. Water, ground and air

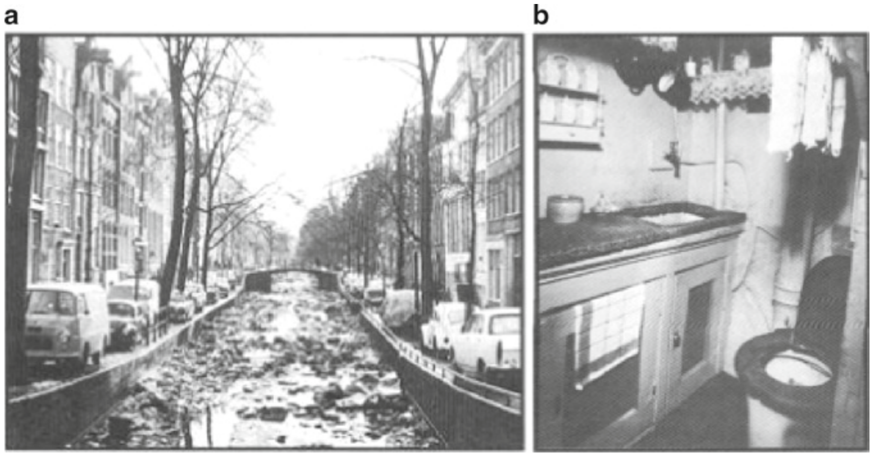

Fig. 5.1 (**a**) Polluted canal in Amsterdam and (**b**) toilet in the kitchen. Source: Het water in de vingers, NVA 1958–1998, Marion De Boo

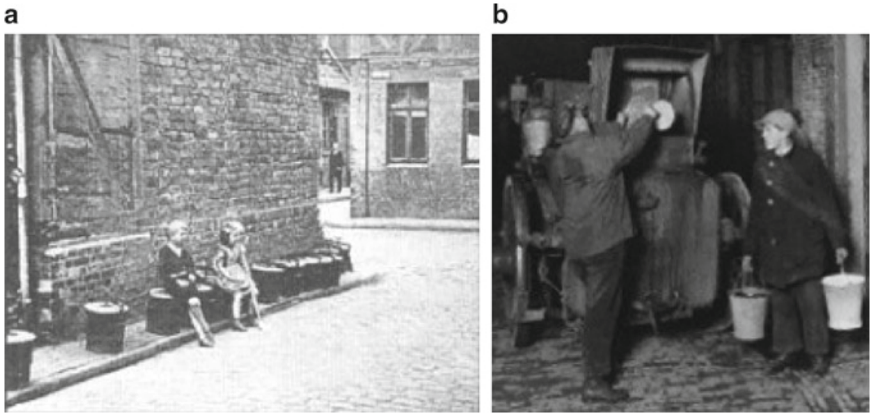

Fig. 5.2 (**a**) Barrels ready for collection and (**b**) buckets to be collected. Source: Het water in de vingers, NVA 1958 – 1998, Marion De Boo

pollution was heavy in many places. In the main municipalities, human waste was collected in buckets by people or brought to special places, which were cleaned during the night (although much was still thrown in the canals). In 1871, the city of Delft started a rotation system with exchangeable barrels. If you delivered a filled barrel, you received an empty one for the coming week. Agriculture used the excrement and remarkably, the last barrel was in use in 1978 (see Fig. 5.2).

In the middle of the nineteenth century, many cities and villages still faced cholera outbreaks, from contaminated drinking water. The solution was building sewer systems. The disadvantage was that contamination relocated to areas outside the cities. Discharge into a river was a suitable solution, except for villages downstream. Discharge to local surface water like a lake created further problems. The purification capacity of these waters was insufficient to deal with the pollution. The environment slowly became more and more contaminated and many people living in these areas faced serious health risks.

The oldest treatment of wastewater used was to flood a specific field, where the water could infiltrate the ground and bacteria took care of the harmful contamination. With the right load and filtration capacity of the soil, these systems were sufficient. Interestingly, many kitchen gardens were also situated at these sites. These special fields were built from 1900 to 1940.

Not only was domestic wastewater a major problem; the increase of industrial wastewater was reason to expedite water treatment. In the early twentieth century, research on the biological treatment of textile wastewater took place, but direct discharge into the sea by a pressure main was also an attractive and cheap solution.

Around 1930 the first sceptic tanks were built, where waste material could decompose. This was the first biological treatment or pre-treatment of wastewater. From 1920 to 1960, the Imhoff tank was an attractive treatment for wastewater. The Imhoff tank had a sedimentation compartment and the overflow could be treated elsewhere. In the sedimentation compartment (anaerobic) digestion of the settled material (sludge) took place creating a stable disposable product. Another invention around 1900 were (discontinuous loaded) contact-beds, later becoming continuous working trickling filters, when sprayer systems became available. They were used until the 1980s. The filling in these filters was often lava stone, on which the necessary bacteria could grow.

The most widely used treatment for wastewater was the activated sludge process. Invented in 1920, it mimicked the natural treatment of wastewater by bacteria in healthy rivers and lakes, under controlled conditions in special compartments and with the help of mechanical devices providing the bacteria, the oxygen needed. Natural processes at the bottom of lakes result in digesting the settled material, while other bacteria oxidise the suspended and dissolved material with the available oxygen in the water. Optimisation in a wastewater treatment plant improved quality and sped up the process. The digester at a treatment plant was heated and the activated sludge system aerated to add oxygen to the mixture of activated sludge and wastewater. The final clarifier separated the activated sludge from the clear water.

An important new development in 1954 was the oxidation ditch or *Pasveer sloot* named after its inventor Pasveer. This was a very low load activated sludge system, including aerobic sludge stabilisation. Later this system developed into the Carrousel system with the use of surface aerators.

Due to increasing effluent demands and technological developments, treatment techniques continued to improve. In the 1960s and 1970s, treatments served to avoid or limit odour emissions and hazardous situations. Disposal in surface water was only to the level the receiving water could handle. Today the effluent should meet standards near the water quality of the receiving water itself.

5.2.2 Changes in Policy and Legal Framework

Since 1900, water treatment depended on the local situation and varied between places. The removal of human waste (water) was the responsibility of each municipality, and they often constructed combined sewers for the discharge of wastewater and rainfall. After the Second World War, a special committee concluded that municipalities were not always the most suitable organisation to deal with wastewater treatment and that water boards would be better able to handle the responsibility. In 1950, the first water board in the Netherlands assumed responsibility for the fight against water pollution.

In 1970, a new national law (the Pollution of Surface Water Act: WVO 1970) was implemented in which water boards had an important new responsibility. Measures were taken on a national level, and water boards united themselves in a representative Union of Water Boards. From then on all sewage treatment plants, whether owned by municipalities or provinces, shifted to water boards. These water boards provided the best insight into necessary water quality and what effluent demands to consider. It was cost effective to keep all water tasks, including the treatment of wastewater, within one organisation, with legal regulations to determine discharge authorisation. In 1989 and 1993, the national government set new standards for water quality. This required further treatment and construction of new wastewater treatment plants, and explored options for (cheaper, simpler) measures elsewhere.

Knowledge of wastewater treatment remains highly localised and had to start from nothing. It is an empirical field where operators, designers and decision-makers have little contact with those outside their own location. In response to an urgent need to share knowledge and experience with other people working in the field, the Dutch Association for Waste Water Treatment formed in 1958. Special activities were organised, including excursions to different treatment plants to discuss problems and learn from other situations. The Association also became the Dutch representative to other (governmental) organisations. They started providing training and education programmes, and more people become members.

There was a growing interest in troubleshooting and research by the water boards. Instead of each water board doing this separately, in 1971 a special foundation opened to serve all general interests of the water boards. Consultants, research institutes and universities carry out the research under foundation supervision.

5.2.3 Public Investment in Sewage Treatment

In 1958, the total treatment capacity in Holland was two million p.e. (person equivalents). By 1970, it had tripled to 6.6 million p.e., which was about one-third of the total domestic waste water production. More than 50% of all the sewer systems were built between 1970 and 1982, after the implementation of the law against pollution of surface waters (WVO 1970). In 1988, there were 600 sewage treatment plants in operation, with a total capacity of 24 million p.e. To finance the enormous investments, operation and maintenance was a challenge. The repairs and replacements of pipes in the sewer systems alone cost more than 1 € billion/year. In addition, large investments are needed to comply with the more stringent effluent demands and other environmental demands (sludge treatment, covering parts of the plants, ventilation and air treatment, noise reduction, etc.).

The Dutch Pollution of Surface Water Act of 1970 (WVO) introduced a levy based on the principle that the polluter has to pay, and the amount varies according to the type and amount of pollution produced. The industry is responding with the construction of more treatment plants, specified for each branch. This is much more attractive than paying the levy every year. Every polluter now pays a tax, based on the total cost of treatment measures. Under the motto, 'no taxation without representation', different groups (household and industrial, agriculture, environment) have representation on the water board. To improve the willingness to make necessary investments in wastewater treatment systems, the national and provincial government began paying subsidies. After the last new construction and upgrades of treatment plants in the 1990s, these subsidies stopped. Between 1970 and 1990, water boards and industry invested two-thirds and one-third respectively of, 4 € billion.

5.2.4 Evolution of Environmental Standards for Wastewater Treatment Plants

In the 1960s, the focus was on the removal of (smelly) biological and chemical pollution (carbon molecules) of surface waters. The Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) removal was necessary to put oxygen back into the water. BOD and COD represent the amount of oxygen consuming components (pollution) in the water. The smelly, black waters with dead fish had to turn into clear water again. This was the first large-scale project with a relatively low budget.

About 10 years later (Regulation of Oxygen Demand – Pollution of Surface Water Act: WVO 1970), awareness grew that in summer, problems arose with ammonia (NH_4^+). This was also a large oxygen consumer resulting in bad water quality leading to creation of new demands for removal of ammonia from effluent during high temperatures.

In the 1980s, the focus moved from oxygen demand to eutrophication of surface and groundwater making nutrient removal important. At the European level, the European Council Directive on Nutrients is the operant regulation.

According to the North Sea Action Plan, the overall nitrogen and phosphate removal should be at least 75%, to cut loads into the North Sea in half. Of course, more specific demands by treatment plant could be made if it was deemed necessary for local water quality. This resulted in different effluent quality demands for different treatment plants. New regulations however demanded that when a new treatment plant was built or upgraded by more than 25%, the effluent demand was N = 10 mg/l and P = 1 mg/l for plants bigger than 100,000 p.e. and for smaller plants P = 2 mg/l.

An interesting point is that the nitrogen demand is a yearly average value and the phosphate demand is a moving average of 10 sequential samples. The reason is that phosphate is the short-term determining nutrient for initialising algae blooms or not during warm periods. On the other hand, basic nitrogen concentrations must be low enough, but this nutrient mainly influences the long-term situation. Before these new standards were set, an investigation was carried out to explore cost, environmental benefit and technical possibilities. The main discussion was to go for N = 10 or 20 mg/l. It became 10 mg/l. For the near future, effluent quality should go to the general quality of surface water itself, below values where algae bloom can occur. The demands should then go to N = 2.2 mg/l and P = 0.15 mg/l. This will also force the use of new techniques.

In the 1990s, another change in focus occurred. After the regulation of oxygen demand and nutrient removal, a third step towards improving the ecological function of water bodies took place. For different types of water bodies, the European Water Framework Directive of 2001 prescribes specific ecological and chemical goals. In addition to this, the focus is on new toxic particles, medicine and hormone residues, micro pollutants, pesticides and heavy metals. This will not only lead to new treatment techniques, like membrane filtration but also to new discussions about preventing pollution at the beginning of the chain (the source). Efficiency will be measured on diffuse pollution as well. At a certain point the treatment of wastewater is at such a high level that it becomes the smallest waste load on a water body and other measures may be better. In view of reuse of effluent (drinking water is scarce and precious) this development will continue.

The overall coverage of sewage collection in Holland is now 97%. Of this 97%, nearly 100% is treated in 390 wastewater treatment systems. The overall efficiency of these treatment plants is depicted in Table 5.2.

Table 5.2 Percentage of waste treated in wastewater treatment systems

Parameter	Efficiency (%)
0_2	98
P_{total}	80
N_{Kj}	87
N_{total}	74

Salomé (2008), UNESCO-IHE lecture notes

5.3 Scale of Wastewater Management by the Dutch Water Boards

5.3.1 Organisational Development

Due to population growth, in the eleventh century more people moved to the lower parts of the Netherlands. There arose a number of small hamlets and municipalities/villages. The exploration of woods, fields and swamps started, together with trading and small industry. The new grounds were rich for farming. There was a constant battle with the water to preserve the land from flooding. For farmers it was nearly impossible to build a dike let alone to protect his land from the sea or river, but together with other farmers, it was possible. By doing this, local participants cooperated and the goals of general interest and policy came together as pacts for water control, responsibility, finance and trading.

The first water board in the Netherlands was founded around the year 1122 near Utrecht, with the goal of damming up the Rhine. From 1200 on, new water boards appeared, often from where concerned people organised a special interest group to build and maintain dikes, roads and channels. They also elected their own management board to discuss and decide strategy and policy, based on deliberation and agreement. Thus, the water boards were the first example of democratic political structure in the Netherlands. From castles and monasteries (often funded by influential people) came increased collaboration, of which a side effect was that landowners gained more influence, control and legal rights. Important leading positions went to those from rich families. This went on in the Republic of the Seven United Provinces. About 2,000 very rich aristocrats had control at every political level, including the water boards. The Water Boards Schieland and the Krimpenerwaard, for example, were founded in 1296.

In the centuries that followed, the number of water boards increased enormously, due to the creation of new polders, dikes and mills. All relied on the same organisational principle: a responsible, elected water board. As early as the fifteenth century, reorientation and reorganisation took place, often due to flooding of precious land. With the St Elisabeth flood of 1421, 72 villages disappeared completely and more than 10,000 people drowned. In the sixteenth century, a new generation of water boards was responsible for supervision, instruction, direction and drainage of water from the area to a river or the sea. Local people took detailed control of many thousands of polders.

Although the battle against the water was the first and only responsibility of all water boards, they did not always share the same interests. A typical conflict of interest occurred when the dike was lower on one side of the river than on the other side. The water board with the lowest dike wanted to increase the height for better flood protection of their land. The other water board found this disadvantageous for their situation. It increased their risk of flooding.

The number of water boards reached a maximum at the end of the eighteenth century. By 1850, there were about 3,500 different water boards. Almost each polder, small or large, had its own water board. Due to the French Revolution not only villages and cities, but also the water boards had to change into real democratic organisations. They lost a lot of their own jurisdiction to the provinces. With the constitution of 1848 (by Thorbecke), the responsibility was controlled on three different levels: the national government (Directorate-General for Public Works and Water Management) for large rivers and the sea; the provinces (public works departments) for water control; and management in their own region, where they could delegate to the water boards. By the beginning of the twentieth century, there were about 2,000 water boards left, in 1969 about 1,000. By 1995, this had fallen to 88, and in 2002, only 52 remained. The process of centralisation has continued and now there are only 26 left, due to a long period of merging smaller water boards into larger ones. The most recent merger was in Sealand where two water boards became one.

Each area of the Netherlands has its own water board, forming a democratically operated administrative layer. Once every 4 years the members of the general committee of each water board are elected. This committee is drawn from all categories of taxpayers, including owners of land without buildings (farmers and administrators of nature reserves, etc.), owners of houses and buildings, householders, commercial buildings (industrial polluters) and leaseholders of land. The general committee in turn appoints an executive committee, which manages the day-to-day operations of the water board. Today water boards are modern (semi-governmental) authorities. The board is still elected, separately from national governmental and local authority elections, as in the Middle Ages (see Fig. 5.3).

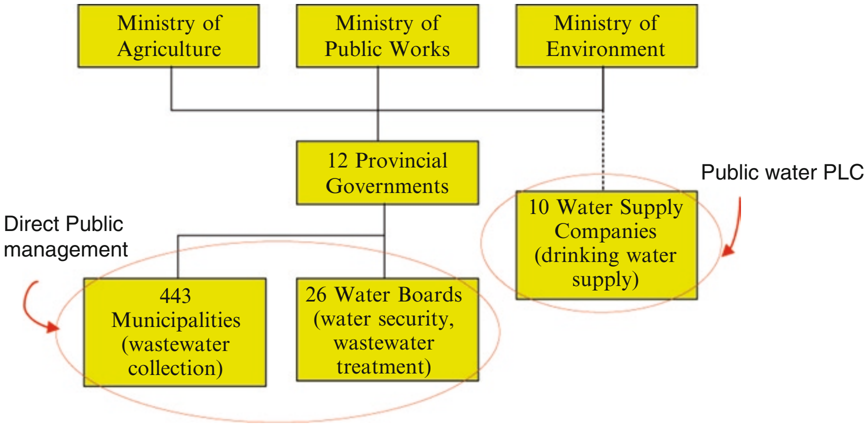

Fig. 5.3 Organisation of sanitation and drinking water supply in the Netherlands, 2008. Source: Salomé (2008), UNESCO-IHE lecture notes

5.3.2 Transition Towards Centralised Systems

The transition from small local treatment plants to larger centralised systems and the reduction of many small water boards was a major influence on the operation and maintenance of the plants. With a small staff, everybody knew and did everything. The focus was on process operation, measure water quality, repairs and cleaning. Now for every task there is a specific person, qualified in his own technical field. Therefore, management also changed to operate on a higher level. New management information systems like the Balanced Score Card (BSC-method) have also been introduced.

Over the past 10–20 years, the applicable techniques have become more complicated; automatic systems and advanced (computer) process control were introduced, as well as the need for more reliability. Despite efficiency goals, the knowledge and experience of employees changed and needed to be increased. Now, semi-continuous learning and training programmes organised for employees and working effectively are crucial, to prevent failure. Due to mergers, water boards are now organisations with as many as 1,000 or more employees. The organisation and its management must adapt.

Beside the main tasks and departments for wastewater transportation and treatment, water quality control, flood protection, water quantity control, special departments for finance, licenses, personnel, facilities, taxes, legal support and communication were introduced. Treatment management by water boards is an important link in the water chain, but the municipal authorities are responsible for collecting and transporting wastewater and sewage to the water board in accordance with the agreements made for processing. Municipal authorities and water boards agree on a 'transfer point' for wastewater, at which the water board assumes responsibility for its treatment.

The agreements between the water board and the various municipal authorities set out the requirements that wastewater must meet; these agreements are important for the so-called take-up commitment. The water boards undertake to take up and treat wastewater according to the terms of the agreement. Problems, such as overflow, can arise when the water board fails to meet its commitment, or when the supply of wastewater exceeds that defined in the agreement. Collaboration between municipal authorities and water boards is therefore essential to avoid these problems. Water boards and municipal authorities regularly perform joint optimisation studies, in which supply and take-up are coordinated as effectively as possible.

5.4 Influence of European Directive on Environmental Standards

For many years, each country within the European Union had its own standards. For the Netherlands, this meant that, being the farthest downstream country a lot of pollution came from neighbouring countries. With a lot of political effort, it was possible to decrease the pollution load to the Netherlands.

For the main European rivers, agreements between the different countries were made. The new approach was to organise and regulate more to the natural river catchments in European countries. The Rhine Action Programme (1987) introduced new initiatives. In international programmes, countries along a European river force themselves to decrease the discharge of many chemicals by 50%. However, pollution from abroad remains a difficult topic. In Holland, measuring specific heavy metals for example is difficult, knowing that 100 times more is entering through river flow from other countries and it is difficult to gain firm and effective control of foreign diffuse discharges.

At the beginning of 1990, new standards for water quality were set not only by the national government, but also by other European countries. They were based on ecological interests to be reached in different upcoming years. This was also done for sediment levels of water bodies (see Fig. 5.4).

European regulation led to the Urban Wastewater Treatment Directive. This directive addresses nutrient-based, bacterial and viral pollution caused by urban wastewater, which discharges excessive levels of nutrients (in particular, phosphorous and nitrogen) into rivers and seas, causing eutrophication. Eutrophication occurs when there is a sharp increase of photosynthetic organisms including algae in the water. This leads to a lowering of oxygen levels (as microbiological organisms degrade the dead algae and other organic material) and to other negative ecological effects. The result is an imbalance in the organisms present in water and a reduction in water quality, which can drastically change the ecosystem of a lake or sea and may even lead to the death of large numbers of fish.[3]

[3]Salomé (2008) UNESCO-IHE lecture notes.

Fig. 5.4 Wastewater treatment plant, Kortenoord. Source: Water Board Schieland en de Krimpenerwaard

By introducing potentially harmful bacteria and viruses, the discharge also poses human health risks in waters used for bathing or shellfish culture. The directive requires that urban centres meet minimum wastewater collection and treatment standards within fixed deadlines. Two deadlines expired at the end of 1998 and 2000, another in 2005. These deadlines were fixed according to the sensitivity of the receiving waters and to the size of the affected urban population. The directive required member states to have identified sensitive areas by 31 December 1993, and to have met strict standards for the discharging of wastewater directly into sensitive areas or their catchment areas. This should have been achieved by 31 December 1998 (the same applies to the extraction of the nutrients that contribute to eutrophication). The directive also imposed other requirements, including those relating to wastewater of certain agro-food industries, the monitoring of wastewater discharges and sludge.

New European directives will lead to better adjustments of measures in the different countries. The new European Guideline Water Framework (KRW) agreed to improve the quality of surface water and ground water to adequate, sustainable, desired level by 2015. The KRW gives a framework for every country for the protection of surface water, coastal waters and groundwater. The guideline determines what local measures, which are feasible and payable, must be undertaken. Therefore, every country is, within a range, free to determine standards, depending on the function of a water body. In practice, this means that some countries are looking at enormously complicated and expensive programmes, while others have only limited efforts to meet new agreed standards. Every European country should meet this new situation by 2015 and certainly by 2027.

The Dutch Association of Waste Water has a European division as well: the EWPCA (European Water Pollution Control Association), which is part of the association of European sister organisations. In this organisation, not only are knowledge and experience from the participating countries exchanged, but future strategies are discussed and opinions formulated, to influence European politics to make the right decisions.

5.4.1 Monitoring Environmental Standards

For each water board to take responsibility for treatment results, as described in discharge permits by the licensing authority, it is important to prove that license limits are fulfilled.

Every year water boards must make a complete sampling programme, in which is exactly described where in the process and which samples must be taken, how often and under what conditions, and what must be measured in a certified laboratory. The licensing authority must approve this programme. These daily sampling and analysing activities are an expensive part of regular business at treatment plants. Standardisation is assured by national guidelines for all Dutch water boards. An independent National Authority and the responsible organisations for the different receiving surface waters (local small rivers, canals, lakes or large rivers) carry out control on a national level. These organisations also control the industries discharging on surface waters or sewer systems.[4]

5.5 Tariff Setting for Wastewater Treatment Services

Tariff setting is mainly a political issue. Of course, municipalities and water boards are non-profit organisations, like provinces or the national government. They all raise their own taxes. Municipalities raise taxes for the collection of wastewater in the sewer system. Water boards raise taxes for the transportation and treatment of wastewater, in addition to a tax for water quantity control and safe dikes. On a national level, the state finances the safety and water quantity of the main water system. Table 5.3 provides an overview of water management responsibility and financing.

The financing principles for the different services are as follows:

- Flood protection and water quantity: emphasises the principle that groups with an interest in use of the dikes and surface water level control are required to

[4]For more information, see the various Dutch Water Boards, found online.

make a larger contribution as a result of which they are entitled to a greater say in decision-making

- Water quality: the polluter pays

Table 5.3 Dutch water management

Responsibility	Organisation	Financing
Water quantity and flood protection main system	State	General means
Water quantity and flood protection	Water board	Regional tax
Groundwater	Province/Water board	Regional tax
Water quality and waste water treatment	Water board	Regional tax
Sewage collection	Municipalities	Local tax

Salomé (2008), UNESCO-IHE lecture notes

Table 5.4 provides a breakdown of taxation for the water boards and municipalities.

Table 5.4 Task and taxation for water boards and municipalities

Task	Taxation
Water board	
• Flood protection/safety	150 € million
• Water quantity	650 € million
• Water quality/waste water	1,300 € million
Total	2,200 € million
Municipalities	
• Waste water collection	1,000 € million
Total waste water	About 2,300 € million

Salomé (2008), UNESCO-IHE lecture notes

The general opinion is that water boards are too expensive. There is political pressure to reduce costs and limit the increase of tariffs. Therefore, on the one hand there is a high ambition for the future; on the other hand, cost reduction and better efficiency and effectiveness are needed to maintain the (political) position that the water boards are still the best organisation for the job. From a consumer's point of view, not many people know what the water board does and why it is so important. For many years, people have been so used to the fact that it is safe to live in the Netherlands, that surface- and ground water levels are always stable (despite all the rainfall) and that water quality (also swimming locations) and the collection of wastewater in every household or industry is always secured. Most of that work occurs behind the scenes or without special notice of others.

To avoid the discussion of the right to exist, the water boards introduced benchmarking to show in a transparent way what they do, at what costs, and with what results. During the past 10 years, the benchmark has become a real science. The price of water per family in the Netherlands for drinking water, wastewater collection and treatment and water security is around 750 €/year.

5.6 Emerging Trends

5.6.1 Technical Efficiency and Resource Recovery

The reuse of treated wastewater has been an issue for more than a decade. Reuse in practice however is difficult. This is for three reasons: (1) use of drinking water is in most situations more cost effective. (2) Local possibilities determine the chance of success. Still there are a number of projects achieved, a few with treated effluent and partly with the use of upgraded drinking water or pre-quality drinking water. (3) There's hardly any public acceptance for using treated wastewater as a source of drinking water.

The separate collection of solid (faeces) and liquid (urine) waste is an entirely different concept than the collection, transportation and treatment systems, which are used today. Investments over the years have been enormous: billions and billions of Euros but, centralised collection, transportation and treatment is still the most economically viable concept.

The idea of separate collection is interesting but also introduced new problems. First, it is a measure at the beginning of the process versus 'end of pipe', which means handling on very small scale compared to the very large economic centralised systems now in place. Second, it will introduce problems with handling processes and hygiene, not to forget the high extra costs of rebuilding the existing infrastructure. Local solutions often result in more difficult process control and maintenance, due to the available techniques but, on this small scale, it is more expensive. The idea behind separate collection is that costly and scarce drinking water goes only for transportation and for a very basic low value product as faeces. However, the result is design and implementation of other toilets such as the compost toilet. Grey water is all domestic wastewater, not from the toilet, such as that from a bath, shower, washing machine or hand basin. It contains soap residues and cannot be discharged without treatment. After treatment, it is useful as flush water for toilets.[5]

In a few newly built city areas in the Netherlands, a completely separate water supply system was built, one for drinking water (consumption) and the other with a slightly lower quality (also called grey water) for use in washing machines, toilets, etc. Due to the parts used, cross connection should not be possible. However, in practice cross connections occur. The risk of creating serious health problems increased public opinion against these new ideas.

Black water is wastewater from toilets. It is heavily polluted with excrement. It needs extended treatment before discharge is possible. If effluent is not seen as a waste product but useful for other purposes, it can be a commodity for upgrading to an intermediate product in industry or even after membrane filtration as 'pure' water. Of course, drinking water can also be a water source for this purpose.

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[5]Salomé (2008) UNESCO-IHE lecture notes.

The increasing effluent demands and new conditions have meant that during the last two decades knowledge has increased, and innovations, new sciences and systems have been invented. This is especially significant because of the new demands on nitrogen and phosphorus. In the future even stronger effluent demands must be met. The challenge is to do this at the lowest cost possible. Due to efficiency moves already made this will be a hard goal to achieve. Since energy consumption is a global problem, energy saving is an important topic. Because of climate change (and the film by Al Gore), the focus is on CO_2 production and reduction. This means that either alternative energy sources must be found or the existing systems should recover energy thus, neutralising any addition of CO_2 into the environment.

Besides energy recovery, end-savings sustainability in general has become important. This means that the uses of chemicals, materials, maintenance methods and so on are part of the decision tree. The interaction between sewer system and wastewater treatment plant is another important issue. Physically these systems are connected to each other, but organisation and ownership is different. Intensive cooperation between municipalities and water boards should optimise both systems together and save public money (taxes).

5.6.2 Combined Billing of Water Supply and Sanitation Services

Combining the billing of water supply and sanitation can save a lot of money on administration and other paperwork. More important perhaps is the effect on water consumers. It was however not achievable until now, due to the discussion that not all drinking water ends up in the sewer. In addition, the rainwater component of the sewer system is the major element of cost. The influence of discharge of only used drinking water is many times smaller.

The maximum hydraulic load determines the size, and therefore the total cost of the system, and the running cost of the pumps is influenced by the amount of rainwater collected in the system. An adequate formula or calculation that everybody can agree on is preventing this important step. It would help the general understanding that consuming water is also creating a wastewater flow to be treated. Another, more strategic reason is the fact that drinking water companies let consumers pay a price for the supplied water amount. The water boards raise a tax for the transportation and treatment of sewage. Both parties control their own finance and are comfortable with that. Combining it in one bill would require negotiations, changing laws, achieving new agreements and other complications. Until now, the public has saved no money in this area.

5.6.3 Benchmarking Water Boards

In 1999, the water boards took the initiative to benchmark their performances. Benchmarking was to show in a transparent way, how revenue and expenditure streams of budget are formulated, for what and with what results. This enables one to explore a direct correlation between expenditure and outcomes.

This Water Boards benchmarking report explains and compares the performance of all water boards in wastewater treatment both with each other and against former benchmark standards. All water boards engaged in treatment have taken part, making this the first fully transparent government task compared and accounted for. All information in the benchmark report is available to the public.

The introduction of the benchmark had two purposes:

- *Political*: In the 1960s the responsibility for wastewater treatment was with the local municipalities, later also with the provinces. After the implementation of the Dutch Law Pollution of Surface Water Act of 1970 (WVO), the water boards were made responsible for wastewater treatment. These water boards already controlled the water management tasks, organisation and expertise on flood protection, water quality and quantity. To expand this with the wastewater task was both logical and economical. However, not all municipalities and provinces liked the new situation. It took many years and many mergers between water boards before the whole switching operation was finished. There are still some political schools of thought that water boards are not as efficient and effective when it comes to wastewater treatment, which are in the spotlight again after some years out of the discussion. Introducing the benchmark (willingness to show in public how money is used and what is achieved) takes the pressure off the discussion.
- *Business*: The benchmark optimises efficiency, cost reduction and increase of results on several aspects, for example, effluent quality, innovation, maintenance, chemical and electricity use, organisation, licenses, environmental impact, sludge treatment, and so on. The water boards opted for a broad and balanced comparison, meaning that finances and treatment performance are not the only aspects examined; efforts and results in the areas of environment and innovation are also considered. Finally, an examination has been made of 'the performance in the eyes of interested parties' (e.g. local residents, companies, licensing authorities and sewerage managers).[6]

The first benchmark for water boards came in 1999. Every 3 years a complete benchmark is carried out. The comparison of operations was based on the Balanced Score Card introduced by Kaplan and Norton. The BSC has been adapted according to the specific characteristics of the water boards including the following:

1. Plant functioning: what treatment performance is provided?
2. Finances: at what cost?
3. Environment: how environmentally aware is the organisation?
4. Innovation: is the organisation capable of innovating and improving?
5. Interested parties: how is the organisation performing in the eyes of interested parties?

[6]Salomé (2008) UNESCO-IHE lecture notes.

Within these categories, approximately 80 indicators were developed and subsequently divided into sub-indicators. A survey was also made of possible explanatory variables. The information was collected down to the level of individual processing plants, and the data were analysed and incorporated in 26 water board reports. These reports are primarily for learning and improving. For the purposes of this chapter, seven indicators have been selected in order to present and account for the performance of the water boards carrying out treatment. An explanation is provided of what each indicator represents, why it is important and how the performance developed.

5.6.3.1 Indicator 1: Plant Functioning

The general combined performance of COD, nitrogen and phosphate removal increased from 79% in 2002 to 84% in 2006. Nitrogen removal increased from 62% in 1999 to 67% in 2002 to 78% in 2006. Phosphate removal increased from 77% in 1999 to 78% in 2002 to 82% in 2006. The general performance is %COD-reduction + %N-reduction + %P-reduction.

The take-up of wastewater by water boards from municipal authorities should be 100% exactly. Half the water boards achieved 95% take-up in 2002. In 2006, it increased to an average of 96% for all water boards. Water boards and municipal authorities have to agree on the level of the take-up commitment. It is important for the water boards to improve their fulfilment of the take-up commitment in order to prevent overflow from the sewer systems in municipalities.

5.6.3.2 Indicator 2: Finance

The WVO rate is the level of tax levied by the water boards for overall water quality management. The different tariffs between water boards are difficult to explain to citizens and companies. Geographic differences, scale of operations and population density are a partial explanation of these differences. Another factor is the level of extra capacity each water board has. The benchmark shows that treatment of wastewater in thinly populated large areas is relatively expensive, mainly because of small treatment plants and long transportation systems. Under these circumstances, transportation costs can run up to 30–40% of total local exploitation costs.

Tariffs are also depending on the age of the different wastewater treatment plants. New or modernised plants provide high effluent quality but are expensive in capital cost on the financial balance. Also being under construction, upgrading, expanding or modernising sewage treatment plants in a specific year means little decrease in overall effluent quality. This effect is shown clearly in the benchmarks. Finally, the remaining capacity for the future is determining the tariff. In areas without any population growth or industrial expansion, it is possible to maintain the exact capacity needed. If growth is expected, extra capacity must be available on time. This means that extra capacity must be built before it is needed. The investment costs are then already made.

The increase in the cost of treatment management is modest, being below the level of annual inflation (CPI 3.3%).

5.6.3.3 Indicator 3: Environment

Since 1999, the water boards have been operating in a more environmentally conscious manner. The indicator for environmentally conscious operations should not be a report mark, although clearly the higher this is the better. Most water boards have introduced quality and environmental management systems. The use of harmful substances (crop protection products and sodium hypochlorite solution) has reduced. Every water board has to comply with 75% nitrogen (N) and phosphorus (P) removal. For environmental reasons, a water board may opt to remove more nitrogen and or phosphorus than the minimum legal requirement. Due to these more stringent effluent demands for sensitive receiving waters, individual effluent demands per treatment plant can result in better overall performances (e.g. 83% N- and 79% P-removal). Of course, this will increase cost, due to available extra treating capacity and investments. An increasing number of water boards are taking treatment further than the minimum 75% removal of nitrogen and phosphate.

The focus is also on energy consumption and savings. The use of green energy is encouraged, but is difficult to compete with conventional (fossil) energy sources, like gas, oil and coal.

5.6.3.4 Indicator 4: Environmentally Conscious Operation

Water boards may opt to incur costs in order to become more environmentally friendly.

5.6.3.5 Indicator 5: Innovation

In the eyes of a jury constituted especially for the purpose of this comparison, water boards have become more innovative in order to meet strict requirements and to make creative use of available space. In addition, more joint ventures have been initiated, and new techniques such as membrane technology are being increasingly used.

Joint venture projects achieve use of knowledge that is more effective, and can result in cost savings. Assessment of the water boards' innovation is by an independent organisation. From all the planned investments about 130 € million is spared, due to optimisation studies in the water chain (sewer system collection, transportation and treatment of wastewater), together with water boards and municipalities. Over the past years, more technological and organisational innovations have been used by water boards. The focus is on reuse of effluent, effluent polishing, membrane bioreactor systems and local decentralised treatment of wastewater. One difficult topic in these situations is the influence of rainfall.

There must be more improvement in the field of energy consumption. An agreement was made with the state to increase efficiency in 15 years by 30%. That means an average of 2% improved efficiency per year. One recent example is a special upgrade installation for produced biogas from a digester at a wastewater treatment site. This gas flows into the general supply system of a gas company, enough for about 400 households.

5.6.3.6 Indicator 6: Organisational Innovation

The management changed from a (multi) task organisation to a process driven organisation. From company strategy and policy, a translation to the identification, modelling/design and control of the necessary processes takes place. From here possible improvements and renewals are made as a continuous process (PDCA-cycle = Plan-Do-Check-Act-cycle).

5.6.3.7 Indicator 7: Customer Satisfaction

Finally, a comprehensive customer satisfaction study has been carried out among interested parties. People living near treatment plants, companies, suppliers, licensing authorities, sewerage managers and license applicants were asked to give their opinions about their own water board. The average score was 7–7.5 (scale of 1–10). In comparison with other customer satisfaction studies, this represents a good score. Although the average scores do not vary widely, there are nevertheless interesting differences between both the water boards and the various satisfaction measurements per water board.

The next benchmark will take place in 2010, concerning the year 2009.

5.7 Lessons for Developing Countries

This chapter describes the evolution of the Dutch water boards responsible for management of wastewater. From a historical institutionalism standpoint, the chapter highlights a number of issues of relevance to water and sanitation in developing countries. First, it becomes clear that change in management of wastewater occurred gradually; notice that the last solid waste barrel was collected in a city in The Netherlands as recently as 1978. Further, today there is hardly any public acceptance for using treated wastewater as a source of water suppy. Wastewater re-use for agriculture, river pollution and serious public health risks characterised life in the Netherlands a century ago. There were important tipping points that consolidated the position of the water boards such as the St. Elizabeth flood of 1421 that resulted in deaths of people by drowning. National laws on public health were soon followed by the European directive for monitoring quality of rivers. The implementation of the programme is predicated by collection and analysis of reliable data, sharing of best practices among the federation of water boards and benchmarking that facilitates performance monitoring.

There has a gradual trend towards centralisation of wastewater management, aided in large measure by a large network of underground drainage systems. Municipal control gave way to treatment of wastewater by the Water Boards. Presently there is a heated debate on the merits of doing away with the Water Boards altogether driven primarily by arguments for cost-cutting and reducing administrative overlap and institutional fragmentation. With the enormous capital invested in establishing combined sewers for collection, transport and treatment of wastewater, the transaction cost of shifting towards a system that is focused on source separation becomes cumbersome. There is lesson for secondary towns in developing countries – simplified sewage systems could be a viable alternative to wastewater management focused on end of pipe treatment. There is another important lesson that relates to the fact that local finances (from water boards and municipalities) support a large proportion of the cost of operating and maintaining wastewater management while central transfers are focused on protecting water quality in rivers. Implementation of the European Framework Directive has added another layer of rules for monitoring water quality with European subsidies supporting its implementation.

5.8 Conclusions

Water boards are independent regional authorities who control and manage water quantity, quality and treatment of wastewater. They are public regional authorities with limited legally defined tasks, elected boards and allowed to raise taxes. This chapter examined the evolution of the Water Boards; we looked at the emergence of policy and legal framework at both national and European levels. We looked at historical developments notably decentralised practices for collection and disposal of wastewater, a large proportion of which was untreated. With the development of environmental standards, wastewater treatment became more sophisticated and technology gradually became more centralised. The chapter also shines light on financing arrangements – taxes, tariffs and transfers. We also examined a number of important policy options of relevance to developing countries – combined billing of water supply and sanitation services, benchmarking service delivery and wastewater reuse. This discussion offers a number of important lessons on institutional change in general and for water and sanitation policy and practice in particular.[7]

[7]In addition to the lecture notes and private archives of the author, this chapter is based on information found online on Dutch Water Boards (both past and present); various issues of *Water Spiegel*, magazine of the Dutch Water Companies (Vewin 2009); various issues of *Zo zit dat*, a Dutch scientific magazine; various issues of H_2O, magazine for water supply and water control; and Bedrijfsvergelijking Zuiveringsbeheer 2002–2006.

Chapter 6
Financing the Millennium Development Goals (MDGs) for Water and Sanitation: Issues and Options

Mathew Kurian

Abstract The cause of institutional reform could be furthered considerably if capacity is built to ensure that appropriate technologies and financing packages are designed, implemented and effectively monitored. For this reason, it is important to understand that infrastructure financing trends vary by sub-sector (*water supply*, *wastewater*), by geographical region and by sources of financing (*domestic or international private sector*). There are a number of lessons that can be drawn from financing of investments in sectors like energy and telecom; one of the most significant lessons is the importance of legal and policy frameworks and autonomy and accountability of local authorities. Subsequent sections of this chapter attempt a categorisation of countries depending on levels of economic growth and sector reform with a view to exploring differences in types of demand for multilateral financing in the water sector. The importance of multilateral development issues like aid harmonisation, budget support and local twinning projects are discussed. Private sector financing of investments in the water sector are also discussed based on examples of Dutch development cooperation; role of commercial banks, small-scale service providers and usefulness of a franchise approach by NGOs.

6.1 Introduction

The introductory chapter of this volume pointed out some of the weaknesses of MDG concepts related to access of the poor to water and sanitation services. The UN Human Development Report 2006 for instance notes that presence of improved technology such as a pit latrine is at best a partial indicator[1] of success with ensuring

[1]*Improved sanitation*: connection to public sewer, connection to septic tank, pour flush latrine, simple pit latrine, ventilated improved latrine. *Not improved sanitation*: bucket latrines (*manual removal of excreta*), public or shared latrines, open pit latrines.

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improved access to water services. *What constitutes an improvement?* Infrastructure coverage matched by an improvement in relative access of the poor to services like improved latrines for shared use, connection to a sewer network or access to technologies that separate solid waste and domestic wastewater at source. Does improvement in relative access also ensure *adequate* access to services? One example is 24 h of water supply instead of only 6 h of supply a day.[2] Finally, does the MDG definition of improved access adequately reflect how issues like service standards, service quality and affordability apply to shared facilities like communal toilets are considered (Bartlett 2003)? The MDGs have also been criticised for overlooking structural causes of poverty and for being driven by a simplistic equation: external assistance + technological fixes + good governance = poverty reduction (Saith 2006: 19).

Financing and technology are no doubt important considerations in ensuring improved service delivery. The disconnect between what development economists thought development assistance would achieve and what it has actually done is best illustrated by the Harrod–Domar model (Bhagwati 2010: 124). In essence the model used parameters to define development; growth rates were considered a function of how much a country saved and invested (*savings rate)* and how much it got out of the investment (*capital-output ratio).* Aid was meant to finance the gap between a recipient country's capital-output ratio and its savings rate. But we pointed out in the introductory chapter that such an approach only served as an incentive for recipient countries to stay dependent on aid flows through a focus on infrastructure spending and much less emphasis on improving returns on investment through enhancing service coverage and quality.[3] For this reason, it is important to consider infrastructure financing trends by sub-sector (*water supply, wastewater*), by geographical region and by sources of financing (*domestic or international private sector*). There are a number of lessons that can be drawn from financing of investments in sectors like energy and telecom; one of the most significant lessons is the importance of legal and policy frameworks and autonomy and accountability of local authorities. One of the outcomes of multilateral initiatives in this regard has been the design of Output Based Aid (OBA) approaches that aim to leverage behaviour change in city level planning (World Bank 2009).

Subsequent sections of this chapter attempt a categorisation of countries depending on levels of economic growth and sector reform with a view to exploring differences in

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[2]Gender Water Alliance (GWA) notes that sanitation programmes are often built around assumptions of gender-neutrality. Gender specific concerns relate to construction of toilets with doors facing streets and pour flush toilets that require women to spend time on transporting water. Failure of sanitation interventions imposes a greater burden on women since it is difficult for women to find a place to defecate in urban slums when compared to rural areas.

[3]Economist Rosenstein-Roden pointed to the challenge of 'absorptive capacity'. Arguments that aid can and should be used to promote development seem reasonable but have run into problems; not only because corrupt dictators have been want to funnel money away but because even in democracies, provision of aid creates perverse incentives (Bhagwati 2010).

types of demand for multilateral financing in the water sector. The importance of multilateral development issues like aid harmonisation, budget support and local twining projects are discussed. Private sector financing of investments in the water sector are also discussed based on examples of Dutch development cooperation; role of commercial banks, small-scale service providers and usefulness of a franchise approach by NGOs. The experience of rating and reward schemes in developing countries and their potential role in linking budgetary allocation to accomplishment of policy objectives (like connection of households to sewer networks) are explored. The chapter concludes that international development cooperation could play an important role in furthering institutional reform by consolidating sources of finance and knowledge of financing instruments, risk mitigation strategies and norms that guide policy and programme implementation.

6.2 Results-Based Financing in the Water Sector

6.2.1 Infrastructure Financing Trends

In the mid-1990s, domestic public sector accounted for between 65% and 70% of financing in water and sanitation. However, a large proportion of public investment did not translate into effective service delivery for a number of institutional reasons: poor reliability, uncertain quality or affordability of services. As a result of this failure of public investments, individual households are financing their sanitation arrangements, such as construction of septic tanks. International private companies accounted for between 10% and 15%, domestic private sector for 5% and international donors for between 10% and 15% of financing. Private sector financing of water and sanitation projects has been small in terms of quantum of funds compared to telecom or energy. During 2001–2004, the domestic private sector comprised important investors in water sector – illustrated in part by the presence of local parties in several concession contracts awarded in Chile. South Asia accounted for the largest share of investment by domestic private sector at 60% of the region's total during 1998–2006. Investments in the water sector came almost exclusively from the domestic private sector. The Report of the World Panel on Financing Infrastructure noted that annual required investments in municipal wastewater treatment are likely to grow much faster than any other sector (see Table 6.1). In fact, the Public Private Infrastructure Advisory Facility (PPIAF) of The World Bank noted that by 2006, projects involving wastewater treatment plants accounted for more than half the investment in the water sector and more than 40% of projects closed (2006a).

According to the World Panel on Financing Water Infrastructure,

> Financing water infrastructure essentially entails spending cash to finance long-term physical assets. This could be financed by present cash flows or reserves of the water undertaking, or by taking loans or equity, which have to be reimbursed over time by water users or fiscal transfers. Such financing sources are only feasible if long-term reimbursement by users, taxpayers or donors is possible.

Table 6.1 Indicative annual investment in water services for developing countries

	Annual costs	US$ (billions)
Sector	2003	2002–2025
Drinking water	13	13+
Sanitation and hygiene	1	17
Municipal wastewater treatment	14	70
Industrial effluent	7	30
Agriculture	32.5	40
Environmental protection	7.5	10
Total	75	180

World Panel on Financing Water Infrastructure (Camdessus and Winpenny 2003)

Sanitation challenges are different from water supply in that per-unit investment costs are higher. Costs of wastewater treatment can be high owing to costs involved in sewerage transport and treatment. Private sector participation for financing water infrastructure is limited because of inadequate guarantees that public finances will be raised to ensure return on capital investments. In this regard, the issue of sub-sovereign risk has received considerable attention especially in the literature on private sector participation in water sector in Latin America (see Box 6.1).

Box 6.1 Private participation in sewerage financing, Malaysia

The Malaysian programme for private participation in sewerage illustrates some of the disappointments that can occur when an aggressive private participation plan is put in place to mobilise finance and accelerate investments. After a few successful water and sanitation Build, Operate and Transfer (BOT) projects in Malaysia, the government chose to support a national sewerage project, the Indah Water Konsortium (IWK). This project arose from concerns over local government's weak technical and financial capability in the face of poorly maintained facilities and rising demand for better sewerage services. An unsolicited proposal was brought to the government, and approved rapidly in 1994. Investments and the level of service improved dramatically in the immediate term. However, even before the economic crisis of 1997, consumers objected to the tariffs imposed. The tariff structure originally stipulated in the agreements was suspended without compensation for private contractors, and a new tariff structure was only established in 1997. The economic crisis then prompted further reductions, while the IWK discovered that the rehabilitation needed was more than anticipated. As a result, the government felt obliged to provide financial support to IWK, including long-term soft loans amounting MYR 450 million. This transaction could have been designed better: the economic crisis multiplied the difficulties tremendously, but the

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Box 6.1 (continued)

problems had already emerged before devaluation aggravated them. While private participation doubtless brought considerable implementation capacity to the task, they did not resolve the fundamental impediments to making provision of sanitation services a viable financial proposition. The government succeeded in attracting private investment, but the structure of guarantee provided and the nature of risks involved in the project were such that both the capital mobilised and the physical achievements of the projects were much less than originally expected.

Source: Urban Infrastructure Finance from Private Operators: What have we Learned from Recent Experience? *World Bank Policy Research Working Paper 4045, Nov. 2006.*

6.2.2 Private Investments in Infrastructure: Lessons from Telecom and Energy Sectors

A number of private technology suppliers exist today with the expertise to meet urban sanitation challenges in developing countries. As incomes rise, citizens around the world are likely to demand improved services to ensure collection, treatment and reuse of wastewater. The old paradigm of subsidising toilets will give way, gradually, to total sanitation solutions focused on community level behaviour change. In countries where public agencies are slow to reform, the private sector will step in to provide them. For example, cleaning of septic tanks and transport of solid waste to landfill sites is already being undertaken by private companies in many developing countries. However, private sector participation has been less forthcoming when it comes to creation of landfills or construction of wastewater plants because of archaic land tenure arrangements or inadequate guarantees that people will pay for services because of political interference. Here there are important lessons to be drawn from capital-intensive energy and transport projects that succeeded in attracting private financing (Fig. 6.1). Unlike water supply projects, *off-site* urban sanitation projects are similar to transport and energy projects in that they require high upfront capital investments and private alternatives are absent.[4] By contrast, on-site sanitation measures are unlikely to attract substantial private sector investment in toilet collection and waste removal and transport.

[4]Upfront capital investments in the case of energy and transport projects are usually designed in the form of Build- Own-Operate (BOO), or Build, Own, Transfer (BOT) projects with the justificcation that they would generate employment and economic growth due to improved connectivity. In the case of urban sanitation projects, public investments could be justified in terms of adverse economy-wide impacts on health, tourism, etc. from pursuing *business as usual* policies. Further, like investments in transport and energy, direct government involvement is required because of multiple agencies and jurisdictions involved and because of issues of *eminent domain*, especially when it comes to acquisition of private property, which is required for construction of wastewater plants, roads or electricity distribution networks.

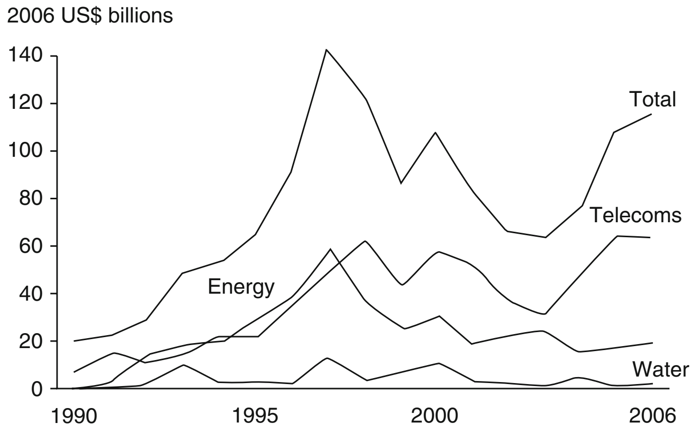

Fig. 6.1 Investment commitments to infrastructure projects with private participation in developing countries by sector. Source: World Bank (2006a) and PPIAF: PPI Project Database
Note: The Investment data refer to commitment and include private and public contribution

6.2.3 Importance of Legal and Policy Frameworks

The Panel on Financing of Water Infrastructure notes, 'the intensive, time-consuming nature of project financing leads to large economies of scale. Although there are many small water projects, banks will want to finance projects exceeding US$ 50–100 million. The private sector is also interested in long duration contracts'. It is unlikely that investments will occur unless guarantees are provided that costs can be recovered. Costs could be recovered directly through taxes, tariffs and central transfers. Legal and policy frameworks can play an important role in ensuring that investments are realised by specifying how resources will be recovered, defining environmental and service standards that utilities should adhere to and laying down guidelines for inter-governmental transfers and tariff structures that promote equity.[5] The World Panel provided a set of recommendations with a view to tapping into financial resources from private sources. The following are an illustrative guide.
Small-scale entrepreneurs

- Governments and water authorities should recognise the present and potential role of small-scale water and sanitation service providers by providing a legal framework that can facilitate long-term investments by them, including their role in private concessions and decentralisation.

[5]Studies in Brazil and India indicate that when policy framework is weak or unambiguous, the effects of private sector participation on service delivery may be limited to only relatively well to do segments of the population. This is because private sector may be uninterested in setting up facilities in regions where poor consumers are unable to pay for services. A robust policy framework would use a range of instruments (examples include corporate tax breaks, subsidies, etc) to channel private sector financing effectively to meet the service requirements of poor consumers.

- Governments should include small-scale private providers in their national water and sanitation strategies and service development plans, including incentives for them to improve their services.
- Small-scale private providers should be encouraged to improve their access to finance to increase their capacity to invest in the sector and reduce their cost of capital.

Private international companies

- Water and sanitation projects should be financed by combining public funds with private financing in transparent and acceptable ways.
- ODA should be available to facilitate water and sanitation projects managed by private operators under private control, for example, OBA could be used to expand networks or fund revenue shortfalls on a diminishing basis under a concession. Alternatively, aid could be used to finance investment in assets owned by the public and operated by the private sector.
- Devaluation liquidity backstopping facility could be employed to absorb risk posed by devaluation for public and private service providers taking on foreign currency commitments.
- Revolving funds could be used to overcome the heavy fixed costs involved in preparing tenders and contracts for private participation projects.

Community initiatives and service oriented NGOs

- Civil society roles in water and sanitation service provision needs to be supported, and their capacity to perform independent oversight should be strengthened. For this purpose, micro-credit schemes should be supported by ODA and multilateral financing through provision of seed capital, initial reserves and guarantees.

Water consumers in industrialised countries could be invited to add, on a voluntary basis, a modest amount to their bills, on the understanding that the proceeds would be allocated to decentralised bodies in developing countries for financing well-chosen projects. However, accountability and autonomy of local government decision-making and resource allocation processes are crucial to imbue contributors with a sense of confidence in the proposal.

Autonomy and accountability of local authorities

During the last two decades, responsibility for providing sanitation services has been devolved to municipalities and regional agencies. In most cases, these agencies do not have powers to raise finance or the autonomy to spend money in ways they see fit. A study of functional devolution to local governments in India for example, found that decentralisation percentages for expenditure that is devolvable are uniformly low for public health, minor irrigation, drought relief and water supply. By contrast, for sectors like rural development with a preponderance of schemes where the central government lays down strict rules on how such funds may be used, devolvable percentages tended to be higher as was the case for employment generation schemes.[6] The emphasis in many countries remains on creating infrastructure like toilets or wastewater treatment plants, but with little or no regard to whether households, especially the poor, have access to reliable water supply or connection to sewer networks. As a result, sanitation facilities constructed with the best of intentions very often do not serve their purpose. Further, fewer meet environmental water quality standards.

Norms for inter-governmental transfer of physical water resources and finances are skewed in favour of urban areas. For example, in India, Litres Per Capita Daily (LPCD) norms stipulate a higher water supply allocation for urban areas of approximately 120 when compared to rural areas of approximately 40. In the case of financing, lower tiers of government who are expected to play significant roles in setting development priorities and executing plans are receiving the lowest proportion of central transfers. A World Bank study of fiscal decentralisation reveals expenditure of higher tiers of government at district and sub-district levels were mostly focused on disbursing salaries of health and education workers. Transfers for public works and agriculture only constituted 6% and 5.9% of total fiscal transfers respectively. Further, contrary to principle of allocative efficiency, local governments that have a high proportion of irrigated area and hence have a better revenue capacity also received higher grants. Therefore, in reality inter-governmental transfers far from serving an 'equalisation function', putting all areas on the same competitive footing, were actually putting more money in the hands of well off districts. As a result, poorer households were not being given priority in inter-governmental fiscal transfers. The study highlighted a number of crucial steps that are required to be undertaken to address shortcomings in the decentralisation programme as it relates to service delivery (Box 6.2).

Box 6.2 Fiscal decentralisation and service delivery in India

Fiscal decentralisation that has evolved from a centralised system cannot be designed and implemented in textbook fashion. A top-down approach essentially means that higher tiers of government transfer schemes along with employees for selected functions. The transfer of employees has to be accompanied by assurance to protect their salaries, hierarchy and promotional avenues. Given these limitations, local governments do not have the autonomy and flexibility in making allocative decisions between different sectors and functions, in designing ways in which schemes should be implemented, or in appointing employees and ensuring their accountability. Overall, lessons of

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[6]For a detailed discussion on reform of inter-governmental finances, see Rajaraman I. and Sinha, D. (2007). See also World Bank (2006b). *Fiscal decentralization in India*. Oxford University Press.

Box 6.2 (continued)

decentralisation in Karnataka suggest that decentralisation has to be planned and implemented in four broad areas:

Functional Assignment: Consolidation of multiple schemes arising from state and central levels of government, autonomous boards and agencies.

Augmenting Revenues: Granting lower tiers of government autonomy to raise revenue (e.g. property tax).

Inter-Governmental Transfers: Determining requirements of different types and tiers of local government, imparting allocative efficiency and autonomy, generating better information, linking transfers to public service delivery.

Accounting for Equity: Identifying areas or households who need to be targeted by transfers and subsidies and developing a mechanism to monitor need for equalisation grants or other equity enhancing transfers continuously.

Source: World Bank (2006b). *Fiscal decentralization to local governments in India.*

6.2.4 OBA Approach to Financing Service Delivery

In recent years with a view to overcome the shortcomings of top-down fiscal transfers, Output Based Aid (OBA) approaches have been devised. According to the World Panel on Financing Water for All, OBA approaches essentially aim to tie disbursement of public funding (whether sourced from government resources, bilateral donors or multilateral agencies) to specific services or other outputs delivered by private firms or NGOs. This contrasts with traditional approaches of directing public funding to pipes, pumps, treatment plants or other inputs provided by public sector. OBA approaches have four main applications in the water sector. It can be used for on-going consumption subsidies, as in Chile, where subsidies are used to reimburse water bills of the target group of low-income consumers. It can be used to support the expansion of existing water or sewer networks, such as when disbursement is tied to the number of new connections made and served. It can be used to implement time bound subsidies to ease transition to cost-covering tariffs. Disbursement can also be used to tie subsidies to achievement of specific environmental targets (such as volume of wastewater treated to a certain standard). All four approaches promise better targeting of intended beneficiaries or outcomes, sharpen accountability for results, improve incentives for efficiency and help mobilise private finance in support of development objectives.

A recent study[7] by the World Bank Group notes that 'although OBA is increasingly being used as a tool to increase access to services, the percentage of the OBA

[7]Output Based Aid: A Compilation of Lessons Learned and Best Practice Guidance, Final Draft, GPOBA and IDA-IFC Secretariat, Washington DC, September 2009.

portfolio as compared to overall IBRD and IDA activities is small'. About 2.7% of World Bank project portfolio in the transport, ICT, health, water and sanitation, energy and education sectors, approved between fiscal year 2000 and 2009 used an OBA approach. From the point of view of achieving the MDG target, it is imperative that OBA approaches are taken to scale. In this regard, the World Bank report emphasises the importance of sustainability of public funding and importance of its proper targeting through use of subsidies. Renewed focus is required on issues such as capacity of implementing agencies/service providers and aid harmonisation. Another important point made by the World Bank Report is that monitoring of public finances improves accountability for donors and governments. In this regard, the report calls for an active communication strategy that advertises what services are to be delivered to whom and at what price, as is currently being done in Morocco's urban water sector (Box 6.3).

Box 6.3 Limitations to shifting risks to service providers

Although OBA in general can mitigate the risks to governments/donors/users of cost over-run and benefit shortfalls as described in the review, there is still a need to take into account factors outside the control of the service provider, as in the case of any well-designed intervention.

- In the case of the GPOBA-funded *Morocco Urban Water and Sanitation* with unit subsidies fixed in Moroccan Dirhams, the output projections were lowered by 14% in the first quarter of 2008 as a result of a 14% depreciation of the US dollar against the Dirham.
- The *East-Meets West Foundation*, an NGO providing output-based connections in the GPOBA-funded Vietnam water scheme, has received an increase in unit subsidy as a result of unit cost increases partially due to the recent increase in commodity prices. This is especially relevant for projects implemented by small and medium service providers who do not have means to hedge against price increases.
- In the *Colombia Natural Gas project*, the Grant Agreement specified the unit cost of $141 to be payable in Colombian pesos. Given the depreciation of the US dollar against the Colombian peso, this meant that the actual subsidy payable to the distribution companies was reduced significantly. At the time of grant agreement signing, the exchange rate was 2,300 Colombian peso to the US$, while in 2008 it was 1,705 pesos to the US$. In the case of the project, the distribution companies effectively absorbed the depreciation.

With the onset of the global financial and economic crisis in late 2008, it is difficult to predict which way projects will be affected. By October 2008, the global economic landscape changed dramatically with the unraveling of the credit markets, yet inflationary pressures have eased considerably due to a

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Box 6.3 (continued)

crash in commodity and energy prices, with the dollar strengthening against most developing country currencies. It is important to take these issues into account when structuring an OBA project and have some flexibility to adjust subsidy amounts if the sustainability of the project is at risk.

Source: A Compilation of Lessons Learned and Best Practice Guidance, World Bank, GPOBA and IDA-IFC Secretariat, Washington, DC, September 2009.

OBA schemes that involve performance based inter-governmental transfers are being piloted by The World Bank in Latin America through use of IBRD loans (e.g. Guanajuato, Mexico) and an OBA facility is being piloted in the water sector in Honduras. These are important steps to take OBA from project intervention to wider sector reforms. In a similar vein, the 2009 OECD report on sustainable financing for water supply and sanitation notes that as countries develop there tends to be a shift towards use of commercial, increasingly local finance, reimbursed ultimately by cash flows from user charges. The report cites evidence from Austria and Korea to argue for strategic financial planning to ensure tariffs, taxes and transfers are coordinated to ensure that subsidies, if required are targeted at the poor. The report emphasises, 'tariff reform tends to focus on levels and rates of change in charges. However, the process of tariff-setting is a vital consideration'.

6.3 Leveraging Behaviour Change in City Planning and Sanitation Financing

Three trends emerged in recent years that suggest that a transformation in relationship between national states and their citizens is underway: (1) a process of devolution of decision-making power to lower tiers of government, (2) growth of new public management that legitimised a role for the private sector in delivery of basic services, and (3) the rise of transnational networks aided by the internet revolution. An important consequence of these processes has been the destabilisation of older hierarchies of scale, necessitating in many instances a re-scaling of politico-administrative territorialities. The destabilising of national state-centred hierarchies of legitimate power has also unleashed a multiplication of non-formal political dynamics. Notwithstanding these trends, international aid programmes continue to direct funding towards hierarchically-organised and territorially-bounded national ministries and line departments with a poor record of delivering affordable, reliable or safe water services. International development cooperation in the water sector for example has begun to acknowledge some of the developments discussed above.[8]

[8]We refer to Dutch examples given the significant contribution of the Netherlands to international development cooperation (as a percentage of GDP) and examples of innovation in the Dutch water sector.

6.3.1 Predicting Demand for Capital Investment

Given high levels of investment that are required, public investment (*realised through taxes or user charges*) is likely to continue to be an important source of infrastructure financing. Private financing can play an important role in meeting shortfalls that are also likely to be substantial in the future (Fig. 6.2). Based on a review of literature, demand for international financing of capital-intensive infrastructure projects is likely to be mediated by two factors: Levels of economic growth and initiation of process of sector reform that reflects political commitment to institutional change.

Depending on where countries are located on this *Growth & Reform* spectrum, one can identify a fourfold categorisation of demand for multilateral/bilateral financing of water sector investments. The following is only an illustrative guide.

Segment 1: Low Hanging Fruit

Countries making substantial progress with sector reform and experiencing high level of economic growth. Here the focus could be on deepening sector reform through facilitation of city level sanitation plans that spell out clearly technology requirements, scale and size of consumer base, tariff structures and investment requirements. These countries should also be encouraged to move forward from SWAPs to Budget Support approaches that aim to align country systems further with donor procedures as part of process of prioritising investment requirements and sector and regional priorities.

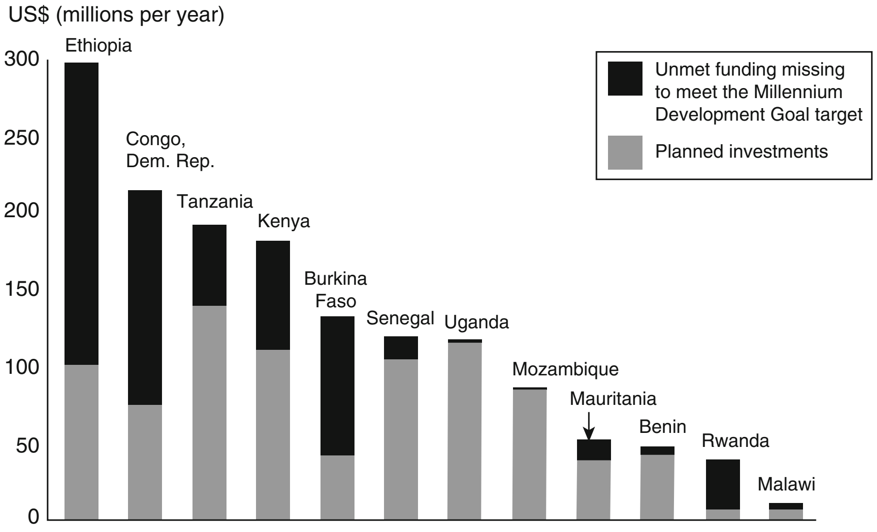

Fig. 6.2 Public investment in water and sanitation is insufficient to meet the Millennium Development Goal target in many countries. Source: WSP-AF forthcoming

Segment 2: Model Developers

Countries that have made substantial progress with sector reform but are experiencing lower levels of economic growth could serve as incubators of new models that could be taken to scale and/or replicated in other countries. Some of these models could include modalities for development of city sanitation plans, CLTS approaches, public expenditure tracking, micro-finance and design of fiscal reward schemes. OBA approaches could also be tested and refined further especially with reference to targeting of subsidies for urban poor, expansion of sewer networks, and implementation of time-bound subsidies to ease transition to cost-covering tariffs. OBA approaches could also experiment with design issues related to tying of subsidies to achievement of specific environmental or policy targets (such as volume of wastewater treated to a certain standard or proportion of poor households connected to sewer networks).

Segment 3: Long Haul Reformers

Countries experiencing higher levels of economic growth, high levels of poverty, but with little or slow progress with sector reform. These countries experiencing high rates of urbanisation and poor access to services are likely to meet a large part of their financing deficits from external sources. Partnerships may be forged with a large and growing domestic private sector for technology design and transfer. First, advocacy is important in convincing governments at national levels of the need to reform public finance norms and structures as a prerequisite for partnerships with private sector. Advocacy efforts to be able to succeed must involve consultations with private sector, opinion leaders, civil society and donor agencies. Consensus on the public health benefits of urban sanitation investments are critical to paving the way for lowering levels of sub-sovereign risks that presently discourages private sector participation for capital-intensive urban sanitation projects.

Segment 4: Reconstruction and Relief

Countries recovering from war and in need financing for reconstruction and disaster relief. Investments in these countries may follow the project financing mode as a prerequisite for opening up a dialogue on SWAPs and Budget Support at a later stage. Depending on local context, physical space constraints, ability to pay, cultural perception and acceptance of reuse, important choices will have to be made with regard to management emphasising principles of fiscal accountability, participatory planning and performance monitoring.

6.3.2 Donor Deliberations on Aid Harmonisation and Budget Support

Hard budget constraints and ring fencing of public accounts can have an impact on public service delivery since they will make providers more financially accountable for services and ensuring that revenues obtained from water supply and sanitation functions are spent on the same services. The 2004 World Development Report notes that budget support restores the compact between policymakers and providers. It allows contestability in public spending. Moreover, it reduces costs from fragmentation and separate project implementation units. Providing funds to a general budget also offers a better framework for discussing inter-sectoral allocations. The European Commission is explicitly linking part of its budget support to performance. Progress is measured by a small number of performance indicators agreed upon by the recipient and European Commission. Indicators are typically drawn from the recipient country's poverty reduction strategy. So far, 30% of the EC's budget support is linked to performance indicators. The system is not an end in itself, but a means to get policymakers and the public in developing countries to pay attention to results and to balance performance rewards and the recipient's need for predictable budget finance.

6.3.3 Enhancing Accountability and Capacity of Local Authorities

Deliberations on aid harmonisation can be slow and take time to produce results. Another route to further the agenda on enhanced accountability of aid flows is to explore opportunities to engage directly with local authorities responsible for delivery of water and sanitation services in cities. Here Dutch development cooperation has supported development of city sanitation strategies in Jakarta.[9] A core principle of the programme is that water and sanitation planning should be embedded in routine government planning and budgeting procedures. Consequently, it is crucial that specific outputs of the water and sanitation planning process (e.g. proposed projects and action plans) become available on time for integration in the routine city development planning process. More recently, the Dutch Association of Municipalities (VNG) has begun discussions with SNV, an NGO and municipalities in Tanzania on supporting improved budgeting practices with a view to make local government decision-making more accountable with regard to service delivery. At the moment, local authorities in Tanzania remain dependent on central government transfers for 97% of their expenditure and as a result, there is no incentive for them to be accountable to consumers. Under the agreement, the Dutch will provide grant support of 1.5 € million a year with SNV providing staff time for demand brokering and advocacy with VNG providing manpower to support the learning component of the programme. The learning component of the programme has two elements:

- *Local Twinning Projects*: Involving cooperation between municipalities in the Netherlands and Tanzania. A 'colleague to colleague' approach is adopted to facilitate exchange of information on management aspects: tariff setting, scale of operation, standard setting or technology choice.

[9] For an interesting discussion of local government planning issues, see WSP (2009).

- *Activities at Country Level*: VNG collaborates in a project with ISS to build capacity of the Institute of Rural Development Planning. The project aims to develop human resources through financial and administrative management and improving content of training programmes offered by the Institute.

6.3.4 Private Participation in Service Delivery

Earlier on in this chapter, we pointed out that the private sector was reluctant to invest in water sector, except in areas like wastewater treatment plants where large capital investments were required. This was primarily due to the absence of a predictable policy and legal framework. Instead, the private sector has been keen to engage with local authorities through management contracts. Here it is important to recognise institutional diversity: some countries like Tanzania have separate authorities in charge of water supply and sanitation while others like Indonesia and Iran have single authorities. In cases where privatisation of assets has been undertaken, utilities are responsible for operations and maintenance. However, in a number of cases, utilities remain dependent on local governments/municipalities for annual fund flows to operate and maintain plant capacity. In many cases, sewer treatment plants or community toilets are established without due attention being given to tariffs or sewer connections. Private sector participation is unlikely to be forthcoming in circumstances where municipalities are unable to remove constraints to households connecting to sewer networks or paying for use of community toilets. Local governments are primarily responsible for ensuring that tariffs set by utilities for services such as collection, treatment or disposal of waste balance the interests of the poor with that of environmental protection. Further, local governments can play an important role in creating an enabling environment through creation of a transparent set of standards for services, improve upon land tenure regulations or building codes and identify new sources of revenues from local tax sources.

There are a number of examples of the Dutch private sector playing an important role in enhancing private participation in the water sector: from tapping new sources of funds to developing business models for mobilising investments in developing countries.

1. *Design of financial instruments: the role of Dutch banks*

The World Bank has recently experimented with financial credit instruments to optimise the flow of funds towards meeting MDG goals. One initiative is *GEMLOC*, which is based on the fact that while 70% of all emerging market debt is currently denominated in local currency, only 10% of the foreign money going into bonds issued by emerging markets is denominated in local currency. In addition, while about a dozen emerging economies have already developed liquid local currency bond markets, many others would seek to improve liquidity, build market infrastructure, develop efficient tax regimes, and cut red tape. The World Bank is planning to raise the funds – an anticipated \$5 billion annually – in international markets, and to manage a portfolio of investments in local currency bonds across as many as 40 emerging markets. Up to 30% of assets could also be financed by sub-sovereign and corporate bonds.

ECO 3 PLUS Bonds: The bonds, with a guaranteed minimum return of 3%, help finance anti-poverty World Bank projects. The bonds' upside return is tied to the performance of an index of companies that focus on climate issues and the environment. Given the growing interest in green issues in the Netherlands, ABN AMRO has opened up its retail distribution network for the first time to an outside issuer for this type of product. The World Bank brand is being used to increase the credibility of the fund issue.

2. *Engaging with the small-scale private sanitation sector in peri-urban areas*

Peri-urban areas of Africa suffer from poor sanitation facilities with adverse consequences for public health and the environment. WASTE, SNS REAAL Water Fund and Plan Nederland collaborate in five African countries to address this challenge. The project objective is to provide toilet facilities, ensure emptying, transport and reuse of excreta for agriculture. The Small Scale Private Sanitation Sector (SSPSS) is responsible for toilet construction, waste emptying, transport and disposal. A local level consortium involving utilities, SSPSS, local banks, users, agriculture sector and relevant national sector agencies provide support to the initiative by collaborating to develop a business plan that specifies roles and responsibilities, tariff structure and operation and maintenance plan based on principles of sound financial management. Dutch development cooperation contributes half of the estimated 7 € million project budget while SNS REAAL contributes loans on the condition that municipalities will make matching contributions towards project cost. In a similar vein, WASTE partnered with TATA-AIG in India to develop health insurance products linked to access to safe sanitation. Under the programme, health insurance premiums will vary according to the sanitation situation of the target group: better sanitation is translated into financial incentives, such as lower insurance premiums. National Housing Bank (NHB), a finance institute in India focuses on developing upward policy linkages while SNS REAAL invests in local financial institutions to provide financial advisory services. Minimal donor support from international development cooperation has succeeded in leveraging maximum locally available commercial finance for the initiative. UNU-Merit, Maastricht has provided knowledge support for the initiative by developing performance indicators to monitor accomplishments of project objectives.

3. *Resource recovery from waste: a franchise approach*

Aqua for All has developed the Safi Sana concept aimed at developing partnerships with the domestic sector in Ghana. The objective of the franchise approach is to close the loop on collection, processing and reuse of waste through partnerships involving local governments, NGOs and private operators in developing countries. Four features of the Safi Sana concept include:

- Toilet blocks (extending with water vending kiosks) privately operated and involving local governments and civil society groups

- Flag stores that showcase toilet technologies involving units for urine harvesting and faeces collection, rainwater harvesting, grey water recycling and solar power
- Safi Sana holding acting as fund manager managing an optimal mix of instruments like grants, equity funds, loans or micro-finance to accomplish effective service delivery
- Exploring demand for waste products in urban markets by offering competitive alternatives for electricity, artificial fertiliser and charcoal

The above discussion has a number of implications for international development cooperation. Key implications may be summarised as follows:

- There are a number of potential focus areas: Megacities or peri-urban regions. Table 6.2 is not meant to be prescriptive, but only to provide an illustrative matrix of potential international financing pathways. These pathways would necessarily acknowledge diversity in levels of economic growth and/or differences in the way service delivery is organised in different locations.
- Twinning of municipalities/water boards with their counterparts in the South can facilitate exchange of information. However, primarily the discussion is focused on conventional sewerage, which this chapter suggests may not be a solution in a large number of situations in developing countries. There is an increasing need on both sides (donors and recipient governments) to improve the record with regard to achievement of MDG goals. For this purpose, the OECD has correctly emphasised a move away from designing cost-recovery and tariff targets to focusing on the process that underlies cost-recovery and tariff setting. This essentially involves engagement with the political process.
- There are also indications that a paradigm shift is already underway on many fronts. This is evidence from a growing emphasis on use of rating and reward mechanisms, changes in type of engagements signifying a move away from technology transfer to leveraging knowledge of improved management practices.

6.3.5 Linking Budgetary Allocation to Accomplishment of Policy Objectives: The Role of Rating and Reward Systems

International development cooperation has a critical role to play to achieve behaviour change at multiple levels: national governments, municipalities, water ministries/line departments, utilities and consumers. For this to be accomplished, it is important that accountability and transparency of policymaking, implementation and monitoring processes are improved. In other words a framework that links inter-governmental fiscal transfers (*involving donors, national and sub-national entities*) to achievement of policy objectives (*24/7 water supply, connection of poor households to sewer networks, maintenance of water quality, adoption of water saving technology design*) is required. Rating and reward approaches can be useful in this regard. Experience with

Table 6.2 Illustrative guide to international financing of urban sanitation services

Sanitation service	Role specification	Institutional dimensions	Financing arrangement	International development Cooperation financing Instrument
Toilet construction	Municipality in consultation with ward committees	Compliance with engineering norms, targeted at poor and local tax options explored	Part municipal budget and part recovered through central transfer	Strategic lending targeted at informing budget process of municipality
Collection	Private service provider	Accountable to municipality through management contract	Tariffs/user fees	Equity fund or Output Based Aid (OBA)
Transport	Private service provider	Accountable to municipality through management contract	Part municipal budget and part recovered through surcharge on water bill	Loan/Private sector guarantee to support implementation of Build-Own-Transfer (BOT)/Build-Own-Operate (BOO) contract
Treatment	Private service provider	Accountable to municipality through management contract; Municipality guarantees supply of water and energy	Part municipal budget and part recovered through surcharge on water bill	Guarantees for private sector investment
Reuse	Municipality and/or rural local government	Benefit-cost of reuse options ascertained	Tariffs/User fees	Grant to support design of micro-finance arrangement
Disposal	Private service provider	Compliance with environmental standards specified by relevant agency	Part municipal budget and part recovered through central transfer	Loan to support design of monitoring framework and prospective studies

Community Led Total Sanitation (CLTS) areas highlighted a number of important policy principles that emerged out of a process of rating rural local governments for their performance in reducing the incidence of open defecation. Key departures from the earlier technology and disbursements focused paradigm were the following:

Collective action

Mobilising the community rather than establishing household contacts since the use of hygienic latrines impacts on the community as a whole.

Local choice

Accommodating a variety of technological options and getting people to assess affordable technologies.

Setting up appropriate institutional frameworks

Giving local governments a central role in scaling up and sustainability of CLTS approaches.

Incentive structure

Directing incentives to the community and rewarding outcomes, rather than subsidising construction of household toilets.

Market development (NGO role)

Promoting development of markets for sanitary material and allowing private suppliers to respond to demand.

There have been attempts to relate results of rating local governments for accomplishing policy goals to inter-governmental fiscal transfers. One example is that of the Baba fiscal reward in Maharashtra, India given to rural communities who can guarantee a stop to the practice of open defecation. Other examples include Morogoro ODF prize in Tanzania in recognition of community-level behaviour change with regard to sanitation and hygiene practices. More recently, the Urban Sanitation Policy of the Government of India has sought to institutionalise use of rating and reward instruments.[10] The new policy specifically commits to the following:

- Supporting individual states in preparing state level sanitation strategies
- Supporting cities in preparing model city sanitation plans
- Promoting public–private partnerships in respect to key projects/activities identified in city sanitation plan
- Providing technical assistance and support for awareness generation and capacity building
- Providing incentives for launch of periodic rating of cities in respect of sanitation and recognising best performers by instituting a national award

[10]It must be recognised that when reward schemes operate outside the normal budget process their usefulness in creating a hard budget constraint may be weakened. However, they may play a powerful role in generating awareness of the links between sanitation/hygiene practices and public health.

6.4 Reform Pathways: Consolidating Sources of Finance and Knowledge

6.4.1 Mixing and Matching Resources from Public and Private Sectors

To retain a chance of achieving the MDGs in water and sanitation, international development cooperation must proactively choose to play a role of facilitator: leveraging resources from traditional grant sources and combining them with resources from the international private sector. In this process, it must recognise that different contributors to the resource pool have different interests: grant sources rely on taxes and are accountable to parliament. On the other hand, private sector financing is ultimately driven by commercial or philanthropic motives and accountable to corporate shareholders. Nevertheless, both sources of financing are well placed to contribute to specific demands placed on international development cooperation. For example, direct grants and loans can play an effective role in financing implementation activities, for example, improved O&M through twinning of municipalities in industrialised countries with their counterparts in developing countries. Another example could include support for design of legal or regulatory reform instruments like improved building codes, inter-governmental financing norms, etc. Knowledge institutes in the global north can also play a role in design and implementation of an effective programme for monitoring progress of select municipalities through identification of MDG performance benchmarks. This initiative could be modelled along lines of the City Indicators Programme (*The Drama of the Commons*), but based on real-time information collection, sharing, analysis, decision-making and coordinated action.

6.4.2 Leveraging Local Finances to Facilitate Improved Access to Sanitation Services

Earlier on in this chapter, we noted that while political decentralisation has occurred in many countries, sub-sovereign entities like municipalities do not have the power to raise revenues through taxes or set tariffs for services. Yet, issues such as tariff levels and quantum of 'equalising' transfers required from higher tiers of government and subsidy structures that target service delivery at the poor are best decided based on inputs from municipalities[11] who are ultimately responsible to consumers. In this regard, a strategic opportunity exists for international development cooperation to facilitate establishment of a Results Based Financing (RBF) facility, the

[11]IWA's 2008 paper titled *Sanitation Challenges and Solutions* makes a strong case for addressing sanitation challenges by targeting the city as a unit of planning.

basic aim of which should be to leverage more repayable funding from a given stream of local revenues (*transfers*, *taxes* or *tariffs*) and to increase the total volume of financing available from the domestic private sector to expand access to urban sanitation services. At the moment, there is a serious knowledge gap with regard to an understanding of the role of financing instruments that effectively lower transaction costs, cover particular forms of risk and improve the terms on which private financing can be made available to meet shortfalls in public financing. The RBF facility should aim to fill this knowledge gap and be administered by an agency with credibility and global reach. Key outputs of the proposed facility could include the following.

Design of financing instruments that lower transaction costs

- Appreciation of comparative advantages of results-based financing approaches in relation to specific sanitation services along the entire value chain from source to reuse and disposal (*budget support, sector wide approaches, performance based inter-governmental transfers, conditional cash transfers, OBA*)
- Local planning capacity for design, implementation and monitoring of service delivery (*tax/tariff systems*)

Design of risk mitigation strategies

- A typology of risks for different sanitation services (*along value chain from toilet construction to waste disposal*)
- Bilateral/multilateral private sector guarantees to support particular contract forms (*Build Own Operate* (*BOO*), *Build Own Transfer* (*BOT*)) for infrastructure creation

Enabling policy framework

- Budgeting norms that enhance accountability of revenue and expenditure
- Inter-governmental financing norms that enhance transparency of decision-making processes and autonomy of local authorities
- Real-time information mechanisms for monitoring and acting upon service delivery targets at multiple governance levels (*donors, national and local authorities*)

6.5 Conclusions

This chapter began by posing the question: *What constitutes an improvement?* Infrastructure coverage matched by an improvement in relative access of the poor to services like improved latrines for shared use, connection to a sewer network or access to technologies that separate solid waste and domestic wastewater at the source. Does improvement in relative access also ensure *adequate* access to services, for example, 24 h of water supply instead of only 6 h of supply a day? Finally, does the MDG definition of improved access adequately reflect how issues like service standards, service quality and affordability apply to shared facilities like communal toilets? One of the most significant lessons that can be drawn from OBA approaches to financing investments in the water sector is importance of legal and policy frameworks and autonomy and accountability of local authorities. Interestingly, we find that when accountability of legal and policy frameworks is enhanced, the likelihood of financing by the private sector improves. An important conclusion of this chapter is that international development cooperation can facilitate leveraging of local sources of financing through strategic lending that supports improved knowledge of investment risks, financing instruments and inter-governmental financing norms. The experience of budget support interventions are important in this regard; an issue that is examined in greater detail in the next chapter.

References

Bartlett, S. (2003). Water, sanitation and urban children: The need to go beyond “improved” provision. *Environment and Urbanization, 15*, 57.

Bhagwati, J. (2010). Banned aid: Why international assistance does not alleviate poverty. *Foreign Affairs, 89*(1), 120–125.

Camdessus, M., & J. Winpenny (2003). Financing Water for All: Report of the World Panel for Financing Water Infrastructure, Paris.

OECD. (2009). *Strategic planning in the Water Sector*. Paris: Environment Department.

Rajaraman, I., & Sinha, D. (2007). Financial devolution to rural local bodies in four states. *Economic and Political Weekly, June 16*, 2275–2283.

Saith, A. (2006). From universal values to millennium development goals: Lost in translation. *Development and Change, 37*, 6.

World Bank. (2006a). Urban infrastructure finance from private operators: What lessons have we learned from recent experience? *World Bank Policy Research Working Paper No. 4045*, Washington, DC.

World Bank. (2006b). *Fiscal decentralization to local governments in India*. New Delhi: Oxford University Press.

World Bank. (2009). *Output based aid: A compilation of lessons learned and best practice guidance*. Washington, DC: GPOBA and IDA-IFC Secretariat.

WSP. (2009). Urban Sanitation in Indonesia: Planning for Progress, *Field Note,* April, 2009, Washington DC: Water and Sanitation Program, The World Bank.

Chapter 7
Budget Support for Local Government: Theory and Practice

James Warner Björkman

Abstract This chapter delineates policy issues underlying government budgets as well as approaches to supporting public finances, particularly through inter-governmental transfers. It reflects on debates about the policy process during the past half-century of government-led development policies, whether in urban sanitation, water management, health services, education or similar areas.

7.1 Introduction

The chapter explores processes of government budgets, public finance and budget support through inter-governmental transfers. Transfers entail interactions among multiple layers of government – local, regional, national and/or international – and their jurisdictions. Recently, through agreements among and between multiple donors and local government, sector-wide approaches to budgeting have been used to harmonise separate projects and programmes into a single coherent whole (Iyer et al. 2005: 12). It specifically examines core elements of budgets within the parameters of revenue and expenditure, changes over time in approaches to government budgeting and categories of actors who are critical to creating budgets as well as their respective strategies.

Topics addressed are: (1) context, definitions and functions of budgets; (2) basic terms and macro-variables of budgets; (3) major categories of actors and their norms of behaviour; (4) cyclical timetables within which budgets occur and strategies to shape them; (5) so-called uncontrollable line-items in budgets; (6) inter-governmental transfers to provide revenues; and (7) trends in approaches over time to budgeting.

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7.2 Context, Definitions and Functions

At the heart of the policy implementation process lies the budget because, without money, there's little that can be done except, perhaps, prophylactic planning.

As you will see, budgeting is an attractive focus of study for several reasons:

- A budget provides a good index of allocative decisions about 'who gets what' by displaying scorecards in a relatively public and accessible manner.
- A budget can show significant constraints on agency behaviour, whether it's assigned tasks and commitments are possible, improbable, likely or unfeasible.
- A budget is measurable and hence readily lends itself to analysis.

Wildavsky (1975: 5) observes that 'budgets are attempts to allocate financial resources through political processes to serve differing human purposes'. Budgets are political documents that ration resources among the agencies and programmes that seek support. Rather than dispassionately neutral technical exercises by experts, budgets entail conflict and compromise in order to reach resolution. Hence, a budget is a provisional contract or compact among players that changes (slowly) over time.

In the perspective of planning, a budget is a specialised plan. It is a forecast by government of its revenues and expenditures for a specific period, usually on an annual basis but sometimes in a longer-term context (for example, 5-year plans or rolling plans). Unlike budgets per se, typically one calculates budget support over a medium-term period between three and 5 years, now commonly called the Medium Term Expenditure Framework (MTEF).

7.2.1 Basic Terms and Macro-variables

Wildavsky (1975) defines budgeting as an expenditure process, as a mechanism to allocate resources (whether at macro or micro level). Three basic terms describe this process – base, fair share and increment or decrement. Each term is quite simple but also profound for its impact on behaviour.

The *base* of a budget is the going-level of expenditures that people expect will continue. In a sense, the base is what people take for granted without undue questioning. The base of a budget is, as it were, the foundation for stability and predictability.

A fair share is an informal sense of equity, of expecting decisions about budgets that do not deviate too much from the past. Fair shares are usually taken for granted.

An increment or a decrement marks a marginal change in whatever level of expenditure has gone before. Periodically or 'punctuated time' in evolutionary terms, there may be radical or revolutionary changes in the distribution or apportionment of the base. However, inevitably, and within a short period, the annual changes in this once-radical base will become marginal rather than massive.

Given the complexity of reality, prudent analysis of a budget requires actors to calculate their respective advantages and liabilities. They do so by simplifying reality through general calculations – whether based on decision-models of a rational actor, of political bargaining or of organisational process.

Every budget can be contextualised through five major elements or macro-variables (whether the level of analysis is countrywide, local or even individual). These are:

1. Budget Authority: Authorisations based on law and legislation deemed 'legitimate' and 'legitimated'; therefore, there is considerable emphasis on adoption and approval.
2. Appropriations/Outlays: Amounts of money allocated annually to finance budget authorisations (commitments, in accrual accounting = obligations).
3. Revenues: Often presupposed but vital (domestic savings, taxes, windfalls, donors).
4. Surplus/Deficit: Caused by subtracting outlays from revenues.
5. National Debt: A 'privileged' item in budgets because interest on it must be paid before other expenditures; over time, it can become an 'uncontrollable' (see Section 7.2.4 below).

Our third topic spans major categories of actors in making budgets and, how they relate to one another. As a prefatory note, three constants characterise budget-making – time, scarcity and complexity. Time is relentless so needs little introduction, but perhaps it would be helpful to elaborate on the consequences of the other two constants.

7.2.2 *Actors and Classic Norms of Behaviour*

In addition to the relentless march of time, every society, every country, is characterised by scarcity and by complexity. Scarcity simply means limited resources versus limitless demands; therefore, actors in budget processes can be divided among key roles within which are social-psychological personality variables, such as active, passive, aggressive and civil.
Spending Advocates: Spenders

- Spenders include agencies and their clients: Note the relative prestige/standing among agencies
- 'Liberal' and 'socialist' politicians (proactive rather than reactive)

Treasury Guardians: Savers

- Savers include central control organs: Finance Ministries/Management & Budget Offices
- 'Conservative' politicians: whether partisan, elected or appointed

Interestingly, one might think that citizens as consumers of public services would advocate more spending by government in order to improve access to better services. However, evidence reveals that citizen-consumers balk at or object to any mention of extra taxes or user-charges to pay for such additional services. Whether water, education or health, citizen-consumers are ready to receive public services but not to pay for them directly.

Consequently, politicians who rely on citizens to vote them into office (or keep them in office) are loath to raise extra revenues through taxes. Indeed, politicians often inveigh or argue against extra levies … unless, of course, the revenues are allegedly ‘free’ when given by donors of any type (bilateral, multilateral, philanthropic and similar).

Complexity in society is self-evident because knowledge is never adequate. In order to cope with this problem, actors in the budget process engage in short cuts or ‘aids’ to calculate and estimate the likely parameters of what is true.

1. Simplification (part, not the whole)
2. Projections/extrapolations (the flaws of forecasting)
3. Increments/decrements (marginal changes in the base)
4. Base (precedent of past allocation)
5. Fair-share (sense of ‘equity’ or just apportionment, but NOT equality per se)

In order to make interactions among key roles possible, actors in the budget process share norms.

Elite norms that make play/interaction among key roles possible include:

- Trust versus deception
- Proportionality (fair share/equity)
- Arbitration/Compromise (face-to-face bargaining versus courtroom-legalism)

The constant of time reappears when budgeting occurs, which is often on a cyclical basis, and which involves strategies of action.

7.2.3 Cyclical Timetables and Strategies

As Iyer et al. (2005: 7) observe, ‘all budget support is tied to the recipient government budget cycle’ and this annual agenda includes:

- Initiation of requests by agencies, often more than a year in advance of an actual budget being adopted
- Preparation of consolidated budget proposals, by the central executive
- Approval or legitimating of formal budget, by those with the money (if internal, legislatures or assemblies; if external, then donors)
- Budget execution (by agencies and the executive)
- Audits (ex-post accountability)

Actors have strategies to maximise their interests in the budget cycle. At minimum, they seek to defend programmes (that is, to maintain their base). Then they may seek to increase or augment the base with more resources to perform their normal functions. Finally, they may seek to expand the scope of their base by building clientele or support as well as expanding their programmes.

7.2.4 Uncontrollable Budget Items

Many countries (and sub-units) are almost totally ‘blocked in’ by prior agreements that must be financed. For example:

- Fixed costs (prior legal commitments) – for example, interest on the national debt
- Multi-year contracts and obligations – for example, large-scale government projects (dams, power plants etc.)
- Entitlements – for example, individual benefits in food-subsidies, social pensions and public assistance

Uncontrollable does not mean out-of-control but rather no longer subject to effective appropriations control in any 1 fiscal year in the absence of any change in the substantive law. All of these categories of uncontrollable can change, but only by changing the law (the authorisation to spend). One can, for example, reschedule the debt, revise the contracts, restrict eligibility or change benefit levels.

However, the so-called controllable line items are a type of commitment, even if not so heavily embedded in law. This category includes, for example:

- Salaries and benefits – payroll (often two-thirds or more of this category)
- General operating expenses – energy costs, maintenance (often cut, so deferred consequences such as rail-tracks decaying and inevitably causing an accident)
- Research grants, new programmes, R&D – usually the first to go

In a sense, 90–95% of an annual budget is uncontrollable. Conversely, only about 5% discretion exists in any annual budget. For some, this observation is depressing; for others it is reassuring. Of course, one can use under-spending to reduce the uncontrollable, too, but there is little precision in prediction, not to mention political problems.

Then there is backdoor-spending, when authority to borrow is shed from the government itself, and delegated to agencies that are off-budget (housing corporations, for example).

The purpose of uncontrollables is to insulate and protect one’s favoured or preferred programmes/goals/objectives from being changed by successors or subsequent regimes. Having achieved truth, politicians (whether elected or appointed, partisan or administrative) seek to embed it into a formula that cannot be touched politically.

7.3 Inter-governmental Transfers and Budget Support

Chronic shortfalls in revenue bring us to the *deus ex machina* of budgeting: transfers. During the past half-century, decentralisation to sub-national levels of government has been a major theme in developed, developing and transitional countries. A critical issue is financing of sub-national levels of government, whether by raising their own money or receiving funds through inter-governmental financial relations, including international donors. An equally critical issue is how various levels of government – national, regional, provincial, municipal or local – spend their money and manage their expenditures.

Inter-governmental transfers are determined by their institutional setting. In particular, by (1) legal assignment of authority to tax, (2) a country's degree of centralisation and its trends towards decentralisation, (3) constitutional rules, and (4) political decisions. The usual form of inter-governmental transfers is through grants (general or specific formulas) between levels of government. Because relative wealth often varies greatly in different regions of a country, equalisation is another justification for inter-governmental transfers.

The constitution of India, for example, requires that an episodic Finance Commission convene every 5 years to reallocate federal revenues among the states and territories of the Indian Union. As a percentage of total local revenue, the degree of inter-governmental transfers ranges widely in different countries. Current examples include South Africa (10–20%), India (30–40%), Argentina (40–50%), Indonesia and Brazil (60–70%) and Poland and Uganda (70–80%) (Boadway and Shah 2007).

Classic revenue sharing takes the form of unencumbered general grants while formula grants use objective, quantitative criteria to allocate revenues among the eligible local government units. Commonly used indicators include population, physical factors (such as land area, population density and urbanisation) and measures that reflect the concentration of high-cost populations (percentage of families living below the poverty line, percentage of school-age children, etc). An old adage notes that 'he who writes the minutes of a meeting controls its contents.' Likewise, he who writes the formulas used to distribute revenue controls the outputs, if not the outcomes.

It is a nearly universal fact that local governments in developing countries have limited authority to raise revenue through taxes. Usually the central government has the power to generate revenues and then to provide subsidies to lower levels of government in order to accommodate the mismatch. Consequently, inter-governmental transfers comprise the major component of sub-national government revenues. Nonetheless, such centralised collection and then disbursement also generate transaction costs and some argue that, if local governments could raise their own revenue rather than be dependent on central governments, they could avoid these transaction costs.

Given this lack of local authority to raise revenue through taxes, there is a classic imbalance between the expenditure responsibilities of sub-national governments and their capacity to implement their responsibilities. At early stages of development, the priority of public sector responsibilities is on building infrastructure, such as roads, railroads, canals, water pipes and sewage systems. Later public expenditures shift towards social services, education, health care and environmental concerns.

For whatever sector of government policy is being promoted (health, education, welfare, water, housing, etc.), budget support presumes a continued flow of foreign resources from donors through grants and loans to national and local governments. According to Iyer et al. (2005: 63), no one speaks about raising local revenue through taxes of any kind.

Inter-governmental transfers are nonetheless justified by concerns for (1) fiscal equity, (2) national standards and, (3) fiscal efficiency. They seek to correct vertical imbalances between the responsibilities of sub-national levels of government for expenditures and their capacity to raise revenue. According to Robin Boadway (in Ahmad and Brosio 2006: 376), 'Equalization transfers are the life-blood of federations. They facilitate decentralization of fiscal responsibilities by addressing the inequities and inefficiencies that would result from decentralization of spending and revenue-raising responsibilities'.

Nonetheless, there is always endemic tension between equalisation grants and equity considerations in inter-governmental financing. Currently inter-governmental financing is focused on the creation of infrastructure alone with a few attempts to link annual budget disbursements to achieve policy goals, whether connections to piped water or a sewer network. One way to change behaviour is to introduce an element of competition among local governments for funds disbursed by central authorities. Competition can take two forms: geographical competition among local authorities for a share of central transfers; and competition between different tiers of local government for a share of local tax revenues in the same geographical area.

To understand this point, it is important to examine issues of structure and autonomy. Structurally arrangements range from consolidated local governments where a single unit spanning a wide geographic area provides all services to fragmented local governments, divided into a number of tiers with many units in a tier. Autonomy, in turn, concerns the ability of local authorities to raise local revenue, to experiment and to innovate in management and programme implementation. As previously noted, however, local units of government rarely levy taxes on local people so revenue usually remains an issue for central governments.

7.4 Approaches and Trends in Budgeting

Approaches and trends in budgeting describe mental perspectives on the subject with diverse units of analysis. Among a trio of options are approaches of process, of function and of tools.

- A *process approach* identifies the actors who under conditions of uncertainty rather than of full control make estimates, forecasts and plans.
- A *functional approach* stresses instruments of control over budgets such as planning and systematic analysis.
- A *tool approach* emphasises methods such as Planning-Programming-Budgeting-Systems (PPBS), Management by Objectives (MBO) and Zero-Based Budgeting (ZBB).

Trends over time range from classical-analytic with presumptions about ideal conditions to actor-oriented behaviour that is intentional and creative rather than passive. The latter requires dialog and adaptation. Usually the USA is the originator of a trend that then becomes global through international agencies.

During the past century, four forms of orientation to budgeting have been evident:

1. Control orientation based on line-item budgeting
2. Management orientation based on performance budgeting
3. Planning orientation that has had several variations:
   (a) PPBS: Planning, Programming, Budgeting System (practiced first by the Ford Motor Company, then by the Pentagon and the World Bank)
   (b) MBO: Management by Objectives with an emphasis on practices from private business that then became New Public Management (NPM)
   (c) ZBB: Zero-Based Budgeting based on 'sunset legislation'; that is, laws with a specific end-date, not continuing in perpetuity
4. Budgeting as Political Management

Human desires are unlimited, yet resources for fulfilling these desires are limited, sometimes to the point of non-existence. Therefore, it is necessary to find a way of rationing available resources among competing people and purposes. Budgeting derives from this premise. It is an attempt to resolve the dilemmas and complexities that are inevitable when trying to apportion scarce resources. Wildavsky's definition of budgets as a 'series of goals with price tags attached' is clear, concise and accurate. He regards budgets as 'attempts to allocate financial resources through political processes to serve differing human purposes' (1975: 5). Budgets are statements about the future, which attempt to link proposed expenditures with desirable future events.

Budgets are mechanisms for allocating resources. They are instruments for pursuing efficiency, if they stress receiving the largest possible returns for a given sum of money. Budgets are tools for effecting income distribution that taxes some people while subsidising others. When investments are made through budget proposals, then budgets become means for securing economic growth. Budgets reflect organisational aspirations and budget proposals often represent the strategies of an organisation. The purpose of budgets is to introduce frugality and inculcate financial prudence; they are therefore devices through which some actors try to control the behaviour of others. In this way, they are forms of power. Budgeting is a political process since allocation is competitive among various forces. Such budgeting, while often discussed largely at the national level can apply at individual, unit, organisational and regional levels.

Budgeting is an attractive focus of study because budgets are good indices of allocative decisions, they show significant constraints on agency behaviour and they readily lend themselves to analysis because they are measurable. At its core, a budget is a political document where demands put pressure on resources, and where rationing is attained through conflict, compromise and resolution. In a sense, budgeting is rationing and a budget is a compact that rations available resources. In this regard, budgets are annual plans, with important constituents of planning for development.

The financial year of the central government (and other governments) usually begins on the first day of July or the first day of a calendar quarter (1 January, 1 April, 1 October). While possible, the fiscal year rarely coincides with the calendar year. Budgets usually come out a week or two before the fiscal year starts. This budget is the consolidated proposal of the executive to the legislative branch. The proposed budget is then analysed, dissected, discussed and debated in public. In some countries, when there is an expectation that prices will rise, speculation may occur when, for example, merchants hoard goods in anticipation of higher prices. In such situations, the budget becomes the government's 'scorecard'.

During the twentieth century, budgeting evolved, sharpened and modified its concepts. Yet the essential meaning of a budget remained unchanged. Unlike many other concepts, there are no major disagreements on the meaning of the term, but there are different types of budgeting. Here are some of the major phases that have historically overlapped each other; indeed today, they often exist side by side.

7.4.1 Line-Item Budgeting

Traditional budget where each line on a sheet of paper has an item on the left followed by a cost on the right. Governments need this type of budgeting to keep a record of expenses. The Line-Item Budget was refined because of national political and reformist pressures during the so-called Progressive Era in the United States. There was a perceived, and well articulated, need to eliminate financial corruption in government, to assure efficiency and coordination, and to build administrative honesty through the discretionary powers of public administrators. The Line-Item Budget was thus associated with governmental honesty, probity and efficiency largely because it was easily audited. This type of budget covered only inputs and remains the classic bedrock of the budgetary process. A Line-Item Budget represents a way of thinking about, measuring and evaluating public policy.

7.4.2 Performance Budgeting

Advocating a budget attuned to government performance and the objects of expenditure, performance budgeting became popular in the 1930s during the Great Depression and the New Deal Administration of President Franklin Delano Roosevelt. At the time, proponents of Line-Item Budgets established firm control techniques and liberated the concept from many of its traditional watchdogs. Because government was expanding enormously, it needed to centralise and to coordinate managerial activities more effectively. This could come by using the budget to coordinate government management.

Because of the perception of the government as an institution for delivering benefits, the budget was seen as a means by which the appropriate managerial delivery systems could be measured. All these considerations influenced the new thinking of pegging or linking financial allocations to agencies on their performance. As Nicholas Henry (2009: 205) summarised,

> In sum, Performance Budgeting covered more administrative activities than had the traditional Line-Budget. Now *outputs* as well as *inputs* were considered [italics added for emphasis]. Budget officers saw their mission not only as one of precise and controlled accounting, but also as the development of activity classifications, the description of an agency's program and its performance, and the exploration of various kinds of work/cost measurement.

In this way, the responsibilities of management were centralised. Planning remained dispersed and policymaking was incremental. The role of the budget agency evolved from a fiduciary function to an efficiency function. Unfortunately, Performance Budgeting did not delve into the deeper levels of government. It increasingly became subjective because the description of programmes that accompanied the agency's budget to the legislature was beginning to serve a justificatory function for the agency. Worse many regarded performance budgeting as an impediment to effective planning because there tended to be an incremental increase in the annual cost of an agency's programmes. These concerns led to the displacement of Performance Budgeting concepts in governments by Planning-Programming-Budgeting (PPB). These weaknesses notwithstanding, Performance Budgeting significantly contributed to budgetary theory by attempting to measure an organisation's effectiveness.

7.4.3 Planning–Programming–Budgeting

With its component parts, Planning–Programming–Budgeting is an attempt to integrate budgetary formulations with how they affect government spending in the national economy. It recommends the development and use of new information sources and technologies in order to bring more objective and quantitative analysis into public policymaking. It seeks to integrate system-wide planning with budgeting. As Henry observes:

> PPB is also associated with budget officers who have skills in economic analysis as well as in accountancy and administration. The purposes of various programs become the chief concern, as opposed to the objects of expenditure or the activities of the programs. PPB is not only concerned with inputs and outputs, but also with *effects* and *alternatives.* (Henry 2009: 206–207) (italics added for emphasis)

PPB's main virtue is that it sharpens and clarifies the policy options available to administrative decision-makers. When introduced, many agencies reconsidered their missions and found, perhaps not surprisingly, a broader range of policies. PPB's problems emanate from its misuse and misinterpretation because it cannot make value judgments. Its use of quantification sometimes clouds value issues. It thus operates effectively in agencies that possess 'hard' technology such as ministries of defence or space agencies but less helpful in 'softer' human services like health and education. Another problem of PPB is its centralising bias, which gives the legislature monopoly control over policymaking. Its stress on planning, goal clarification and systematic decision-making culminates in decisions forced on higher levels of the hierarchy. Its failure brought its demise in many establishments.

The budget officials turned to a new concept called Management by Objectives (MBO), which originated in the private sector.

7.4.4 Management by Objectives (MBO)

MBO is a process whereby the organisational members participate in setting organisational goals and objectives in light of expected results. It encourages self-management and decentralisation, and it advocates an integrated approach to total management. MBO stresses communication and feedback, encourages organisational development and change. Its advantage is that it gives people closest to the problem a chance to deal with that problem, and simultaneously measures their performance according to criteria developed by policymakers at the highest level. It permits individual initiative and innovation. It can obscure as well as promote efficient and effective management. It is flexible and helps to alleviate corruption.

7.4.5 Zero-Based Budgeting

Closely associated with sunset legislation, a ‘sunset law’ provides that, unless the legislature specifically acts otherwise, public programmes or agencies dissolve after a set period. Programmes and agencies undergo periodic review by the legislature with the idea of eliminating overlapping jurisdictions and inefficient programmes. ZBB employs two steps:

- Development of decision packages for each agency, with each package containing a summary analysis of each programme within the agency.
- Evaluation of each decision package by top management to determine whether it is justified for further funding. Ineffective programmes are discarded, modified or combined with programmes in other agencies.

In sum, ZBB gets its name from the fact that each year’s budget is computed from a hypothetical ‘zero base’. Speaking practically, programmes are never cut to zero. ZBB is useful for comparing programmes and assisting decision-makers on prioritising and subsequent funding of agencies. It can co-exist with other budgetary concepts and processes. It adapts easily for it is a marginal and incremental budgetary tool. Programme managers feel they are involved in the budgetary process, and communications are enhanced with ZBB. However, this programme does not necessarily reduce government spending as had once been thought. If not introduced carefully, programme managers can become parochial in their application of it. Yet more problematic is that ZBB increases paperwork and its expansion appears uncontrollable.

Budgeting as Political Management contends that a large proportion of the budget derives from the operation of legislative formulas, which automatically determine their amount. Budgeting as political management comprises two components: the move towards top-down budgeting and an orientation towards budgeting for legislative advantage. These are to reduce government expenditure arising out of growing entitlements and uncontrollables.

Remember, uncontrollable items in a budget are 'outlays that cannot be changed without change in substantive law'. Many countries are almost entirely 'blocked in' by prior agreements that must be financed. Among members of the Organization for Economic Cooperation and Development, these prior agreements comprise 90–95% of an annual budget. Controllable items, on the other hand, are also a type of commitment, albeit not so heavily embedded in the law.

Under-spending is one way to reduce uncontrollables, although there is concern that so-called 'trimming the fat' in government programmes ends up being 'cutting out muscle and bone'. Backdoor-spending is yet another mechanism used to reduce budgetary pressure and is a situation when authority to borrow money is delegated by government itself. Government off-loads authority to other agencies outside the budget. Of course, while the picture may look good (even convincing) on paper, the reality remains something else.

Altogether, when we analyse the evolution of budgeting, there has been a movement from classical-analytical conditions to actor-oriented actions (rather than behaviour per se). The budget has shifted over time from a control orientation to a management orientation to a planning orientation. Of course, these orientations overlap and/or exist in the same country at the same time in different (and sometimes at the same) levels of government. Each approach has strengths and weaknesses. Therefore, a flexible combination is often good policy.

7.5 The Budgetary Process

The methods by which agencies secure money are essentially the same regardless of what form of budgeting is used. Secrecy, lack of a comprehensive review procedure and inadequate decision criteria generally characterise these methods. While it is important to understand the process in its formal sense, it is imperative to note that the budgetary process is political. Strategies in this process are used in the same way as in politics. A good budgetary politician requires the use of ubiquitous and contingent strategies.

Ubiquitous strategies are pervasive and applied continuously by an agency. They are designed to build outside confidence in the agency and to add to its clientele. The idea is first to find, then to serve, and thereby to cultivate a clientele for the services you perform. Given this perspective, an agency when threatened with any challenge mobilises its clientele. The purpose is to establish confidence in the mind of the reviewer (usually a higher-level executive but also the legislative source of funding). The claim is that an agency can carry out the complicated programmes under its jurisdiction efficiently and effectively.

Contingent strategies, on the other hand, postulate that an agency should guard against cuts in its current base. For example, an agency may dramatically cut or prune its most popular programme on the logic that a wave of citizen complaints will emerge to restore the funding cuts. Another contingent strategy is to attempt to inch ahead with old programmes but also to add new ones, especially those with inspiring titles like a ‘war on poverty’ or even ‘Vision 2020’.

It is important to acknowledge that the budget is an administrative technique with its own combination of means and ends, methods and values. Likewise, the ways in which administrators inter-relate these variables are in essence political, and they affect programmes and people in the directly political consequence of attempting to change behaviour of others, or perhaps to inhibit such behaviour. While budgeting bears the trappings (and sometimes the reality) of technology, professionalism and expertise, it is also a system of values and politics.

Wildavsky (1975) distinguishes between Savers and Spenders in the budgeting process. He calls these key roles by the labels ‘Guardians’ and ‘Advocates’. Agencies try to protect their spending levels and to increase them on a yearly basis in order to make organisational life easier. In turn, finance ministries try to keep spending totals within acceptable levels. Policies are thus negotiable. Wildavsky notes:

> Guardians and advocates play a mixed motive game. Though they conflict, they must also cooperate. Both require trust. Each role implies its opposite; guardianship expects advocacy to provide a choice among items to cut, and advocacy needs guardianship to supply at least tacit limits within which to manoeuvre. Resources, after all, cannot be allocated without either proposals for spending or boundaries within which to fit them (1975: 8).

Wildavsky further argues that, because of the overwhelming complexity of budgeting, decision-makers adopt aids for calculation in order to simplify the task of decision-making. The standard (almost inevitable) practice is to proceed from a historical base, to accept the recent past as a given in order to concentrate on proposed new increments. Because of this complexity, the actors use mechanisms or devices such as padding, across-the-board cuts, accelerated spending at the end of the fiscal year, and often refusals to release a proportion of budgeted funds during the year until the last possible moment, if then.

The budgetary process can be related to the three basic models of policy analysis: Rational Actor, Political Bargaining and Organisational Process. In each case, the perception of the budgetary process depends on the way policy is thought to be made. The popular phrase is, ‘where you stand depends on where you sit’, and it applies to these three perspectives when explaining the budgetary process with its sequence of phases:

- Initiation of requests by agencies
- Preparation of consolidated budgets by the executive
- Approval of formal budgets by the funders
- Budget execution by agencies and the executive
- Audits (both pre-audits and ex-post accountability)

Despite the core elements and the semi-sequential phases of the budgetary process, the environmental context shapes the process itself, in particular by the relative degrees of wealth and of predictability. Consequently, the budgetary process differs between rich and poor nations, and between those characterised by stable versus unstable flows of information. Quite obviously, poverty means the inability to mobilise sufficient resources versus likely demands for spending, or the inability to control expenditures, or both. Budgetary uncertainty means the inability to calculate the flow of revenues as well as of expenditures, both in the immediate present and in projections into the near future. States characterised by relative wealth and certainty of information can, and do, engage in relatively accurate calculations of revenue and expenditure.

These two contextual variables: relative wealth and relative predictability generate patterns of budgetary behaviour. In simple terms, the budgetary processes associated with pairs of variables are as follows:

- Rich and certain conditions are characterised by incremental budgeting.
- Poor and certain conditions are characterised by revenue budgeting.
- Rich and uncertain conditions are characterised by supplemental budgeting.
- Poor and uncertain conditions are characterised by repetitive or formalistic budgeting.

All four patterns of budgeting represent attempts to shape or guide behaviour, to forecast revenues and expenditures during a future period, to 'allocate financial resources through political processes to serve differing human purposes'. The utility of such a framework is not to pigeonhole a particular country or budgetary system, but to observe trends over time among such patterns and to understand their overlaps as well as occasional simultaneity within the same system.

Naomi Caiden's classic publications (1980 with Wildavsky, 1991) provide practical observations about budgeting in developing countries, which are usually characterised by conditions of scarcity and uncertainty. She points out the mistakes made by many analysts in their descriptions and their prescriptions for budgeting in Less Developed Countries – especially when recommendations copy whatever occurs in the developed world. She stresses the point that successful budgeting depends on both the internal operations of the system and the environment within which it works. Caiden criticises the tendency of classifying all poor countries under one category. Classification should not be determined a priori but through empirical examination of budgetary practices in order to discover meaningful criteria for differentiation and thus to arrive at realistic prescriptions for improving or developing the budget process.

After acknowledging that generalised advice from afar is not helpful, Caiden devises realistic suggestions. Because local conditions vary too much to allow uniform prescriptions under a 'one size fits all' formula, she advises the establishment of a comparative typology of national systems. Modes of budgeting are not simple carbon copies of those used in developed systems but are based on criteria of budget performance with the discussion organised around major common problems rather than abstract comprehensive categories.

One common problem, for example, is the pervasive tendency towards fragmented budgeting because of the creation of autonomous funds. When these special funds are put 'off budget' or, outside of the annual cycle of budgeting, the purpose is often laudable, such as protecting some activity from political manipulation.

However, a plethora of such autonomous funds or special agencies means that the budget itself loses control of annual revenue and expenditure, and so the budget can no longer guide the behaviour of government.

Another common problem is the tendency of finance ministries in developing countries to release funds late rather than in timely instalments. While arguably justified because of scarce and uncertain resources, the delayed financing generates further problems or compounds them.

A third problem frequently encountered concerns the relationship between capital budgets and recurrent budgets. Both are needed, but there is an intimate relationship between these categories. Expenditures under capital budgets set the scene for future expenditures under recurrent budgets. Construction of a school, which requires subsequent expenditures not only on maintenance/upkeep but also on salaries for teachers, is a good example. In fact, present capital investments increase requirements for future recurrent expenditures, and thus reduce the amounts available for future investments. This explains why Finance Ministers are sometimes reluctant to authorise expenditure of available funds for investment.

Fragmented budgeting, the tardy release of funds and the implications of capital expenditures on future recurrent expenditures are all issues of significance in public finance. Without reform of the budgetary process, these issues will continue to be major obstacles to development.

7.6 Concluding Thoughts

Within the process of policy implementation, budgets and inter-governmental transfers play crucial roles. Students now know what budgets are and what they are not. They know how budgets evolved over time, how they serve different functions and how they go through a series of stages that involve five basic elements. The environment within which they occur, affects the process of budgeting and of intergovernmental transfers. Certainly, budgets and transfers provide important tools in planning for and then implementing development. As Allen Schick is fond of saying, 'the art of budgeting is letting someone else pay for your benefits'.

References

Ahmad, E., & Brosio, G. (Eds.). (2006). *Handbook of fiscal federalism*. Cheltenham: Edward Elgar.

Boadway, R., & Shah, A. (Eds.). (2007). *Intergovernmental fiscal transfers: principles and practices*. Washington, DC: The World Bank.

Caiden, N., & Wildavsky, A. (1980). *Planning and budgeting in poor countries*. Piscataway, NJ: Transaction Publishers.

Caiden, N. (1991). Unanswered questions: planning and budgeting in poor countries revisited. In A. Farazmand (Ed.), *Handbook of comparative and development public administration*. New York: Marcel Dekker.

Henry, N. (2009). The budget: concepts and process. In N. Henry (Ed.), *Public administration and public affairs* (11th ed.). Englewood Cliffs, NJ: Prentice Hall.
Iyer, P., Evans, B., Cardosi, J., & Hicks, N. (2005). *Rural water supply, sanitation and budget support: guidelines for task teams*. Washington, DC: The World Bank.
Wildavsky, A. (1975). *Budgeting: a comparative theory of budgetary processes*. Boston: Little, Brown.

Recommended Print and Electronic Resources

Bird, R., & Vaillancourt, F. (Eds.). (1998). *Fiscal decentralization in developing countries*. Cambridge: Cambridge University Press.
Blore, I., Devas, N., & Slater, R. (2004). *Municipalities and finance: a sourcebook for capacity building*. London: Earthscan.
Boyne, G. (1996). Competition and local government: a public choice perspective. *Urban Studies, 33*, 703–721.
Devas, N., Alam, M., Delay, S., & Venkatachalam, P. (2008). *Financing local government*. London: Commonwealth Secretariat.
Martinez-Vazquez, J., & Alm, J. (Eds.). (2003). *Public finance in developing and transitional countries*. Cheltenham: Edward Elgar.
Ostrom, E., & Ostrom, V. (1965). A behavioral approach to the study of intergovernmental relations. *Annals of the American Academy of Political and Social Science, 359*, 137–146.
Intergovernmental Transfers/Grants Design. *The Online Sourcebook on Decentralization and Local Development*. Available online at www.ciesin.columbia.edu/decentralization/English/Issues/Transfer.html
Intergovernmental Transfer in Transition and Lessons from Other Countries. Direk Patmasiriwat, Thammasat University. The Conference Jointly Organized by King Prachatipok and the World Bank, Pattaya, Thailand 1 April 2009. Available online at www.kpi2.org/kpith/downloads/05.Intergovernmental%20transfer_Direk_230409.pdf
Secretariat of the Federal Revenue of Brazil. *Intergovernmental transfers*. Available online at www.receita.fazenda.gov.br/principal/Ingles/SistemaTributarioBR/Intergovernmental.htm

Chapter 8
Information's Role in Adaptive Groundwater Management

Mathew Kurian and Hugh Turral

Abstract This chapter draws on a case study of rural water supply schemes in India to highlight the importance of information in facilitating adaptive management of groundwater resources. The chapter begins with a discussion of the diversity of state structures and processes of information gathering that support public policy formulation. The chapter outlines public policy responses of the India State to the challenge of declining water tables and quality. Some of the gaps in the science and practice of groundwater management are discussed by critically examining some of the assumptions guiding policy interventions in rural water supply. The subsequent discussion discusses the potential role information can play in facilitating adaptive groundwater management; links between aquifer characteristics, water quality and health impacts and potential for ICT's to facilitate accountability are discussed. The importance of local capacity for information management is emphasised with a view to informing discussions on development of incentive systems that enable adaptive water resource management.

8.1 Introduction

Rivers and groundwater are two major sources of drinking water. Water supply agencies in developing countries typically respond to rising agricultural water demand by transiting from single village piped schemes to multi-village piped schemes that pump water from relatively greater distances. Another option exercised by individual households is to drill bore wells that pump water from underground aquifers. Both multi-village piped schemes and groundwater-based schemes tend to

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involve rising input costs (energy) and result in environmental costs such as declining water tables (Kemper 2007). Rainfall variability further compounds the challenge by limiting freshwater availability from surface and groundwater sources as a result of lower recharge of aquifers (IPCC 2007).

Behaviour of individual households and water supply agencies in many developing countries is unsustainable. Adaptive management is required to ensure water security that is sustainable and meets water quality standards (Berkes 2002). Given the common pool features of rivers and groundwater – non-excludability and subtractability of resource units – collective action is essential for adaptive management to succeed. Some compare groundwater to a big tub that loses water as more people enter it (Schlager 2007). Unlike surface water where exclusion and subtraction of resource units is readily observable and for which sanctions for over-exploitation can be devised, groundwater is a more fungible resource (Kemper 2007). This situation makes development of low-cost mechanisms devised to monitor groundwater use through collection of information, sharing, analysis, decision-making and coordinated action by stakeholders at multiple levels and involving both formal and informal processes imperative (Bulkeley 2005).

Over the last decade, New Institutional Economics (NIE) has made a strong case for community-based collective action, arguing that it had the potential to reduce transaction costs of institutional arrangements for management of common pool resources (Ostrom 1990). The establishment of low-cost arenas for regulating use of resources such as forests or irrigation systems, for example, could be aided by information that local inhabitants have of the resource as compared to field staff of forestry or irrigation departments who are recruited from outside the community. North (1990) has also pointed to the significance of information flows in enabling rational individuals to make strategic choices with regard to cooperation and facilitating a process of economic reorganisation and institutional change. In developing countries, poor information flows have knock-on effects on decisions relating to resource allocation, with consequences for quality, affordability and reliability of service delivery.

Improved information can potentially improve service delivery in three specific ways: (1) improving citizen awareness of available physical, financial and human resources; (2) improving decision-maker awareness of available water resources and sectoral demands; and (3) improving consumer awareness of distribution of benefits and costs of current and planned water resource use (World Bank 2004). In this regard, discussions on service delivery usually point to the absence of ‘incentives’ and ‘rent seeking behaviour’ of bureaucrats and field staff (North 1990). NIE has quite rightly pointed to the influence of information asymmetries in subverting resource allocation decisions by government at different levels. Implicit in this argument is the postulate of ‘bounded rationality’ that assumes that as soon as information is made available people will make rational decisions and overcome rent seeking behaviour. Bates (1995) on the other hand emphasised the political and social motivations that influence people’s strategic choices and behaviour, especially in the context of scarce environmental resources (see also Bardhan 2005). Further, policy science has been unable to account for the role of discretion of street level bureaucrats in implementation of social programmes (Minogue 1983).

This chapter draws on a case study of rural water supply schemes in India to highlight the importance of information in facilitating adaptive management of groundwater resources. The next section of this chapter provides an overview of the diversity of state structures and processes of information gathering that support public policy formulation. Section three outlines public policy responses of the India State to the challenge of declining water tables and quality. Some of the gaps in the science and practice of groundwater management are discussed by critically examining some of the assumptions guiding policy interventions in rural water supply. The subsequent discussion discusses the potential role information can play in facilitating adaptive groundwater management; links between aquifer characteristics, water quality and health impacts and potential for ICTs to facilitate accountability are discussed. The importance of local capacity for information management is emphasised with a view to informing discussions on development of incentive systems that enable adaptive water resource management.

8.2 The State Apparatus and Delivery of Public Services

8.2.1 Centralising, Fragmented and Aggregate Information

Service delivery and attempts at its reform must recognise at the outset the diversity that exists in the structure of the state. It is important to recognise that there are structural, cultural and functional differences in the structure of states. We may list the following key features over which differences exist (Pollitt and Bouckaert 2000):

- The constitution – a structural feature
- The nature of executive government at central level: a mixture of structural and functional features
- The nature of relationships between political executives (ministers) and top civil servants: a functional element with cultural overtones
- The dominant administrative culture; here, administrative culture refers to expectations of staff of an organisation about what is 'normal' and 'acceptable'
- Degree of diversity among main channels through which ideas come that fuel public management reform: cultural and functional features

Two features of state structure are important. First, the degree of vertical dispersion of authority; that is to what extent different levels of government share authority. Along this dimension, three broad types emerge – unitary and centralised states, unitary but decentralised states and federal states (Table 8.1). The second dimension concerns the degree of horizontal coordination at central government level – the extent to which central executives are able to organise (ranges from pole of highly fragmented to highly coordinated). Reforms in federal states or highly decentralised

Table 8.1 Types of politico-administrative regimes

Country	State structure	Executive government	Minister–civil servant relations	Administrative culture	Diversity of policy advice
Australia	Federal-coordinated	Majoritarian	Separate, mildly politicised	Public interest	Mainly civil service until 1980s
Canada	Federal	Majoritarian	Separate	Public interest	Mainly civil service
Sweden	Unitary, decentralised	Intermediate	Separate, increasingly politicised	Originally legalistic, changed to corporatist	Academics, trade unions
France	Unitary, formerly centralised, coordinated	Intermediate	Integrated, fairly politicised	Predominantly *Rechtssaat*	Mainly civil service
Germany	Federal, coordinated	Intermediate	Separate, fairly politicised	*Rechtssaat*	Mainly civil service (plus a few academics)
The Netherlands	Unitary, decentralised, fairly fragmented	Consensual	Separate, fairly politicised	Originally legalistic, pluralistic, consensual	Broad mixture (civil service, academics, other experts)
New Zealand	Unitary, centralised, mildly fragmented	Majoritarian (until 1996)	Separate, not politicised	Public interest	Mainly civil service
UK	Unitary, centralised coordinated	Majoritarian	Separate, not politicized	Public interest	Mainly civil service, recently think tanks, consultants
USA	Federal, fragmented	Intermediate	Separate, very politicised	Public interest	Political appointees, corporations, think tanks, consultants

Pollitt and Bouckaert (2000)

unitary states are likely to be less broad in scope and less uniform in practice than unitary centralised states. The focus of management reforms in unified centralised states tends to be heavily involved in the business of service delivery (education, health, etc.) than do governments of federal or decentralised states (where lower tiers of government administer these functions). The effects of extensive decentralisation within unitary states is similar to federalism, where the chances of scope of management reforms broad of application are uniformly reduced. The impact of these changes is a modest decline in central government's share of both total public expenditure and total taxation. Another indicator of extent of decentralisation could be percentages of public servants who work for central governments, as compared to those working for sub-national entities – states, regions, counties and municipalities.

Presence of the Rechtsstaat or Anglo-Saxon model of public interest exhibits diversity in administrative culture. Underlying both Anglo-Saxon and Rechtssaat models are principles of social justice, sovereignty, liberty, equality and solidarity, which come from a distinct intellectual tradition of Hobbes, J.S. Mill and John Rawls and are rooted in particular historical contexts like the French Revolution (Sevenhuijsen 1998; Barcalow 2003). From the Rechtssaat perspective, the state is a central integrating force within society, and its focal concerns are with the preparation, promulgation and enforcement of laws. Most civil servants will train in law, whereas under the Anglo-Saxon model generalists are the norm. By implication, service delivery reform would be slower and more difficult under the Rechtssaat system than under the Anglo-Saxon model. The public interest model is essentially a consensual approach, very different from the closed and juridical purity of Rechtssaat philosophy. From this difference, one can deduce that the scope of information to share under the Anglo-Saxon model may be greater. The sources of policy advice available to civil servants in the formulation and execution of laws and policies reflect this difference. Nevertheless, processes of information gathering in both systems tend to be centralising, and the nature of data collected is driven by a need to monitor public expenditure and revenue closely. Seldom are bottom up perspectives on the outcomes of expenditure (e.g. quality of schools or water supply) and levels of local government contribution towards project cost-recovery monitored. Further, information is fragmented, collected as it is by several line departments and agencies. Finally, information is usually aggregated to provide bureaucrats a simplified view of what are essentially complex socio-ecological realities.

8.2.2 Information and Public Representation: Consumers Versus Citizens

The challenges confronting consumers with regard to delivery of water and sanitation services in developing countries raise a number of issues tied to discussions of public representation. The inability of formal mechanisms such as voting and information flow to influence service delivery effectively has raised an important question: How can consumers make their voices heard? Should governance structures and the politics of representation be reconfigured by the power of citizenship – understood here as a status bestowed on those who are full members of a community and serving to incorporate different sectors of society, reduce social inequality and ensure social consensus (Koffman 1998; Reich 2007). As we may recall from the discussion in Chapter 2, contemporary perceptions of 'boundary' and 'territory' are proving ineffective in responding to needs of a diverse and spatially dispersed set of consumers with differing expectations and demands for service provision. For example, can the decisions regarding peri-urban wastewater management be contained within boundaries of a village or city or must they straddle them through social networks that could possibly include relations involving consumers on both sides of the jurisdictional divide? Initiatives that attempt to forge such networks through legislation or state directives are unlikely to meet with effective collaboration (Kabeer 2005). Alternatively, in attempts to address fundamental issues such as relationship between citizenship exercised at different scales (village, town or centre), gaps between formal and substantive citizenship and relationship between individual and group rights are likely to be more promising. Here mere representation[1] of identity or economic interest in local governments needs to be supplemented by recognition of diverse interests and a shared commitment to public welfare (Squires 1999).

More questions that are pertinent include the following: are structures of representation aligned with the need for enhanced service delivery? Some have argued that re-drawing electoral constituencies enhances information flow and could help to align better resources with constituents' demand for better public services (Forrest 2005). Second, how can information generated through electoral systems: are proportional or first past the post systems better aligned with issues of service delivery? Third, how are bureaucratic procedures related to annual budget preparation, elected representatives/consumer needs for affordable and reliable services and line department managers' concern for cost-recovery aligned with the need for improved service delivery (Pollitt and Bouckaert 2000)? Seldom are these issues of information flow within structures of the formal state apparatus discussed. Instead, many discussions remain focused on signals sent out by the market: for example, the influence of pricing on certain types of cropping patterns or water tariffs on consumption behaviour (Hanemann 2000). These price signals are important information flows that influence people's behaviour. However, information that is collected by the state that is seldom open to public analysis and debate on its potential to influence quality of public services is also important. Information on decision-making processes of multiple government departments/local governments offers an opportunity to improve consumer voice and enhance targeting of public expenditure on the poor (Saith 2006).

[1]There are four key questions to understand the concept of representation: (1) When claiming to be a representative, what is one representing (beliefs, constituencies, interests, identities)? (2) How does one represent it (microcosm representation – age, sex, race, symbolic representation – class based representation, principal agent representation – acting on behalf of a particular interest group)? (3) Where does one represent it (in legislature or in informal groups)? and (4) What is the purpose of representation (to raise awareness, change laws)?

8.3 Rural Water Supply in India: Data Incongruities and Evidence Based Decision Making

8.3.1 Legislative Approach to Policy Implementation

In 1992, India embarked on a process of political decentralisation. This process involved devolution of powers to local governments to raise local sources of financing and certain degree of freedom to make decisions related to financial resource allocations. Nevertheless, basic service delivery has fared poorly (World Bank 2006). The rural water supply sector in India is characterised by a substantial gap between the population with access to public infrastructure and the population with access to safe drinking water (Government of India 2006a). At current rates of investment, it is anticipated that while 100% of the rural habitations in India will have access to 40 Litres Per Capita Daily (LPCD) within only a few years, less than 40% of the population will actually be consuming water that is safe.[2] The difference between access to infrastructure and access to safe drinking water comes about primarily due to declining source sustainability, poor Operations and Maintenance (O&M) and deteriorating water quality. The Planning Commission notes that during the Eleventh Five Year Plan period, 208,000 out of 1,422,000 habitations in the country slipped[3] back from Fully Covered (FC) to Partially Covered status (PC) while another 217,000 habitations have problems with water quality. There is growing consensus that 'failure of water supply sources' is a symptom of an institutional bias towards infrastructure creation in contrast to a more balanced approach that focuses on integrating management of multiple uses of water.[4] The focus of existing policy responses has been to emphasise the importance of legislation in curbing groundwater withdrawals by the agriculture sector (Government of India 2006b). Several States drafted legislation based on a model groundwater bill of the central government but recourse to legislation has provided very little success in terms of reversing excessive groundwater mining (see Fig. 8.1).[5]

The failure to bring about effective institutional change in groundwater usage patterns has serious implications for the water supply sector considering the fact

[2]The *Millennium Development Goal* (MDG) for water is to increase population with access to safe source of water (piped connections, hand pumps, etc.) within one kilometre distance from habitation.

[3]Whether habitation is fully covered, partially covered or not covered is defined by service standards: partially and fully covered habitations have a safe drinking water source, within 1.6 km (plains) or 100 m elevation (hills) and between 10 and 40 LPCD (partially covered) or more than 40 LPCD (fully covered).

[4]Presentation by Joint Secretary, DoDW at Conference of Ministers in charge of water supply, New Delhi, July 2007.

[5]A recent report of the *Expert Group* on Groundwater Management and Ownership reveals that the number of semi-critical, critical or over-exploited development blocks has actually increased from 7% in 1995 to 28% in 2004 (Government of India 2007a).

- Excessive focus on permit system to restrict number of wells, which typically slows down development process.
- Even if the number of tube wells is restricted, an individual farmer can render legislation ineffective by increasing the power of the pump set and drawing more water.
- Procedures for appeals against sanctions provide scope for misuse of power, corruption and waste of time.
- Existing model groundwater legislation bestows right to use groundwater to those who already have sunk a well, while excluding others making it inherently iniquitous.

Fig. 8.1 Difficulties encountered in existing groundwater legislation. Source: Government of India (2007c)

that up to 80% of water supply services are dependent on groundwater sources. With a view to overcome shortcomings, an *Expert Group* constituted by the Planning Commission recommended that all states introduce modified groundwater legislation that accords water user groups and local governments an important role in identifying a sustainable yield management goal and planning for sustainable aquifer management.[6]

8.3.2 Feedback Loops Between Policy Intervention and Environmental Outcomes

Groundwater provides natural storage, but recharges slowly and indirectly from rainfall. When net abstraction from an aquifer is greater than the rainfall that reaches it, water levels decline. Water levels may exhibit cyclic fluctuations, rising in years of high rainfall, especially after monsoon season flooding, or may rise and fall over a long-term mean. However, in many catchments all over India water levels are falling, and where abstraction is greater than 100% of natural recharge, the aquifers are said to be critical, and may be termed overexploited if extraction rates are greater. In many parts of Peninsular India aquifers are mined, that is 150–200% of annual average recharge is extracted each year. The minor irrigation census of 2000 has seen a step increase in the area estimated under groundwater irrigation. It can be seen that the hard rock areas in Peninsular India are one of two heavily over drafted regions, and the one where resource depletion in absolute terms is most acute (Shah 2008).

[6]The *Expert Group* recommended that institutions like Central Ground Water Board scientifically ascertain a sustainable yield management goal that could form the basis of planning and management by local governments and water user groups. On the other hand, the guidelines on source sustainability issued by Department of Drinking Water Supply emphasises stakeholder participation for preparation of water security plans at district level (Government of India 2007b).

The revolution in agricultural groundwater use throughout India has brought many benefits, especially to relatively well-endowed farmers, in the form of an increase in cropping intensity and agricultural incomes. In many instances, such farmers have engaged in selling water to other farmers. This revolution in areas under irrigation and cropping intensity patterns has been facilitated by development of low-cost pump technologies that relied either on subsidised diesel (as in North India) or subsidised electricity as in many parts of peninsular India.

The dramatic expansion of low cost pump technologies has reduced the time and investment in maintenance of traditional community sources such as dug wells and canals. Another factor has been favourable agricultural terms of trade for certain crops that encouraged double cropping or more intensive water use. An outcome of both these factors has been an unregulated expansion in extraction of groundwater in circumstances that would otherwise be uneconomic – especially where groundwater is deep and yields are low. Energy subsidies for irrigation are intended to enhance the equity and scale of benefits from agriculture to raise household income. But at the same time initiatives from a different sector of government attempt to improve the quality of life and opportunities for productive employment through provision of safe and clean drinking water, with capital and sometimes operational subsidy. In many cases, people who benefit from operational subsidies for drinking water supply projects are also the same people who engage in unsustainable aquifer withdrawals for agriculture. Since farmers are not constrained by the costs of abstraction, collectively they deplete groundwater resources, resulting in declining water tables, associated with water quality degradation in some conditions, such as in parts of hard rock aquifers in Peninsular India. This has a negative feedback on the quality of water for drinking as well as the quantity available.

8.3.3 Science and Practice of Groundwater Management

At some point, it is no longer possible to extract the same volume of water, but it is possible to recharge aquifers artificially. The recharge movement has become a national concern in India, with watershed development undertaken to enhance the productive use of water in agriculture in the upper catchments, where poorer farmers reside, and to recharge more stream flows to groundwater. Figure 8.2 gives a schematic representation of a typical small catchment: most of the rainfall that falls on the catchment is stored in the soil and returns to the atmosphere as evaporation or transpiration (evaporation through plants).

Runoff and groundwater feed stream flows when water tables are high. Where water tables are below the bed level of a river, a portion of stream flow percolates to the water table. Where water is impounded, for example in a tank, it may have more opportunity to percolate to recharge groundwater, but this is dependent on the condition of the tank bed. Siltation can seal the tank bed and limit infiltration (Ahmed 2007).

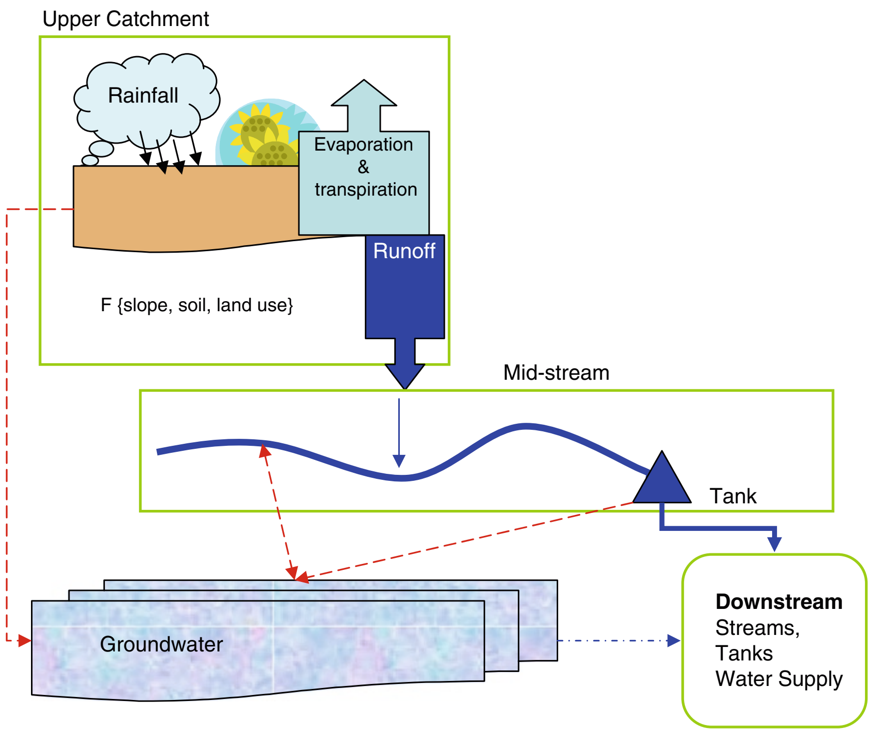

Fig. 8.2 Schematic relationships between rainfall, vegetation water use, recharge and runoff in small catchments. Source: Created by Hugh Turral

Water availability to downstream users (like rural water supply bore wells) is determined mostly by the runoff from the upper catchment. Typically, in semi-arid conditions, values for annual runoff vary from 5% to 15% of annual average rainfall, with greater amounts after heavy rainstorms on wet (saturated) soils and with relatively higher rates at the plot, field or micro-watershed scales as compared to the sub-basin or basin scales. Replanting upper catchments with trees tends to reduce runoff, as do agricultural intensification and water harvesting activities, which retain and use more water and allow less to flow downstream. The Andra Pradesh (AP) Livelihoods project noted that while many benefits are obtained from watershed 'improvement' programmes, runoff rates fell (to as little as 2%) and tanks spilled less frequently, further reducing surface water supplies to tanks lying further downstream. Farmers claim that rainfalls have declined, but there is little evidence of this in the rainfall records over the last 40–100 years. Thus increased up-catchment water use can further enhance the competition for groundwater farther downstream, and this can be important if the Rural Water Supply Scheme (RWSS) sources are sited in areas with declining recharge and increasing and excessive abstraction.

8.3.4 Accounting for Spatial and Temporal Variation in Groundwater

In peninsular India, more than 80% of aquifers are hard rock aquifers. A typical hard rock aquifer is shown in Fig. 8.3, where a porous soil overlies a deeper layer of fractured and weathered rock. This layer is typically 10–15 m in Karnataka and AP, and has high storage capacity (10–20%), but water does not flow easily from one part of the aquifer to another (low transmissivity).

Below this layer is dense rock (usually granite or basalt), with occasional cavities and joints that store and transmit water. Although highly variable, the connections (vertically and horizontally) between these water bearing fissures are very haphazard and cannot be easily mapped or predicted. Farther below this unevenly porous layer is mostly impervious basement and has virtually zero water content. Typically, storage in the weathered hard rock layer is very low (around 2%), and it is more or less a matter of luck whether a bore intercepts sufficient cavities and joints to produce a high yield. Where a bore is successful, water flows rapidly through all connected pores, and if the volume is small, this can result in rapid depletion of available water. It is common experience that water levels fall rapidly during pumping in hard rock aquifers so that the active pumping water level (dynamic level) may be significantly lower than the normal static water level. The graph in Fig. 8.4 shows what happens in a typical hard rock aquifer, which experiences extensive groundwater development for agriculture. After initial over-abstraction of water, the phreatic zone (portion of the weathered rock layer filled with water) is recharged by monsoon rainfall and subsequent percolation from all secondary sources (such as rivers, tanks, etc.).

As abstraction continues, the water levels fall to the level of the bedrock, typically around April. This means that all the easily abstractable water has been removed. Figure 8.4 shows that this depletion gets more severe year by year (Anon 2007; Department of Mines and Geology 2005).

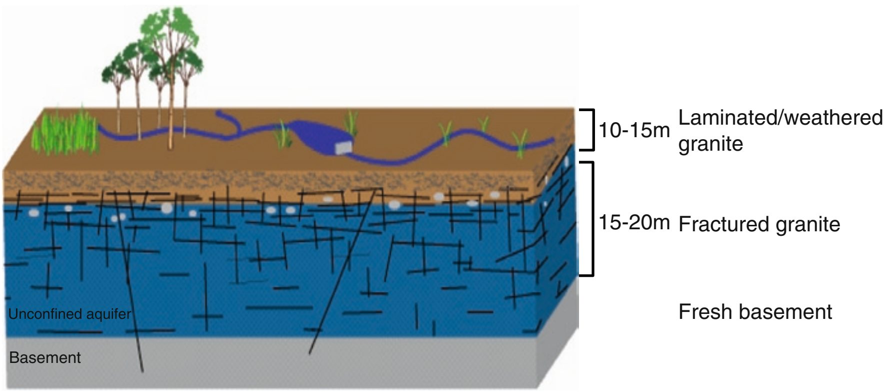

Fig. 8.3 Schematic depiction of a typical hard rock aquifer. Source: International Water Management Institute (2007)

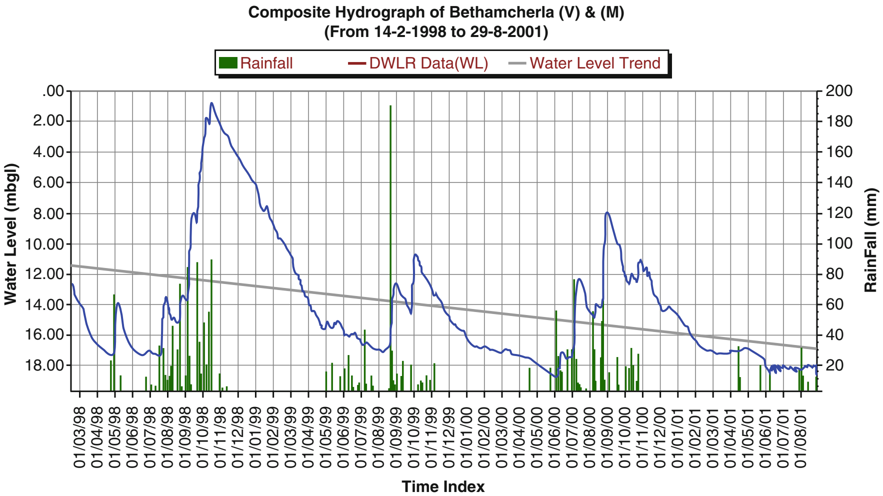

Fig. 8.4 Typical water table behaviour in hard rock phreatic aquifer: Seasonal and three-year trend

Interestingly, data for Fig. 8.4 is taken from an observation well and not a production well. Farmer surveys and case histories of all bores revealed that the extent of depletion and water table fall was far deeper, with many wells penetrating into the fractured rock, but yielding relatively little water. The farmers' main response to this trend has been to deepen their wells, which often involves drilling new wells, with decreasing chances of success, the deeper they go. Many farmers have lost a great deal of money in trying and failing to strike a successful bore, and impoverishment has followed. Those who are lucky to succeed may continue to reap profits from high value crops but also further reduce the chances of others tapping water. Such competitive deepening can result in failure of a water supply well, sometimes only for the summer season, and sometimes entirely. Continued competitive deepening of RWSS wells is expensive and undesirable, and it is increasingly important to protect their source and maintain or improve their reliability (Simmers 1988).

8.4 Information's Role in Facilitating Adaptive Management

8.4.1 Relationship Between Aquifer Characteristics, Water Quality and Health Impacts

There are many water quality concerns associated with the provision of drinking water, but the three most important are fluoride, arsenic and toxins (heavy metals, and in some cases, pesticides). Arsenic affects some 14 million people in the west of the Ganges and famously in Bangladesh. Fluoride is however, the major water quality problem affecting more than 65 million people. When fluoride concentrations rise above 1 mg/l, water is not potable, but where better sources are unavailable, Indian practice accepts levels up to 1.5 mg/l. Where levels are higher, there is increased risk of dental and skeletal fluorosis, and there are many villages in India where the consequences of consuming high fluoride content water are all too evident. The distribution of fluoride-affected areas in India in 2002 appears in Figure 8.5 and it is important to note that there has been considerable worsening of the situation in some blocks since then. Further, note that there is a strong superficial correlation between areas with severe overdraft and areas with high fluoride contents (MacDonald et al. 2002; Nagaraj et al. 2003).

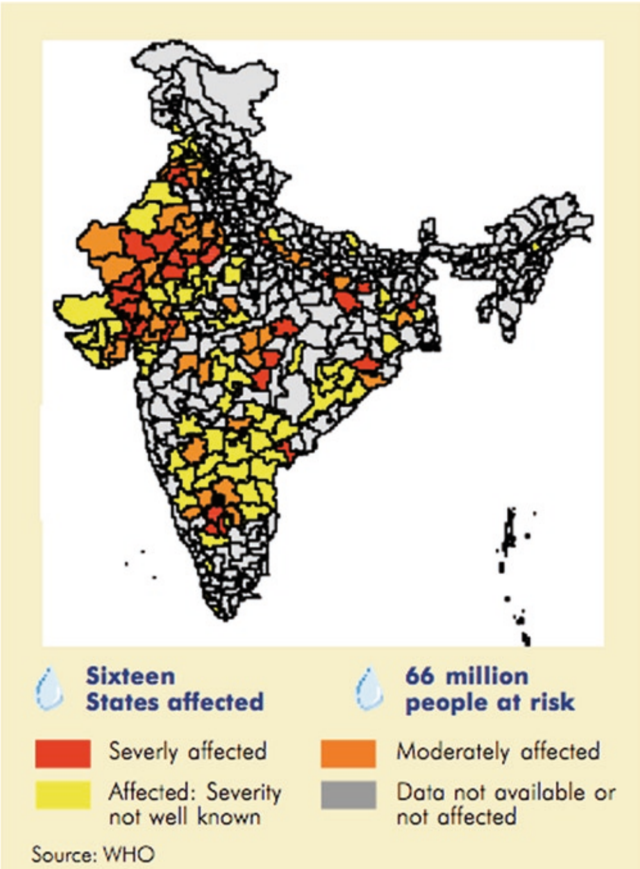

Fig. 8.5 Distribution of fluoride problems in groundwater in India

8.4.2 Implications for Water Quality Monitoring Strategies

The sustainability of water supply wells in hard rock areas depends on water quality, which determines hazard, potability and the amount of water available for rural water supply. Slippage is inevitable without addressing and managing water quality issues. However, the current practice of monitoring observation bores prior to the monsoon has shown an underestimation of the extent and severity of fluoride problems in aquifers in southern AP (APRLP 2003). Spatial interpolation of data between observation bores can be highly misleading due to spatial variability and it is desirable to test and monitor water quality routinely (especially fluoride) on a well-by-well basis. Routine surveys of all wells are likely to generate a much better picture of the true situation than occasional sampling of observation bores not pumped often and actively: this activity becomes central to both water resource audits and subsequent monitoring guidelines for what to sample (given in Smith 1999).

The susceptibility to fluoride is not a simple relationship (see Smith 1999) since many other factors are involved. Likewise, the susceptibility of an aquifer to fluoride contamination is not easy to predict. The mechanisms are complicated, and relate to both the mineralogy of rock formations and the travel times and pathways of water through them. CGWB (Bangalore) and the Karnataka Department of Mines and Geology note that fluoride concentrations in an aquifer increase with the extent of over-draft, but evidence around the world is not clear. Fluoride concentrations can vary dramatically between adjacent wells, and will change over time. Therefore simply moving the source of a drinking water supply scheme to deal with supply shortfalls, a current practice in Peninsular India, will not necessarily provide sustainable solutions to the problem of slippage of habitations from Fully to Partially Covered (FC/PC) due to the ever-present danger of contaminated groundwater. In this context, sustainable solutions are identified better through a well-informed understanding of aquifer characteristics and lifecycle costs of water treatment technologies (see Figure 8.6).

8.4.3 Community Level Adaptive Management

Information can play a critical role in facilitating local level innovation to deal with competition for water for multiple uses. Some local level institutional options that have been experimented on in some regions of rural India include the following:

- Voluntary exclusion zones limiting agricultural pumping within the vicinity of a RWSS bore (say 500 m)
- Maintenance of recharge areas (tank desilting) to maintain groundwater recharge

There are many treatment options of varying cost and ease of application from filtering water through activated alumina to reverse os mosis (Smith et al. 1999). The alternative option to treatment at domestic and system level is to use an alternative surface or groundwater source, but this would require sound analysis of lifecycle costs and effectiveness, and to date there seems to be little documented experience. To elaborate, groundwater based supplies (e.g. single village water supply schemes as in Karnataka) have the advantage of being local to one or a few communities, and providing they are well suited and protected, they have complete flexibility and reliability in supply, but they are likely to be hostage to competitive deepening of agro wells and water quality degradation as previously described. On the other hand, a surface system (multi-village water supply schemes) usually has higher capital costs (e.g. costs of pumping, storage, treatment and distribution facilities) that are offset by sharing the system across a larger number of communities. However, a larger service area in turn introduces greater demands for operation and maintenance, as well as for inter-community cooperation. In many cases, surface water resources may also be subject to greater natural variability in supply than groundwater ones. However, such schemes are easier to measure and cheaper to run as they can be designed to work by gravity and do not require pumping. Water treatment units can be attached to either surface or ground water supplies and would incur different costs according to the water quality problem and scale and intensity of treatment that is required.

Fig. 8.6 Choosing between water treatment technologies and re-location of water supply source

- Voluntary zoning of up-catchment development to preserve runoff
- Local taxes or energy tariffs on groundwater pumping for irrigation
- Exclusion zones for irrigation pumping at certain (low yield) times of the year
- Installation of water treatment filters for fluoride, paid for by local taxes on agricultural water users
- Substitution of RWSS supplies by agricultural well output (free) in shortage periods
- Restrictions on commercial loans for agricultural groundwater development
- Crop pattern changes, although there is divided opinion and evidence on the utility of this approach
- Increased use of local water resources, such as roof harvesting of rainwater

8.4.4 Information Communication Technology and Enhanced Accountability

Information is being used in innovative ways to inform policy dialogue in many developing countries. In the ensuing discussion, we provide examples of use of community scorecards and use of GIS technology to monitor access to basic services in Africa. We inquire what relevant use of GIS technology can be put to in identifying a viable groundwater management unit to ensure sustainability of water supply sources. Finally, given some of the shortcomings in information currently collected by water supply agencies, we ask what potential exists for the use of improved methodologies for staff development training. With a view to ensuring that capacity development can translate into sustainable institutional change, we discuss the issue of 'payment for environmental services'.

Use of community scorecards in South Africa

The Centre for Social Accountability (CSA) in South Africa argues that social accountability is a fundamental human right whereby citizens have a right to obtain justifications and explanations on the way public funds are managed. CSA's approach includes:

Approach 1: Policy monitoring at national/international level with an advocacy strategy of CSOs engaging policymakers
Approach 2: Accountability system monitoring focusing on the interface at national policy formulation and local programme implementation
Approach 3: Social auditing at local level focusing on verification of implementation of public service programmes at community level

Use of GIS for service delivery monitoring, Tanzania

Mobile GIS technology has potential to inform decision-making in water, sanitation and hygiene data collection, real time updating, analysis and feedback to stakeholders and decision-makers. Bringing these technologies together makes the enterprise database directly accessible to field-based personnel, whenever and wherever required and therefore dynamic and gaining efficiency in performing one's duties. Four distinct advantages emerge through use of innovative information technology services:

- Monitoring the effectiveness of its investments in service delivery
- Verifying water supply and sanitation coverage, evaluating access, and equity in rural and urban contexts
- Strategic planning and advocacy at local government level and at times at higher governmental levels
- Enhance collaboration among the district stakeholders and the three ministries (Health, Water and Education) to develop a joint action plan to address WaSH at schools

Potential applications of GIS in identifying a viable groundwater management unit in India

Essentially, the community manages rural water supply schemes and integrating activities at a river basin, or sub-basin scale, would require coordination between hundreds of villages. This is clearly not practical, so it is necessary to find management units at a scale that includes the hydrologic connection between different users, but at the same time does not involve so many stakeholders that coordination is not possible. In the case of groundwater based water supply schemes, it is harder to define a simple hydrological unit such as an aquifer, since the scale can vary. For instance, one aquifer might underlie vast areas, such as in the Ganges River Basin, or it may be very localised. Aquifers can be interconnected, and it is often hard to quantify the flow of water between one aquifer and another. There are many types of aquifers, some with very high and easily replenished storage. However, in the case of the hard rock aquifers discussed in the case study, it is possible to define a groundwater management unit, based on topography, aquifer characteristics and usage patterns. It may often be that a mini-watershed or watershed will provide an appropriate and convenient boundary for a groundwater management area, but it is best to define this on a case-by-case basis. We therefore emphasise that selection and definition, management and coordination of such units be determined by district and sub-district workers in consultation with village stakeholders. Information on ecological interconnectedness of groundwater and disaggregated information on socio-economic variation among water users can be useful in this context.

8.4.5 Water Resource Audits: Reliability, Frequency and Dis-aggregate Information

As the Indian case shows, slippage of water supply sources is inevitable if water quality issues remain unaddressed. However, the current practice of monitoring observation bores just prior to the monsoon has shown to underestimate the extent and severity of fluoride problems in aquifers in southern AP (APRLP 2003). Spatial interpolation of data between observation bores can be highly misleading due to the short-range spatial variability and it is desirable to test and monitor water quality routinely (especially fluoride) on a well-by-well basis. Routine surveys of all wells are likely to generate a much better picture of the situation than occasional sampling of observation bores not intensively pumped: this activity becomes central to both the water resource audits and subsequent monitoring guidelines for what to sample (given in Smith 1999).

From the point of view of local government planning, we therefore highlight the following priority areas where information can play an important role:

- *Data collection methodologies* related to water balance, estimation of extraction and recharge rates, water quality sampling and access of poor to water services.
- *Processes of data sharing* between different levels of local government and line departments; possibility for outsourcing this function through use of information technology tools.

- *Capacity for data analysis* related to water levels, water quality and service standards.
- *Capacity for informed decision-making* by local governments to make professional choices on actions required to address critical shortages of water supply, especially in summer months.
- *Capacity for coordinated action* by community groups on issues such as maintaining run-off from watersheds to facilitating recharge of water supply bore wells in downstream areas. At intermediate levels, local governments could coordinate their actions to ensure that funds, clearly articulated functions and skilled functionaries are brought to bear to address the challenge of source sustainability of rural water supply services. Coordination of actions at the level of community groups and local governments could increase credibility of demands for action at higher policymaking levels on issues related to energy pricing, bulk water allocations, expansion of storage capacity, crop pricing and non-revenue and unaccounted for water.

8.4.6 Informing Design of Incentives[7] for Source Protection (ISP)

Based on select performance indicators, the opportunity to leverage the full power of information exists within incentive schemes that promote changes in behaviour regarding water use and financing arrangements. This discussion relates to donor level discussions of budget support aimed at better alignment of financial resources with the needs of citizens for better service delivery. Facilitating competition between local authorities (local governments) based on a robust system of ranking based on prior agreed upon and easily verifiable performance indicators is one such approach (Figure 8.7). Incentives schemes would require information to be dis-aggregated, reliable and frequent. Depending on the sector for which incentives are being designed (for example, water supply or irrigation) information on socio-economic profile of water users will need to be complemented by seasonal, diurnal or annual information on rainfall, precipitation, recharge and temperature.

[7]Payment mechanisms can include (FAO 2004):

- Direct payment to land users
- Direct payment to land-user associations
- Technical and/or political support for the legalisation of land-ownership titles
- Provision of social services and infrastructure
- Investment financing to improve property or land use management
- Technical assistance in training and marketing support
- Expansion of access or use rights to water or other natural resources

Aim

To concentrate recharge in areas around rural water supply bore wells through a combination of supply and demand management measures. Facilitate achievement of policy goal by employing principles of Payment for Environmental Services (PES) schemes (FAO 2004).

Main elements:

- Based on field survey, hydrological and hydro-geological surveys and estimates of current and future demand estimate whether there is scope for improving recharge around the existing WaSH source to the extent that current and future demand can be met.
- If necessary, consider shifting the WaSH source to a location that has a higher recharge potential. If this is a tank bed, no payments will be needed as this is not private land.
- Identify farmers with water harvesting structures in the catchment area of the WaSH source recharge structure(s). Estimate the impact of these structures in runoff to the WaSH bore well domain.
- Facilitate dialogue on supply management measures like the number and location of structures that should have gates fitted and the rules for leaving these gates open (e.g. the number and scale of runoff events), maintenance of ring-fenced groundwater sanctuary.
- Facilitate dialogue on demand management measures like improved transformer operations, compact that mandates high intensity irrigators to divert a proportion of groundwater pumped beyond an agreed slab towards augmenting village water supply, use of group bore wells in community designated critical zones during dry season, maximum well depths and sanctions for non-compliance.

Payment mechanism:

- Local government (LG) pays relevant farmers to fit gates to water harvesting structures with storage greater than 0.5 ha metre and to keep these gates open during the south-west monsoon until an agreed number of runoff events have occurred. Thereby routing runoff to recharge structures (e.g. tanks or other water bodies) that recharge the WaSH water source.
- LG pays farmers to desilt the WaSH recharge structures on an annual basis to ensure rates of recharge are maintained.
- LG pays farmers to clear feeder channels into WaSH recharge structures.
- LG paid for reducing wastage of water by ensuring reliable energy supply & transformer operations.
- LG paid for plumbing irrigation wells into water supply network to facilitate diversion of irrigation water towards water supply/groundwater sanctuary.
- LG paid for enforcing operation of group bore wells in critical zones during dry season.
- LG paid for identifying and publicising maximum well depths and enforcing sanctions for non-compliance.

Fig. 8.7 Incentive-based schemes that promote source sustainability of water supply

8.5 Conclusions

The introductory chapter of this volume discussed the role of information in mitigating the consequences of contractual hazards in situations of opportunism. This chapter seeks to provide a framework for understanding opportunistic behaviour for a fungible resource like groundwater. We employ a case study of rural water to demonstrate the shortcomings of a legislative approach to addressing the policy challenge of declining water security. We argue instead that the cause of enhanced service delivery would be better served by emphasising information's role in promoting citizen awareness, enhancing decision-makers prowess in resource allocations and improving monitoring mechanisms involving complex geo-hydrological resources and heterogeneous interests of water users. The Indian example shows that despite a commitment to political decentralisation, basic service delivery fares poorly because of poor accountability. Poor accountability is aided by centralising, fragmented and aggregated information that seldom allows for open discussion of management or policy priorities guiding allocation of financial resources.

References

Ahmed, S. (Ed.). (2007). *Groundwater dynamics in hard rock aquifers: sustainable management and optimal monitoring network design*. New York: Springer.

Anon, A. (2007). Deciphering potential groundwater zone in hard rock through the application of GIS. Environmental Geology Springer Berlin / Heidelberg. ISSN 0943-0105 (Print) 1432–0495 (Online)

Barcalow, E. (2003). *Justice, Equality and Rights*, London, Wadsworth Publishing.

Bardhan, P. (2005). *Scarcity, conflicts, and cooperation: essays in the political and institutional economics of development*. Oxford: Oxford University Press.

Bates, R. H. (1995). Social dilemmas and rational individuals: an assessment of the new institutionalism. In J. Harriss, J. Hunter, & C. Lewis (Eds.), *The new institutional economics and third world development*. London: Routledge.

Berkes, F. (2002). Cross-scale institutional linkages-perspectives from bottom up. In T. Dietz, N. Dolsak, E. Ostrom, & P. Stern (Eds.), *The frama of the vommons*. Washington, DC: National Research Council.

Bulkeley, H. (2005). Reconfiguring environmental governance-towards a politics of scales and networks. *Political Geography, 24*, 875–902.

Department Mines and Geology (2005). *Report on dynamic groundwater resources of Karnataka as on March 2004*. Bangalore, India: Department Mines and Geology.

FAO. (2004). *Electronic forum on payment schemes for environmental services in watersheds*. Presented in Santiago, Chile. Available online at http://www.rlc.fao.org/foro/psa/pdf/report.pdf

Forrest, B. (2007). Information Sovereignty and GIS: The Evolution of "Communities of Interest" in Political Redistricting. *Political Geography*, 23, 435–451.

Government of India. (2006a). *Planning at the grassroots: An action program for the eleventh five year plan*. New Delhi, India: Ministry of Panchayati Raj.

Government of India. (2006b). *Towards faster and more inclusive growth: an approach to the 11th five year plan.* New Delhi, India: Planning Commission, Government of India (GoI).

Government of India. (2007a). *Report of the expert group on groundwater management and ownership*. New Delhi, India: Planning Commission.

Government of India. (2007b). *Guidelines on sustainability of drinking water sources*. New Delhi, India: Ministry of Rural Development, Department of Drinking Water Supply.

Government of India. (2007c). *Proceedings national groundwater congress*. New Delhi, India: Ministry of Water Resources, 11 September 2007.

Hanemann, M. (2000). Price and rate structures. In Duane D. Baumann, John J. Boland & W. Michael Hanemann (Eds.), *Urban water demand, management and planning* (pp. 137–179). New York: McGraw Hill.

IPCC. (2008). *Climate change and water.* (Presented at Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva).

Kabeer, N. (2005). *Inclusive citizenship: meanings and expressions*. India: Zubaan Press.

Kemper, K. (2007). Institutions and instruments for groundwater management. In M. Giodarno & K. Vilholth (Eds.), *The agricultural groundwater revolution: opportunities and threats to development*. Wallingford, UK: CABI.

Koffman, E. (1998). Rights and citizenship. In J. Agnew, K. Mitchell, & G. Toal (Eds.), *A companion to political geography*. London: Blackwell.

MacDonald, A., Davis, J., & Dochertaigh, B. (2002). *Simple methods for assessing groundwater in low permeability areas in Africa*. London: British Geological Survey Report.

Minogue, M. (1983). Theory and practice in public policy and administration. *Policy and Politics, 11*, 63–85.

Nagaraj, N., Chandrashekar, H., & Yatheesh, H. S. (2003). Sustainability and equity implication of groundwater depletion in hard rock areas of Karnataka - an economic analysis. *Indian Journal of Agricultural Economics, 58*(3), 438–447.

North, D. (1990). Institutions, Institutional Change and Economic Performance: Political Economy of Institutions and Decisions, Cambridge University Press.

Ostrom, E. (1990). *Governing the commons – the evolution of institutions for collective action*. Cambridge: Cambridge University Press.

Pollitt, C., & Bouckaert, G. (2000). *Public management reform – a comparative analysis*. Oxford: Oxford University Press.

Reich, R. (2007). Supercapitalism: The Transformation of Business, Democracy and Everyday Life, New York Knopf.

Saith, A. (2006). From universal values to millennium goals: lost in translation. *Development and Change, 37*(6), 1167.

Schlager, E. (2007). Community management of groundwater. In M. Giodarno & K. Vilholth (Eds.), *The agricultural groundwater revolution: opportunities and threats to Development*. Wallingford, UK: CABI.

Sevenhuijsen, S. (1998). *Citizenship and ethics of care: feminist considerations on justice, morality and politics*. London: Routledge.

Shah, T. (2008). *Taming the anarchy*. Washington, DC: RFF Press.

Simmers, I. (1988). *Estimation of natural groundwater recharge*. NATO ASI Series.

Smith, M. D. (1999). *Study of fluoride treatment, Andra Pradesh water and environmental sanitation project. Final consultancy report*. London: WELL/DFID.

Squires, L. (1999). *Gender in political theory*. London: Blackwell.

World Bank. (2004). *Making services work for the poor: World development report*. Washington, DC: The World Bank.

World Bank. (2006). *Fiscal decentralization in India*. Oxford: Oxford University Press.

Chapter 9
Making *Sense* of Human–Environment Interaction: Policy Guidance Under Conditions of Imperfect Data

Mathew Kurian

Abstract Changes in the policy and legal environment may support adaptive environmental management. The introductory chapter of this volume referred to this set of change as belonging to the institutional environment. We distinguished this set of change from institutional arrangements: access to markets, information, technology, financial resources, skilled staff with clear roles and responsibilities. The dispersion of institutional arrangements will most certainly differ across *space* – district, village or watershed. *Process variables* like connectivity to critical infrastructure such as roads, electricity or internet and motivated agency staff may mediate access to institutional arrangements. The chapter distinguishes between process variables and access to *services* like soil and water conserving techniques. Realisation of higher order service outcomes like delivery of affordable and reliable water *services* like soil conserving farming techniques, sustainable water sources or connection to a sewer network are very often mediated by market and state forces that support planning and technical development. Further, in many situations lack of socio-ecological data hampers planning and management interventions. This chapter grapples with some of these issues through an analysis of soil conservation interventions in Laos. In doing so, the chapter emphasises the importance of constitutional choice, collective choice and operational rules that we discussed in the first chapter of this volume.

9.1 Introduction

The introductory chapter of this book referred to the literature on CPRs to discuss evolution of institutions for management of forests, irrigation systems and pastures. In a later chapter, we discussed the importance of information flows in facilitating adaptive management of groundwater resources. Often, one of the challenges of

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research evaluation is to distinguish between the effects of human intervention and ecological change on adaptive outcomes. The example of groundwater management is illustrative: the objective here is to facilitate recharge of aquifers for which a number of human interventions are possible like construction of water harvesting structures or delineation of safe zones. After a few years, recharge of aquifers may become evident, but the important question is how much of this change is a result of adaptive management when an improvement in rainfall or precipitation patterns during the same period could have also played a crucial role. This example highlights the importance of the *temporal* dimension in analysis of human–environment interaction (Berkes 2002).

In many instances, changes in policy and legal environment may support adaptive management. The introductory chapter referred to this set of change as belonging to the institutional environment (Dorward et al. 2005). We distinguished this set of change from institutional arrangements: access to markets, information, technology, financial resources and skilled staff with clear roles and responsibilities. The dispersion of institutional arrangements will most certainly differ across *space* – village, town or watershed. Here *process variables* like connectivity to critical infrastructure such as roads, electricity or internet or motivated agency staff may mediate access to institutional arrangements. In this connection, an attempt may be made to improve access to institutional arrangements through planning and management interventions that focus on better coordination in use of funds, clear delegation of roles and enhanced capacity of agency staff.

Process variables like connectivity to critical infrastructure such as roads, electricity or internet and motivated agency staff may mediate access to institutional arrangements. The chapter distinguishes between process variables and access to *services* like soil and water conserving techniques. Realisation of higher order service outcomes like delivery of affordable and reliable water *services* are very often mediated by market forces and forces that operate within the public sector. In many instances, lack of socio-ecological data hampers planning and management interventions as this chapter describes based on a case study of soil and water conservation in Laos. In doing so, the chapter emphasises the usefulness of political ecology concepts of time and space for study of human–environment interaction. In distinguishing between issues of institutional environment and institutional arrangements, the chapter also emphasises the significance of nested rules in institutional analysis.

9.2 Policy and Institutional Context

9.2.1 Farmer Adoption of Soil Conservation Practices, Luang Prabhang, Laos

In recent years, significant reductions in levels of poverty in Vietnam, Lao PDR and Cambodia have been accompanied by a shift towards market and trade liberalisation, a phenomenon that occurred in neighbouring Thailand 30 years before (Kurian and Lestrelin 2004). Increasing integration by upland populations in markets for agricultural products exacerbated by changes in land tenure policies resulted in shortened fallow periods under the traditional slash and burn system of cultivation (Evrard and Goudineau 2004; de Rouw et al. 2003). The decline in fallow period under the slash and burn system has increased weed infestation, heightened labour requirements and intensified tillage practices in upper catchments. The transformation of the slash and burn system has the potential to exacerbate soil erosion and reduce soil fertility and crop yields with adverse consequences for livelihoods of poor farmers in upper catchments (Roder 1997; MRC 2003).

Controlled studies documented the hydrological impacts of land use change in upper catchments of the Mekong river basin (see IWMI and ADB 2003; Bricquet et al. 2003). The Management of Soil Erosion Consortium (MSEC) research project offers technical alternatives in the form of best practices such as contour cropping, improved fallow and hillside ditch farming (Maglinao et al. 2003). When adopted in catchments characterised by diversity in soil types, slope and rainfall dynamics, such technical options have the potential to reduce soil erosion and increase soil fertility (NAFRI 2002). However, despite the demonstrated advantages of alternative practices, farmer adoption of alternative practices remains low in the region for a variety of institutional reasons ranging from low household incomes and poor market access to inadequate farmer extension services (Wapet and Buranatanung 2004).

This study posed two questions to assess potential for farmer adoption of soil conservation practices at the MSEC project site in Luang Phabang province of Lao PDR. First, what are the potential socio-economic impacts of adoption of alternative practices and management systems in the Mekong river basin? Second, what is the policy, legal and organisational constraints to adoption of alternative practices? In this light, we provide an overview of the study area and description of the MSEC research project. Next follows explanation of research methods adopted by this study and an analytical framework for analysis of farmer adoption of alternative practices in uplands of Lao PDR. We then report on key findings of the assessment of farmer adoption of practices proposed by MSEC research in Lao PDR and finally, highlight some of the key conclusions of the study.

9.2.2 The Mekong River Basin in Lao PDR

Lao PDR occupies the largest land area among six countries in the Mekong River Basin (MRB). The largest share of the catchment of the MRB falls within the boundaries of Lao PDR. Further, among all lower MRB countries Lao PDR contributes the largest amount of water to the basin (MRC 2003). As a percentage of total population, Lao PDR has the largest share within the MRB. The province of Luang Phabang has the largest area under slash and burn agriculture representing about 25% of the national area (Roder 1997: 3). Most of the cultivation is in the 300–1,200 m altitude range and a slope gradient of 20% or more (Roder 1997: 3). In recent years, policy changes such as resettlement schemes intensified pressure on land and water resources in upper catchments and shortened fallow periods under the slash and burn farming system (Lestrelin and Giordano 2005; Vandergeest 2003). Further, policies relating to grant of private land use rights regulated access to areas previously communally managed for livestock forage (IUCN 2000; Fujita and Phanvilay 2004). In fact, Luang Phabang is one of the pilot focal areas of the government's attempt at land tenure reform. Since implementation in 1989, the government's land use planning and allocation programme in Luang Phabang province provided for allocation of temporary land use rights to farmers for agriculture and hill land. A critical assumption of government policy is that regulation of shifting cultivation in the uplands is vital to protecting remaining forests and reducing poverty (Dupar and Badenoch 2002: 27).

The estimated fallow length required to maintain soil fertility, especially, Organic C at optimal levels in Lao PDR is 15–20 years (Whitaker et al. 1972). 'Given the fact that average fallow periods declined to between 6 and 8 years, at present organic matter levels are expected to decline further until reaching equilibrium. The *potential yield* of rice and other cash crops may reflect the most obvious effect of a decline in soil carbon and nitrogen as markets for these crops expand in the future' (Roder 1997: 5). Recognising this challenge, the MSEC consortium, which is one of four consortia of the Soil, Water and Nutrient Management (SWNM) system wide initiative of the Consultative Group on International Agriculture Research (CGIAR) was set up to promote integrated watershed management. In 1998, MSEC initiated a research project in Lao PDR with financial support from the Asian Development Bank (ADB) (IWMI-ADB 2003: 11). At the Lao MSEC site, rainfall, runoff and sediment yields were monitored using installed equipment. Erosion and runoff in each catchment were recorded manually using staff gauges and automatically using the automatic water level recorders (Maglinao et al. 2003: 34). Based on analysis of biophysical data best bet technical options were proposed for upper catchments in Lao PDR under the assumption that appropriate farmer participation would stabilise rates of soil and nutrient loss and increase per ha yields of farming systems.

Lao PDR is working on three options. These are improved fallow with pigeon pea (*Cajanus cajan Hutch)* and *Crotalaria micans* (recommended by Integrated Upland Agriculture Research Project), contour planting of pineapple as recommended by Asia land/sloping land project. The third method recommended by CIRAD (French Research Centre for Agriculture and Development) is no till and direct sowing in dead mulch of Ruzzi grass (*Brachiaria ruziziensis* Germain and Evrard) with limited use of glyphosate (de Rouw et al. 2003). The Improved Fallow (IF) option includes planting of pigeon pea and crotolaria seeds in plots of annual crops like maize, Job's Tears and upland rice to enrich the poor bush fallow with additional biomass, early ground cover and extra litter to improve the soil and suppress weeds in a short period (de Rouw et al. 2003: 17). The Contour Planting (CP) method[1] envisages planting

[1]Agronomists point out that the CP system can be adopted easily when the fallow period is no longer possible (de Rouw et al. 2003: 17). In the case of the MWNT system, Ruzzi grass acts as a grazed fallow.

fruit trees including bananas, pineapple, rambutan or sour lychee spaced every six metres along contour lines in upland plots of Maize, Job's Tears and upland rice with a view to reducing soil erosion and increasing farm income from sale of fruit products. The Mulch with no Tillage option (MWNT) includes planting of Ruzzi grass in upland plots and simultaneous spraying of herbicide to reduce soil erosion and prevent weed infestation respectively. An additional benefit of Ruzzi grass would be provision of livestock forage in upland plots.

9.2.3 Bio-physical Characteristics of the MSEC Catchment in Lao PDR

The term used for MSEC *catchment* in Lao PDR is *Houay Pano*. The catchment receives an annual average rainfall of 1,400 mm of which 90% falls between April to October (the rainy season) and the balance during the dry season that extends from November to March (Lestrelin and Giordano 2005). The catchment has a total area of 64 ha comprising five micro-catchments. Elevation in the site ranges from 425 to 718 m and slope angles range from three to more than 350°. The northern reaches of the catchment contain the highest elevation whereas high slope angles are in the northern and southern parts of the catchment. A detailed soil survey revealed that Alfisols (*topsoil texture classified as heavy clay and rated medium in soil fertility*) covered about 50% of the site (IRD-NAFRI-IWMI 2004). Water that originates in the upper part of the *Houay Pano* catchment runs into the Xon stream, one of the tributaries of the Nam Dong River that drains in the Mekong River in the town of Luang Phabang.

9.2.4 Socio-economic Profile and Crop Production System of Lak Sip Settlement

Houay Pano catchment is located 10 km from the town of Luang Phabang. The Houay Pano catchment is near the settlement of Lak Sip, formed by the relocation of five, neighbouring villages beginning after the 1975 political revolution (IRD-NAFRI-IWMI 2004). In 2003, there were 93 households in Lak Sip, but only 25 farmed-plots in the area covered by MSEC catchment known as Houay Pano. Household surveys from 2004, of 20 of 25 households with plots in Houay Pano catchment, revealed that Khamu is the main ethnic group with 87% of the population. Average farm income was US$ 370 while average income from non-farm sources was US$ 1,906.[2]

[2]On average, households at the MSEC site in Lao PDR derive 70% of their annual income from non-farm sources.

According to ethnographic literature the main economic activities of this group is shifting cultivation of upland rice, collection of timber, Non Timber Forest Product (NTFP) and hunting in forest areas (Preisig 1997). Although average size of plots owned is 3.75 ha, the average size of operational farm plots in the settlement varies between 1.4 ha in the wet season to 0.64 ha in the dry season. Upland rice and Job's Tears are the most important crops cultivated in Houay Pano catchment in the wet season (IRD-NAFRI-IWMI 2004). The catchment utilises no tillage and inputs of fertilisers or chemicals. Land preparation consists of slashing secondary forest or shrub vegetation in January or February and burning the dry biomass in March or April. With the onset of the monsoon rain in June, locals plant rice that is mostly glutinous using a double stick. A single crop of maize is harvested towards the end of August followed by rice towards the end of October and Job's Tears in early November (Roder 1997).

9.2.5 Analytical Approach

Unlike previous studies that benefited from *before after* or *with and without* comparisons of farmers that adopted new practices, this study did not have a ready sample of farmers to interview based on technology adoption (Namara et al. 2003). We found field trials still proceeding at the scale of MSEC experimental plots and farmer adoption is yet to take place at farm, catchment, watershed or river basin scale.[3] The absence of data on actual adoption should not prevent attempts to understand the *potential* for technology adoption.[4] Preliminary results of studies on crop yields and soil and nutrient loss when analysed in tandem with results of studies on cost-benefit of crop production can highlight potential for technology adoption by farmers.

We foresee three particular benefits of prospective studies for scaling up outputs of biophysical research. First, consultations with farmers' groups and the field staff of parastatals enhance *social learning* on processes of information exchange, capacity building and project cycle management (Biggs and Smith 2003). Second, a number

[3]Discussions with farmers whose plots are being used for MSEC experiments revealed that a majority of them are unaware of the nature of experiments being undertaken on their plots despite the fact that such experiments have been going on for at least two to three years.

[4]We acknowledge the importance of data in arriving at policy conclusions; time series data may make our arguments more attractive when compared to data from a single year. However, in the context of studies on technology adoption time series data may improve our understanding of biophysical processes (erosion, nutrient loss, etc.) but does not necessarily enrich our understanding of institutional factors that mediate technology adoption by farmers. As Scott points out, 'schemes for introduction of such new crops as cotton, tobacco, groundnuts and rice as well as plans for mechanization, irrigation and fertilizer regimes had been preceded by lengthy technical studies and field trials. Why, then, have such a large number of these schemes failed to deliver anything like the results foreseen for them?' (Scott 1998: 288). Scott suggests that the failure lies partly in the obsession with data generated by a narrow, experimental and exclusively quantitative approach that drives out other forms of local knowledge and judgment posed by cultivators.

of institutional issues related to labour availability for farm operations and access to markets for agricultural inputs and commodities are flagged even as technology development proceeds apace (Scott 1998). Finally, an added benefit of a prospective study is that a methodology that incorporates perspectives on distribution of costs and benefits of technology adoption among farmers of differing class and gender categories could be developed that helps monitor and evaluate pro-poor impacts of technology adoption across both time and space (Kurian and Dietz 2005).[5]

Explaining technology adoption: Importance of process variables

To identify constraints and opportunities of farmer adoption of alternative soil conservation practices we focused on gross margins and costs that farmers experience from crop production under a given set of technological practices. Farmers in Luang Phabang do not incur costs for fertiliser and transportation. Therefore, gross margins were most likely influenced by per ha yields and labour costs. Labour exchange is a customary practice to perform farm operations in the region. This entails reciprocal hiring of labour as a form of self-help (see Preisig 1997). Therefore, in calculating labour costs we assumed that every employable member of a household would offer his or her services on farms of at least three households. Depending on family size of the household hiring out labour, the same household can expect to receive three times the same number of labour to help with farm operations. This figure when added to the number of members of employable age in the household would give us the total number of labourers available to perform farm operations free of charge. Every additional labourer required would incur a wage of US$ 1.50 per day.[6]

In calculating yields for Job's Tears under the improved fallow system we allowed for a 20% increase in per ha yields over the slash and burn system for plots in higher reaches of the catchment, a 30% increase for plots in the middle reaches of the catchment and a 40% increase for plots in lower reaches of the catchment. These categories fit well with the range of figures of yield increase for Job's Tears as reported by agronomic studies in Houay Pano catchment (see de Rouw et al. 2003). Potential constraints to generating gross margins were size and quality of farm plots, quality of output (for example rice or Job's Tears) and differences in price received by farmers for sale of agricultural crops.

Our analysis of food security benefited from nutrition studies in Lao PDR. We found that an average person would consume 535 g of rice daily yielding approximately 1,900 kcal, which gives a 90% adequacy of daily intake (Aree et al. 2003: 10).

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[5]Sen makes a strong methodological case for assigning evaluative weights to different components of quality of life (forests, soils or household incomes) and then to place the chosen weights for open public discussion (Sen 1999: 81). Others emphasised the need to examine issues of intergenerational equity in tandem with generating and analysing data on biophysical change to understand potential for farmer adoption of alternative technologies and management practices (see Dasgupta 2005).

[6]Roder points out that daily wages for agricultural labour are normally paid at the rate of 4–6 kg of rice plus free meals (Roder 1997: 4).

Based on group discussions in Lak Sip, we found that balanced nutritional requirements come normally from consumption of vegetables, crabs, rats and forest products. The population at Lak Sip consumes meat, eggs and poultry products less frequently. By combining information on household size with 1999 market price for a kilo of rice, we calculated household food requirements. We then calculated the extent to which gross margins derived from sale of Job's Tears would meet household food sufficiency requirements of poor households.

We found that on average each household comprises three members of employable age.[7] The availability of members of employable age within households is crucial in determining potential for cultivation of commercial crops like bananas and pineapples. In the case of pineapples, 2 years after initial planting the crop is available for harvest annually in August. However, since the weeding operations for pineapple coincides with similar operations for rice, Job's Tears and maize, there is intense demand for farm labour. Most households prioritise achieving household food security based on production of rice and maize or sale of Job's Tears to purchase food items. On average, we found that each household could sustain its food production from domestic production for up to 9 months. Using 9 months as an average, we found that about 30% of households did not meet the average figure and we classified them as food insecure.

We also consider transparent policy processes as reflected in information exchange between MSEC scientists and field staff of parastatals to have an important influence on farmer adoption of alternative practices at different scales: experimental plot, farm, catchment, watershed or river basin. The predictability of the legal and policy framework as reflected in, for instance, stability of market prices for some crops or flexibility of land-tenure reform process could also influence farmer adoption of alternative practices. The sensitivity of cropping patterns to changes in market prices was evident, for example in the 1990s, when the decline in price of coffee on the international market resulted in a sharp decline in area under coffee cultivation in Luang Phabang from 313 ha in 1990 to 90 ha in 2000 (State Planning Committee 2000). It is also important to recognise that fluctuation in export volumes of agricultural crops has been accompanied by a steady devaluation of the Laos currency (*Kip*) against the US Dollar between 1999 and 2004.

9.2.6 Household Sampling Strategy

At the MSEC site, we chose 20 farmers for structured interviews ensuring that we had selected at least three farmers with plots located at the upper, middle and lower

[7]We used age 20 as criterion to determine employable age since that was a minimum age required to undertake meaningful wage labour in towns or undertake farm activities like cropping, weeding and harvesting. We acknowledge that young children are employed to undertake farm activities like transporting weeds and harvested crops, but only in exceptional cases are children involved with harvesting activities on farms.

reaches of the catchment. Nine MSEC weirs are located at different reaches of the catchment and over time data on rates of sediment discharge, run-off and sediment load are available based on analysis of soil erosion data collected at these weirs. Based on analysis of soil erosion data, MSEC biophysical research identified alternative options to sustainable land use management in upper catchments. By sampling farmers with plots located near these weirs, we are in a position to understand constraints and opportunities for farmer adoption of alternative technological options recommended by MSEC research.

9.2.7 Data Collection Techniques

Data collection occurred over 1 year by employing structured farmer interviews complemented by focused group discussions with representatives of farmer groups and field staff of government departments. Secondary information like field reports and country documents were also reviewed. Discussions with farmers took place at two other micro-catchments near Lao PDR MSEC site: *Donekang* village, in the Nam Dong watershed and Kok Ngio that lies outside the Nam Dong watershed but is part of the Mekong river basin. At Donekang and Kok Ngio villages,[8] we discussed a strategy for scaling up farmer adoption of alternative practices in the Mekong river basin based on our analysis at the Lak Sip.

9.3 Discussion of Study Findings

The establishment of a large network of benchmark catchments for soil erosion research provided a valuable tool for evaluating the impact of land use changes on soil erosion. At the Lao MSEC site (*Houay Pano*), nine hydrological stations were established in 1999–2002. In 2001–2002, four additional stations were added, each draining a micro-catchment of less than 1 ha. These four mini catchments were each used to study rates of soil erosion, weed infestation and crop productivity under the short cycle Slash and Burn system and compared them with rates under alternative farming systems namely improved fallow, contour planting and mulch with no tillage (de Rouw et al. 2003: 16–17). In 2003, the results of the first season of hydrological assessments became available.

[8]The MSEC village (*Lak Sip*) and Donekang and Kok Ngio are all characterised by similarities in crop production system and edaphic features related to slope, elevation and soil and forest types. Kok Ngio has 145 households of which 106 belong to the Khamu ethnic group, 32 are Lao Lung and seven are Lao Sung. Donekang has 64 households of which 38 are Khamu, 19 are Lao Lung and six are Lao Sung. Close to 90% of households at both Kok Ngio and Donekang villages are engaged in non-farm jobs as a primary source of household income.

9.3.1 Evidence on Soil and Nutrient Loss: Fallow Period and Agricultural Yields

Marked differences in soil and nutrient losses showed between the four mini-catchments (Table 9.1). The biggest loss produced by either run-off water or by accumulation of sediments outside the field was recorded in the short rotation slash and burn system. In comparison, erosion and nutrient losses in the other three systems reduced from one-third to less than one-tenth. On the other hand, agronomic studies in Houay Pano catchment reveal that although erosion rates were the highest under the slash and burn system, crop yields were highest under this system, averaging 1,900 kg per ha for rice and 1,400 kg per ha for Job's Tears. Crop yields of Job's Tears under the improved fallow system averaged 400 kg per ha.[9]

However, discussions with farmers reveal the importance of topographic features like slope and soil erosion potential of individual farm plots and their effect on crop yields. For instance, on erosion prone plots that are located on steep slopes, Job's Tears yields were more likely to be in the range of 400–500 kg per ha under the slash and burn system (see Table 9.2). On erosion prone plots that are located on land with moderate to lower slopes, Job's Tears yields under the slash and burn system were likely to be still lower and in range between 200–300 kg per ha respectively.[10] Therefore, an IF system has the potential to increase per ha agricultural yields on erosion prone plots with diverse slope characteristics.

9.3.2 Potential Economic Benefits

Discussion in the previous section leads to the conclusion that results of yield increases for Job's Tears under the IF system represented an improvement over yields under the slash and burn system, especially for erosion prone plots in the catchment. Our socio-economic analysis reveals that 70% of farmers with plots in Houay Pano catchment cropped Job's Tears on an average area of 0.79 ha. Under the slash and burn system, average annual production of Job's Tears was 753.5 kg per ha requiring 58 labourers, on aggregate, to be hired. Our analysis of potential

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[9]Mixed cropping of Job's Tears and Pigeon Pea caused a yield reduction of between 26% and 53%. Mixed cropping of Job's Tears with Crotolaria on the other hand gave an improved grain yield of between 5% and 47% (de Rouw et al. 2003: 19). Yields of maize under MWNT were only 280 kg per ha since sowing of maize in MSEC experimental plots was delayed due to problems of clearing and access (de Rouw et al. 2003: 19). Further, none of the farmers we interviewed had yet adopted contour planting. We therefore did not consider the CP and MWNT systems in our analysis of potential economic benefits.

[10]Higher yields reported by farmers for erosion prone plots located at steeper locations when compared to similar plots located at moderate and lower slopes is probably explained by the fact that plots at steeper locations are under a long rotation fallow period.

Table 9.1 Soil and nutrient losses in two farming systems

	Slope %		Soil loss (tons per ha)		Nutrient loss (kg per ha)				
					Suspended load	Bed load			
Farming System	Mean	Range	Suspended load	Bed load	Org. matter	N	P_2O_5	K_2O	Org. matter
Conventional slash and burn	45	35–71	0.99	4.74	58	8	3	1	262
Improved fallow	40	30–49	0.01	0.40	1	1	0	0	24

Suspended loads are evacuated by runoff water, bed loads are sediments trapped in the weirs
de Rouw et al. (2003)

Table 9.2 Influence of soil fertility on yields under slash and burn farming system

Slope of Farm Plots	Productivity of Job's Tears on erosion prone plots under S&B system (kg)	Job's Tears yields on erosion prone plots under IF system (kg)
Steep	500	900
Moderate	200	500
Low	300	1.5 t

Author's field surveys in 2004

economic benefits reveals that in aggregate terms gross margins under the improved fallow system would rise from US$ 83.8 under the slash and burn system to US$ 140.40 under improved fallow system (see Table 9.3).

9.3.3 Social and Political Acceptability of Improved Fallow Technology

It is clear from the above discussion that the improved fallow system has the potential to improve per ha yields and gross margins from production of Job's Tears. Further, all farmers with erosion prone plots who could potentially benefit from an improvement in per ha yields and gross margins belonged to either middle or low farm income categories.[11] Nevertheless, would improved fallow be socially and politically acceptable as a technological alternative? To analyse this issue we examined two factors: potential impact of adoption of improved fallow on distribution of gross margins from production of Job's Tears among different categories of farmers and its effect on household food security.

Does improved fallow technology favour poor farmers?

Our analysis indicates that farmer adoption of improved fallow technology has the potential to reduce levels of income poverty. Gross margins from production of Job's Tears increases by US$73.00 and US$33.20 for high, middle and low-income farmers respectively (see Table 9.4). Under this scenario, distribution of aggregate gross margins from Job's Tears production has a pronounced effect on levels of income poverty for all categories of farmers. Further, the number of farmers in the low-income category declines since gross margins from production of Job's Tears using IF has potential to move them into a middle-income category.

[11]Based on an examination of income distribution, we classified farmers into three categories: High income-greater than USD 600, middle income-between USD 370–599 and low income-USD 369 and lower.

Table 9.3 Gross margins from Job's Tears production

Technology	Average gross margins (in US$) from Job's tears production
Conventional slash and burn	83.3
Improved fallow (IF)	140.4

We did not include the cost of crotolaria seeds since according to farmers; they are not available locally and were procured by MSEC staff for purposes of experimentation
Author's household surveys in 2004

Table 9.4 Distribution of aggregate gross margins from production of Job's Tears and its impact on income poverty

Farmer Category	Conventional slash and burn (US$)	IF (US$)
High income	148.5(2)	+57.3(2)
Middle income	91.6(3)	+73(5)
Low income	66.9(9)	+33.2(7)

Figures in parenthesis refer to number of households
Author's household surveys in 2004

Does adoption of improved fallow technology improve household food security?

We point out above that on average, each household could sustain their food production from domestic production for up to 9 months. Using 9 months as an average figure, we found that about 30% of households did not meet the average figure and we classified them as being food insecure. Of the five households classified as food insecure, one household stood to improve its food security by adopting IF technology (see Table 9.5). Discussions on intra-household decision-making related to food and expenditure (*for the household most likely to improve its food security*) reveals, in contrast to the Lao Luang ethnic group, improvement in household food security was more evenly distributed across household members irrespective of age or gender differences in the Khamu ethnic group, the majority populations in our study villages. For the other four households a combination of socio-ecological factors like household size, plot size and productivity could explain lack of improvement in food security despite a change in farming practices.

9.3.4 Farmer Access to Benefits of IF Technology: Institutional Environment Versus Institutional Arrangements

9.3.4.1 Rigidity of Land Tenure Reform Process

We found that all five farmers identified earlier as food insecure all had farm plots that are erosion prone. One of the five farming households stood to improve its food security situation by adopting IF technology. But of the four farmers who are not

Table 9.5 Trends in household food security

Farmer name	Annual average food requirement in kilos (No. of household members * grams per day/1,000)	Total Monetary Cost in US$ (assuming cost of 1 kg of ordinary rice at 1999 prices = Kip 2,521)	Gross margins from job's tears production using IF technology (US$)	Household food sufficiency improves from job's tears production using IF technology
Keo	1,757.4	443	129.6	No
Manh	1,171.6	295	108	No
Tong Van	585.3	147.6	156	Yes
Jansiphan	781	196.9	120	No
Tong Kham	781	196.9	120	No

Author's farmer surveys in 2004

likely to improve their food security, two have farm plots that are erosion prone with low levels of productivity while the other two households have farm plots that are too small proportionate to household size. The two farmers with relatively small farm plots had a family of nine and six individuals and relied on plots of sizes 1.5 and 1.4 ha respectively, well below the village average of 3.75 ha. In their view an additional 2 ha of land would be sufficient for them to meet their food requirements.[12] Yet discussions with field staff of the District Forestry and Agriculture office revealed that further land distribution is unlikely in the near future. The rigidity of the land-tenure reform process is apparent from Article 17 of the Land Law, which makes no allowance for changes in plot size due to population growth (Lestrelin and Giordano 2005). Rigidity of the land-tenure reform process constrains farmers from benefit of the potential yield increases offered by alternative technological practices.

9.3.4.2 Poor access to Information

Farmer surveys at Lak Sip, Kok Ngio and Don Kang revealed that most farmers had no information on the cost of Crotoloria seeds (used in IF). Lack of information on sources of good quality seeds also affected quality of crop production reflected in variable prices that farmers received for their output. We are confident that information exchange between MSEC scientists, farmers and extension agents may address the concerns expressed by de Rouw about labour constraints during cropping of Job's Tears under (De Rouw et al. 2003: 19). Further, in 2001–2002 inaccurate information on market conditions was responsible for government extension workers persuading farmers to cultivate Job's Tears as a cash crop. However, when the Thai company that struck a deal with the province of Luang Phabang to purchase a tonne of the crop reneged on its agreement farmers were left with insufficient money to buy food (Dupar and Badenoch 2002: 60). Lack of adequate information exchange is another serious constraint to farmers benefiting from IF technology in Lao PDR.

9.3.4.3 Price Fluctuation

Price of Job's Tears has a crucial bearing on whether farmers would adopt IF technology on a large scale. Between 1999 and 2004, the price of Job's Tears fluctuated because of changes in the structure of the export market. Continuous changes in demand from Thailand, China and Taiwan affected volume of exports with implications

[12] Our discussions with villagers at Don Kang village in Nam Dong watershed revealed that no allocation of land use rights had been undertaken there.

Table 9.6 Market trends for Job's Tears in Luang Phabang province

Year	Price received by farmers (US$ per kg)	Export price (in US$ per t)	Total volume exported (t)	Export market
1999	0.02–0.07	0.11	1,793	Thailand
2000	0.02–0.07	0.11	4,894	Thailand (4,834 t) China (50 t)
2001	0.3–0.46	0.5	605	Thailand (582 t) Taiwan (23 t)
2002	0.2–0.3	0.38	1,110	Thailand (857 t) Taiwan (253 t)
2003	0.15–0.20	0.19	4,586	China (215 t) Taiwan (1,041 t) Thailand (3,330 t)
2004	0.08–0.1	0.15	In process	Thailand Taiwan

Department of Commerce, Luang Phabang

for price that farmers received for their production of Job's Tears in Luang Phabang province (see Table 9.6). Other studies documented how the price of upland rice declined in the latter part of the 1990s (Roder 1997: 4), drastically affecting crop productivity and area under rice cultivation in Luang Phabang province (State Planning Committee 1999). Price fluctuation for crops like rice and Job's Tears poses a challenge to benefit streams available to farmers from adoption of IF technology.

Technical capacity

Discussions with field staff of the District Agriculture and Forestry office, which are primarily responsible for natural resource management in Luang Phabang province revealed that in their visits to villages, farmers sought their advice on where they may purchase mango and avocado seeds (see also Roder 1997: 7). Field staff pointed out that their ability to provide technical assistance to farmers as outlined by Article 72 of the Law on Agriculture (*survey natural resources potential*) and Article 61 of the Forestry Law would improve drastically if they had access to nationwide data sets on issues such as trends in land cover change (GoL 1996, 1998). Further, field staff emphasised the importance of adequate staffing levels so that they could effectively discharge their duties related to organising of farmer training as outlined in Article 59 of the Law on Agriculture and prioritising forest management activities in accordance with Article 11 of the Order on Customary Rights and Use of Forest Resources (GoL 1995, 1998). Building up technical capacity at local levels would go a long way in ensuring that farmers benefit from adoption of improved fallow technology.

9.4 Conclusions

This chapter posed two sets of research questions. First, what are the potential socio-economic impacts of adoption of alternative practices and management systems in the Mekong river basin? Second, what are the legal, policy and organisational constraints to adoption of alternative practices? Our first conclusion is that agronomic and socio-economic studies suggest that farmers with erosion prone plots stood to benefit from an increase in per ha yields of Job's Tears from adoption of IF technology. Further, we concluded that IF technology has the potential to improve gross margins. We argue that positive changes in gross margins could also potentially reduce incidence of food insecurity among poor farming households.

Our analysis also highlights constraints that prevent farmers from benefitting from adoption of IF technology. First, information exchange among stakeholders: MSEC scientists, extension agents, policymakers and farming communities are poor at the moment. Information and data on hydrological, agronomic and socio-economic studies when shared among various stakeholders like researchers in universities, NGO field workers and field staff of parastatals may go a long way in creating a sense of ownership and foster technology development besides generating improved methods for monitoring, evaluation and performance indicators of pro-poor development and erosion control.

This study also emphasises the need for enhanced technical capacity to ensure that extension agencies can effectively undertake research programmes that address regional development priorities.[13] We also highlighted institutional constraints related to price fluctuation for agricultural crops and rigidity of the land-tenure reform process. In the case of IF, inter-sectoral policy coordination may be required to stabilise the market price of Job's Tears (see Kurian et al. 2003). Inter-sectoral policy coordination that targets expansion of non-farm employment can also potentially optimise agricultural land use especially in the context of government sponsored population resettlement schemes and grant of land use rights in upper catchments of the Mekong river basin in Lao PDR.

[13]The Lao Asia Land project supported by the Swiss Agency for Development and Cooperation highlights the following lessons (Bouahom et al. 2004: 25–27):

- SLM technologies for upland farmers should not only address conservation aspects but also farmers' income; this should receive high priority.
- An incentive subsidy for poor upland farmers who implement new technologies should be considered.
- Need to organise cross-site/country visits for farmers for learning, sharing of experience and knowledge.
- The involvement of local administrative agencies is very important and is needed to promote SLM technologies.
- SLM technologies should be included in school curriculum for better understanding by the younger generation.

References

Aree, J. Y., Meusch, E., Homsambath, K., & Feliciano, E. (2003). Women, water and household food security in selected Lao PDR communities. Chapter presented at the First South East Asia Water Forum, Empress Hotel, Chiang Mai, 17–21 November.

Berkes, F. (2002). Cross-scale institutional linkages: perspectives from bottom up. In T. Dietz, N. Dolsak, E. Ostrom, & P. Stern (Eds.), *The Drama of the Commons*. Washington, DC: National Research Council.

Biggs, S., & Smith, S. (2003). A paradox of learning in project cycle management and the role of organizational culture. *World Development, 31*(10), 1743–1757.

Bouahom, B., Sengtaheuanghoung, O., & Phanthaboun, K. (2004). Participatory upland development for sustainable agriculture in Lao P.D.R.: a comprehensive final report of the Asia land sloping lands. Project-5. Vientiane: National Agriculture Forestry Research Institute, 1 September 2001 to 31 December 2004.

Bricquet, J. P., Boosaner, A., Bouahom, B., & Toan, T. D. (2003). Statistical analysis of long-term series rainfall data: A regional study in south east Asia. Proceedings of the IWMI-ADB Project Annual Meeting and 7th MSEC Assembly, Vientiane, 2–7 December.

Dasgupta, S., Deichmann, U., Meisner, C., & Wheeler, D. (2005). Where is the poverty-environment nexus? Evidence from Cambodia, Lao PDR and Vietnam. *World Development*, *33*(4), 617–638.

De Rouw, A., Kadsachac, K., & Gay, I. (2003). Four farming systems: a comparative test for erosion, weeds and labour input in Luang Phabang District, *Juth Pakai, 1*, 15–23. United Nations Development Program Lao PDR, December

Dorward, A., Kydd, J., Morrison, J., & Poulton, C. (2005). Institutions, markets and economic coordination: Linking development policy to theory and praxis. *Development and Change*, *36*(1), 1–25.

Dupar, M., & Badenoch, N. (2002). *Environment, livelihoods and local institutions: decentralization in mainland south-east Asia*. Washington, DC: World Resources Institute.

Evrard, O., & Goudineau, Y. (2004). Planned resettlement, unexpected migration and cultural trauma in Laos. *Development and Change, 35*(5), 937–962.

Fujita, Y., & Phanvilay, K. (2004). Land and forest allocation and its implication on forest management and household livelihoods: comparison of case studies for community based natural resource management research in central Laos. Chapter presented at the 10th Biennial Conference of the International Association for the Study of Common Property, Oaxaca, 9–13 August.

GoL (1995). Order on customary rights and the use of forest resources based on the constitution of Lao PDR, Government of Lao PDR, Vientiane.

GoL (1996). The forestry law, adopted by the National Assembly and promulgated by the President. Vientiane: Government of Lao PDR, 2 Nov.

GoL (1998). The law on agriculture, adopted by the National Assembly and promulgated by the President. Vientiane: Government of Lao PDR, 6 Nov.

IRD-NAFRI-IWMI (2004). Houay Pano catchment (district of Luang Phabang): A field guide, January.

IUCN-The World Conservation Union (2000). Luang Phabang province environmental inventory, Vientiane.

IWMI-ADB. (2003). *Catchment approach to managing soil erosion in Asia: results and lessons learnt*. Bangkok: IWMI-ADB.

Kurian, M., & Dietz, T. (2005). How pro-poor are participatory in watershed management projects? An Indian case study. Research Report No. 92, Colombo: International Water Management Institute.

Kurian, M., Dietz, T., & Murali, K. S. (2003). Scaling up participatory watershed management: Evidence from the Himalayan foothills. *Economic and Political Weekly, 38*(50), 5285–5293, 13 December.

Kurian, M. & Lestrelin, G. (2004). Market integration, natural resource degradation and poverty: a comparative analysis of Thailand and Lao PDR. *Proceedings of the International Conference* *on Innovative Practices for Sustainable Sloping Lands and Watershed Management.* Chiang Mai: Chiang Mai Hill Hotel, 5–9 September.

Lestrelin, G., & Giordano, M. (2005). When conservation leads to degradation: a case study of Ban Lak Sip, Lao PDR, International Water Management Institute Research Report No. 91, Colombo: International Water Management Institute.

Maglinao, A., Valentine, C., & Penning de Vries, F. (2003). The management of soil erosion consortium project: A case of integrated natural resources management research. Proceedings of the IWMI-ADB Project Annual Meeting and 7th MSEC Assembly, Vientiane, 2–7 December.

MRC. (2003). *Mekong river basin profile: towards the development of strategic research and development plans*. Vientiane: Mekong River Commission Secretariat.

NAFRI (2002). An innovative approach to sustainable land management in Lao PDR. National Agriculture and Forestry Research Institute, Annual Progress Report, Vientiane, October 2001 to November 2002.

Namara, R., Weligamage, P., & Barker, R. (2003). Prospects for adopting system of rice intensification in Sri Lanka: a socio-economic assessment. Research Report No. 75. Colombo: International Water Management Institute.

Preisig, E. (1997). *Khamu livelihood: farming the forest*. Vientiane: Unpublished Manuscript.

Roder, W. (1997). Slash and burn systems in transition: challenges for agricultural development in the hills of Northern Laos. *Mountain Research and Development, 17*(1), 1–10.

Scott, J. C. (1998). *Seeing like a state: how certain schemes to improve the human condition have failed*. New Haven, CT: Yale University Press.

Sen, A. K. (1999). *Development as freedom*. USA/UK: Oxford University Press.

State Planning Committee. (2000). *The households of Lao PDR: Social and expenditure indicators*. Vientiane: National Statistical Centre.

Vandergeest, P. (2003). Land to some tillers: Development-induced displacement in Laos, *International Social Science Journal, 175*, 47–56, UNESCO, Blackwell.

Wapet, S., & Buranatanung, N. (2004). Factors affecting the adoption and non-adoption of the sloping land conservation farming systems by small-scale farmers in Thailand. *Proceedings of the International Conference on Innovative Practices for Sustainable Sloping Lands and Watershed Management*. Chiang Mai: Chiang Mai Hill Hotel, 5–9 September.

Whitaker, R. H. (1972). Evolution and measurement of species diversity, *Taxon 21*, 213–251.

Chapter 10
Approaches to Economic and Environmental Valuation of Domestic Wastewater

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Abstract The main purpose of this chapter is to introduce the conceptual frame and methods of valuing the economic and environmental impacts of wastewater use in peri-urban locations. Urbanisation increases the demand for domestic water and supply of wastewater as 80% of the drinking water supplied would return as wastewater. Despite the volumes, economics of wastewater is less understood, especially with regard to the positive and negative impacts of wastewater use for different purposes. This chapter provides a dis-aggregated picture of wastewater generation, use, impacts and their costs and benefits accruing to communities. For the first time the health impacts for human and livestock populations are assessed in a systematic manner.

The first section focuses on the importance of wastewater, theoretical framework, wastewater generation/use, externalities associated with wastewater and methodological tools to measure the estimates. These methods include direct and indirect methods of valuation. The second section presents the case study, where some of the methods discussed in part one was applied to estimate the impacts of wastewater use on local communities in peri-urban localities. These impacts include agricultural production, human and livestock health impacts. The concluding section provides some strategies for policy and introduces the Life Cycle Cost Analysis (LCCA) as an alternative and appropriate framework for planning and management of wastewater in a sustainable manner.

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10.1 Concepts and Methods

10.1.1 Background

As urbanisation increases, so does the need for an organised water supply. Greater demand and supply of water will generate greater volumes of wastewater (80% of all water supplied, turns into wastewater). Unless wastewater is collected, treated and used properly, it can cause serious environmental problems (land degradation, water and air pollution), which in turn result in human and economic loss for the local community. In most cases, despite existing regulations and quality standards, urban wastewater is left to flow untreated into open fields or rivers (CPCB 2000). While local communities downstream often use this wastewater for productive purposes, the negative consequences are felt later. Typical consequences include loss of drinking water sources and health problems associated with the consumption of contaminated water and food grown under wastewater irrigation.

Unlike industrial effluent, urban wastewater can be used productively, provided its collection, quality and disposal are managed properly. Productive uses of domestic wastewater may include its use in livestock and poultry rearing, kitchen gardens, and minor/medium irrigation. Domestic wastewater re-used for productive purposes is a form of unaccounted for water in need of proper valuation (for both its economic benefits and the health risks it poses). Mechanisms for cost-recovery for water supply services must reflect the benefits and costs of domestic wastewater re-use. An estimated 20 million hectares in 50 countries are irrigated (either directly or indirectly) with wastewater – close to 10% of total irrigated areas (Rijsberman 2004). A national survey of Pakistan showed that one-third of all wastewater produced in the country is used for irrigation, undiluted and untreated. An estimated quarter of all vegetables grown in the country are irrigated with wastewater. Some concerns have been expressed about the health effects of using wastewater for minor irrigation (Smits 2007), but a study in Pakistan's Haroonabad district concluded that some potential health risks of using wastewater for agriculture could be mitigated by conjunctive use of irrigation water. However, changes in farming practices and cooperation between municipal authorities and farmers over sharing of wastewater and management of storage facilities for proper mixing of both water sources would be necessary (Ensink et al. 2002).

10.1.2 Methods of Valuing Externalities

Methods used in valuing costs and benefits can be broadly grouped as direct and indirect. Indirect methods use actual choices made by consumers to develop models of choice for market and non-market goods. These include effects on production/income, human capital approach, averting cost method, travel cost method (TCM), hedonic pricing method and loss of production method. Direct methods ask consumers about their willingness to pay for possible improvement in environmental amenities. Individuals do not make any specific behavioural changes but state how they would be willing to change behaviour. Contingent valuation methods (CVM) and contingent ranking or contingent behaviour are all forms of the direct method. This section considers methods used in valuing health costs and benefits.

In general, the economic cost of human health impacts due to wastewater use consists of three categories: resource costs (direct medical and non-medical costs associated with treatment for adverse health impact), opportunity costs (associated with the loss of productivity and/or leisure time due to health impact) and disutility costs (pain, suffering, discomfort and anxiety linked to illness). In the following section, estimates for developing countries will be presented by various methods.

10.1.2.1 Direct Methods

The most important and widely used direct method is the CVM. Researchers have also recently begun to employ contingent ranking or contingent behaviour to estimate an individual's willingness to pay for environmental amenities. Despite numerous criticisms levelled against CVM, a reasonable degree of success and persistence led to increasing focus on its use.

CVM elicits how people would respond to hypothetical changes in the availability of environmental resources, by using direct questions related to the individual's willingness to pay for certain environmental changes. Given the poor quality of drinking water, many households are willing to pay (WTP) for improved water quality. In a study of six villages, not a single household expressed unwillingness to pay for the provision of quality water by a private firm (Reddy et al. 2008). This applied to both capital costs and a membership fee. The majority of households are willing to pay US$0.75 and above as a membership fee, with the majority of non-poor households willing to pay US$1 and above. In the case of user charges, all households surveyed are willing to pay the present rate of US$0.038 per 12 l. Most of the households prefer home delivery of water and are willing to pay extra for the transport. Among non-poor households, 82% are willing to pay extra (US$0.063/12 l), but only 52% of poor households are willing to pay this price. The differences between poor and non-poor households in the WTP bids are due to the differences in ability to pay. Ability to pay is examined by looking at the household income and expenditure figures. Poor households are willing to pay 4.8% of their household income as opposed to 0.93% in the case of non-poor households. This is quite a substantial variation, as it is often assumed that households are willing to pay up to 3% of their income. It is also observed that willingness to pay for public provision of drinking water is often lower when compared to private suppliers, mainly because of the lack of trust in public utilities in developing countries.

It is observed that the WTP estimates are often higher than when the human capital approach is adopted. A comparison of these two methods in the Chongqing region of China revealed that WTP estimates are more than three times higher than estimates from a human capital approach, which is mainly attributed to the incidence of cancer due to water pollution in this region (Yongguan et al. 2001). In other words, people add the cancer premium to the WTP responses. The difference in estimates could be because WTP estimates often include non-tangible/non-economic costs (social, psychological and aesthetic values).

10.1.2.2 Indirect Methods

The effects on production (EOP) approach states that an activity may affect the output, costs and profitability of producers through its effect on the environment. If there is a market for goods and services, environmental impact can be represented by the change in value, or the reduced value of crops grown as a result of water pollution. EOP has also been used to trace the impact of environmental changes such as soil erosion, deforestation, wetland and reef destruction, and air and water pollution on agriculture, forestry, fisheries, power, public services and other sectors (Bateman et al. 2003). The impact of wastewater use (irrigation water) on agricultural productivity and the annual benefits/losses incurred by the households can be estimated by using actual current market prices.

Agricultural crop production is affected by high concentrations of electrical conductivity (EC), the main indicator of irrigation water quality (Pearce et al. 1993). EC conveys the intensity of salinity of water bodies. This coupled with other pollutants can affect crop production. The loss of income from agriculture is estimated based on the difference between average income earned by those households using wastewater and those not using wastewater. The household level losses due to loss of production are determined based on market prices of the produce.

In a South Indian study, it was observed that wastewater irrigation is characterised by low investments, low yields and lower market price. Due to the better nutrient value of wastewater, farmers do not apply fertiliser. However, they do tend to spend more on pesticides. The incidence of pests is higher during the rainy season as water stagnates. The yield difference between wastewater agriculture and fresh water agriculture is estimated at seven quintals (paddy) per acre. When coupled with an Rs 50 (US$2.50) difference in the price of paddy, farmers using wastewater end up with a gross return of Rs 13,650 (US$359) per acre against Rs 19,600 (US$516) per acre of well-irrigated paddy.

The human capital approach considers people economic capital and their earnings a return on investment. Environmental economics focuses on the impact of poor environmental conditions on human health, and the effect this has on the individual and societal productive potential (Bateman et al. 2003). This method estimates the economic cost of illness. Two variants of this can be taken into account: loss of earnings (working days) due to illness and cost of medical treatment. Often human capital is calculated by using the actual medical expenditure for illness caused by consumption of or exposure to polluted water. Local medical practitioners can help to indicate a correlation between illness and pollution, using a series of water samples and tests to identify contaminants and related diseases.

The human capital method looks only at opportunity costs while the cost of illness (COI) approach additionally includes resource costs. In the context of poor water quality, households adopt various mechanisms whereby resource costs may accrue. Some may replace family labour with hired labour and some knowingly (due to lack of affordability) or unknowingly are exposed to wastewater directly. The last category of households are the subjects for human capital approach and cost-of-illness approach, as they lose productivity and might incur other costs such as for medical treatment. A case study in Andhra Pradesh, India shows that about 5% of households still drink sewage-contaminated water due to cost or inability to bring water from a nearby town. Those who consume the contaminated water complain about stomach pain, diarrhoea and joint pains. Women complain that the water quality has worsened over the years and many are now scared to use the water even for domestic uses. Families consuming this water may have to spend between US$5 and 8 per month on doctor fees and medicines. However, there are no serious complaints of severe sickness leading to loss of working days in the study region. The estimated total costs of water contamination comes to US$88,763 per year for the entire village.

The incidence of sickness and inability to work due to pollution was estimated between 48 and 50 days per year in another study in Andhra Pradesh, India, where water was polluted by industrial discharge (Reddy and Behera 2006). The average number of working days lost per household per year was calculated at US$28 using the market wage rate in the villages. Households in the region used to visit doctors four to five times a year, spending only US$3–4 on health, but after pollution, it has increased substantially in the affected villages. This has an adverse influence on the socio-economic conditions of the people in the affected villages. Health expenditure depends on two factors: the severity of diseases, and the economic condition of the family. Small and marginal farmers (owning less than two hectares of land) visit doctors 20 times per annum and their typical expenditure on medical services is $30. However, in case of medium (owning between 2 and 5 ha of land) and large (owning above five hectares of land) farmers, the average number of visits to doctors is 25 and medical expenses total $40 and $60 respectively after pollution. Large farmers often prefer to go to doctors who charge more and who may prescribe expensive medicines.

The human capital approach was used in a case study of Chongqing region, China, where medical treatment, loss of work and premature death were all considered. Three diseases linked to contaminated water (hepatitis, dysentery and selected cancers) were used in cost estimations. Assuming an adult working age of 18–60 years of age, the study showed the median age for premature death was 53 years, hence a 7 year loss of working life. Individual contributions to production were estimated using the per capita growth (8%) and a discount rate of 12%. The total loss due to poor health was estimated at $21.7 million in the region (Yongguan et al. 2001).

10.1.2.3 Replacement Cost (RC) or Averting Cost (AC)

The RC or AC approach states that in order to avoid environmental degradation, one has to spend some money. Similarly, if the environment has already been damaged, one must spend some money for it to be restored to its original state. For example, some victims of environmental damage might replace their environment by moving away from the affected area. The costs incurred by moving to a clean environment are called replacement costs. One of the techniques adopted in the replacement cost method is direct observation of actual spending on safeguards against environmental risks (Winpenny 1991; Bateman et al. 2003). RC method is often used to estimate the cost of water pollution by measuring actual household expenditures of those who have to purchase clean water to avoid drinking polluted water. A study in Andhra Pradesh observed that about 2% of households buy water from the market in order to avoid adverse health effects. The estimated cost is US$95 per household per year. In the arid regions of Rajasthan almost a quarter of total households buy water from the market, at a cost of more than US$1 per household per day.

10.1.2.4 Travel Cost Method (TCM)

TCM uses people's actual behaviour as a measurement tool. Based on an extended theory of consumer demand, TCM is the most straightforward of the indirect methods, since it recognises that visitors to a recreation site pay an implicit price – the cost of travelling to it, and the opportunity cost of their time. A modified version of this method can be used to estimate the value of time. This random utility theory approach is based on the assumption that household decisions depend upon at least two sets of explanatory variables: source attributes, which affect the household's utility, and household characteristics, which reflect difference in tastes and preferences. According to random utility theory, the probability that household 'h' chooses alternative source 'j' equals the probability that the utility derived from using source 'j' is greater than the utility derived from any other alternative. Following this framework, utility function is estimated with two sets of variables – source attributes and household characteristics.

The functional form is as follows:

$$uih = f\,[Xih, Z1h]$$

where

Uih = Utility derived by household 'h' using a source site 'i'. Here, utility is indirectly determined by the choice of the source [site].

Xih = Represents source attributes like distance between source and household, time spent, money paid for collecting water, etc.

Zih = Represents household characteristics like income, social status, education level, preferences, etc.

In this model, the dependent variable (source/site) is a dichotomous variable estimated with the help of a conditional logit model. This model is found to be useful in estimating the household's value of time and thus is suitable for adaptation in the context of valuation of resources. Two clear cases of such adaptation are drinking water and fuel wood where rural households spend substantial amounts of time collecting/hauling both. The value of time spent by the household is calculated by the ratio of the two coefficients measuring time and money spent for water or fuel wood by the household. The value of time is defined as the marginal rate of substitution between time spent in collecting water/fuel wood and money paid for them. Health costs of using poor quality water can be estimated if households have access to two sources with different source characteristics in terms of quality, time/money spent. For instance, the extra effort put in/amount spent by households collecting/buying good quality water represents the value households place on health. One problem that may arise here is the existence of markets for these items as it may be difficult to find markets for drinking water in all regions. Another problem may be the large variations in tastes, availability of alternative sources, incomes and more, all of which can be taken care of with appropriate econometric techniques. Overall, TCM is believed to be a useful tool and has worked well in different contexts.

To avoid the ill effects of poor quality water, a large proportion of poorer households in developing countries must obtain water from farther away. Rural and peri-urban communities may go to nearby towns to collect water from municipal suppliers. Some households spend an hour each day collecting two cans of water (about 40–50 l). The situation can worsen in summer as waits extend to 2–3 h. About 80% of households resort to this method of water collection, at an estimated cost of US$270 per household per year. In arid regions, the travel time tends to be substantial, with worst-case scenarios as much as 18 h per day per household (Reddy 1999). Often these travel costs are not accounted for as opportunity costs of labour for women and children (whose primary responsibility is the collection of water) are often assumed to be zero in some rural areas of developing countries (Reddy 1999).

10.1.2.5 Hedonic Pricing Method

Hedonic pricing uses surrogate market prices to estimate the value of environmental amenities. Often land values/prices in locations with different air/water quality attributes are used to estimate the value of clean air/water. The difference between land prices in different locations is the value placed by the communities on environmental amenities. Often people pay higher rents or have property values in locales with a good environment. Similarly, workers who prefer a quality work environment may accept lower wages rather than work for a higher wage in a poorer quality environment.

10.2 The Case Study

10.2.1 Sample Design

Karimnagar town in the Karimnagar district of Andhra Pradesh, India was selected as the subject of a detailed case study. Karimnagar district is situated within the geographical co-ordinates of 17–5 Northern latitude and 78–29 Eastern longitude, and is 480 m above sea level. Annual rainfall is 966.2 mm with moderate temperatures, except at Ramagundam, which records the highest temperature in the state (48°C during April–May). Karimnagar district extends over an area of 11,823 km^2 with a population of 3.49 million consisting of five Revenue Divisions, 57 Mandals (local level administrative division) and 1,103 villages of which 42 are uninhabited. The population density is 294 per km^2 according to the 2001 Census. Agriculture is the main activity with a gross cropped area of 0.423 million hectares of which 56% is irrigated. The main crops are rice, maize, green gram, chiles, turmeric, cotton, and groundnuts. The Sriram Sagar Project is a major irrigation project in the area; 5,353 tanks, 198,567 wells and seven other minor projects provide irrigation supplies. As well as agriculture, the major industries are the coalmines at Godavarikhani, thermal power plant at Ramagundam, the Kesoram Cement Factory and the Nizam Sugar Factory.

For the purpose of the study, different locations in Karimnagar town and various wastewater-affected villages were selected. Four wards prone to wastewater stagnation in Karimnagar town were selected. Here the focus was on seasonal flow analysis, discharge and aggregation points, health impacts (incidence of mosquitoes, malaria, water borne diseases, etc.). Among the surrounding villages, one (Bommakal) is directly affected as it uses wastewater for agriculture and livestock purposes. Meanwhile another village (Alaganur) is a victim of the secondary impact of wastewater. Alaganur uses the wastewater discharged into the Manair River for agricultural purposes. Until recently, Alaganur used an infiltration well on the riverbed for drinking water purposes, but the village shifted to a new source after learning of the water contamination. Alaganur is typical of a number of villages in river basins across the country. Bommakal and Alaganur were ideal sample points for assessing the impacts of wastewater. Another two villages using the Manair River as a source of drinking water (infiltration wells) were selected for assessing the downstream impacts of wastewater on drinking water and health. These villages are Srinivasanagar and Lakshmipura. In addition, the village of Chegurthi was selected as a control. The socio-economic and demographic profile of the sample villages is presented in Table 10.1.

10.2.2 Origin of Wastewater

The town of Karimnagar has a good sloping terrain, with mean river levels varying from 300 to 255 m above sea level. The town slopes towards the southeast side,

Table 10.1 Basic features of selected villages

Village	Total cultivated area	Population	No. of households	Number of families[a]			Road connectivity	Distance from nearest town (km)
				S&M F	MF	LF		
Bommakal	1,800	5,000	1,000	550	150	30	Very good	5
Alugunur	1,600	10,000	1,550	500	110	25	Very good	6
Srinivasanagar	350	1,264	291	135	5	0	Poor	10
Laxmipur	1,550	1,638	385	170	90	15	Good	12
Chegurthy	580	2,116	385	190	30	6	Poor	18

Approximate estimations by the villagers during FGDs at village level
[a]Remaining are landless and families involved in employment
S&M F = small and marginal farmers; MF = medium farmers; LF = large farmers

with the Manair River flowing from west to east on the southern side of the city. Karimnagar municipality is one of the biggest in the Telangana region of Andhra Pradesh with an area of 26.85 km^2. The town is divided into 50 wards with 32 notified slums and 16 non-notified slums while another 10 are recommended for recognition, making 58 slums. Notified slums get some basic amenities like water and power, while the non-notified do not get any facilities. Karimnagar is a well-planned town, and was upgraded to the status of Municipal Corporation in 2005. As of 2001, the town population was 205,653 with 42,995 households. The literacy rate is 67%. There are 10 Gram panchayats on the periphery of Karimnagar, with an estimated current population of 275,000. Well connected by road to other cities, Karimnagar is about 160 km from the state capital Hyderabad, 70 km from Warangal and about 60 km from Ramagundam.

10.2.3 Extent, Incidence and Disposal of Wastewater

As discussed, wastewater consists of three components: storm water, domestic and industrial effluent. Karimnagar does not have any major industries that produce waste; hence, storm and domestic waste are the primary sources of wastewater.

Storm water

The geographical area of Karimnagar is about 2642 ha, divided into 50 wards. Storm water drainage in the main city of Karimnagar is well laid out on both sides of the streets and roads. Towards the Manair River, the terrain is flat. Drains are silted up and flooding takes place in the tail end of the drainage system. The storm drainage network is connected to two major nallas, or storm water drains one and two. These two drains meander across the city from west to east and southeast respectively. The urban area of Karimnagar is divided into 14 sub-drainage zones.

The runoff coefficients ranging from 0.70 to 0.45 are used in different zones for calculating the runoff from the design rainfall. The sub-zones draining into a particular aggregation point have been considered for calculating storm water drainage at that point. The monthly rainfall of Karimnagar and number of rainy days has been analysed for different probabilities of occurrence. The monthly rainfall at 50% probability for the five monsoon months (June–October) has been divided by the corresponding number of rainy days at 50% probability to arrive at 1 day's duration of rainfall per month. The weighted values of runoff for each sub-zone have been evaluated. Based on the weighted run off coefficients, 1 day of rainfall and the area for each aggregation point, the drainage volume at each point, has been arrived at for both drains (Tables 10.2 and 10.3). Storm water drainage is higher during the month of October due to high intensity of rainfall.

10.2.3.1 Domestic Wastewater

Domestic wastewater output is directly proportional to domestic water use in the town. The existing piped water supply system was commissioned in 1959. It was

Table 10.2 Storm water drainage at aggregation points on drain one

Month	Monthly rainfall (mm)	No. of rainy days	Avg. daily rainfall (mm)	Storm water drainage/day Point 1	Point 2	Point 3 (final confluence point)
June	141	10	14.2	28,902	67,424	87,795
July	237	15	15.9	32,352	75,470	98,273
August	216	15	14.7	29,993	69,968	91,108
September	157	10	15.9	32,440	75,676	98,541
October	96	5	18.9	38,444	89,682	116,778

Final confluence point cumulative wastewater generation in the town

Table 10.3 Storm water drainage at aggregation points on drain two

Month	Monthly rainfall (mm)	No. of rainy days	Avg. daily rainfall (mm)	Storm water drainage/day Point 1	Point 2	Point 3	Final confluence point
June	141	10	14.2	31,556	51,248	56,773	111,744
July	237	15	15.9	35,322	57,365	63,548	125,080
August	216	15	14.7	32,747	53,182	58,915	115,960
September	157	10	15.9	35,419	57,521	63,722	125,422
October	96	5	18.9	41,974	68,167	75,515	148,634

The final confluence point cumulative wastewater generation in the town

designed to meet the requirements of 20,000 people (based on the 1941 census) at a per capita supply of 100 LPCD with an infiltration gallery 260 ft long in the Manair River bed. Changes made after 1968 to increase water supply included laying an additional 700 ft of gallery, constructing 50,000-gallon capacity elevated service reservoirs, and 250,000 gallon ELSR or OHSR (elevated service reservoir or overhead service reservoir) at court buildings to serve high-level areas. Distribution lines were also extended. Depletion in the yield from the headwater works resulted from the construction of an L.M.D (Lower Manair Dam) project upstream, leaving the present system inadequate. In order to provide relief to the local population, a 24″/18″ RCC gravity main has been laid from L.M.D to head works. In doing so, the water supply scheme was able to provide 13.64 million l per day from the infiltration gallery in the Manair River.

At present, water is released to households on alternate days, from 6 am to 6 pm. The water covers half the area under each reservoir on a single day and the remaining area the next day. In addition to this, 26 3,000–4,000 l capacity tankers mounted on tractors continuously supply water to the slums as well as to elevated areas. These tankers make an average of 80 trips per day. In addition, 0.77 MLD (million litres per day) of water is supplied from bore wells, and 770 hand pumps supplement water for domestic uses. Forty percent of the households further complement the organised water supply with open or bore wells. Water is supplied through 24,380 individual tap connections and 1,000 public stand posts to ensure 135 LPCD.

10.2.4 Total Wastewater Generated

Karimnagar water supply comes only from surface water resource from Manair dam. The per capita daily water supply is 135 l. The water is used for domestic purposes only as there is not much industrial activity in the town. The wastewater generation is 80% of the water supply as per the guidelines in CPHEEO (Central Public Health and Environmental Engineering Office). The population in the catchments of each aggregation point has been calculated and the wastewater generation has been computed (Table 10.4). The total domestic wastewater generated amounts to 22,210 m^3 per day (22.21 MLD). During the 5 months in the rainy season the total wastewater generated in the town ranges between 133,950 m^3 per day (133.95 MLD) and 170,844 m^3 per day (170.84 MLD). The storm water drainage is more than 6 times that of wastewater generation during peak months.

10.2.5 Quality of Wastewater

Both ground and surface water sources have been adversely impacted by wastewater. Untreated wastewater flows into the Manair River directly and through the agricultural fields where it has been used for raising crops. Drinking water is supplied through direct pumping from the infiltration wells located in the Manair River bed. Water samples from the drains in the town as well as from the infiltration wells of the villages were collected and analysed for quality. The villages of Bommakal and Chegurthy are located on the left bank of the river while Alaganur, Sadasivapalli, Sreenivasanagar, Vegurapalli and Otoor are located on the right bank of the river. The tested water samples show that most of the parameters exceeded the limit of normal range, especially in the case of samples 1–6 taken from Karimnagar town and Bommakal (Table 10.5). Bacterial contamination (coliforms) is very high in all the samples. None of the samples are suitable for drinking purposes, although some of the sample villages still use these sources for drinking purposes (S8, S10, S11 and S13). In fact, in samples S1–S6, contamination levels are too high for irrigation. The EC (Electrical Conductivity) and TDS (Total Dissolved Solids) levels in the samples, which determine the agricultural productivity, are above permissible levels. These high levels of contamination have adverse effects on human and livestock health and on crop production. The quantity of MPN coliforms decreases from 2,400 to 240 as one moves farther from Karimnagar. Similarly, the TDS and

Table 10.4 Wastewater Generation (MLD) in Karimnagar Town at aggregation points

Drain	Aggregation point 1	Aggregation point 2	Aggregation point 3	Aggregation point 4	Total
1	2,476	3,141	4,364	–	9,981
2	4,240	596	4,555	2,838	12,229
Total	6,716	3,737	8,919	2,838	22,210

Table 10.5 Quality of wastewater across sample locations

Parameters	Normal range	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13
PH	7.0–8.5	7.6	7.5	7.3	7.9	7.2	7.6	7.4	7.6	7.9	7.6	7.8	8.1	7.6
EC (mho)	750	1469	1232	1468	1478	1225	1539	1369	1225	1125	772	813	379	1444
TDS mg/l	500	954	800	954	960	796	1000	889	796	731	501	528	246	938
Chloride mg/l	200	130	170	164	168	140	236	216	164	140	80	92	28	228
Fluoride mg/l	1	0.24	0.16	0.19	0.18	0.16	0.24	0.20	0.27	1.76	0.20	0.22	0.10	0.29
Nitrate as NO_3 mg/l	45	56	92	116	107	84	78	72	84	72	24	65	06	96
Nitrate as NO_2 mg/l		N	N	N	N	N	P	P	N	N	N	T	N	N
Total hardness mg/l	100	430	430	396	356	328	408	420	364	312	220	196	160	376
Alkanity mg/1	75	560	384	484	480	368	460	392	352	368	268	256	140	388
MPN coliforms /100ml (after 48 h)	<50 for drinking<1,000 for irrigation	2400	2400	2400	2400	2400	2400	552	918	348	240	918	348	240

TDS = total dissolved solids, EC = electrical conductivity
P = present; N = not present and T = trace
S1 = Swashakthi college (town); S2 = Collector office (town); S3 = Civil Hospital (town); S4 = Rythu Bazar (town); S5 = Bommakal bypass; S6 = Dhobi Ghat; S7 = Bommakal; S8 = Sadasivapalli; S9 = Srinivasnagar; S10 = Vegurupally; S11 = Outoor; S12 = Filter bed; S13 = Chegurthy
Water samples tested at the State Level Referral Institute, Hyderabad

Table 10.6 Crop responses to irrigation water with different levels of TDS and EC levels

Crop responses	TDS (mg/1)	EC (mho)
1. Water for which no detrimental effects will usually be noticed	Less than 500	Less than 750
2. Water, which can have detrimental effects on sensitive crops	500–1,000	750–1,500
3. Water that may have adverse effect on many crops	1,000–2,000	1,500–3,000
4. Water that can be used only for salt tolerant plants	2,000–5,000	7,000–7,500

TDS = Total Dissolved Solids, EC = Electrical Conductivities
Goel and Sharma (1996)

EC dropped significantly. These results clearly establish that the harmful effects of the pollutants decreases as travel time increases.

Yield responses are sensitive to salinity or EC and TDS levels. Table 10.6 shows yield responses for irrigation water with different concentrations of salinity and TDS. Actual levels of TDS and EC in the samples are high enough to affect adversely the yields of sensitive crops (see later section). Since paddy is the dominant crop grown with wastewater, the direct impact of wastewater on paddy yields could be marginal. On the other hand, high levels of pollutants in most of the samples indicate that the water is not suitable for human or livestock consumption. Some of these polluted sources are not used for drinking water at present, but some villages still receive their drinking water supply from these sources.

People typically judge the quality of their water by its colour, smell and taste. Although most of the households complain that the water quality is poor in these regards, few of them are aware of its real quality in terms of bacterial contamination. Total coliform bacteria are commonly found in the environment (e.g., soil or vegetation) and are generally harmless. If only coliform bacteria are detected in drinking water, the source is probably environmental, meaning that faecal contamination is unlikely. However, if environmental contamination can enter the system, there may also be a way for pathogens to enter the system. The main sources of contamination are domestic waste (sewerage) and agricultural runoff. The study found that water pumped from infiltration wells in the villages created health problems because of the presence of fungal and bacterial infections. The problems are more serious in Bommakal, Alaganur and Manakondur due to polluted base flow.

10.2.6 Impact of Wastewater on Local Communities

Wastewater affects the local communities on three levels: in Karimnagar town, in locations where wastewater is used directly for agriculture, and at downstream locations where wastewater could have indirect impacts. We will only consider Bommakal, as this is where clear impacts can be seen.

10.2.6.1 Impacts on Agriculture and Livelihoods

The village of Bommakal is 5 km from Karimnagar and a merger of the two has been proposed. The completion of the nearby Hyderabad–Ramagundam highway boosted the land values, and agricultural lands in the village are being converted to housing and commercial purposes. Many villagers do not want to merge with the Karimnagar Municipality as agriculture is their primary occupation and they do not want to lose their land. Bommakal Panchayat has two villages (Bommakal and Gunturpally) and seven colonies, which are merged with the Karimnagar Municipality. The total population of the village is about 5,000 and the total panchayat population is 10,000 (7,628 according to 2001 census). There are some 1,000 households in the village.

Agriculture is the main livelihood in the village, followed by hamalies (labourers at rice mills, markets, railway stations, etc.), agricultural labourers and dairy and sheep/goat rearing. Many travel to Karimnagar to work as labourers. About 50 women work in the beedi industry (rolling thin cigarettes) in Karimnagar, while another 15 households are engaged in toddy tapping (collection of juice from the buds of palm tree flowers). Agriculture is very productive due to the availability of water resources. Bommakal has good access to surface water as well as groundwater resources, with 94% of its cropped area irrigated (Table 10.7). Canal water from the Sriram Sagar Reservoir is available for about 40% of the irrigated area; another 22% is supported by open wells. Traditional systems (i.e. tanks) complement these two sources. Wastewater agriculture accounts for 22% of the total irrigated area. The main crops are paddy, maize and cotton, with paddy accounting for more than 90% of the cropped area.

10.2.6.2 Wastewater Agriculture: Costs and Benefits

About 454 acres of land is cultivated by wastewater draining from Karimnagar. Cultivation with wastewater started in 2003 with two diversion canals namely *kothakaluva* (new canal) and *pathakaluva* (old canal) irrigating a combined 404 acres. About 50 acres is directly irrigated through Gopalcheruvu (wastewater). Originally, these canals were dug to divert water away from the Manair River. *Kothakaluva* was dug about 150 years ago while *pathakaluva* is 600 years old. The wastewater from Karinmnagar accumulates at Gopalcheruvu and flows through the two

Table 10.7 Land use in Bommakal

Item	Area (acres)	Crops grown
Total area	2,138	
Area irrigated	2,014 (94)	
(a) Under SRSP	800 (40)	Paddy
(b) Open wells	500 (25)	Paddy, maize
(c) Waste water	454 (22)	Paddy
(d) Tanks	260 (13)	Paddy
Rain fed	124 (06)	Maize, cotton

Figures in parentheses are respective percentages channels to irrigate lands. Construction of the Lower Manair Dam resulted in low or no flow into these diversion canals from 1989 onwards. In 1999, wastewater started flowing but, in 2003, villagers approached the Karimnagar Municipal Corporation to construct a diversion drain to avoid wastewater flow into the Manair and to connect to these two channels, which ultimately flow to their fields.

The availability of wastewater facilitated irrigated agriculture on 454 acres, which, prior to 1989, were irrigated with these two canals and from the tank. There is a marked difference between the net income from un-irrigated and irrigated crops grown. Assuming that the entire area is devoted to rain-fed maize, we can estimate the net returns per acre. With an expected yield of 20 quintals per acre and an average price of Rs 600 (US$16) per quintal, gross returns amount to Rs 12,000 (US$320) per acre. The cost of cultivation is about Rs 1,500 (US$39) per acre, making the net returns Rs 10,500 (US$276) per acre per crop. Under rain-fed conditions, farmers grow only one crop.

Cultivating with wastewater may cost less financially, but it becomes highly disadvantageous when we consider the health risks for humans, livestock and the returns from crops. This is especially true when we compare the outcomes to those crops grown under open well or river/tank/canal irrigation (Table 10.8). Wastewater irrigation is characterised by low investments, low yields and low market price. Because of the better nutrient value of wastewater, farmers do not apply fertiliser, which is valued at Rs 1,000 (US$26). On the other hand, farmers spend more on pesticides due to high incidence of pests (whitefly and Jassid). The incidence of pests is higher during the rainy season due to prolonged stagnation of water and

Table 10.8 Investments and returns to paddy crop under wastewater and well irrigation (Rs/acre)

Wastewater irrigation		Well irrigation	
Type of operation	Investment in Rs	Type of operation	Investment in Rs
Tractor for ploughing	2,000	Tractor for ploughing	2,000
Seed	500	Seed	500
Urea	1,000	Fertiliser before sowing	1,000
Labour (for planting)	800	Urea	800 (–1,000)
Pesticides	600 (–800)	Labour (for planting	700
Labour (for weeding)	500	Pesticides	200
Harvesting	1,000	Labour (for weeding)	400
Transport to market	1,000	Harvesting	1,000
Total investment	7,200	Transport to market	1,000
Yield/acre	30–35 bags	Total investment	7,600
Number of quintals	21 quintals (1 bag = 60 kg)	Yield/acre	35–40 bags
Rate/quintal	650–700	Number of quintals	28 quintals (1 bag = 70 kg)
Return/acre	21 × 650 = 13,650 (US $359)	Rate/quintal	700–750
		Return/acre	28 × 700 = 19,600 (US$516)

Based on discussions with farmers

cloudy climate. Rs 600 (US$32) per acre is spent on pesticides compared to Rs 200 (US$11) in areas with well irrigation. Farmers save about Rs 400 (US$22) per acre on cost of cultivation. On the other hand, the yield difference is about seven quintals per acre. Coupled with Rs 50 (US$2.50) difference in the price of paddy, farmers using wastewater end up with a gross return of Rs 13,650 (US$359) per acre against Rs 19,600 (US$516) per acre of well-irrigated paddy. Net returns from wastewater paddy cultivation are Rs 6,450 (US$170) per acre, which is lower than that of maize (Rs 10,500) (Table 10.9). However, due to the assured availability of wastewater, farmers can grow two crops. Therefore, the net gain from wastewater agriculture amounts to Rs 2,400 (US$63) per year. Although the difference is minimal, farmers prefer the reliability of wastewater irrigation, particularly since the returns from maize are made uncertain by climate and market variability. The total benefits from wastewater agriculture to the villages are about Rs 1.09 million (US$28,674) per year.

It may be noted that the loss of production in the wastewater paddy is not due to water quality per se. Rather, it is poor management of water in terms of control and distribution. The impact of the quality of wastewater is reflected in the variations in crop performance across locations of the wastewater distribution systems. If wastewater is managed properly, returns can be more than six times higher (Table 10.9). With better management, wastewater can give a similar yield to well water, with less fertiliser. In value terms, the gross returns per crop would be Rs 19,600 (US$516) with a cultivation cost of Rs 6,600 (US$174). Annual net returns per acre when two crops are grown are Rs 26,000. After netting out for rain-fed maize (Rs 10,500 or US$276), additional returns would come to Rs 15,500 (US$408) per acre. With wastewater treatment, the total annual benefits to the village would be in the range of Rs 7.04 million (US$185,184).

Yields at the beginning of the distributory are lower than those at the tail end of the wastewater canal are. Mondaiah, a farmer who cultivates at the beginning of the distributory has to invest more on pesticides, and a part of his paddy crop near the inlet dries. His plot has a high risk of submergence due to excess flows in the rainy season, pest attacks are common and more skin infections are observed. Yields are 25–28 bags and the quality of grain is poor. Yellaiah, another farmer, who cultivates in the middle of the distributory gets about 30–35 bags and has moderate risks of pests, flooding and skin infections. Another farmer (Mallayya), who cultivates at the tail end, gets around 35–38 bags and has far lower risks of crops drying up and pest attacks. Submergence of his fields is a rare occurrence despite excess flows; in fact, water scarcity is reported during the summer months. It appears that the concentration of pollutants is high at the starting point of the flow but as it reaches the tail end, the water is filtered through sedimentation. Further, pests are more common at the starting point as the water cannot be drained out due to a continuous flow from the town, thereby becoming stagnant.

Farmers opined that only paddy could be grown with wastewater in this type of land, as there is continuous availability of water. The quality of this paddy is far inferior to paddies cultivated under well water in terms of appearance and quality. The grain is often black and spotted, and it breaks while milling. Similarly, the rice

Table 10.9 Benefits and costs of wastewater irrigation in Bommakal

Particulars	Wastewater Irrigation: Before	Wastewater Irrigation: After (Kharif)	Wastewater Irrigation: After (Rabi)	Total income from wastewater	Additional benefits (net)	With treated/better managed wastewater
Crop area (acres)	454	454	454	908	454	908
Area irrigated (acres)	00	454	454	908	454	908
Crop grown	Maize	Paddy	Paddy	Paddy	Paddy	Paddy
Gross value of produce (Rs/acre)	12,000	13,650	13,650	27,300	15,300	39,200
Cost of cultivation (Rs/acre)	1,500	7,200	7,200	14,400	12,900	13,200
Net returns (Rs/acre)	10,500	6,450	6,450	12,900	2,400	26,000
Total benefits/year (for 454 acres after netting out for rain-fed maize)	–	–	–	–	1,089,600 (US$28,674)	7,037,000 (US$185,184)

becomes watery by evening and cannot be stored for long hours (even overnight). Seasonal differences in crop performance are also observed. While yield performance is better in summer and there are low cultivation costs, the health risks are high. During the rainy season, dilution lessens any health risks. Labourers are reluctant to work in the paddy fields, especially during harvesting due to the health risks associated with wastewater. On the other hand, tail enders face water shortages during summer/rabi crop (November–March, second crop).

10.2.7 Health Impacts

A series of focus group discussions (FGDs) helped to assess impacts of wastewater within Karimnagar. The most serious problem in the town is inadequate, open drainage systems. Although rainfall in town is far below the district average for the past 5 years, there are a few divisions in the municipality that face problems. Numbers of divisions are affected regularly although the problem is severe in the Indiranagar, Adarshanagar, Ganeshnagar Ameernagar and Sanjaynagar divisions. FGDs were conducted in these four locations.

Residents of Indiranagar revealed that every rainy season they have to vacate their houses at least once because of floods, leaving behind all their belongings. They are forced to take shelter in temples, on construction sites or even on elevated roads. Sometimes this may last for days, during which time the people depend on municipal authorities for water and food. Year 2007 was the third consecutive year of flooding and many old houses were damaged. Apart from inadequate drains, the main reason for this is the encroachment of common areas like ponds and other open places where water is stored. Open wells were observed 2 m from wastewater drains, increasing the likelihood of contamination. Households use well water for washing clothes, cleaning utensils, bathing, and so on, as the municipal/public tap water is sufficient for drinking only due to its alternate day supply system. During the rainy season, well use discontinues for 10 days while the Municipality sprays disinfectant. When this happens, wastewater overflows into the open wells.

When asked about the contamination of wells, local women reported that the water smells and tastes bad, but they can do very little about this, as they cannot afford individual connections. Even if they do own an individual connection, it is difficult to construct the overhead tank for their small houses. The water is more contaminated in the rainy season, and small insects and green algae are common. The water sources are located close to the drains where pigs scavenge in the filth that accumulates at the drains making local residents, especially children, vulnerable to diseases.

The situation in Katta Mysamma colony, Ammernagar and Sanjaynagar is not as severe but the water often stagnates for 3–4 h at a time. Households have to clean their houses at least ten times to drain out the stagnated water before resuming their normal activities during the rainy season. When asked about health problems or disease outbreak during the rainy season, the complaints range from colds, coughs and fevers to malaria, typhoid and brain fever. Although respondents were not sure that the diseases could be linked to wastewater drains, they said that compared to relatives and friends in other locales, their children suffered more illness. On average, they spend Rs 300–500 per month on medicine despite using Government facilities. The drinking water and drainage water pipes pass through the same outlets and breakages or leakage in the drinking water pipes lead to contamination.

The story of a labour colony in Adarshanagar is much worse. One hundred construction workers live alongside wastewater as there is no drainage channel and the wastewater flows next to their houses. During rainy season, they live with the uncertainty of having to vacate their houses at anytime. They have been living in this rented area for the last 20 years and have to vacate their houses two to three times each rainy season. In one instance, a boy fell into the storm drain and was carried away by the water. He was later found in the collection complex suffering from major injuries. As in the other villages, the residents take shelter in temples or in municipal function halls until the situation is under control. Mosquitoes breed continuously in the open drain water, adding to the spread of disease. The drinking water from public taps is murky (green algae or small insects) during the rainy season, but there is no option other than to filter and use it. People depend on hand pumps for domestic needs as piped water is only available on alternate days and is not sufficient for all uses. Because of the poor quality water supply and lack of hygiene (open defecation is a common practice), children and older people frequently fall sick. The family breadwinners then have to care for the sick, thus losing valuable labour days.

10.2.7.1 Health Impacts on Washer Men/Women

There are between 300 and 350 dhobi families in Karimnagar who depend on the Manair for washing clothes. The average income per family is about Rs 5,500 and those who wash clothes for hospitals and educational institutions earn more. Before construction of the LMD, the water was pure, and even their fathers and forefathers used to wash at the same place. Over the last 10 years, pollution has slowly increased and the problem has been particularly aggravated in the last 2–3 years as wastewater flowed directly into the river. The water in this small canal is now filthy, with high concentrations of green algae and fungus causing dhobis to develop itching and skin irritations, which lead to wounds and ultimately to fever. The problem is most severe in summer. Dhobis start washing at 6 am and try to complete their work by noon, as the water is relatively fresh in the morning. The clothes must be dried, and then ironed twice to remove the bad smell from the water. So far, customers have not complained about the itching but they do notice the bad smell.

Last year the dhobis had to go to another area (about ½ km along the river) as the water was too poor to wash clothes. Once the rainy season arrived, the water started flowing and conditions improved. Every summer the dhobis work with the Bommakal farmers to renovate the canal, thereby ensuring sufficient water.

Although the construction of a dhobi ghat has been proposed, the dhobis are not keen on the idea. They feel that washing in flowing water is easier.

10.2.7.2 Impact on Rural Water Supplies

Skin infections are a common occurrence among those who work in wastewater-irrigated paddy fields. What starts as a rash and reddening of the skin turns into an open wound and sometimes fever. The itching is most severe in the initial days of exposure to the polluted water, but sufferers slowly get used to the itching. To quote one local doctor,

> Naturally, the growth of bacteria and fungus is more in wastewater and results in these infections. I receive cases of skin infections, leech bites, fevers, etc., and the number of cases is increasing…. I am receiving more cases related to respiratory infections, which could be due to more exposure to pesticides and insecticides used to protect their crops.

Bommakal village has a 60,000-l capacity overhead tank connected to an infiltration well in the Manair River. An older infiltration well had to be abandoned due to wastewater contamination. A new well was dug above the riverbed and water is pumped to the tank with a 10 HP motor, filling it every day. There are 400 household connections and 7 public taps in the village. Of those seven taps, two are non-functional. Only 5–7% of the households still use this water for drinking, as the majority of families stopped using it within the last decade. There is an alternative water supply but houses located at elevated points cannot access it because of pressure problems. The water supply is on alternate days and once every 2 days in summer because of electrical problems. The Operations and Maintenance (O&M) is done by the Panchayat. Individual house connections require a deposit of Rs 500 (US$14) and a monthly payment of Rs 20 (US$0.50). In reality, no one pays the monthly cost (which is intended to cover maintenance). Instead, the Panchayat bears all the expenses, amounting to Rs 25,000–30,000 (US$658–789) per year. Tanks are cleaned and bleaching powder is added regularly but this is not helping to improve the long-term quality of water.

Given the poor water quality (Table 10.5, S7), about 10 years ago villagers stopped drinking water from the tank or from their open wells (after the start of wastewater discharge into the Manair). Following complaints by the locals, the District Administration declared that the water supplied via the infiltration well should not be consumed. Villagers go to Karimnagar to fetch drinking water, which is a time consuming process. Some families buy 20 l-cans from mineral water vendors at a cost of Rs 15 (US$0.39) per can on alternative days. Approximately Rs 3,600 (US$95) is spent on water annually. About 5% of the people still drink the well water since they cannot afford otherwise. They complain about stomach pains, diarrhoea and joint pains. Women complained that the water quality is getting worse over the years and they are now scared to use the water even for domestic uses. Families consuming this water may have to spend Rs 200–300 (US$5–8) per month on doctor fees and medicines while poorer families cannot afford these fees. The costs of drinking water are estimated using the cost of avoidance/prevention, replacement cost and travel cost methods. Although there are no serious health complaints leading to loss of working days (HCM) in Bommakal, the estimated total cost of water contamination comes to Rs 3.37 million (US$88,763) per year for the entire village (Table 10.10).

10.2.8 Health Impacts on Livestock

The village is home to more than 2,000 buffalo, about 5,000 oxen, 4,000 goats and sheep and a few cows. The livestock population is declining. Farmers complain that the buffalo are providing less milk after consuming grass paddy straw from wastewater irrigation. The animals do not like to drink the river water, probably because of the bad smell and taste. When given water at the wells, they drink one or two buckets at a time. Some livestock have also developed diarrhoea after eating the fodder. If left untreated, the infection results in death. Although some medicines are free, an average of Rs 500–600 per year is spent on health expenses for dairy animals, and about Rs 200–300 on goats and sheep. The impact on livestock health is estimated based on the local veterinarian's assessment of treatment costs in Bommakal in comparison with other villages. The livestock health costs are estimated to be about Rs 0.43 million (US$11,316) per year in Bommakal (Table 10.11).

Table 10.10 Costs of wastewater use in Bommakal (humans)

Indicator	No. of HH	Economic cost/HH/year in Rs	Total cost in Rs/year
No. HH buying water	20	3,600	7,2000
No. of HH collecting water from town	900	3,650 at each HH spend 1 h/day collecting water and the wage rate is Rs. 10/h.	3,285,000
No. HH drinking contaminated water	80	200 (medical expenses)	16,000
Total	1,000	7,450 (US$196)	3,373,000 (US$88,763)

Table 10.11 Costs of water pollution due to impact on livestock in Bommakal

		Cost of medical treatment (Rs/animal/year)			
Livestock	Numbers	Bommakal	Normal village	Additional cost/animal due to wastewater use (Rs/year)	Total extra cost (Rs/year)
Buffaloes	2,000	100	155	55	110,000
Oxen/cows	5,000	100	155	55	275,000
Sheep/goats	4,000	35	45	10	40,000
Total	11,000	–	–	–	425,000 (US$11,316)

Based on the discussions with veterinary doctor in Bommakal.

According to the veterinarian Mr Lingareddy,

> I have been working here for the past 5 years and over the period of time the infertility rate is increasing and calf mortality is high compared to other villages. Since the animals are drinking the contaminated water in Manair and consuming fodder grown with wastewater, I can attribute it to the water, but I cannot conclude that the decreasing livestock is only because of this. Other reasons like mechanisation, shortage of labour and low interest of the farmers also contribute to reduced livestock.

Ramulu, who manages a herd of 40 goats and sheep, said ‘after eating the grass for the last 2–3 years the sheep and goats developed some stomach problems and diarrhoea and yield of the animal is very low.’ Today, one animal sells for Rs 2,000–2,500 (US$52.63–65.79) compared to Rs 1,500 (US$39.47) about 3 years ago, but the investment is higher now. Ramulu used to spend Rs 3,000 (US$79) per year towards medical expenses but now, it is Rs 6,000 (US$158) for 40 heads leaving a marginal benefit despite the high price.

Srinivasnagar, Alagunur, and other downstream villages face similar problems. Under the SHG (Self-Help Group) Bank Linkage programme where banks lend money to the members of the SHG, 50 murra (high breed) milch animals were sanctioned in some of the villages but not one survived. Villagers complained that the water is not suitable for the improved breeds although local livestock can withstand it to some extent. They added that in the past year, animals have become weak and productivity rates declined. No one will buy them and farmers are forced to sell them to slaughterhouses. Another prospective livelihood is the rearing of ducks on the riverbed. The families who rear them earn Rs 3,000–4,000 (US$79–105) per month by selling eggs and meat.

10.2.9 Costs and Benefits of Wastewater Use

Of the six sample villages and the town of Karimnagar, only Bommakal seems to face serious wastewater problems. The problems in the other villages are mostly related to drinking water. The number of people buying and collecting water from elsewhere is on the rise and as this figure increases, so does the increase in wastewater generation in Karimnagar, as well as its disposal without treatment. The total costs and benefits of untreated wastewater were estimated based on the experience of Bommakal. This is a good indicator for other similar locations. Unlike industrial effluent, wastewater has positive impacts in terms of improved agricultural production. After considering both positive and negative, the costs of wastewater are estimated at Rs 2,708 (US$71) per household per year (Table 10.12). The total costs in Bommakal village are estimated at Rs 2.71 million (US$71,316), while local or downstream communities bear about Rs 0.12 million per one MLD wastewater generated. Conversely, the environmental costs of supplying 1.25 MLD drinking water in towns would cost the downstream communities Rs 0.12 million (US$3,158). This is more than six times the actual charges levied to domestic consumers (assuming an average of Rs 20 per KL). However, these costs are not

Table 10.12 Total costs and benefits of wastewater in Bommakal village

Benefits/costs	Per household/ year	Total (1,000 HH)/ year	Benefits/costs/MLD* wastewater
Agriculture (net benefit)	+1,089.6	+1,089,600	+49,059
Human health (net loss)	−3,373	−3,373,000	−151,869
Livestock health (net loss)	−425	−425,000	−19,136
Total	−2,708.4	−2,708,400	−121,946

Total wastewater generated in Karimnagar is about 50 MLD

uniformly born by all the households. While the benefits from wastewater agriculture accrue to the landed, the costs of livestock health are borne by those who own them. These problems are increasing rapidly as the urban population in these secondary towns grows. Water supply norms Litres Per Capita per Day (LPCD) rise along with the population, affecting more and more downstream villages. These costs can be avoided only through proper treatment, management and disposal of wastewater.

10.3 The Way Forward

10.3.1 Wastewater Management Options

As indicated earlier, wastewater in Karimnagar is neither collected/treated nor discharged properly. At present, wastewater is discharged through storm drains at four aggregation and discharge points. Wastewater discharged at three of these locations moves towards Bommakal, where it is used for irrigation and then let out into the river. Presently a sewerage treatment plant (STP) is planned to treat the wastewater before discharging it into the river. The cost of the proposed STP is Rs 765 million (US$20.13) (NCPE 2007). Analysis has shown that the STP is a financially viable option (Kurian et al. 2009), mainly because the use of wastewater for irrigation adds to the benefit flow. Therefore, establishing a treatment plant makes economic sense as long as the wastewater will be used for productive purposes. Our case study, based on field observations, suggests some cost effective and sustainable measures that need to be incorporated into the overall planning of the sector. These strategies include:

1. *Revival of water bodies*: Karimnagar is endowed with good water bodies that have become defunct due to improper management. It is necessary to restore the storage as much as possible by training the feeder channels, desilting tanks and strengthening the bunds (embankments). They help to store storm water in rainy seasons for subsequent release in summer to dilute wastewater and reduce its harmful effects.

2. *Creation of additional storage*: The areas that are encroached upon (46 acres approximately) in different localities should be evaluated for technical feasibility to locate storm water collection ponds. This water could be released to dilute wastewater as needed to reduce the pollution level. The area between the highway and the Manair River could be used to store storm water.
3. *Promotion of groundwater recharge*: The construction of recharge pits in open public places and connecting surface runoff to these structures would help to improve groundwater recharge and regenerate flow on a continuous basis. This could be used to dilute wastewater downstream. Such structures have been found to maintain an infiltration rate between 6 mm per h and 25 mm per h (Subba Rao N. et al. 1999).
4. *Reduction in pollution levels through increase in travel time*: The biological oxygen demand (BOD) is very high with wastewater. Reducing this demand is possible through both an increase in travel time and mixing oxygen with water by increasing contact time with the atmosphere. This can be achieved by constructing small check dams wherever the bed slope changes and releasing the water through pipe holes.
5. *Oxidation Ponds*: Also known as stabilisation ponds or lagoons. They are used for simple secondary treatment of sewage effluents. Within an oxidation pond, heterotrophic bacteria degrade organic matter in the sewage, resulting in the production of cellular material and minerals. The production of these minerals supports the growth of algae in the oxidation pond. In turn, growth of algal populations allows further decomposition of the organic matter by producing oxygen. The production of this oxygen replenishes that used by the heterotrophic bacteria. Typically, oxidation ponds need to be less than ten feet deep in order to support the algal growth. The use of oxidation ponds is largely restricted to warmer climate regions because they are strongly influenced by seasonal temperature changes. Oxidation ponds also tend to fill quickly, due to the settling of the bacterial and algal cells formed during the decomposition of the sewage. Degradation is relatively slow and the effluents containing the oxidised products need to be periodically removed from the ponds.

All these measures combined would reduce contamination levels substantially. As our wastewater analysis shows, faecal coliform (FC) contamination in Bommakal is 2.5 times higher than the WHO guidelines (1,000 FC/100 ml). The mixing of storm water or fresh water with zero FC contamination with wastewater would help to maintain WHO standards. Studies indicated that these guidelines are appropriate in hot climates, especially for restricted crops (cereals, pulses (gram), etc.). In case of resource constraints, the standard can be relaxed to the level 10^4/100 ml complemented with appropriate health protection measures (Blumenthal et al. 2001). FC contamination levels of above 1,000 per ml are found to affect the quality of vegetable crops like radish and lettuce (Bastos and Mara 1995). Since the crop pattern in Bommakal is restricted to rice crop and because of the prevailing hot climate, the proposed methods of wastewater management are expected to be effective in mitigating adverse health impacts.

10.3.2 Framework for Sustainable Wastewater Management

Although sewage treatment plants are financially viable, planning has to be carried out in a comprehensive manner, taking into account some or all of the aspects suggested by our case study. It must consider issues pertaining to resources (wastewater), infrastructure (technology) and the communities (demand, preferences, etc.) in order to be sustainable in the end. In the absence of such an approach, state institutions cannot ensure economic viability of projects due to poor enforcement and collection of tariffs. Currently, only 10% of wastewater generated in urban areas worldwide is safely collected and only 10% of the existing wastewater treatment plants work reliably and efficiently (World Bank 2003). While the previous section dealt with the policy options specific to Karimnagar and other similar towns, here we attempt to provide a framework for a system level and macro strategy.

10.3.3 Life Cycle Cost Assessment: A Framework for Integrated Planning

The life cycle cost assessment (LCCA) is a comprehensive tool often used in project evaluation, especially in the context of environmental sustainability of various investments leading to products or services. Although the basic principle of LCCA is nearly a century old, its systematic use is only about 25–30 years old (Salem and Ossama, 1999). LCCA is an economic assessment tool that can be applied at any phase of the project life cycle. It takes the whole chain and spread of activities required for production into consideration (Fig. 10.1). The idea behind LCCA reflects the comprehensiveness of the approach in a systems perspective. Such a perspective is valid not only for the environmental dimension, but also for social and economic dimensions (Salem and Ossama 1999). Despite its comprehensiveness and usefulness in project selection, its application rates are quite low, even in developed countries. A survey conducted among urban authorities in the USA revealed that only 40% of the towns adopt LCCA methods. Of these 40%, only 29% use LCCA for water services (Salem and Ossama 1999).

Some argue that the applicability of LCCA in water and sanitation development projects is limited in scope in the context of developing countries, as the all-pervasive social and political factors are not adequately considered (McConville 2006). LCCA is data intensive, often making it difficult to use for development work. A life cycle evaluation of development projects must incorporate diverse factors in a practical manner with a combination of quantitative and qualitative aspects. Lack of formal guidelines or reliable past data, and difficulty in estimating future costs appear to be the main reasons for the reluctance to adopt LCCA. The tool, therefore, must be consistent with successful development practices and simplified. What we propose is a combination of natural, socio, economic and political aspects that influence Water, Sanitation and Hygiene (WaSH) service delivery over the life stages of the schemes.

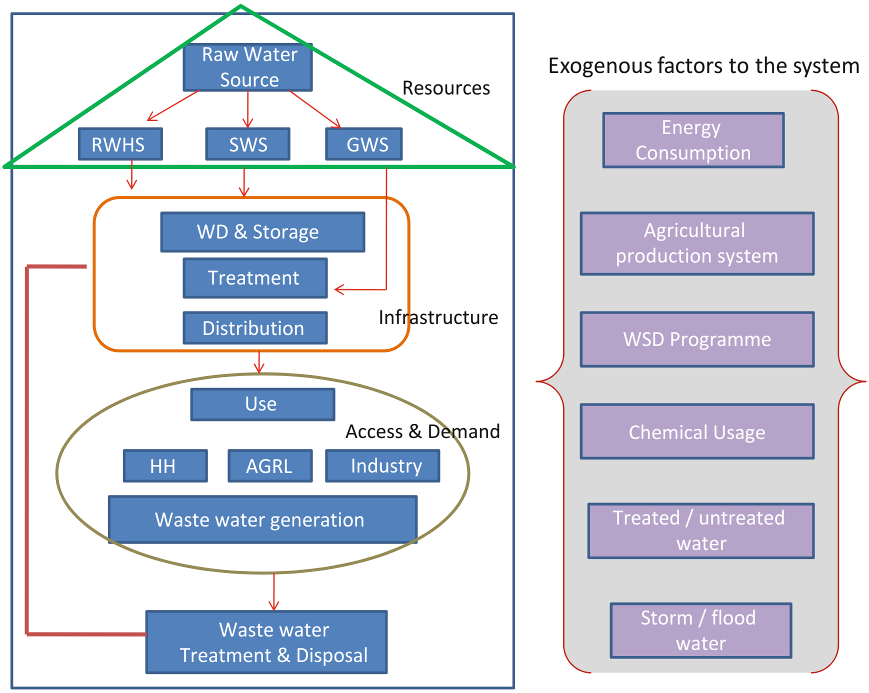

Fig. 10.1 LCCA system boundaries for rural and peri-urban water supplies. Source: Adopted with modification from Lundin (2003)

This could be achieved through a combination of methods and tools for understanding the dynamics of service delivery.

LCCA's comprehensive nature limits the practicability of its application. It is therefore necessary to define system boundaries in order to reduce its complexity. The choice of system boundaries depends on the nature and type of project (for a review see Lundin 2002) and needs to be considered carefully. The life cycle (or functional) boundaries define the unit processes to be included in the system such as where upstream and downstream cut-offs are set. For the rural and peri-urban water systems, four levels of system boundaries can be identified. Resource boundaries (level 1) are defined to ensure resource sustainability and aim to provide sustainable service delivery. Assessment at this level helps in understanding potential environmental benefits and costs, and is limited to understanding environmental sustainability of a water system.

The second level of system boundaries pertains to infrastructure, usually linked to the managing agency. This provides a more complete view of the system in terms of technologies, design efficiencies and planning. Often agencies are constrained by financial and legislative obligations, meaning they tend to overlook options that allow a move towards environmental sustainability. Such a perspective may limit the potential of the agency to identify major environmental impacts or improvements through the life cycle. The third level of boundaries deals with demand issues that are often dealt with at the community or household level. These issues include access, competing demands (domestic, agriculture, industry, etc.), water use practices, sanitation and hygiene practices. Often these issues are marginalised, if not ignored, at the project planning level.

The fourth level represents the issues within the system that are closely linked to the main system but beyond the scope of LCCA. Interaction with surrounding systems is critical for the proper functioning of water systems. Energy consumption and supply is crucial for water pumping, treatment and distribution. Agricultural production not only determines the demand for water, but also affects the quality of water (i.e., livestock-based systems or intensive agricultural practices (chemical use)). Implementation of soil and water conservation programmes (WSD) in rural areas would impact the quantity and quality of water in the system.

10.3.4 Implications of LCCA on Project Costs and Tariffs for Water Services

Untreated domestic wastewater use is known to cause public health risks, but none of these costs are presently being internalised in water supply projects. Given the interconnectedness of water supply, sanitation and solid waste management, there is a strong case for advocating integrated cost models for urban water supply projects and combined billing of water and sanitation services. Some examples of tariff structures include: flat rates for water and tax on solid waste (as in Bangalore, India); a sewerage charge whereby 50% of the water supply fee is allocated for sanitation operations and maintenance (as in Manila, Philippines); an environmental charge of 10% for water to cover the cost of cleaning septic tanks (Manila, Philippines); and sewerage tax and sewer connection fees calculated based on area, house insurance amount, pay use for communal systems and bank loans for new plants (Nyon, Switzerland). However, combined billing of water and sanitation services is not always easy to accomplish for a variety of reasons. First, water supply coverage may be limited so that combined billing has little tangible effect on consumption behaviour. Second, when different entities provide water supply and sanitation services (as in The Netherlands or Iran) it may be difficult to reach an agreement between utilities with differing commercial or budgetary resources. Therefore, although an LCCA approach emphasises integration, the actual means to achieve the goal may be less straightforward.

10.4 Conclusion

This chapter endeavours to introduce and examine the conceptual frame and valuation method of urban and peri-urban wastewater impacts on the environment and economy. It introduced direct, indirect, replacement (averting), travel cost and hedonic methods. It employed a case study conducted in the district and town of

Karimnagar in Andhra Pradesh, India, which examined the origins of wastewater in the area as well as its disposal in three ways—storm water run-off and, domestic and industrial wastewater.

The chapter notes the volumes and quality of wastewater generated in the town, the benefits and adverse affects to people, especially washer men/women and agricultural workers, livestock, the agricultural industry as a whole and commerce in many villages throughout the region.

The LCCA is a complex, broad-based system and despite these limitations is appropriate as a potential means for the integrated planning, execution of urban and peri-urban wastewater management policies that consider environmental, economic and human capital factors. The chapter argues that by defining certain boundaries for example, functional resource, infrastructure and, community or household level, the complexity of the LCCA can be reduced adequately to make it a viable platform for wastewater planning and management. Finally, the chapter explores implications of LCCA on water service costs.

References

Bastos, R. K. X., & Mara, D. D. (1995). The bacterial quality of salad crops drip and furrow irrigated with waste stabilisation pond effluent: an evaluation of WHO guidelines. *Water Science Technology, 31*(12), 425–430.

Bateman, I. J., Carson, R. T., et al. (2003). *Economic valuation with stated preference techniques*. London: Edward Elgar.

Blumenthal, U. J., Mara, D. D., et al. (2001). Reducing the health risks of using wastewater in agriculture: recommended changes to WHO guidelines. *UA-Magazine, March*, 26–29.

Central Pollution Control Board. (2000). *Status of water supply and wastewater generation, collection, treatment and disposal in class-I cities*. New Delhi: CPCB.

Ensink, J. W., Van de Hoek, Y., et al. (2002). Use of untreated wastewater in peri-urban agriculture in Pakistan: risks and opportunities. *Research Report 64*. Colombo: International Water Management Institute.

Kurian, M., Reddy, V., Van Dijk, M., Dietz, T., & Brdjanovic, D. (2009). Adapting to climate variability: Productive use of municipal wastewater as a risk management option in peri-urban regions, *Proceedings of Urban Research Forum.* Marseille: The World Bank, 28–30 June.

Lundin, M. (2002). Indicators for measuring the sustainability of urban water systems: A life cycle approach. Dissertation. Sweden: Chalmers University of Technology.

McConville, J. R. (2006). Applying life cycle thinking to international water and sanitation development projects: an assessment tool for project managers in sustainable development work. Master's thesis, Michigan Technological University.

National Commission for Public Expenditure. (2007). *Consultants report*. Hyderabad: NCPE.

Pearce, D., Pearce, C., & Palmer, C. (2002). *Valuing the environment in developing countries: case studies*. Cheltenham: Edward Elgar.

Reddy, V. R. (1999). Quenching the thirst: Costs of drinking water in fragile environments. *Development and Change, 30*(1), 79–113.

Reddy, V. R., & Behera, B. (2006). Impact of water pollution on rural communities: an economic analysis. *Ecological Economics, 58*(3), 520–537.

Reddy, V. R., Kullappa, M., & Rao, D. M. (2008). Social cost-benefit analysis of improved water quality in rural areas: an exploratory study in coastal AP. *Journal of Social and Economic Development, 10*(1), 68–97.

Rijsberman, F. (2004). Sanitation and access to clean water. In B. Lomborg (Ed.), *Global crises, global solutions*. London: Cambridge University Press.

Salem, E., and Ossama, T. (1999). Infrastructure construction and rehabilitation: risk-based life cycle cost analysis. Dissertation, University of Alberta.

Smit, S. (2007). Background paper presented at the Thematic Group Meeting of the Multiple Uses of Water Services Group, International Water and Sanitation Centre (IRC), Delft.

Subba Rao, N., Srinivas Rao, G.,Venkateshwara Rao, S., Madhusudhan Reddy, P., & Jhon Devadas, D. (1999). Environmental control of groundwater quality in a tribal region of Andhra Pradesh, India, *Indian Journal of Geology, 71*, 294–304.

Winpenny, J. J. (1991). *Values for the environment: a guide to economic appraisal*. London: HMSO.

World Bank. (2003). *Financing water for all*. Retrieved from http://www.worldbank.org/html/fpd/FinPanRep.MainRep.pdf

Yongguan, C., Seip, H. M., & Vennemo, H. (2001). The environmental costs of water pollution in Chongqingm, China. *Environment and Development Economics, 6*(3), 313–333.

Chapter 11
Benchmarking Water Services Delivery

Maarten Blokland

Abstract Benchmarking began as a process used by the manufacturing industry in the 1970s. As companies found themselves facing greater competition, they devised methods of comparing practices, in order to improve efficiency and thus secure their survival in the marketplace. By the 1990s, public services began to adopt the concept of benchmarking for their own needs. By adapting the methodology to match their mission, context and resource constraints, water utilities have been able to improve the quality of services offered, while also meeting the demands for greater transparency. Customers and associated interest groups are using a different set of performance assessment tools that has proven successful in exposing and improving the quality of public services. This chapter explores how water utility providers and communities have adapted performance assessment tools, and demonstrates the variety of ways they can be used within the public services domain.

11.1 Introduction

Benchmarking originated in the manufacturing industry in the 1970s as a strategic tool to stay ahead of competitors. After some time, benchmarking also entered the public domain where it is increasingly being used by regulators, national and local governments and public enterprises as a means to enhance both the transparency and the performance of public services. Water utilities have been using benchmarking since the 1990s and the use of water utility benchmarking has since spread and is now being used worldwide.

This chapter provides an introduction on the evolution, definition and methodology of benchmarking and then focuses on the application of benchmarking in the water services sector. In its most mature form, water utility benchmarking is a complex and costly exercise, but the experiences with water utility benchmarking

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show a variety of valid applications ranging from a basic level that uses a small number of easily accessible indicators to an advanced level with multiple indicators that cover all business processes. Water utility benchmarking typically focuses on product quality, customer satisfaction, innovative strength, and finance and efficiency, with a tendency to include environmental and social impacts of water services operations. In the Netherlands, drinking water companies have jointly conducted highly effective benchmarking exercises over a 20 year period and results show that water quality continues to improve, that service quality is at a high level, that environmental performance is improving, and that prices and costs decrease when adjusted for inflation. The final section of this chapter reviews a different set of performance assessment tools that are more tailored to the needs and resources of the users of public services and related interest groups. The use of these tools has proven to be very effective in engaging local communities, developing social, financial and public transparency, and in promoting the responsiveness of public service providers.

11.2 Definition and Evolution of Benchmarking

Benchmarking comprises both performance assessment and performance improvement. It is a strategic tool that allows an agent to improve performance by studying the behaviour of other agents, and by subsequently adapting and implementing (parts of) this behaviour to fit the specific situation.

The varied definitions of benchmarking all emphasise that in order to achieve enhanced levels of performance, one must be ready to learn from others. Boxwell (1994) defines benchmarking as 'setting goals by using objective, external standards and learning from others – learning how much and, perhaps more important, learning how'. Harrington and Harrington (1994) states that benchmarking is a 'systematic way to identify, understand, and evolve superior products, services, designs, equipment, processes and practices to improve an organisation's real performance' and describes the approach as a 'never-ending discovery and learning experience'.

Figure 11.1 shows the performance gap between one's own practice and that of industry's best. The gap or surplus expresses the challenge to improve one's own processes. In competitive industry, the ability of an organisation to close the performance gap may signal the difference between survival and demise.

The concept of benchmarking is illustrated in Fig. 11.2. It is an endless loop where benchmarking is applied to a particular business process that is subsequently enhanced, leading to better quality products, processes or services that can be expressed in terms of increased customer satisfaction and/or better performance. Upon review, the process starts afresh with a focus on the same or another business process. There are four distinct characteristics to the process: it is a systematic approach, it has a cyclical nature, it is about goal setting and achieving, and it requires commitment at all levels.

Benchmarking originated as a strategic tool to stay ahead of competitors in the manufacturing industry in the 1970s. It was reportedly first used by Xerox when the

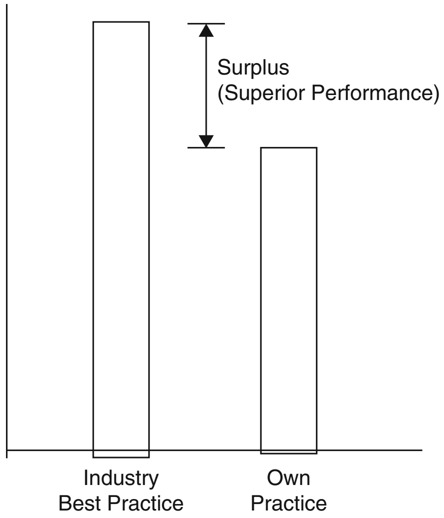


Fig. 11.1 Concept of superior performance. Source: Fong et al. (1998)

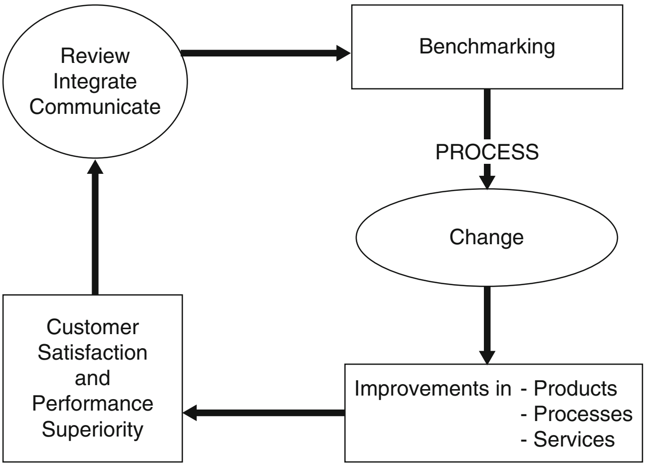


Fig. 11.2 Benchmarking cycle. Source: Booth (1995)

company, a world leader in copying machine manufacture, rapidly lost market share to Japanese competitors that sold equally good machines for less. The history of the rise, fall and repositioning of the company is illustrated in the following sequence (Boxwell 1994):

- For nearly 20 years, Xerox enjoyed a near-monopoly in the copier industry (patent protection/high growth).
- By 1975, Xerox had a world market share of 75%, and revenues of US$4 billion, but earnings declined for the first time since 1951.

- By 1980, their market share had dropped by half.
- In 1979, Xerox began competitive benchmarking and in 1981, the practice was enforced throughout the company: 'every department should be benchmarking itself against its counterpart department at the best companies we compete with' (as stated by David Kearns, Xerox CEO in 1981).
- By 1990, Xerox had regained much of its lost market share and was able to compete successfully with more than 100 copy machine makers worldwide.

Table 11.1 shows how the Xerox company engaged in benchmarking with several companies, each time focusing on a different business process in which the competing company was considered a leader.

Benchmarking rapidly spread across the manufacturing industry and through private business, becoming a useful strategic and operational tool, often in association with Total Quality Management (TQM) and Continuous Quality Improvement (CQI).

In the 1990s, the process of benchmarking entered the public sector, in such diverse organisations as the Army (recruitment process), hospitals (costs, quality, customer satisfaction), and regulatory agencies (staying ahead of those that are being regulated). Since then, benchmarking has spread out over the entire public sector, to the extent that now the Netherlands Government reports to Parliament on its performance relative to the approved annual Plan and Budget.

Public sector benchmarking is connected to the emergence of New Public Management (NPM). NPM is characterised by market-orientation, customer orientation, increased autonomy of public bodies, decentralisation of authority and greater discretion at lower points within public bodies, lessening of hierarchical rules, and accountability for results. Benchmarking is a necessary tool for assessing and improving performance within the NPM model.

Other performance assessment tools have also been developed that are more tailored to the needs and resources of the users of public services, their representatives and associations, CBOs, NGOs and others. These tools include Public Expenditure

Table 11.1 Benchmarking companies and processes by Xerox

Company	Process
American Express	Collections
American Hospital Supply	Inventory control
AT&T	Research and development
Baxter International	Employee recognition; human resources management
Cummins Engine	Plant lay-out and design; supplier certification
Dow Chemical	Supplier certification
Florida Power and Light	Quality process
Hewlett-Packard	Research and development; engineering
L.L. Bean	Inventory control; distribution; telephonics
Marriott	Customer survey techniques
Milliken	Employee recognition
USAA	Telephonics

Boxwell (1994)

Tracking Surveys (PETS) and Community Score Cards. New tools that are entirely Information and Communications Technology (ICT)-based have surfaced recently and proven to have huge potential.

11.3 Benchmarking Methodology and Application

11.3.1 Classification

There is no generally accepted classification of benchmarking. Fong et al. (1998) proposes a classification along three lines: the nature of the referent, the content and the purpose (see Table 11.2). The 'nature of the referent' defines the party with whom the benchmarking is being done. Benchmarking can be done internally, comparing similar business units (e.g. comparing water distribution districts), or externally, with other companies in the same sector (e.g. benchmarking water utilities), with organisations in other sectors on common processes (e.g. when comparing customer satisfaction between telecom and water providers) or even internationally (quite common in water utility benchmarking). The 'content of the benchmarking' defines levels at which benchmarking may take place, distinguishing for the process, functional

Table 11.2 Classification of benchmarking

Classification	Type	Meaning
Nature of referent other	Internal	Comparing within one organization about the performance of similar business units or processes
	Competitor	Comparing with direct competitors, catch up or even surpass their overall performance
	Industry	Comparing with company in the same industry including non-competitors
	Generic	Comparing with an organization which extends beyond industry boundaries
	Global	Comparing with an organization where its geographical location extends beyond country boundaries
Content of benchmarking	Process	Pertaining to discrete work processes and operating systems
	Functional	Application of the process benchmarking that compares particular business functions at two or more organizations
	Performance	Concerning outcome characteristics, quantifiable in terms of price, speed, reliability, etc.
	Strategic	Involving assessment of strategic rather than operational matters
Purpose for the relationship	Competitive	Comparison for gaining superiority over others
	Collaborative	Comparison for developing a learning atmosphere and sharing of knowledge

Fong et al. (1998)

(multiple processes), performance (outcome) and strategic levels. All these types are common in water utility benchmarking. The ‘purpose of the relationship’ defines the character of the relationship between organisations taking part in the benchmarking process. This relationship may be competitive or collaborative, the latter being mostly the case in the benchmarking of (public) water utilities.

11.3.2 Process

Benchmarking is a tool for (re)developing the strategy and operations of an organisation and is an integral part of the planning process. Modelled after the common planning cycle (plan, do, check, act), it typically distinguishes four phases: planning, analysis, integration and action. These phases are executed through a sequence of steps that starts with the identification of the benchmarking subject and ends with the recalibration of the benchmark after a process to seek out, adapt and implement the practices that should result in the enhancement of the value of the associated performance indicators. Figure 11.3 shows the four phases covering ten steps. First comes the planning phase, deciding what is going to be benchmarked. This should be decided in light of company strategy, mission, customer expectations, and so on. The next step is to identify the best performer, with emphasis on the subject to be benchmarked. Data collection methods are then defined and data is collected. After collection, the performance gap is quantified and the practices that should be improved are identified. Future performance levels and related improvement activities can now be established. Thus ends the analysis phase. Next is the integration phase where commitment is obtained for actual change. The findings of the benchmarking study are communicated and support is obtained for the implementation of the required changes. The functional goals of the change process are defined, including the reformulation of the mission statement and/or the strategy as necessary. The final steps provide and implement the action plans including activities, time schedule and resource requirements to (re)develop the concerned business practices and achieve the new performance targets. Lastly, if the process has been successful, the benchmark is recalibrated, and the organisation repositioned within the market.

11.3.3 Outcomes

Benchmarking in the private sector has traditionally been aligned with shareholder interests but that focus is starting to change to reflect broader stakeholder interests (Hubbard 2006). The original alignment with shareholder interests delivered four typical benchmarking perspectives: finance, customer, internal business, and innovation and learning (Kaplan and Norton 1992).

Financial perspective: How do we perform for our shareholders, including aspects such as cash flow, market share, return on equity?

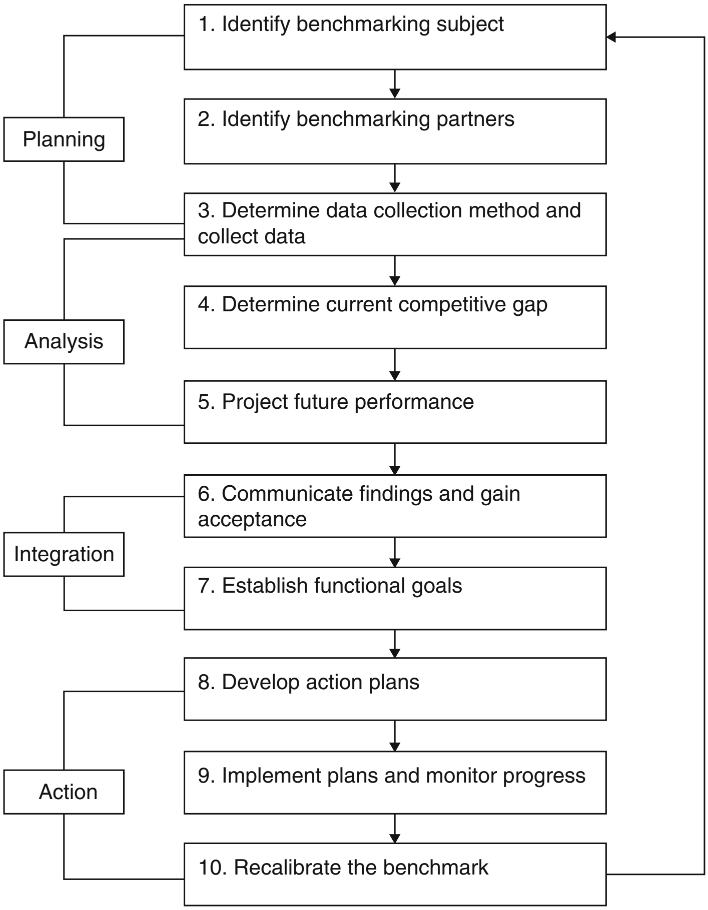


Fig. 11.3 Phases and steps in the benchmarking process. Source: Anand and Kodali (2008)

Customer perspective: How do customers see us, including aspects such as lead times, quality, performance and service and costs?

Internal business perspective: In terms of critical processes and competencies, and concerned with aspects such as cycle time, quality, employee skills, and productivity, what must we excel at?

Innovation and learning perspective: Can we continue to improve by launching new products and improving efficiency?

Each of these perspectives can contain a multitude of goals and measures (benchmarks). The outcomes are presented through a Balanced Score Card (BSC), used throughout the benchmarking community.

The focus of benchmarking started to change to reflect broader stakeholder interests. In a post-modern society, where businesses are increasingly called upon to shoulder broader responsibilities, in particular the sustainability of their operations, the nature of many organisations has changed. Sustainability is expressed by measuring the impact of business operations on the communities and the physical environments in which they operate. Consequently, the four conventional benchmarking perspectives needed to expand to include social and environmental perspectives.

In benchmarking terms, this broadened perspective results in a so-called Sustainability Balanced Score Card, as shown in Table 11.3.

11.3.4 Application in Water Utilities

Water utilities have been involved in benchmarking since the 1990s and water utility benchmarking is now a common, worldwide activity. The International Water Association (IWA) has played a key role in promoting benchmarking by producing separate manuals for water utilities (Alegre et al. 2006) and for wastewater utilities (Matos et al. 2003). The manuals propose performance indicators, provide a rationale for performance assessment and promote the adoption of a system of performance indicators. The water supply manual identifies 166 performance indicators (PIs) in six categories: Water resources (4 PIs), Personnel (26 PIs), Physical indicators (15), Operational indicators (40), Quality of service indicators (34), and Economic and financial indicators (47). In addition, there are 100 indicators for describing contextual information: utility profile, service information, system assets, consumption and peak factors, demography and economics, and environment. The IWA publications stress the importance of arriving at a system of performance indicators (PIs) but warn against PIs becoming a goal in themselves. The PI system must be determined by each utility, based upon its own management strategy and objectives. After determining these and the required activities and critical success factors to make them a reality, the appropriate performance indicators can be identified. The IWA also stresses the need for integral performance assessment including four main perspectives (financial, customer, processes and learning, growth) similar to the Balanced Score Card.

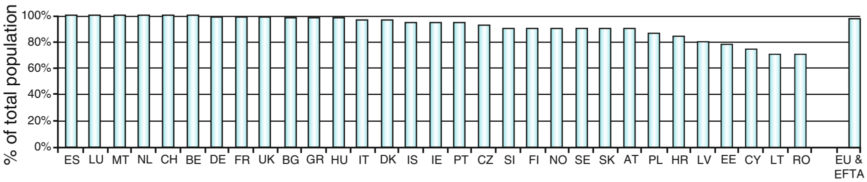
The IWA Task Group on Benchmarking works on adapting benchmarking practice for use in water and wastewater utilities. They propose modelling the benchmarking process after the well-known Deming planning cycle, distinguishing the phases ‘plan, do, check, act’, and also distinguishing between performance assessment and performance improvement. The latter two terms replaced the commonly used terms metric and process benchmarking. The latter was thought to be confusing as it incorrectly suggests a focus on the process level (as compared to task, function and utility levels).

Water utility benchmarking initiatives have been carried out globally. A recent issue of *Water Utility Management* (2008) reviewed some of these initiatives, with reports on activities in Brazil, the Netherlands, Tanzania, Hungary, Moldova and China. The issue also reported initiatives on regional and global scales, such as the North European Benchmarking Co-operation supported by water associations in the region, Eureau for the member states of the European Union, and the IB-Net

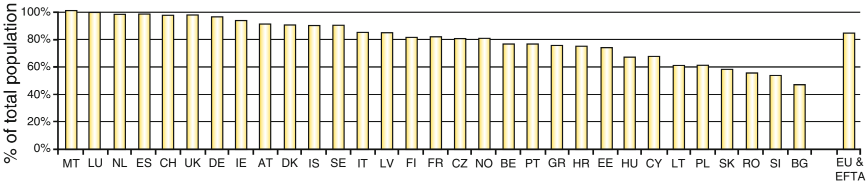
Table 11.3 Example of a hypothetical Sustainable Balanced Score Card

Financial			Internal processes		
	Current	Prior		Current	Prior
Sales growth	3.0%	2.0	Productivity	3.8%	4.0%
Return on sales	6.8%	5.4%	Labour turnover	12.0%	16.5%
Return on assets	5.1%	6.1%	Average unit production	4 days	4 days
Return on equity	15.5%	16.0%	Working capital/sales	10.0%	10.0%
Gearing	73.0%	77%	Capacity utilization	73%	77%
Customers/market			Learning and development		
	Current	Prior		Current	Prior
Market share	32.0%	30.0%	New products	1	0
No. new customers	12.350%	10.145%	New markets entered	2	1
Product return rate	1.5%	1.4%	R&D spend/sales	2.5%	1.5%
Defects	2.8%	3.0%	Training spend/sales	5.5%	7.3%
Order cycle time	7 days	7 days	Invest./total assets	10.0%	10.0%
Social performance			Environmental performance		
	Current	Prior		Current	Prior
Employee satisfaction	4.1	4.4	Key material use/unit	12.0 kg	10.5 kg
Social perf. of suppliers	3.8	3.0	Energy use/unit	2.0 kWh	2.3 kWh
Community relationships	3.0	2.5	Water use/unit	2.5 l	2.6 l
Philanthropic investments/revenue or profit	1.0%	1.0%	Emissions, effluent & waste/unit or as a %of total resources used	3.0 t	4.0 t
Industry-specific factor: e.g., community open days	2	1	Industry-specific factor: e.g., GHG emissions	4.0 t	3.8 t

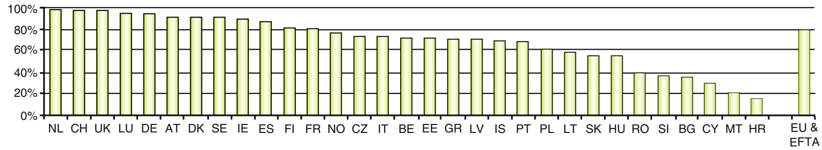
Hubbard (2006)



Population served by drinking water services (EUREAU, 2008; OIEAU, 2004; WHO-UNICEF, 2008; UN, Statistics Division, 2007).



Population served by wastewater collection services (EUREAU, 2008; ECOPROG, 2006; OIEAU, 2004; WHO-UNICEF, 2008; UN, Statistics Division, 2007).



7% of population served by wastewater treatment services (EUREAU, 2008; ECOPROG, 2006; OIEAU, 2004; WHO-UNICEF, 2008; UN, Statistics Division).

Fig. 11.4 Population served by water and sanitation services in member states of the European Union. Source: Eureau (2009)

global database, supported by the World Bank. There are numerous other regional and national programmes such as the South East Asian Water Utility Network (SEAWUN) supported by the Asian Development Bank. At a recent water utility benchmarking congress in Amsterdam, papers reported experiences in Austria, Canada, Denmark, Germany, Hungary, Portugal, South Korea and Switzerland.

A typical example of performance assessment is shown in Fig. 11.4, showing a comparison of water and sanitation services across the European Union.

11.3.5 Experience in the Dutch Water Sector

In the Netherlands water and wastewater services are provided by different organisations. Drinking water is extracted, treated and distributed by ten supply companies that are incorporated as private companies with exclusive shareholdership by local and provincial governments. Wastewater is collected by the 443 municipalities. Wastewater transport, treatment and disposal are carried out by 26 water boards that are public entities with responsibilities in water management.

Benchmarking in the Dutch water sector was first undertaken by a group of water supply companies in the late 1980s. It started as an inter-company exercise with the results shared between the directors of participating companies. From 1997 onwards, the benchmarking results were made public. Later, the water boards and municipalities followed suit, each documenting organisational performance in their own field. The benchmarking activities are conducted on a voluntary basis. The umbrella organisations VEWIN, UvW and Rioned (for the drinking water supply companies, the water boards and the municipalities respectively) play a central role in carrying out the benchmarking, although the actual work is contracted to specialised consulting firms. A large majority of the providers participates in the voluntary benchmarking exercises signalling its widespread importance. In 2009, legislation was passed by Parliament to make benchmarking compulsory for the drinking water utilities.

Benchmarking by VEWIN, the Association of Water Supply Companies in the Netherlands, serves two objectives. It provides greater transparency to interested parties, and provides the water companies with insights on how to improve their processes (VEWIN 2007). The interested parties are central government, customers, supervisory directors and shareholders, and the drinking water companies themselves. Following the tradition of the Balanced Score Card to select four benchmarking perspectives, the water supply companies have chosen their own four categories: Water Quality, Service Quality, Environmental Impact, and Finance and Efficiency. The benchmarking exercise is conducted every 3 years and the outcomes are twofold: one is a document for public use that is downloadable from the VEWIN website. In addition, each participating company is provided with a confidential, tailor-made report that provides information that is more detailed and shows the comparative position of the concerned company relative to the others for all performance indicators.

Water quality performance is assessed in three ways: as perceived by the customers, through an index that expresses compliance with legislated standards, and by determining a score that combines non-compliance and the associated health risk. Service quality is measured through a customer survey in which they are requested to mark general service quality, satisfaction with specific services, and the quality of different types of company–customer contacts (compare with the section on community scorecards). Environmental performance is gauged by assessing environmental impacts, both negative (energy consumption, desiccation and treatment residues) and positive (management of nature areas). Financial performance is assessed at company and process levels. At the company level, this includes the unit price charged to various customers and the composition of costs, distinguishing between taxes, costs of capital, depreciation and operational costs. To make water companies' operational costs comparable on a more detailed level, they are allocated to five processes – production, distribution, process support, sales and general.

The outcome of the four benchmarking exercises conducted in 1997, 2000, 2003 and 2006 show that water quality continues to improve, that service quality is at a high level, that environmental performance is improving, and that prices and costs decrease when adjusted for inflation. The comparison between companies shows significant differences in performance that cannot be explained by contextual

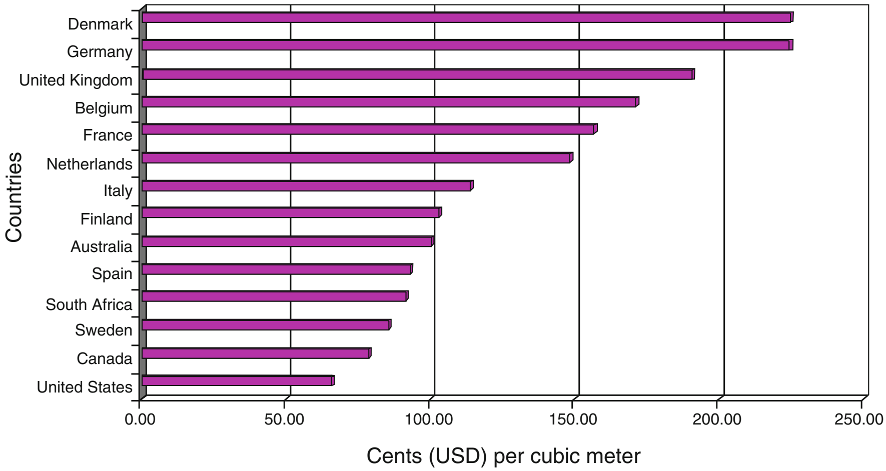


Fig. 11.5 Consumer price of drinking water in 14 countries. Source: NUS (2006)

factors such as customer density and nature of the water source. Figure 11.5 shows how the performance of the companies differs when it comes to answering customer calls.

Benchmarking is thought to have had a positive impact on the sector, both in terms of increased transparency and economic performance, even more so after the companies decided to publicise the results of benchmarking (Braadbaart 2007).

Benchmarking of the wastewater treatment function of the Dutch water boards was first done in 1999, and then repeated in 2002 and 2006. The organisations made their own choice of five benchmarking perspectives: Treatment, Finance, Environment, Innovation and Stakeholders. Like the water utilities, they added the environmental perspective. Stakeholders included in the benchmark comprise the licensing authorities, the municipalities in their role as sewer operators, businesses that choose to treat wastewater themselves and neighbouring residents. The Dutch water boards use a Sustainability Balanced Score Card. The benchmark serves to answer the following key questions: what is the treatment result; at what cost; how environmentally conscious is the organisation; is the organisation able to improve and innovate; and how do the stakeholders view the performance of the organisation? About 80 performance indicators are used overall. The results are presented in a public report that can be downloaded from the website of the Union of Dutch Water Boards, as well as a confidential, more detailed report for each water board (Unie van Waterschappen 2003).

The overall performance of the water boards can be seen in one summary table that shows the ranking of each of the water boards in each of the five perspectives. Reading the table is made more easy by colouring the ranking, showing the highest ranking nine in green, next ranking nine in yellow and worst ranking nine in red (see Table 11.4).

Table 11.4 Ranking of the Dutch water boards for the five benchmarking perspectives

Water Board	Treatment	Finance	Environment	Innovation	Stakeholders
Hoogheemraadschap Amstel, Gooi en Vecht		11	23	4	17
Zuiveringschap Limburg	15	3	20	15	12
Hoogheemraadschap van Delfland	24	15	27	17	
Zuiveringsschap Hollandse Eilanden en Waarden	14	5	18	6	12
Hoogheemraadschap van Rijnland	8	4	5	12	
Hoogheemraadschap Hollandse Noorderkwartier	13	20	2	1	22
Waterschap de Dommel	22	9	19	24	17
Hoogheemraadschap van West-Brabant	16	5	11	17	12
Wetterskip Fryslan	12	13	2	9	17
Hoogheemraadschap de Stichtse Rijnlanden	3	21	9	9	12
Waterschap Rijn en IJssel	10	9	8	2	3
Waterschap Rivierenland	17	19	15	7	3
Waterschap Regge en Dinkel	1	8	9	8	3
Waterschap Vallei & Eem	5	17	12	19	3
Waterschap Veluwe	23	2	23	14	3
Hoogheemraadschap van Schieland	7	18	1	27	1
Waterschap de Maaskant	2	12	7	22	1
Waterschap Hunze en Aa's	20	24	21	16	3
Waterschap De Aa	6	1	15	24	3
Waterschap Groot Salland	21	5	13	3	3
Waterschap Zuiderzeeland		24	4	23	22
Waterschap Noorderzijlvest		21	25	19	3
Waterschap Zeeuwse Eilanden	19	15	17	11	17
Waterschap Reest en Wieden	9	24	5	13	12
Waterschap Velt en Vecht	18	23	26	4	17
Waterschap Zeeuws Vlaanderen	11	24	21	19	22
Hoogheemraadschap Alm en Biesbosch	4	14	13	26	

Rank 1–9	Rank 19–27
Rank 10–18	Nodata

UvW (2003)

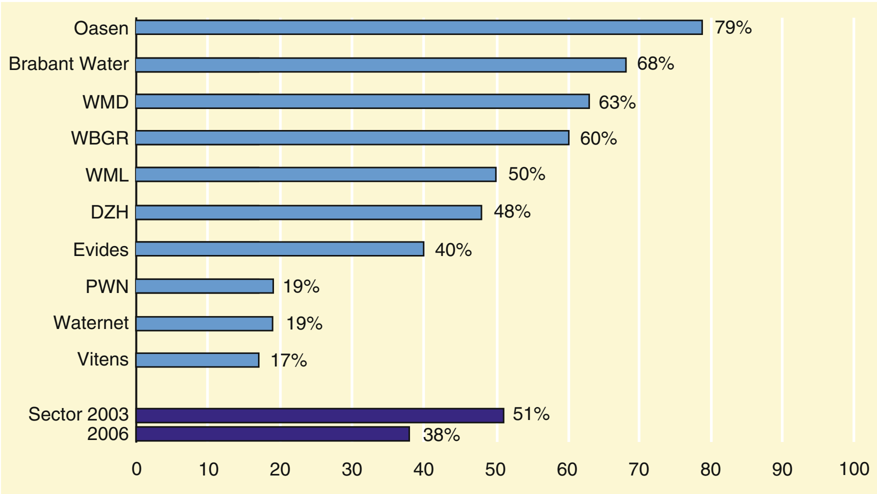


Fig. 11.6 Service quality in Dutch water utilities: Percentage of customer calls answered within 20 s. Source: VEWIN (2007)

Although not a true benchmarking study, RIONED has produced urban drainage statistics covering all Dutch municipalities since 1997 (RIONED 2009). The resulting publication is available online. The statistics presented include technical and financial data, such as length, diameter, year of construction and replacement value of sewers, tax collections and sewerage costs. Most statistics show the figures for the entire urban drainage system in the Netherlands, but some statistics show the variation of outcomes across the municipalities, such as the one reproduced in Fig. 11.6, concerning the amount of urban drainage tax collected from a multiple person household (urban drainage taxation of households by municipalities are in two categories only: single and multiple person households, the latter irrespective of the actual number of persons). The amount collected in 441 municipalities varies between a low 100 € and a high 300 €.

11.3.6 Experiences Elsewhere

In a 2005 study, Tynan and Kingdom investigated the performance of 270 water utilities in both developed and developing countries. They proposed a simple, practical benchmarking format based on the generalised objective that 'a well-run utility provides service to all customers who demand it, at a level that meet their needs and which they are willing and able to pay for'. They proposed seven related performance categories: operational efficiency; cost recovery; commercial performance; coverage and access; asset maintenance; service quality; and price and affordability. Interestingly, they provided only one indicator for each category. For example, operational efficiency was defined as the lowest cost of labour, energy, water and the materials in the day-to-day operation of a utility, with the

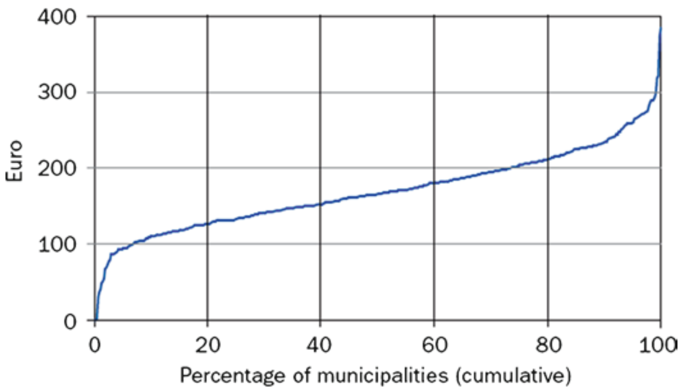


Fig. 11.7 Variation of urban drainage tax for a multiple person household across 441 Dutch municipalities. Source: Rioned 2009

most efficient combination partly dependent on local input prices and prior capital investment decisions. The authors proposed that labour productivity, expressed as the number of staff per 1,000 population (or connections) served, is the performance indicator (PI) for this category. A high number indicates inefficient use of staff. Based on their studies, they recommended five staff per 1,000 connections for developing country utilities (Fig. 11.7).

The Southeast Asia Water Utility Network (SEAWUN) and the Asian Development Bank (ADB) have undertaken performance reviews covering 40 water utilities in 4 countries in the years 2003 and 2005 (ADB 2007). This followed up on earlier reviews by ADB in 1993 and 1997. They measured performance in three categories: management, tariffs and operation and maintenance (O&M). In management the following PIs were measured: Unaccounted-for-Water (UFW), Non-Revenue-Water (NRW), unit production cost, average tariff, operating ratio, staff per 1,000 connections, professional staff, type of annual report, salaries top five positions, priority needs, and Private Sector Participation (PSP). In tariffs, methods of payment, metering, method of collection, tariff structure, rate industrial/domestic tariff, water revenue components, cost of water for domestic use, cost of domestic water at 200 m^3/year, affordability, connection fee, accounts receivable, collection efficiency, sewerage surcharge, and water vending were assessed. Last, in Operation and Maintenance, the areas considered were annual O&M costs, O&M cost components, water meters repaired or replaced annually, leaks repaired annually, annual maintenance expenses, and automation of operations.

The issue of data reliability was the specific subject of a 2004–2005 benchmarking study by the Water and Sanitation Programme (WSP 2008) in India. Ten water utilities operating under a variety of institutional arrangements in cities with populations ranging from 0.6 to 6.5 million people, participated in the survey. The study collected data on six performance indicators, namely population coverage, per capita supply, metering ratio, working ratio, complaints and supply hours. There was an enormous performance range for all indicators (e.g. working ratios varied between 0.8 and 6.6 and supply hours between 0.33 and 12 h/day). Reliability was distinguished in four categories, with category A referring to a high degree of reliability (25% of the data) and category D to low or negligible reliability (35% of the data). Table 11.5 shows the outcome of the survey and the reliability of the performance values shown.

11.4 Other Performance Assessment Methods

Parallel to the introduction of benchmarking in the water services sector, an activity primarily associated with and executed by utilities and their overseers, other performance assessment tools have been developed that are more tailored to the needs and resources of the users of public services, their representatives and associations, CBOs, NGOs and others. These tools include Community Score Cards (CSCs) and Public Expenditure Tracking Surveys (PETS). In particular, the CSCs have been used extensively in tracking performance of water and sanitation service providers. New tools that are entirely ICT based have surfaced recently and proved to have huge potential.

11.4.1 Community Score Card

The Community Score Card:

- Asks service users their opinion about the quality, efficiency and transparency of the service
- Is an instrument for monitoring and evaluation at the local level
- Aims to develop social and public transparency and responsiveness of service providers

The Community Score Card (Singh and Shah 2004) is a community-based monitoring tool that combines techniques such as social audits, citizen report cards and community monitoring. The CSC process lends itself to application in rural areas at the micro level, and can be implemented in a relatively short period of 3–6 weeks. By including a meeting between the service provider and the community, the process is also a strong instrument for community empowerment. Since the CSC process works deep in the communities, a good result requires an understanding of the socio-political context at a decentralised level, a technically competent facilitator, and a publicity campaign to ensure maximum participation of the community and the stakeholders.

Table 11.5 Performance and data reliability for ten urban water utilities in India

		Coverage	Production	Metering	Working ratio	Complaints	Daily supply
		in %	Ipcd	% of total connections	Opex as % of oper rev	% of water connections	Hours per day
City Boards	Bangalore	91	143	90	1.0	na	2.50
City Boards	Chennai	98	107	4	1.4	44	3
City Boards	Hyderabad	95	192	93	1.1	39	1
City Company	Jamshedpur	79	608	1	0.9	43	6
City Corp.	Chandigarh	100	290	71	1.3	2	12
City Corp.	Indore	54	102	0	5.4	0	0.75
City Corp.	Pune	88	274	16	0.8	NA	7
City Corp.	Rajkot	98	126	0.4	6.6	30	0.33
State Agency	Bhubaneswar	45	269	1	3.3	8	3
State Agency	Dehradun	80	149	8	1.4	4	4
Reliablity scale				A[a]	B	C	D[a]

[a]A refers to a high degree of reliability and D refers to low or negligible reliability.
WSP (2008)

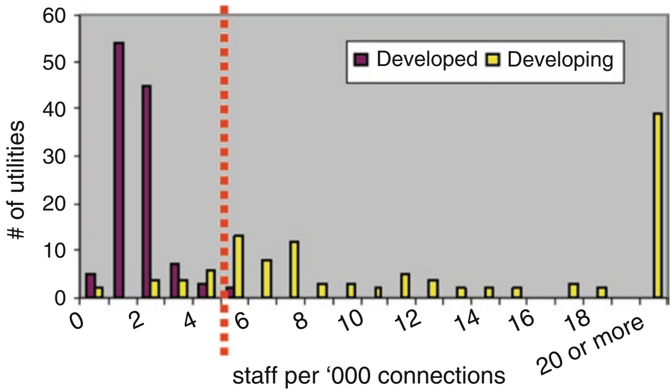


Fig. 11.8 Staff per 1,000 connections for 270 water utilities worldwide (recommended value: 5). Source: Tynan and Kingdom (2005)

Process
The four components of the CSC process are (Fig. 11.8):

1. Input tracking matrix,
2. Community generated performance scorecard
3. Self-evaluation scorecard by the service provider
4. Interface meeting between users and provider

The latter serves to provide feedback and to generate a mutually agreed upon reform agenda.

The implementation of the CSC process distinguishes six key phases. Preparatory groundwork identifies the scope of the CSC and the target communities, establishes the team that is going to execute and assist in the work, and organises a community meeting. Finally, focus groups, which cover the stratification of the community, must be identified. The development of the input tracking matrix requires the organisers to collect supply-side data (facilities, equipment, salaries, etc.), to inform the community and provider about their rights and commitments, to establish the focus groups and to define the input indicators. Once this has been done, the input-tracking matrix can be filled in by all groups and complementary physical inspections can be carried out. An important point to note is that a shortfall in provider performance may be (partially) due to the non-delivery of inputs to the provider. The next phase is the generation of the community performance scorecard, where the focus groups develop and prioritise performance indicators (usually 5–8) and discuss and assess the quality of the services delivered. Explanations for the scores and suggestions for improvement are offered. The process for preparing the self-evaluation score card by the staff of the provider is similar to that for the community. The interface meeting between community and provider is key to the success of the CSC process. At that meeting, the outcomes from the input tracking matrix, the community scorecard and the self-evaluation score card are presented and discussed. The meeting must be well facilitated since it is intended to result in concrete measures that will improve service delivery. The meeting must be well attended by both sides. In addition, the attendance of senior officials and politicians is highly desirable to endorse the proposed measures. In order for this meeting to be constructive rather than adversarial, training and preparatory meetings are usually organised. The follow-up process ensures the implementation of the proposed measures and may act as an entry point to institutionalise the CSC process and apply it to other services as well.

Outcomes

Experience shows that the method works quite well. Reporting on a similar study in Ghana, Wateraid (Addai and Dery 2004) concluded that the CSC method is effective in eliciting user (dis)satisfaction with services. Wateraid recommended that the method be used across the country. The report found that community members are very keen to participate and contribute, and that service providers are willing to be criticised and prepared to listen to users. The report also stressed the need for a good and impartial facilitator, to control the focus group discussions and to avoid antagonism from the service provider. Table 11.6 shows the outcome of the CSC process in the Wa district.

11.4.2 Public Expenditure Tracking Surveys (PETS)

PETS is a quantitative exercise that traces the flow of funds from origin to destination and determines the location and scale of anomalies. PETS are complementary to qualitative surveys on service delivery. They highlight the use and abuse of public money and give insights into the concepts of capture, cost efficiency, decentralisation and accountability (Waglé and Shah 2004).

In terms of components and phasing, PETS is similar to the CSC. The first phase is the identification of scope, purpose and actors to establish why, what and who is going to be investigated, who will undertake the PETS, and who will conduct a rapid assessment to confirm availability of data, identify the messenger and recipients of the findings. The second phase is the design of questionnaires, covering multiple data sourcing, characteristics and performance of the facilities, and the mapping of financial flows. The third phase is the sampling phase that confirms the feasibility and cost-effectiveness of the exercise, determines the sample size and executes field-testing. Phase four, the execution of the survey requires the availability of trained enumerators and the fine-tuning of fieldwork. The fifth phase is data analysis, followed by the final phase of dissemination. Findings are discussed with the relevant authorities to enable them to react and come up with plans for reforms and improvements that may become part of the presentation of the findings. The media are very important to ensure widespread dissemination of findings and thus exert pressure on the authorities to implement reforms. Finally, the follow-up phase includes tracking the implementation of the reforms, and may include institutionalisation of the PETS by government, an independent auditing bureau or a civil society organisation.

Table 11.6 Community Score Card on the performance of public water supply in Wa district, Ghana

Overall district summary from five communities						
	Standard indicators					
Name of community	Rate of water flow	Number of water points	Level of attention to customers demand	Taste of water	Number of sanitation facilities	Community's overall scores
Tawonchelle	–	1.33	1	–	2.7	1.68
Gurungu	1.5	–	1.5	–	1	1.34
Eggu	2	–	–	1.5	0.5	1.34
Kata	–	–	–	–	1	1
Tambileju (Jahan)	–	1	1	–	1	1
District Average	1.75	1.17	1.17	1.5	1.24	District overall score: 1.28

Scale used: 1 (poor), 2 (average), 3 (good)
Addai and Dery (2004)

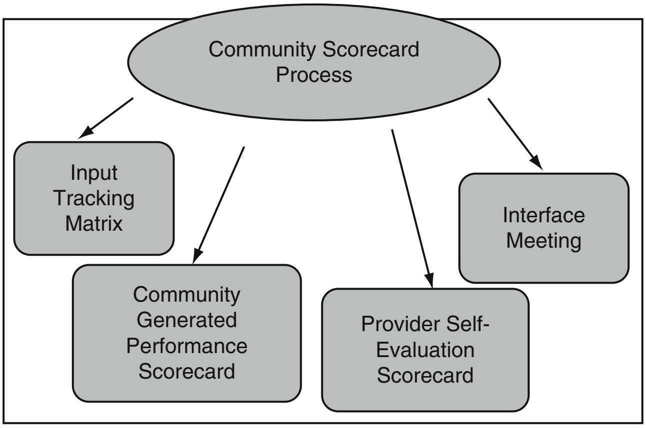


Fig. 11.9 Components of the Community Score Card process. Source: Singh and Shah (2004)

Figure 11.9 shows sample outcomes of the PETS process, one on delays in budget transfers and one on leakage during transfers (Lindelow 2003).

11.4.3 GIS-Assisted WaSH Mapping

This section concerns a recently developed GIS-assisted method for mapping water and sanitation services at schools in Tanzania, as reported by Buberwa (2009). The initiative followed up on a similar project to map water points, and started with a concept note on water, sanitation and hygiene (WaSH) in Tanzanian schools. The note was prepared by three agencies (SNV, WaterAid and UNICEF) to engage in a discussion with the concerned authorities. It led to a pilot project for mapping the current situation regarding school sanitation in two districts. The main objectives of School WaSH mapping are to gain an insight in the current WaSH status at pre/primary and secondary schools and to support the development of a variety of activities such as the dissemination of good practices, capacity-building, awareness raising and infrastructure development. The results of the mapping exercise also serve to start discussions on plans to improve School WaSH with local stakeholders and with responsible ministries.

The mapping is done using Mobile GIS, an expansion of a geographic information system (GIS) from the office into the field, based on the use of mobile devices. The mobile GIS system enables field-based personnel to capture, store, update, process, analyse and display geographic information. By integrating three essential components: a Global Positioning System (GPS), rugged handheld computers, and GIS software, the database is directly accessible to field-based personnel whenever and wherever it is required.

The required equipment includes a GPS, a laptop computer, a digital camera, maps, a survey questionnaire and a means of transportation. A GIS/Mapping expert interacts with the client to compile a survey questionnaire, which will be used to

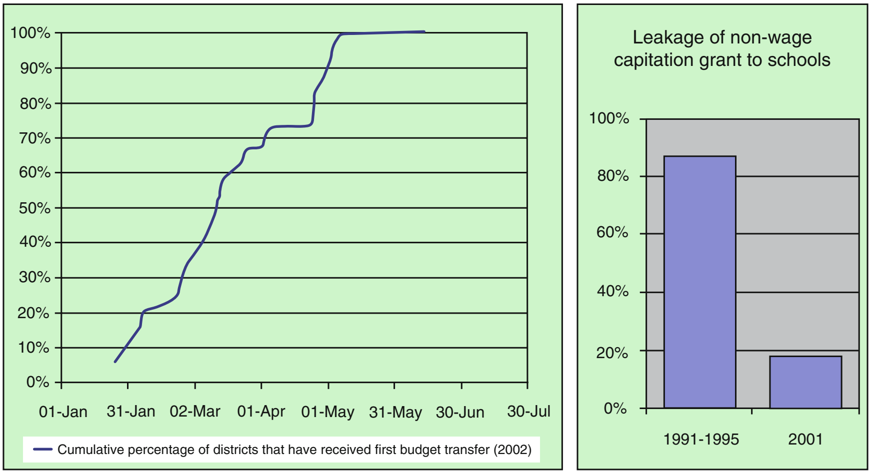


Fig. 11.10 Sample outcomes of PETS on delays and leakages in budget transfers. Source: Lindelow (2003)

capture all required information. The questionnaire is pre-designed in the office and then transformed into a data dictionary, which is uploaded into a mobile device for field data collection.

Before fieldwork can be carried out, digital(ised) maps and textual information is gathered from government agencies. Each school in the study is visited, and location data is recorded in a GPS in the form of the coordinates (Lat/Long), waypoint number and altitude. Facilities are inspected and photographed.

The results of the exercise are presented in a very accessible way: through maps and pictures. The results show substandard access ratios throughout and large inequities across the district. The maps and pictures showed that facilities were more widely available in towns than in villages, that projects had favoured certain wards, and that the quality of infrastructure varied from one place to the other. These outcomes have been presented in meetings with local stakeholders where they raised considerable concerns and initiated the necessary follow-up (see Figs. 11.10 and 11.11).

11.5 Conclusions

Benchmarking is a continuous search for better practices and superior performance. Although the practice originated in the manufacturing industry in the 1970s as a strategic tool to stay ahead of competitors, it has since entered the public domain where it is increasingly used by national and local governments, regulators and service providers as a means to direct, monitor and account for the performance of public services. Water utilities have been using benchmarking since the 1990s and the tool is now being used worldwide with noticeable, positive effects on the performance of the utilities.

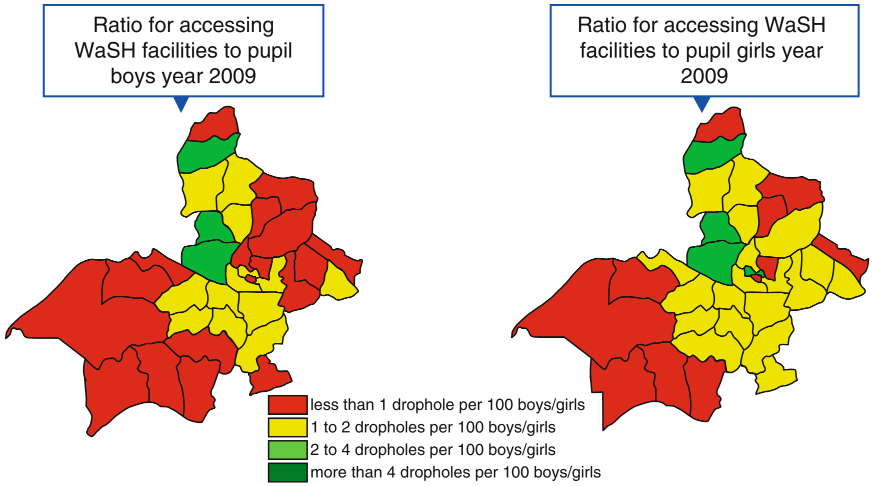


Fig. 11.11 Access to school sanitation by ward, Kahama district, Tanzania. Source: Buberwa (2009)

Fig. 11.12 Dissimilar sanitation facilities, Kahama district, Tanzania. Source: Buberwa (2009)

Water utility benchmarking has adapted the methodologies developed in private business to suit its own contextual situation, strategies, objectives and practices. The focus of water utility benchmarking is evolving from its traditional perspectives on finance, internal business, customer and innovation to include social and environmental aspects of performance. In water utility benchmarking, the number of indicators that are measured range from less than 10 to more than 100. Studies acknowledge the difficulties in collecting reliable data and the considerable costs of benchmarking. These observations result in an emerging practice that differentiates between basic and advanced levels of benchmarking.

Parallel to the introduction of benchmarking in the water services sector, other performance assessment tools have been developed that are more tailored to the needs and resources of the users of public services, their representatives and associations, CBOs, NGOs and others. These tools have been designed to do fact-finding and to promote subsequent interaction between user communities and service providers with the aim to discuss performance and agree on performance improvement measures. The methods include Community Score Cards and Public Expenditure Tracking Surveys (PETS). New tools that are entirely ICT-based have surfaced recently and show huge potential for future development.

References

ADB (2007). *Data book of southeast Asian water utilities 2005*. Asian Development Bank.

Addai, E., & Dery, M. (2004). *The community score card approach for performance assessment*. Ghana: WaterAid.

Alegre, H., Baptista, J. M., et al. (2006). *Performance indicators for water supply services*. London: International Water Association.

Anand, G., & Kodali, R. (2008). Benchmarking the benchmarking models. *Benchmarking: An International Journal, 15*(3), 257–291.

Booth, D. (1995). Benchmarking – the essential phase of preparation, in Kanji, G.K. (eds.) *Total Quality Management: Proceedings of the First World Congress*, Chapman & Hall, pp. 493–496.

Boxwell, R. (1994). *Benchmarking for competitive advantage*. New York: McGraw-Hill.

Braadbaart, O. (2007). Collaborative benchmarking, transparency and performance. Evidence from the Netherlands water supply industry. *Benchmarking: An International Journal, 14*(6), 677–692.

Buberwa, C. (2009). *School water sanitation and hygiene (WaSH) mapping*. Delft, The Netherlands: UNESCO-IHE.

Eureau. (2009). *Eureau statistics overview of water and wastewater in Europe 2008*. Brussels, Belgium: Eureau.

Fong, S. W., Cheng, E. D. L., & Ho, D. C. K. (1998). Benchmarking: A general reading for management practitioners. *Management Decision, 36*(6), 407–418.

Harrington, H. J., & Harrington, J. S. (1994). *High performance benchmarking: 20 steps to success*. New York: McGraw-Hill.

Hubbard, G. (2006). Measuring organisational performance: Beyond the triple bottom line. *Business Strategy and the Environment, 18*(3), 177–191.

Kaplan, R. S., & Norton, D. P. (1992). The balanced score card: Measures that drive performance. *Harvard Business Review, 70*(1), 71–79.

Lindelow, M. (2003, November). *Public expenditure tracking and service delivery surveys.* Presented at the 2003 ICGFM-WBI workshop, Washington, DC.

Matos, R., Cardoso, A., & Ashley, R. (2003). *Performance indicators for wastewater services*. London: International Water Association.

RIONED. (2009). Urban drainage statistics 2009–2010. RIONED.

Singh, J., & Shah, P. (2004). *Community score card process: a short note on the general methodology for implementation*. Washington, DC: World Bank.

Tynan, N., & Kingdom, B. (2005). *Optimal size for utilities. Returns to scale in water: evidence from benchmarking*. Public Policy for the Private Sector, Note No. 283. Washington, DC: World Bank.

Unie van Waterschappen. (2003). Zuiver Afvalwater 02 – Bedrijfsvergelijking zuiveringsbeheer 2002. Deloit/Vertis: UvW.

VEWIN. (2007). *Reflections on performance 2006*. The Netherlands: VEWIN.

Waglé, S., & Shah, P. (2004). *Public expenditure tracking and facility surveys: a general note on methodology*. Washington, DC: World Bank.

Water Utility Management. (2008). Special Issue: Benchmarking. *Water 21*, 3 (2).

WSP. (2008). *Benchmarking urban water utilities in India*. Washington, DC: WSP South-Asia.

Chapter 12
Planning Clinics: A Primer

Mathew Kurian

Abstract This chapter is an attempt to synthesise discussion from previous chapters of this volume in the form of an iterative guide to undertaking broad-based and participatory planning. Planning, by being able to accommodate the spending instincts of line departments, the cost-recovery impulses of finance *mandarins* and consumer/politicians inclination to exit from commitments to pay for services holds the key to enhanced service delivery. Planning clinics can put the spotlight on a larger set of institutional factors that constrain delivery of basic services like funds, functions and functionaries or transfers, taxes and tariffs. This chapter discusses an example of a WSP supported urban sanitation intervention in Indonesia to highlight the usefulness of a gradual and staggered approach to bottom up planning through which consensus for critical aspects of a reform agenda is crafted.

12.1 Introduction

New ecology scholars have amassed a substantial body of work on decision-making under conditions of uncertainty (Scoones 1999; Leach and Mearns 1996; Tiffen et al. 1994). This literature questions notions of 'linearity' in analysis of human–environment interactions. For instance, *More People Less Erosion*, as the title of the book suggests contested the linkage between population growth and deforestation in Kenya (Tiffen et al. 1994). Studies of public administration are also replete with examples of uncertainty from the institutional realm: budget cuts, staff retrenchment, discretionary financial allocations, etc. Organisational shortcomings like the census time lag inherent in modalities of information gathering and inadequacies of the income poverty line that guides decision-making further exacerbate uncertainty of the planning process. Moreover, how can social programmes targeting basic services at the poor flourish when the very legitimacy of hierarchically

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organised state structures are being questioned due to the rise of Information and Communication Technologies (ICTs) in a rapidly urbanising world?

Earlier chapters on budget support to local governments and role of information flow highlighted the arbitrary nature of public policy implementation. Such a pattern of programme design, implementation and evaluation could be pardoned so long as interventions remained focused on infrastructure creation. However, almost half a century of development assistance has shown that when infrastructure creation is not guided by broad-based planning, the wrong technology may be sought and inappropriate expenditure may occur. Planning, by being able to accommodate the spending instincts of line departments, the cost-recovery impulses of finance *mandarins* and consumer/politicians inclination to exit from commitments to pay for services holds the key to enhanced service delivery.

If anything, the chapters by Dietz and Bjorkman teach us that there is nothing to despair; we must learn to live with environmental and political uncertainty. *Planning clinics* can be useful instruments in identifying priorities, articulating a vision, developing action plans and responding with flexibility to contingencies. Clinics provide a diagnosis based on individual case history, discuss a set of exploratory treatments and chart out a timeline for individual action. In many cases, clinics may signal action that may be required on a much larger set of 'root causes'. Likewise, planning clinics can put the spotlight on a larger set of institutional factors that constrain delivery of basic services like funds, functions and functionaries or transfers, taxes and tariffs.[1] This chapter is an attempt to synthesise discussion from previous chapters of this volume in the form of an iterative guide to undertaking broad-based and participatory planning.

The subsequent section discusses a case study of citywide sanitation planning in Jakarta. The section provides an overview of the key interventions of the project, sequencing of various activities and challenges of scaling up to other cities and towns in Indonesia. The third section is a 'how-to' section that provides definitional clarity and justification for terms such as vision, goal and action plan. Focused on water and sanitation services, the section outlines three levels of analysis for mapping access to basic services. Consensus building is emphasised through a discussion of the importance of consultation, communication and sequencing of investments in infrastructure or capacity-building. The importance of resources (*sources of financing*), potential risks and timelines of a proposed set of activities contained in an action plan are explained. Finally, the chapter distinguishes between process indicators (*changes in behaviour related to financing, role allocation or skill training and allocation of funds and recourse to local taxes and tariffs*), and indicators of planning outputs (*taps, dams, schools, water treatment plants*), outcomes (*sustainable water sources or connection to a sewer network*) and impact at the policy level in terms of an improvement in incidence/distribution of poverty and environmental well-being.

[1] In this regard it has been argued by some that 'constituency- based politics' could play an important role in informing policy by articulating interests of diverse constituents through representative political structures located within the formal political system, party politics and lobbying campaigns (DPU, 1997).

12.2 Case Study: City Wide Sanitation Planning, Jakarta, Indonesia

In the context of the development of the Indonesian sanitation sector, 'sanitation' is understood as 'ensuring hygienic excreta, sullage and solid waste disposal so as to contribute to a clean and healthy living environment both at home and the neighbourhood' (Daniels 2009). Access to safe water relates closely to sanitation, but is only considered as far as it relates to sanitation activities. Government of Indonesia has long regarded sanitation as a private matter, and public investments in sanitation infrastructure and services have been negligible. Barely one percent of the population has access to sewerage and while most households have a toilet, many of these discharge into open drains, canals, rivers and ponds. The government has adopted national sanitation goals in line with the Millennium Development Goals, but has not developed a strategy for meeting them in urban areas to date. Municipalities are under little pressure to improve sanitation services and have difficulty accessing funds should they decide to do so. Where improvements are undertaken, they tend to be piecemeal and unconnected to a strategic plan for the city as a whole.

12.2.1 Project Area

The Indonesia Sanitation Sector Development Project (ISSDP) was founded to 'establish a framework for sustainable poor-inclusive urban sanitation services in Indonesia through effective and coordinated policy-making, institutional reform, strategic planning and awareness building' (Daniels 2009). The first phase of the project (2006–2008) had four components:

Component 1: Development of an 'enabling framework' for sanitation development through strengthened policies, regulations, institutions, strategies and action plans
Component 2: Coordinate framework for activity and investment in the sanitation sector developed by government, agreed to by government across regions and sectors and supported by donors
Component 3: Public awareness raising and hygiene promotion
Component 4: Capacity development and sanitation planning in six pilot cities: Surakarta, Blitar, Banjarmasin, Denpasar, Jambi and Payakumbuh

During the second phase (2008–2009/2010), components 3 and 4 merged. In addition to the consolidation of the programme's achievements during the first phase, the programme also focused on the development and enhancement of the role of the provincial governments and the scaling-up of the programme in at least two cities in the provinces West Sumatra, Central Java and East Java.

12.2.2 Preparation of City Sanitation Strategies

The city level component is the heart of ISSDP. Key features of the process developed include the following:

- 'Top down meets bottom-up' participatory planning approach is applied for planning, design and operation. The local city government needs to be empowered and capacitated.
- Follow the formal mechanism and procedures of government programme planning.
- Establishment of a multi-departmental working group (*PokjaSan*) at city level avoiding 'blueprint' approach for infrastructure development by giving due attention to social marketing and long-term (beyond construction) community participation.
- Breaking down a complex planning process into discrete and manageable tasks.
- Recognising and mobilising active support and engagement at community level.

Process facilitation, and if necessary, additional specific expertise (i.e. institutional, technical, financial, communication, community and gender participation) were made available to *PokjaSans*. The framework for planning, monitoring and evaluation of urban sanitation improvements propagated by the programme is based on a comprehensive model bringing together integral, strategic, citywide planning and bottom-up, community-based initiatives, while stimulating increased private-sector participation in the provision of sanitation services. The framework comprises the following stages of development:

(a) Formation of a city sanitation working group (*PokjaSan*); the start of the local sanitation sector development programme
(b) Definition of the city sanitation status – Sanitation White Book
(c) Preparation of the Citywide Sanitation Strategy
(d) Development of the (multi-) Annual Sanitation Action Plans
(e) Consolidation of the urban sanitation planning process

During the various stages of development, the traditional top-down approach is merged with a bottom-up approach. This approach makes urban sanitation planning the process where both approaches meet. In order to be effective the sequence and interaction of various top-down and bottom-up activities within the overall process have to be synchronised with existing government planning, budgeting cycles and milestones. Annual urban planning milestones include: Musrenbang (bottom-up planning at sub-district level) to be completed by April each year, the city annual work plan to be completed by June of that same year, the draft annual budget and a first consultation with the city council to be completed by August each year, the final annual budget, is approved by the city council by 15 December of each year.[2]

[2]See also Water and Sanitation Program Field Note (April 2009) Urban sanitation in Indonesia: Planning for progress. Washington, DC: The World Bank.

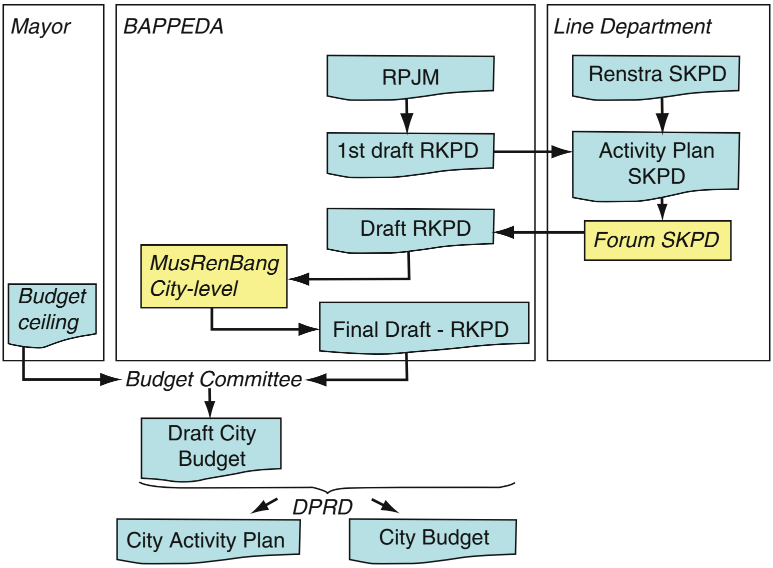

Fig. 12.1 Integration of proposed projects and action plans in routine government planning and budgeting procedures

The leading principles for implementation are that sanitation planning should be embedded into routine government planning and budgeting procedures. Consequently, it is crucial that specific outputs of the sanitation planning process (e.g. proposed projects and action plans) become available on time for integration in the routine city development planning process, as shown in Fig. 12.1.

12.3 Decision-Making Under Uncertainty

12.3.1 Policy Process, Budgeting, Information Flow

Centralised and top-down approaches will not deliver sustained improvements in service delivery. Recourse to policy and project specific approaches is likely to flounder in the face of the uncertainty of climate, complexity of budgetary processes and fragmented nature of information flow. City specific sanitation strategy formulation based on autonomous decision-making and financial arrangements offers potential to produce compacts involving politicians, bureaucrats and consumers. Compacts are most effective when they are based on a shared vision, objectives with specified timeframes, indicators that are easily verifiable, discussion of risks and assumptions of success. Communication and consultation are key processes involved in plan formulation for which financing sources and roles and responsibilities need specification.

12.3.2 Planning Clinics: Vision, Goal, Action Plan

Planning clinics could serve to facilitate drawing up effective plans since they strive to build consensus on sustainable financing of identified objectives. Tying disbursements of bilateral and multi-lateral development assistance to achievement of policy goals by governments at multiple levels (national, intermediate and city/town) could go a long way in operationalising aspects of multi-level governance. In this regard a recent WSP field note points out, 'ISSDP has tried, through the planning process, to directly address the shortcomings of existing sanitation services (in the six pilot cities), notably poor inter-agency coordination, a history of ad-hoc, supply-driven investments, and a lack of skilled human resources and essential information for decision making' (WSP 2009: 11). The field note also highlights important gaps in institutional arrangements like absence of government guidelines and regulations that explain why substantial provisional and local government funds remain unspent. The study discusses the important issue of tariff setting and concludes that willingness of households to pay for collection of solid waste exists but the same may not hold true for wastewater treatment and disposal. Given the fact that only a small proportion of households connect to public water supply this means, cost-recovery for wastewater treatment and disposal is likely to remain low. The field note also emphasises the absence of collective choice rules for management of common pool resources like rivers by pointing out that 'environment laws exist to control water pollution, but enforcement is weak and polluters see little point in reducing their impact when the receiving bodies are polluted anyway, sometimes from distant sources' (WSP 2009). Key steps involved in design of planning clinics to facilitate effective communication and consultation could include the following:

1. A baseline assessment: Involving qualitative and quantitative information on water resources, relevant legislation and policies and range of stakeholders.
2. A vision: Concise description of an imagined future state, containing broad goals.
3. Action plan: Specifies activities to be undertaken within particular timeframes and involving monetary and human resources. An action plan will also specify strategy for sequencing planned interventions involving infrastructure creation, communication and community consultation.
4. Risks and assumptions: Clear delineation of risks that might constrain achievement of action plan together with analysis of assumptions behind likelihood of success.
5. Measurable indicators: Simple and measurable indicators on physical, technical, societal and institutional dimensions. A robust monitoring system will also capture important process dimensions of planning, performance measures, staff motivation, consumer satisfaction, etc.

Another important issue highlighted by the WSP study has to do with the importance of planning. The ISSDP project made it clear to local and national managers that the problem in urban sanitation is not only a lack of investment; it is also the lack of a plan. By challenging the notion that all problems in urban sanitation lie with the community, the project effectively emphasised the importance of behaviour change at higher levels. Further, the project emphasised that behaviour change can be powerful in ensuring that outputs (such as pipes and wastewater treatment plants) translate into tangible outcomes (like household connections to infrastructure) and eventually lead to policy level impact (like reduction in incidence of disease and an improvement in environmental quality). 'City-wide sanitation strategies are important as they prioritize investment needs, enabling municipalities to direct incoming funds (whether from central government, the province or donors) to where they are most needed' (WSP 2009: 17). The project also emphasised the importance of municipal resource allocation processes by putting the spotlight on issues of sectoral allocation and ensuring that preparation of sanitation action plans were properly sequenced to ensure that they met government budget preparation deadlines (Appendix). Because of detailed attention to planning and resource prioritisation, the constraint that frequent turnover of municipal officers posed to continuity of programmes began to be addressed. The project also pointed to important capacity-building requirements because recruitment of skilled facilitators with a suitable understanding of technical issues was hard to find.

12.3.3 Mapping Concentrations of Poor and Access to Services

Policy and management interventions depend on an analysis of water resources trends and consumption behaviour. Trends in ecological conditions, such as pollution of rivers and depletion of groundwater resources are indicative of particular forms of human behaviour. Policy responses to mitigate the effects of these trends could take a variety of forms such as, taxes, tariffs and fines. There are also important technological considerations like type of sewage treatment plants or the issue of centralised versus decentralised water supply that need to be mapped to ascertain cost-effective service delivery options. Within a country, patterns of fiscal transfers from a central government may vary in response to perceived need for greater investments to counter historically entrenched poverty (*presence of hill tribes*) or difficult environmental conditions (*remote or arid desert area*). Mapping concentrations of the poor and their location in relation to the non-poor is a crucial first step. As shown in Blokland's and Kurian's respective chapters on policy guidance and imperfect data, information may not always be available or reliable to permit a credible mapping exercise. A multi-layered approach supported by data triangulation checks can prove to be useful in such situations. There are several possible options to adopting a multi-layered approach.[3]

[3]Rudiments of an interesting pro-poor mapping technique for water services is presently being supported in the slums of Kampala, Uganda by KfW, Germany. The approach involves overlaying a map of the location of the poor on the water supply infrastructure coverage map. Grids are drawn and the poorest of the poor are identified within these grids. Dedicated staff are put in charge of selling credit to households from community stand pipes. Tamper proof water metres record water use and credit is sold using GPRS technology (similar to pre-paid telephone calling cards). So far, 6,000 households have been successfully covered and given the enormous potential for scale up an OBA approach is currently being formulated with support from the World Bank.

1. Use secondary information generated from census, district statistics or satellite imagery to identify concentrations of poor in a country/district of town.
2. Select based on indicators of technical efficiency, financial performance or customer satisfaction utilities located in an area of high or low concentration of poor.
3. Explore reasons behind consumers' ability/willingness to pay for services for utilities studied.

12.3.4 Building Consensus for Identified Priorities

Based on information generated from a mapping exercise, an attempt to build consensus around a set of interventions to address a service delivery challenge is feasible. Building consensus would entail consultation with decision-makers, utility managers and consumers. Communicating the outcomes of consultation process and eliciting feedback is a logical next step. Knowledge and information generated from consultation and communication could go a long way in sequencing of investments.

1. Capital (*construction of sewer trunk lines followed by construction of sewage treatment plant*)
2. Knowledge (*combined or separate billing of water supply and sanitation services*)
3. Advocacy (*education of elected politicians on expected outcomes of planned investment*)

12.3.5 Resources, Risks and Timelines

Once consensus has coalesced around a given vision, goal and action plan, it is important to consider where the resources (finances and human resources) will come from to support execution of the plan. Here important consideration could include whether financing will come from central transfers, local taxes or tariffs or through management contracts with the private sector (international or domestic). A number of ecological risks (poor rainfall), economic risks (input prices like chemicals to run water purification plants), or political risks (decision to withdraw subsidies agreed by a previous political dispensation) could threaten implementation of the action plan. Possible contingency plans to respond to such threats need to be carefully deliberated. Finally, it is important to discuss and agree on timelines for each of the activities once sequencing has been agreed upon.

12.3.6 Monitoring Framework

Identifying benchmarks for evaluations is an important last step of a planning clinic. Periodic evaluations can go a long way in facilitating mid-course correction of a given set of planned interventions. A robust monitoring framework would provide indicators that measure performance against a given set of process variables (*changes in behaviour with regard to allocation of skilled staff or finances*) that address a service delivery variable that measures progress with outputs (*infrastructure construction*), outcomes (*access to water services)* and impacts for (*proportion of poor served*) the environment (*river quality or groundwater recharge*).

12.4 Conclusion

By being flexible, planning clinics are able to respond to uncertainties inherent in the policy process. Depending on the scale at which planning is undertaken and the basic service delivery challenge addressed, planning clinics can vary in time and duration. Over a period of a few weeks and or even 1 year, substantial *durable* progress can be made in terms of building agreement and proceeding with plan implementation. For planning clinics to be effective and not an academic exercise, political support for organisational reform in support of improved modalities for service delivery is important. Taking into consideration the Indonesia case study discussed earlier in this chapter, eventually micro-level sanitation planning must engage with macro-level issues related to budgeting practices, national policy and legal frameworks. There are bound to be a number of risks involved, but also opportunities for capacity development that re-orient planning from an exclusive focus on infrastructure creation towards a balanced approach that ensures capital investments result in tangible improvements in services for the poor. Donors can play a critical role in aiding such a process of incremental change through targeted support and use of instruments like OBA, cash conditional transfers or budget support.

12.5 Appendix: Public Revenue and Expenditure Trends

Leveraging city revenue: The case of Banjarmasin

Revenue (in million Rs)	2003	2004	2005	2006
City revenue (APBD)	29,166	38,328	41,183	45,572
Provincial (APBD I)	31,034	28,013	51,821	50,406
National (APBN)	225,329	233,824	256,138	394,693
Others	17,050	14,800	13,026	
Total	302,579	314,965	362,167	490,672

Allocation of National Special Funds for 2008

No.	Development sector	Special allocation fund DAK (billion Rs)	Percentage (%)
1	Education	20.428	48
2	Health	7.204	17
3	Population affairs	1.075	3
4	Road	7.363	17
5	Irrigation	0,000	0,0
6	Water supply and sanitation	2.354	5
7	Fisheries	1.854	4
8	Agriculture	2.617	6
9	Infrastructure	0,000	0,0
10	Environment	0,704	0,0
11	Forestry	0,000	0,0
Total		42.896	100

References

Daniels, R. (2009). *City sanitation strategies in Indonesia: Lessons learned*. Delft: UNESCO-IHE lecture notes.

DPU. (1997). Gender Policy and Planning Programme Training Materials, Development Planning Unit, University College London.

Leach, M., & Mearns, R. (1996). *The lie of the land: Challenging received wisdom on the African environment (African Issues Series)*. Portsmouth, NH: Heinemann.

Scoones, I. (1999). New ecology and the social sciences: What prospects for a fruitful engagement? *Annual Review of Anthropology, 28*, 479–507.

Tiffen, M., Mortimore, M., & Gichuki, F. (1994). *More people, less erosion: Environmental recovery in Kenya*. Chichester: Wiley.

WSP. (2009). *Urban sanitation in Indonesia: Planning for progress*. Washington, DC: The World Bank. Field note, April.

Chapter 13
Conclusions: Governance Challenges in Urban and Peri-urban Areas

Patricia McCarney

Abstract An array of solutions for effective governance that integrates urban and peri-urban planning has been the subject of this book. The need to recognize better these operations on the ground and the potentials each offers in assisting a more progressive policy evolution in this field is a significant contribution from the authors. This concluding chapter identifies six emerging challenges: one, globalization of urban spaces; two, information, measurement and city indicators; three, effective coordination of funds, functions and functionaries; four, how the peri-urban poor access services; five, financing; and, six, inclusive cities. Finally, the cases documented in this volume demonstrate that inclusiveness is a way to increase efficiency in city management and service delivery across urban and peri-urban areas. New norms of practice and reform of institutional procedures in cities is dependent upon strengthening modes of inclusive urban governance.

13.1 Introduction

Global trends in urbanisation are causing urban populations to spread out beyond their old city limits, and are altering settlement patterns that increasingly bind urban, peri-urban and rural areas, rendering the traditional municipal boundaries, and by extension, the traditional governing structures and institutions, outdated. Empirical evidence shows[1] that urban areas around the world continue relentlessly to expand in terms of both density and horizontal space (Angel et al. 2005). Cities, even those of intermediate size, continue to grow and many of them spread over different administrative units. There is a need to govern these large areas in a coherent fashion.

[1]Research in this area includes the studies of McGee and Robinson 1995; *Environment and Urbanization* April 2000; Myers and Dietz 2002; National Research Council 2003; Rojas et al. 2005; Laquian 2005; *Public Administration and Development* October 2005.

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This spread and alteration in population settlement is not only a spatial phenomenon but also needs to be regarded in terms of the inherent social and economic challenges, shifting service demands, dynamic economic spheres of influence and fluid political relationships.

City labour markets, real estate markets, industrial and agricultural markets, financial and business markets spread over the jurisdictional territories of several municipalities and local districts. In this context, the functional areas of cities can be regarded as extending beyond their established jurisdictional boundaries. Increasingly, these functions demand more integrated planning, service delivery and policy decisions than these multiple but individually bounded local governance institutions can provide. Governing across urban and peri-urban areas is complex since a decision taken in one municipality that is part of the central city affects the whole of the urban, peri-urban and peripheral rural areas. This phenomenon introduces new challenges in urban governance. The requirement, and urgency, for well-governed cities stems from the fact that the world's cities are critical sites for economic production, agglomeration and proximity; for social and cultural development and interaction; for innovation and creativity; and are an essential staging ground for connecting society and the economy to external networks and the global economy (McCarney 2005). Well-governed cities are also a requirement if a planning trajectory for more equitable and just cities is to be accommodated.

Concerns related to an increasingly divided urban society, indicated by the inequalities and poverty that stretch across urban and peri-urban areas, point to the need for balanced urban development policies embedded in planning and governance frameworks. Urban poverty is worsening and, in many cities, has been spreading outwards, rendering the peripheries of large metropolitan areas the poorest and most heavily under-serviced settlements. Cooperation among governing bodies and institutions, working together instead of in competition within the same urban territory, can help to overcome disharmonies associated with poverty, inadequate infrastructure, social inequalities, crime and under-serviced transport systems that inhibit mobility across these areas. Effective governance that integrates urban and peri-urban planning and a broader base of local institutions offers potential for improved urban management and more effective urban development in general in the urban territory as a whole, but more importantly in targeting services for the poor in these areas for improvements in basic water and sanitation infrastructure. Case chapters in this book have demonstrated the array of solutions being introduced and experimented with by governments and local institutions throughout some 20 countries. The need to recognise better these highly varied operations on the ground and the potentials each offers in assisting a more progressive policy evolution in this field is a significant contribution by the foregoing authors of this volume.

13.2 Changing Municipal Territories

In the past throughout the world, cities were characterised as having one central area or central business district, well-defined limits of residential and industrial growth, and a clearly delineated area of commercial influence in a defined larger region, often the surrounding rural hinterland. The urban rural divide, at least in the spatial planning sense, was quite clear. Over the past 50–60 years, as cities have grown by rates not before seen in history, these municipal territories have shifted. Currently, cities worldwide often have more than one central area, very diffused limits defined often not so much by local geography but more in terms of global reach, extended commercial areas of influence (often commanding influence for the country as a whole), and highly diversified economies. It is not so easy to define or to demarcate spatially the urban, peri-urban and rural hinterlands today as perhaps it once was. In Chapter 2 of this volume, Adriana Allen explores the implications of overlapping organisational mandates and administrative jurisdiction for delivery of water services in peri-urban regions in developing countries. From a water services perspective, this introduces an element of complexity and uncertainty since water allocation issues become important, as pointed out by Liqa Raschid-Sally and Daniel J. van Rooijen in Chapter 3. Their discussion of the urban water footprint demonstrated, drawing on examples from several developing countries, the links between water supply, wastewater generation and environmental and public health impacts.

In a recent publication by UN-Habitat, these shifting trends have been detailed and the inherent problems of definition and measurement tracked (McCarney and Stren 2008). The metropolitan area of Mexico City (18 million people), extends over the municipalities and territories of two states as well as the Federal District to include as many as 58 municipalities; the economy of Buenos Aires covers the territories of the City of Buenos Aires (three million people) and the 32 municipalities of the Province of Buenos Aires (nine million people). In Asia, for example, Metropolitan Manila in the Philippines is composed of ten cities and seven municipalities, with a total population of approximately 11 million; while Cebu City is comprised of seven cities and six municipalities (with a population of 1,930,096). Portland, Oregon, with approximately 1.5 million inhabitants, covers three counties and 24 local governments. Hence the task of governing these expanding urban territories is also in need of review since cities worldwide, with few exceptions, are made up of more than one urban unit; they are ‘cities of cities’. However, most comparative statistics on cities and metropolitan areas derive from data with some limitations in terms of reliability and comparability. For example, urban areas and metropolitan areas made up of more than one urban area are defined by each country; there is no consistent definition for the terms ‘urban’ and ‘municipality’ throughout the world. Because urban areas, greater urban areas and metropolitan areas are rarely legally defined entities, there may be a number of different possible boundaries for a commonly understood extended urban area, such as, New York City and the New York Metropolitan Area, or the City of Toronto and the Greater Toronto Area. In all these cases, different designations will mean different sizes and populations (McCarney and Stern 2008).

The issue of land use in cities, and the planning and management of land development in particular, is a highly contested subject. In the decades following World War II, suburbanisation was the norm, rapid consumption of land in ever-expanding rings around cities occurred almost overnight, with highways and transport systems built to support this physical expansion. Valuable farmland has disappeared and car-dependency has deepened. Many cities still exhibit this trend. Urban densities range from the extremely compact places such as Hong Kong with 5,000 people per hectare, or Manhattan and other high density urban places such as the slums of Calcutta, Nairobi or Lima, to the suburban areas surrounding many cities like Johannesburg, Los Angeles and Toronto where averages of 100 people per hectare or less are the norm.

This expansion of cities raises questions about how we define cities and these highly urbanised communities. The United Nations defines an urban agglomeration as the built-up or densely populated area containing the city proper, suburbs and continuously settled commuter areas. It may be smaller or larger than a metropolitan area; it might also comprise the city proper and the suburban fringe or densely populated adjoining territory. A metropolitan area is the set of formal local government areas that normally comprise the urban area as a whole and its primary commuter areas. A city proper is the single political jurisdiction that contains the historical city centre. An analysis of 228 countries shows that governments use different definitions and criteria to define 'urban'. For example, 105 countries base their urban data on administrative criteria, limiting it to the boundaries of state or provincial capitals, municipalities or other local jurisdictions; 83 use this as their sole method of distinguishing urban from rural. One hundred countries define cities by population size or population density, with minimum concentrations ranging broadly, from 200 to 50,000 inhabitants; 57 use this as their sole urban criterion. Twenty-five countries specify economic characteristics as significant, although not exclusive, in defining cities – typically, the proportion of the labour force employed in non-agricultural activities. Eighteen countries count the availability of urban infrastructure in their definitions, including the presence of paved streets, water-supply systems, sewerage systems or electric lighting. Twenty-five countries provide no definition of at all. Six countries regard their entire populations as urban (United Nations 1998, 2003 Revision).

13.3 Emerging Questions: Emerging Challenges

A number of key questions emerged from this volume that needs to be addressed urgently. These include the question of how to address the deepening poverty occurring in the peri-urban areas where new household formation out-paces the ability of governments to provide basic water and sanitation services. This core question is layered with the broader question of how to accommodate another two billion people being added to cities around the world over the next few decades. Second, fragmented governance arrangements of the urban and peri-urban areas across the multiple and varied jurisdictions of these expanding urban territories pose the central question of how best to enter into what can here be predicted as a new urban reform era. This core question too is layered with the persistent ones of the past few decades – deficient intergovernmental relations, inadequate popular local representation processes, weak sub-national institutions and poor financing mechanisms to support these sub-national government forms – which in turn pose critical questions of urban governance for policymakers at all levels of government and leaders of communities, as well as for researchers, planners and international agencies.

In exploring each of these questions, it is critical to do so in a framework of global urban development. The global urban population will increase by approximately two billion reaching close to five billion in 2030. How will our cities accommodate the additional two billion people? What city forms are we contemplating? What density and what physical reach do we expect to experience? What quality of life are we seeking in cities?

Moreover, the urban slum population is expected to increase to 1.4 billion in 2020. This means that in only a decade, approximately one in four urban dwellers will live in impoverished, over-crowded and insecure living conditions. How are the needs of the poor in cities worldwide to be met when most local governments whose primary responsibility is to deliver services and ensure decent living and working conditions, are already over-stretched to capacity and unable to meet more than a fraction of these needs?

Hence the overriding question of how to create sustainable cities with what seems to be a relentless expansion of the urban peripheries. How do we control land speculation practices that leap frog over urban peripheries and inhibit future abilities to plan for future urban development? If we are to reduce the development of new slums, how can we also open up vast tracts of land for new, affordable housing, ensuring liveable places for the poor of these cities with affordable transit to jobs? Moreover, how do we best govern the vast tracts of urbanism that already spill over existing political boundaries into other jurisdictions, while ensuring that these cities raise revenues to support the whole?

This last question raises the larger issue of how we not only plan and manage the form and shape of our growing cities worldwide, but how we govern cities that no longer have a single core, where urbanisation expands across new territories and across competing political jurisdictions. In developing countries, municipal authorities are surrounded by rural and provincial councils with distinct governing systems that often report to different ministries with different development priorities and policies. For example, very different administrative systems in the Greater Mafikeng Area of South Africa include the City Council and the peri-urban Tribal Authorities. An Integrated Development Project was initiated, which sought to overcome these jurisdictional boundaries and administrative barriers. Cities of the twenty-first century need re-interpretation in terms of the spatial territory they increasingly occupy and the multiple cores and multi-nodal growth centres that urban development trends suggest. The ‘metropolitisation’ of cities and the globalisation of urban spaces in cities of both rich and poor nations create new imperatives for political leadership and the planners and managers charged with guiding city growth for a sustainable and a more equitable urban trajectory.

13.3.1 Globalisation of Urban Spaces

At one level, planning and effective management are critical functions but are dependent upon more empowered and effective urban governance frameworks for credible action. When local government is recognised as a legitimate tier in the governance structure of a country, and when financial powers to raise revenues and responsibilities to deliver services are commensurate with the growth and expansion of cities, then the planning and management functions in cities take on meaning, and develop influence. Cities worldwide are entering into renewed dialogues with provincial and national governments to discuss this urban agenda. As seen in Chapter 4, Ton Dietz demonstrated how municipalities are responding to climate change, given its impacts on water and sanitation management. Ir. Adry Abraham Salomé's review of the Dutch water boards indicates that improved planning and management mechanisms usually emerge incrementally. Once enormous investment has been made in establishing a centralised system of combined sewers for collection, transport and treatment of wastewater, the transaction cost of shifting towards a system focused on source separation becomes cumbersome.

In a developing country context the power of good planning and effective management in strong, empowered city governments are critical in propelling cities towards sustainability. Cities have the capacity to encourage participation and engage with local organisations, especially those involved with the poor. Cities, in this context, have the power to address land tenure and land rights in the city and can thereby adopt a pro-poor set of policies governing access to and use of land in the city. In addition, they have important powers over building codes and zoning by-laws and can adopt flexible standards governing construction, infrastructure and plot size that assist the poor to solve the housing crisis by building incrementally. Finally, cities have the power to develop creative financing tools for mobilising investment in housing, infrastructure and services for the growing numbers of urban residents in cities.

When the power to pursue good planning decisions is weak, non-existent or vested in bodies not directly accountable to urban residents, then goals aimed at sustainable cities are difficult to attain. When urban management systems lack adequate cross-sectoral coordination, and city administrations suffer from divisions of responsibilities, then local economic development falters. The issue of institutional coordination is important at many levels as Mathew Kurian's chapter on financing the MDGs demonstrates. He argues that at the donor level, OBA and harmonisation of policy instruments are important and that issues of credible and transparent national policy and legal frameworks are also important to attract private sector participation in the water sector. Local government autonomy and capacity are also critical in ensuring that issues of equity are addressed by intergovernmental fiscal transfers that James Warner Björkman refers to as the lifeblood of the policy implementation process.

Access to land and housing and, security of tenure are critical issues in the alleviation of urban poverty worldwide. In cities with large urban poor populations, security of tenure is acknowledged generally as the critical first step in the social and spatial integration of slums and low-income settlements. When tenure is in question, slum improvement is politically complex, both for city planners and for residents. Any intervention on the part of government is perceived as a de facto recognition legal status and any improvements by residents themselves are regarded as high-risk investments owing to the lack of property rights and the threat of eviction without compensation. Hence, in considering effective planning and management in this context, the overarching policy and legal climate in the city is paramount. Pro-poor enabling legislation and land regularisation instruments are critical components of a robust, healthy and integrated city economy and urban society.

The planning profession and the planning tools to address sustainable urban development in cities of poorer nations face particular challenges of capacity, and up-front resource commitments in both plan preparation and implementation. An information crisis seriously undermines effective urban planning. The lack of monitoring structures and timely and reliable data systems weakens the power of good planning decisions in cities of the developing world. As a new era of planning begins, we must ask how good urban governance defines planning practice, and how sustainability drives reform and the planning agenda. City planners are increasingly concerned with reducing vulnerability to disasters, creating environmentally friendly cities, creating safer cities by rethinking public space, reducing slum formation and guiding asset creation for pro-poor urban strategies. Mathew Kurian and Hugh Turral's chapter on adaptive groundwater management offers examples of how real time information flows could help overcome problems posed by the census time lag that acts as a drag on the planning process. In Chapter 11, Maarten Blokland is optimistic about the concept of service delivery benchmarking, and points out that if data reliability can be ensured, information flows can offer critical inputs towards decision-making on budgetary resource allocations.

A renewed commitment to planning and management of urban land, housing and infrastructure is an essential component of ensuring sustainable cities in our future. Overcrowded and poor quality housing and lack of basic services affect the health, well being and safety of people in cities worldwide. Impoverished living conditions cause illnesses, contribute to an inability to be productive and cause high rates of absenteeism from work, place the poorest households at higher risk in terms of crime and safety, and make them more vulnerable to natural disasters. These living conditions affect economic growth and sustainability of the urban system as a whole. Making progress towards sustainable cities, means designing and improving cities through planning strategies geared to the well being of citizens – particularly those with the fewest resources (Sorensen 2001; Stren 2007; United Nations 2008).

13.3.2 Information, Measurement and City Indicators

For citizens to engage in public hearings and consultative meetings effectively requires that communities have access to information and sound measurements of service delivery and city performance. For example in the area of water and sanitation, measurements of city performance on service standards across urban and peri-urban areas and also measurements that indicate how one city is performing relative to another of similar size and wealth is important information for both city planners and citizen organisations in determining action on service investments. Public meetings often tend to be simply informative – citizens are there to receive information. However, public meetings need to serve a more critical role for citizens and can move beyond the function of informative to one of consultative. Globally, the importance of city indicators gained recognition as important instruments for fostering citizen participation. Information provided by city indicators can improve the effectiveness of active citizen involvement in decision-making and policy development. Voula Mega and Jørn Pedersen (1998) suggest that indicators should aid in decision-making at various levels to promote local information, empowerment and democracy. They should also contribute to making the city's process of decision-making more visible and transparent.

City-level indicators that have a globally standardised methodology are important, not for purposes of numerical ranking of cities, but for informing policy decision-making through comparative city data, that provides policy leverage for city leaders in government and communities. The Global City Indicators Program established by the World Bank provides a system for cities to use globally standardised indicators as a tool for informing policymaking through international comparisons. For example, the Secretariat of Finance in Bogota uses indicators from the Global City Indicators Program as a way to track the city's investments and to compare their city's performance relative to other international cities. By using indicators and drawing global comparisons, the Secretariat of Finance 'is able to evaluate and monitor performance on their investments and to benchmark their performance in comparison to other cities' (City of Bogota – Finance Secretary 2009[2]). Global comparisons allow for sharing of best practices. Bogota's Secretariat of Finance used indicators and reports generated from the Global City Indicators Facility in negotiations 'to inform effective evidence-based policy making. Indicators can provide evidence on how well the city is performing in terms of city services and where to allocate investments. During budget negotiations with other Secretariats having information on how other cities provide services and their results have proven useful in the allocation of resources' (City of Bogota – Finance Secretary 2009[3]).

Indicators improve the accountability and efficiency of local policy processes by building stakeholders', public, and community understanding of issues and city performance on service delivery. As informational policy instruments, indicators provide more and better knowledge to local communities and decision-makers and offer a methodical system of informing decisions. For example, the City of Sao Paulo, a pilot city of the Global City Indicators Program, recognises the need for indicators as a tool for increasing transparency and accountability within their government. Sao Paulo is an important demonstration of how municipal governments can use indicators to enhance governance and institute evidence-based policy development in the City (City of Sao Paulo 2009[4]). 'The government of Sao Paulo

[2]Interview and case study material gathered from City of Bogota – Finance Secretary, 2009.

[3]Ibid.

[4]Interview and case study material gathered from City of Sao Paulo 2009.

is hoping to regain legitimacy and public confidence in government statistics by creating more transparency on its performance in city services and on improving quality of life. The Government of Sao Paulo recognises the growing importance of indicators for planning, evaluating and monitoring municipal services. In addition, use of indicators to assist with public policy making in Sao Paulo has opened more effective dialogue between civil society and the local government' (City of Sao Paulo 2009[5]).

Because urban areas around the world, with few exceptions, comprise more than one urban unit, most comparative statistics on cities and metropolitan areas come from data with serious limitations in terms of reliability and comparability due to definitional issues on jurisdictional boundaries. There is no consistent definition for what is 'urban' or what a 'municipality' is throughout the world and different country designations will mean different area measurements, service areas and populations. Not only do inconsistent definitions pose challenges for policy, but also for identification of performance targets, indicators and measurement of service delivery outcomes. Mathew Kurian's discussion of soil conservation in Laos (Chapter 9) addresses the definitional and information challenges confronting policymakers by drawing a distinction between institutional arrangements (*access to markets*, *information technology*, *financial resources*, *skill sets and clarity of roles and responsibilities*) and policy and legal instruments that constitute the institutional environment. The chapter also distinguishes between services (*access to soil conserving farming techniques*) and process outcomes (*connectivity to infrastructure like roads*, *internet or availability of motivated agency staff*).

13.3.3 Effective Coordination of Funds, Functions and Functionaries

The governance of cities is pivotal in confronting the challenges of poverty and access to basic services. City governments are constrained on a number of fronts. Jurisdictional coordination is one of the most pressing to cities worldwide. This challenge takes two forms: multi-level jurisdictional coordination of services vertically across multiple levels of government and inter-jurisdictional coordination of services horizontally across the metropolitan area. In the case of the former, the inter-governmental relations involved in the governance of cities are often in flux, with extensive and complex decentralisation processes in motion in many countries worldwide. Multiple tiers of government and various levels of state agencies are involved in the affairs of urban governance, often at the expense of municipal level actors. In the case of the latter, existing governing institutions are often fragmented, uncoordinated and in many cases ad-hoc due to multiple jurisdictional and electoral boundaries that span the territories of vast metropolitan areas.

[5]Ibid.

Limited power and responsibility over key public services, including planning, housing, roads and transit, water, land-use, sanitation services and drainage, waste management and building standards weakens many city governments (McCarney and Stren 2003). As seen in the case studies profiled in this volume, many of the poorest cities of Asia, Africa and Latin America do not have basic services such as waste collection, piped water, storm and surface drains and sanitation systems in under-serviced, informal areas of the city. Not only does this inhibit progress, it places a large number of urban residents at risk for disease and large portions of cities at risk of disaster and climate change impacts, particularly from storms, flooding, earthquakes and heat waves.

Some common challenges and characteristics for success in the governance of these urban and peri-urban spatial territories help to inform a policy dialogue on governance.

Over the past few decades, efforts to improve urban governance have focused on the essential first step of devolution of power, authority and resources from the central to municipal level. Governed by the principle of subsidiarity, decentralisation processes seek to ensure that decisions are taken, and services delivered, at the sphere of government closest to the people while remaining consistent with the nature of the decisions and services involved. Empowering cities to govern effectively remains a key platform for urban reform in countries throughout both the developed and developing countries.

The case of Mumbai,[6] India illustrates the challenges of jurisdictional coordination. The Greater Mumbai Municipal Corporation (GMMC) governs more than 12 million people (as of the 2001 census) within a complex institutional structure of two wider metropolitan areas. First, an area defined as the Mumbai Urban Agglomeration of 16.4 million (2001 census) covering three districts of Maharashtra inclusive of five municipal corporations and three municipal councils. Second an even wider area, the Mumbai Metropolitan Region (MMR) covering an area of 4355 km^2 and including seven Municipal Corporations, 13 Municipal Councils, parts of neighbouring districts and more than 900 villages.

The Corporation of Greater Mumbai however is only one entity responsible for planning, development and provision of infrastructure in greater Mumbai. Other key agencies responsible for governance in Greater Mumbai include the Mumbai Metropolitan Region Development Authority (MMRDA). MMRDA is responsible for the planning and development of the entire metropolitan region in a multi-municipal jurisdiction (seven Municipal Corporations, 13 Municipal Councils, parts of neighbouring districts and more than 900 villages). The MMRDA also brings together Central and State Governments to fund urban development jointly. Although the MMRDA Act specifically prohibits it from undertaking any work, which falls under the obligatory or discretionary functions of the Municipal Corporation of Greater Mumbai (MCGM), the Act also gives it overriding power

[6] This case material on India is drawn from 'Metropolitan governance in India: Case studies of Mumbai, Delhi and Kolkata', casework for UN-HABITAT' State of the World's Cities Report (2008).

to direct any urban local authority. The result is that MMRDA and MCGM are often in conflict with jurisdictional responsibilities in infrastructure and service development matters. For example, MMRDA has been responsible for implementation of the Mumbai Urban Development Project, the Mumbai Urban Transport Project and the Mumbai Urban Infrastructure Project.

The interplay of three other key agencies also responsible for governance and infrastructure in Mumbai complicates this overlapping jurisdictional authority between the MCGM and MMRDA. These are the Maharashtra Housing and Area Development Authority, the Slum Rehabilitation Authority and the Maharashtra State Road Development Corporation. Each of these agencies performs key functions within the territory governed by the MCGM and each has different legal status and operates under a complex system of authority. For example, the Maharashtra Housing and Area Development Authority is a nominated body that operates through nine Regional Boards, three of which directly relate with Mumbai – Housing and Area Development Board, the Mumbai Buildings Repair and Reconstruction Board and the Mumbai Slum Improvement Board. On the other hand, the Slum Rehabilitation Authority has a very different legal status and operates under a different system of authority. It has the status of a corporate entity with the Chief Minister of Maharashtra as Chairperson. It also has been declared a planning authority, and can function as a local authority for the slum areas under its jurisdiction.

To address metropolitan governance in Mumbai now requires reengineering metropolitan governance processes, particularly with respect to reducing the multiplicity of agencies and improving jurisdictional coordination, as well as reforming accountability and transparency, improving interaction with citizens and developing appropriate information systems.

In the case of Delhi, the complexity found in the jurisdictional responsibilities in Mumbai is compounded by the fact that it is the national capital of the country. Here, metropolitan governance falls under the National Capital Territory of Delhi (NCTD) and consists of nine urban districts and 27 sub-divisions. There are no less than 98 urban bodies, local agencies, boards and authorities serving the population of some 14 million people (2001 census). The three major local authorities include the Delhi Municipal Corporation, the New Delhi Municipal Corporation and the Delhi Cantonment. In addition, the national Government of India (in particular the central Ministries of Urban Development, Surface Transport, Environment, Home Affairs, and Defence) together with the Government of the National Capital Territories of Delhi, all exercise significant control over metropolitan governance of Delhi.

The most critical challenge of metropolitan governance confronting the Government of National Capital Territory of Delhi (GNCTD) is the continued control by the Central Government over its administration and affairs. Major decisions for preparing and implementing the Master Plan are still taken by the Delhi Development Authority, a body of the national Ministry of Urban Development. Frequent conflicts in governance arise due to this multiplicity of agencies of the central, state and local governments. Jurisdictional overlap, poor coordination and lack of clarity over responsibilities for land-use planning, development, maintenance and enforcement has resulted in ineffective and uncoordinated decision-making and actions in this rapidly growing metropolitan area of Delhi.

While part of the problem, higher order levels of government – national and provincial or state governments – remain essential not only in empowering municipalities to enter into more effective metropolitan governing arrangements but are also the actors who lend legitimacy to this political process and reinforce metropolitan governance for the long term. In many countries where centralist attitudes towards local government are the norm, metropolitan governance arrangements are inhibited. In addition, national assemblies, senates, and other national governing institutions are frequently in the hands of rural interests, while urban interests have poor representation. This can be due to national representation and electoral systems, or constitutional limitations to address urban questions. Decentralisation efforts systematically transfer functions and resources from central to local governments and are designed to improve the provision of services and infrastructure to increase competitiveness and promote local economic growth.

However, the intersection of decentralisation from higher levels and the realities of large metropolitan areas hamper decentralisation efforts. The institutional structures for metropolitan governance and the institutions for planning and service delivery across these territories are often fragmented. Governance of these broad territories is by discrete and often numerous municipal governments behaving independently and commonly lacking effective coordinating mechanisms with which to govern the metropolitan areas. Decentralisation of responsibilities and powers often falls to the municipal structures already in place although they are not necessarily serving well the metropolitan requirements.

Effective metropolitan policies and strategies tend to reinforce coordination across different cities that compose the metropolitan area. Coordination is fundamental not only in basic sectors such as land, transport, environment and related fiscal and funding solutions, but in addressing issues of poverty and social exclusion through innovative mechanisms of inter-territorial solidarity.

Institutional fragmentation of metropolitan areas relates closely to the escalating problem of social segregation in the world's cities. Governance arrangements can be instruments to address social cohesion by promoting economic opportunity, infrastructure investment, access to transportation services and specifically affordable public transit facilities and investments in social housing across large urban metropolitan areas, crossing not only political divides but also socio-economic ones.

In the case of Kolkata, India, the Kolkata Metropolitan Area (KMA) is projected to grow to more than 21 million people from the present population of more than 15 million. The KMA consists of three municipal corporations, 38 other municipalities, 77 non-municipal census towns, 16 out growths, and 445 rural areas, covering about 1,850 km^2. Kolkata faces serious deficiencies in urban infrastructure and services as well as spatial inequalities across the KMA. The high incidence of poverty and inherent spatial inequality poses great challenges in overcoming the lack of coordination across agencies concerned with the provision of housing and water and sanitation services in the metropolitan area.

In the Metropolitan Region of Belo Horizonte, Brazil[7] – consisting of 34 municipalities and a population of 4,982,000 – there are serious inequalities between developed and less developed parts of the urban region. Arising from this concern, the government of the State of Minas Gerais (the current effective senior government level of the urban region) and the Cities Alliance have begun a partnership to undertake research, and to develop plans for the alleviation of poverty in 16 municipalities in the north zone of the Region. Indeed, one of the major factors behind the recent establishment of the Metropolitan Region was to develop policies and programmes that could reduce inequalities within the region. To provide a basis for this approach, the State of Minas Gerais has been working, since 2006, on legislation to create a number of major metropolitan agencies to deal with public functions of common interest, such as inter-municipal transportation, the road system, basic sanitation, land use, exploitation of water resources, preservation of the environment, health, housing and socio-economic development. A number of initiatives by both civil society and the City Council of Belo Horizonte reinforced the formal structures.

Effective leadership is critical for overcoming fragmentation and building consensus across urban and peri-urban areas. Strong leadership can overcome individualism and competition across political ‘turf’. The ability to build consensus and coordinate across urban formal and informal institutions facilitates better investments in basic infrastructure. Strong leadership means not only building consensus, but also aggregating these fragmented interests in a way that builds legitimacy and accountability to stakeholders in the process. When governance institutions are fragmented or are ad hoc creations, corrupt practices can gain strength. Where fragmentation exists, accountability practices are weakened and individuals and networks can be more easily empowered and gain control over a policy sector.

13.3.4 How the Peri-urban Poor Access Services

The emphasis in the 1990s on the privatisation of publicly run water and sanitation services generated debate and questions as to whether the public or the private sector ran these services best. In Chapter 2, Adriana Allen argues that addressing the MDGs requires understanding the changing nature and contemporary dynamics of the peri-urbanisation of poverty and the specific forms of service deprivation affecting the poor in this interface. Formal policy-driven mechanisms supported by institutional arrangements of the state are failing to

[7]This case material on Brazil is drawn from Marlene Fernandes ‘Metropolitan governance survey’ and from ‘Questionnaire on metropolitan governance: RMBH’ (p.7) by Observatorio das Metropoles of Minas Gerais casework for UN-HABITAT’s State of the World’s Cities Report (2008).

deliver the most basic services in the peri-urban areas. The alternative is to look at community and household initiatives and small independent providers. However, when examining specific ways the peri-urban poor gain access to water and sanitation services one identifies a wider range of arrangements. Local private agents, reformed public utilities and community-managed schemes are more likely to reach the poor. These arguments are particularly relevant in peri-urban areas. Thus, the peri-urban poor resort to a wide range of needs-driven mechanisms to access water and sanitation effectively, often with little or no support from the state, its policies and resources.

Localised strategies adopted by the peri-urban poor include informal small-scale independent providers in water vending, latrine construction or pit-emptying services; the community sector might involve relatively formalised arrangements, such as community schemes supported by the public sector or external NGOs (e.g. water kiosks and communal toilet facilities) and informal cooperative initiatives established among community members based on solidarity ties.

Like the urban poor, peri-urban dwellers rarely have access to formal facilities operated by the public or formal private sector, such as network water connections, waterborne sewerage or licensed pit emptying services. Small independent providers play a crucial role in serving the peri-urban poor, but the public sector still regards them with suspicion in terms of both quality and cost, particularly resisted because unorganised vendors are too many, too small and too dispersed for effective regulation. Similarly, informal private pit-emptying services are common in urban and peri-urban low-income areas and often emerge to complement the shortfalls in the formal sector (see the case of Cairo in Allen et al. 2006:80).

Absent affordable and sustained public or private formal service delivery options, the peri-urban poor access basic services at scale through multiple hybrid combinations. Water user associations, technical water fora and local water committees allow peri-urban dwellers to coproduce services with local governments. Coproduction implies participation of users and communities in various stages of public services production (Ostrom 1996). Allen's water wheel (Chapter 2) depicts needs-driven developments in water including rainwater harvesting, clandestine connections, public provision distorted by bribery, and informal sector vendors (e.g. pushcarts, water sold from privately owned wells). Similarly, Allen's sanitation wheel depicts the needs driven, community cooperation solutions such as condominial sewage system, construction and management of communal toilets. In addition to individual household solutions like pit latrines, household septic tanks and informal private services such as pit emptying services.

Lefèvre (2007) suggests that governments of large urban areas demand that new actors be introduced (certain local authorities, associations, the business community, for example) and mobilised. Governance of large urban areas must involve systems of actors, and different forms of action, that are more complex, based on flexibility, partnership and voluntary participation. The 'top down' approach characteristic of many previous attempts has been abandoned in favour of a new idea of the institution.

13.3.5 Financing

A responsible fiscal federalism that positions cities as critical partners in the governing relationship is now recognised as a pivotal policy platform for both global competitiveness and local responsibility for equitable, sustainable and liveable cities. Kurian's chapter 6 emphasises the fact that in certain regions (like South Asia); the domestic private sector has emerged as an important source of financing for water services. He also highlights examples of how Dutch development aid was engaging with small-scale service providers for delivery of critical water services. In this connection, he argued for a greater role for international development cooperation in leveraging behaviour change in financing through support for a system of fiscal reward and rating systems. A special case was made for international support for improved knowledge products related to the design of financing instruments that lower transaction costs, the design of risk mitigation strategies and the development of an enabling policy framework. In this connection, Chapter 12 alluded to important lessons learned from the development of city sanitation strategies in Jakarta with support from the World Bank's Water and Sanitation Program.

Efficient financing is a core requirement for metropolitan governance. Experience to date with the governance of metropolitan areas has been hampered due to deficient financing tools at local levels of government. The redistribution of responsibilities between different levels of government has not always been sustained by a corresponding allocation of resources or empowerment to adopt adequate financing tools needed to raise these resources. If these weaknesses are common at the level of individual municipalities, then the problems of raising finance to support the broader metropolitan areas multiply. Decentralisation of revenue raising capacity by central and provincial/state governments to local governments does not necessarily improve the financial powers for effective metropolitan governance. Indeed, municipal sub-units in metropolitan areas might gain power at the expense of the existing metropolitan governance structures. For example, the Metropolitan Manila Development Authority (MMDA) actually became more dependent on central government grants following passage of the Local Government Code in 1991, which gave local government units within the broader metropolitan area the authority to collect a range of taxes. The MMDA as a result lost a share of the local government units' regular income and its share in real property tax and other local tax revenues (Laquian 2002). Without a clear, permanent and sufficient financial mechanism, it is difficult to implement the principle of territorial solidarity in the metropolitan area in order to redress social and economic inequalities.

Tools to address the financing gap for water and sanitation services have been a core theme in the cases covered in this volume. The range of tools and options is growing with experience gained worldwide. Cities, including those in emerging market economies and less developed economies, are looking to private markets to help fund their massive water and sanitation requirements. Domestic banking systems often view long-term lending for urban infrastructure and water and sanitation as too risky. Domestic capital markets provide an opportunity for raising long-term resources and channelling them to such projects.

While financing of capital investments by issuing long-term bonds is a well-established practice in cities of developed economies, access to financial markets, both domestic and international, by less developed economy cities are more restricted. In many instances, municipalities are not allowed to borrow and often lack efficient municipal financial management and skills. Alternative mechanisms have been used where borrowing powers are restricted. For example, in China, municipal revenue-producing activities are separated from the general budget, allowing cities to borrow against future revenues. In China, off-budget entities operate in municipalities to obtain the capital needed for investment, primarily in infrastructure. These special purpose vehicles (SPVs) are wholly owned companies that raise funds by borrowing from state-owned banks. For example, the City of Shanghai owns the Shanghai Urban Development Investment Corporation (UDIC). It issues bonds to finance the city's infrastructure projects. The implicit guarantee is that the City will not allow the UDIC to fail. The bonds issued by the municipality are viewed as a contingent liability of the municipal authority and are usually backed by municipal assets and transferred to the SPV or by the revenue stream of a self-sustaining project (McCarney 2006).

Cities, particularly cities in developing countries where the demand for new investments in water and sanitation services are greatest, need to improve their financial, technical and operational capacity to finance and deliver these services. In this regard, the international community has an important role to play in technical assistance for the development of a functioning municipal finance system. Local authorities require knowledge and skills in domestic capital market practices, in the development of commercially viable municipal infrastructure projects, in setting out prioritised infrastructure investment plans, improving their credit standing and marketing themselves as creditworthy entities.

In some countries, to strengthen local finances and enhance municipal access to medium and long-term credit, shared revenues become collateral and thus serve as loan guarantees. In the Philippines, municipalities have authority to issue bonds to finance self-liquidating income-generation projects to enhance quality of life. Two government-owned banks and two municipal development funds provide local governments with credit. A steady flow of central transfers and the power of state-owned financial institutions to intercept these transfers to settle arrears have allowed the municipal credit market to function and a limited domestic bond market to operate.

Central governments thus need to enter into partnerships with local authorities in order to provide an environment to promote the credit worthiness of local authorities. Appropriate macroeconomic and regulatory policies – especially those that are conducive to improving their debt servicing capacity including long-term savings pools, intergovernmental payment intercepts guarantees and insurance – all form part of a comprehensive strategy for financing sustainable urban development.

Investments in low-income neighbourhoods particularly targeted to investments in infrastructure to support basic services and to improvements in secure shelter need identification as actions that create wealth and alleviate poverty. Financing for shelter development, for infrastructure development and for community development in low-income parts of the city, creates the foundation for future income generation of the urban poor. New municipal finance tools to assist this effort are pre-conditions for sustainable cities and should therefore be considered as an investment in local economic development, employment generation and productivity. Slums and low-income neighbourhoods form part of the so-called informal economy. Empirical evidence from recent studies (UNH) show that in many developing country cities the informal economy contributes between 50% and 70% of local GDP and eight out of every ten new jobs, a large proportion of which is in the form of home-based enterprises. The granting of secure tenure allows homeowners to leverage their house to finance their work. The fact of renting out rooms for income support is well documented. Secure tenure to slum dwellers transforms their homes into a tangible asset. Investment in community improvements and urban infrastructure build value into this tangible asset while improving the productivity of home-based enterprises. Investment in basic services for the poor therefore leads to poverty alleviation, wealth generation and economic development of the city.

Micro-finance and community finance mechanisms have grown considerably in recent decades because of both demand and failure of conventional financial institutions to cater to the urban poor. The rapid growth of micro-finance agencies in developing country cities is testament to the ability of the urban poor to direct scarce household funds into various savings schemes and community improvement funds.

Despite this ability, public policy reform and reform of the commercial banking sector remains necessary since many poor households are still not able to access sufficient credit. Establishing qualifying criteria for the poor to access commercial sources of credit remains a critical challenge. Micro-finance agencies normally concerned with finance for shelter development are increasingly showing interest in micro-finance for more comprehensive slum upgrade programmes. Best practices in this area show such partnerships can be highly effective when a development agency or local government finances improvements in basic infrastructure and services while community-owned micro-finance organisations provide housing improvement loans. Varying experience has been gained in a number of countries, for example with the Slum Networking Project in India and the Local Development Program (PRODEL) in Nicaragua.

13.3.6 Inclusive Cities

Cities worldwide, whether rich or poor, confront the challenge of civic engagement and fostering an inclusive governance process in their local political environment. Processes of fostering inclusion and enhancing good urban governance are key strategies to achieving the slum-upgrading target of the MDGs. Environmental deterioration and social exclusion go hand in hand. Engaging people within a city, through an inclusive political process that involves long-term residents, international migrants, the poor, marginalised groups, national minorities and indigenous peoples is the critical base for building safe, liveable and sustainable cities in our shared future. Governance invokes more than political strategy; it demands attention to differentiated social circumstances, needs within the community and to accommodating different cultural values and diversity.

Engaging citizens in the running of their city can take many forms and there is increasing documentation of this from cities worldwide. Typical steps include public consultations, public hearings and meetings, appointing citizens to advisory bodies inside municipal authorities, and designing community councils with stakeholder's voice at municipal council sessions. As seen in this volume, valuable research and evaluations have been undertaken of recent experiments involving citizen engagement in environmental and neighbourhood impact studies, in the establishment of people's councils, in the inclusion of non-governmental organisations and other representatives from the private sector on local service boards and development councils in preparing development programmes, allocating funds, and participating in planning and design initiatives for communities, in popular initiatives to put forward urban laws and in the practice of participatory budgeting. This research is a valuable base for considering next best steps in addressing inclusiveness in cities as it informs a deeper awareness of the intersection between civil society and government and improves our understanding of potential new institutions and paths necessary for fostering inclusiveness, empowerment and engagement in cities globally.

How do cities ensure that all citizens are empowered to participate positively and productively in the opportunities that cities offer? How do we ensure that all citizens have access to opportunities and find empowerment to participate in local decision-making affecting their daily lives? How do we avoid the opposite trends associated with exclusion, dreariness and hopelessness in cities that breed frustration, fear and violence?

An inclusive approach requires a deeper understanding of the phenomenon of exclusion itself. The dimensions are broad and include poverty and disadvantage in all their forms, and range from exclusion to access and channels of engagement with local political institutions to, and concerning the case chapters here, access by the poorest urban residents to water and basic sanitation services. Many people are excluded by virtue of unemployment, low skill levels, poor health and poor housing. Others are excluded in spatial terms from the city, by virtue of where they live and their ability to move about the city. 'Participating in society' means: having a job, or taking part in training or education to access better labour markets; having a network of family and social contacts; enjoying collective leisure activities; taking part in community activities; living in confidence and without fear for safety. An inclusive approach to urban governance requires a deepening awareness of the intersection between civil society and government, and the creation of new institutions and paths necessary for fostering inclusiveness, empowerment and engagement.

Inclusiveness is a key means of deepening democracy and promoting citizen involvement and social cohesion. When citizens are effectively engaged in their city's development, engaged in everyday decisions and in long-term planning and policy development, they develop a sense of ownership of and loyalty to the city. As a result, people feel more empowered to shape their own destinies in the city while embracing and participating in forging a common destiny. As was pointed out in the introduction to this volume the notion of participatory democracy goes beyond the limited notion of representative democracy as embodied in the political process of elections which, for many is reduced to the singular act of voting once every few years. The consequences of exclusion are also well-documented and recent experiences in cities worldwide, including upheavals in Paris and London, the proliferation of urban crime in many cities, the growth of violence amongst youth, and the persistence of gender inequity, constitute failing indicators of sustainable urban development, which, in turn, diminish the competitiveness of cities.

Increased efforts are needed that focus on traditionally marginalised groups of urban citizens and on minorities that have failed to engage with the city. An inclusive city is one where everyone, regardless of wealth, gender, age, race or religion, feels free to participate productively and positively in the governing of the city and wherein the pursuit of opportunities that cities have to offer is open and equitable. Urban policies and investment strategies that determine the delivery and accessibility of goods and services to neighbourhoods directly affect the well-being and livelihoods of those urban communities. Removing barriers for women to gain access to assets such as land, providing women-headed households with secure tenure, opening their access to credit, introducing affirmative action and pay equity into local administrative practices, all enforce inclusion of women in urban development.

13.4 Future Directions

Inventing new norms of practice and reforming institutional procedures in cities can effectively enhance civil society involvement and create a politics and culture of inclusiveness that is essential in framing strong local governance. In this connection, a number of conclusions can come from a reading of chapters contained in this volume.

First, given inter-sectoral competition for water, integrated management of water resources is a reasonable goal. However, its realisation can be less predictable given the regional specificities of water resource endowments, variation in domestic water consumption patterns and cultural/economic factors affecting realisation of wastewater reuse potential.

Second, sector reform projects the world over proceeded on the assumption that once the 'right' prices are identified and efficiency of water utilities is enhanced, improved service delivery would be achieved. Both the above assumptions have only succeeded in infrastructure creation without a commensurate emphasis on building capacity for planning and management that could ensure that local resources are forthcoming for asset maintenance.

Finally, norms the world over encourage continued dependence on inter-governmental and/or aid flows without sufficient monitoring of service delivery outcomes. This critical element of behaviour deserves future policy attention. However (from a Lindblomian perspective) given the fact that policy change occurs only incrementally, international financing instruments like Output Based Aid, cash conditional transfers and budget support can play an important role in re-orienting spending and improving accountability of decision-making processes. Information management employing a comparative framework can serve as a powerful tool in facilitating incremental changes in policy, planning and assessment methods that aid in the achievement of improved service delivery outcomes.

New norms of practice and the reform of institutional procedures in cities is dependent upon strengthening modes of inclusive urban governance, since the foregoing chapters have demonstrated that inclusiveness is as a way to increase accountability in city management and service delivery across urban and peri-urban areas. It contributes to a better identification of needs and demands by bridging knowledge gaps between local government and local community stakeholders and therefore enhances greater responsiveness and accountability in the delivery of urban services. It improves learning and understanding and promotes innovative solutions that combine technocratic expertise with local knowledge and ability.

References

Allen, Adriana, Dávila, Julio D. & Hofmann, Pascale. (2006). *Governance of water and sanitation for the peri-urban poor: A framework for understanding and action in metropolitan regions*. London: University College London, Development Planning Unit.

Angel, S., Sheppard, S. C., & Civco, D. L. (2005). *The dynamics of global urban expansion transport and urban development department*. Washington, DC: The World Bank.

Environment and Urbanization. (2000). Special issue on poverty reduction and urban governance (April).

Laquian, A. A. (2002). Metro Manila: people's participation and social inclusion in a city of villages. In B. A. Ruble, R. Stren, J. S. Tulchin, & D. H. Varat (Eds.), *Urban governance around the world*. Washington, DC: Woodrow Wilson International Center for Scholars.

Laquian, A. A. (2005). *Beyond metropolis: The planning and governance of Asia's megaurban regions*. Washington, DC/Baltimore, MD: Woodrow Wilson Center Press/The Johns Hopkins University Press.

Lefèvre, C. (2007). Democratic governability of metropolitan areas: International experiences and lessons for Latin American cities. In E. Rojas, J. Cuadrado-Roura, & F. J. Guell (Eds.), *Governing the metropolis*. Washington, DC: IADB.

Mega V. & Pedersen J. (1998). *Urban Sustainability Indicators.* The European Foundation for the Improvement of Living and Working Condition.

McCarney, P. L. (2005). Global cities, local knowledge creation: Mapping a new policy terrain on the relationship between universities and cities. In G. Jones, P. McCarney, & M. Skolnick (Eds.), *Improving knowledge, strengthening nations: the role of higher education in global perspective*. Toronto: University of Toronto Press.

McCarney, P. L. (2006). Our future: sustainable cities – turning ideas into action. Background paper prepared for UN-HABITAT World Urban Forum III held in Vancouver 19–23 June. Nairobi: United Nations-HABITAT.

McCarney, P. L., & Stren, R. E. (Eds.). (2003). *Governance on the ground: Innovations and discontinuities in cities of the developing world*. Baltimore, MD: Johns Hopkins University Press.

McCarney, P. L., & Stren, R. E. (2008). Metropolitan governance: governing in a city of cities. In *State of the world's cities report 2008.* Nairobi: United Nations-HABITAT.

McGee, T. G., & Robinson, I. M. (Eds.). (1995). *The mega-urban regions of southeast Asia*. Vancouver: University of British Columbia Press.

Myers, D. J., & Dietz, H. A. (Eds.). (2002). *Capital city politics in Latin America. Democratization and empowerment*. Boulder, CO: Lynne Rienner. National Research Council. (2003). *Cities transformed. Demographic change and itsimplications in the developing world*. London: Earthscan for the National Academy of Sciences.

Ostrom, E. (1996). Crossing the great divide: Co-production, synergy and development. *World Development, 24*(6), 1073–1087.

Public Administration and Development. (2005). Special issue on metropolitan governance reform (October).

Rojas, E., Cuadrado-Roura, J. R., & Guell, J. M. F. (Eds.). (2005). *Governar las metrópolis*. Washington, DC: IADB.

Sorensen, A. (2001). Subcentres and satellite cities: Tokyo's 20th century experience of planned polycentrism. *International Planning Studies*, *6*(1), 9–32.

Stren, R. (2007). Urban governance in developing countries: experiences and challenges. In R. Hambleton & J. Gross (Eds.), *Governing cities in a global era: urban innovation, competition, and democratic reform*. New York: Palgrave Macmillan.

United Nations. (1998). *Principles and recommendations for population and housing censuses*. (Department of Economic and Social Affairs, Population Division). New York: United Nations.

United Nations. (2003). *World urbanization prospects: The 2003 revision*. (Department of Economic and Social Affairs, Population Division). New York: United Nations.

United Nations. (2008). *State of the world's cities report 2008*. Nairobi: United Nations-HABITAT.

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