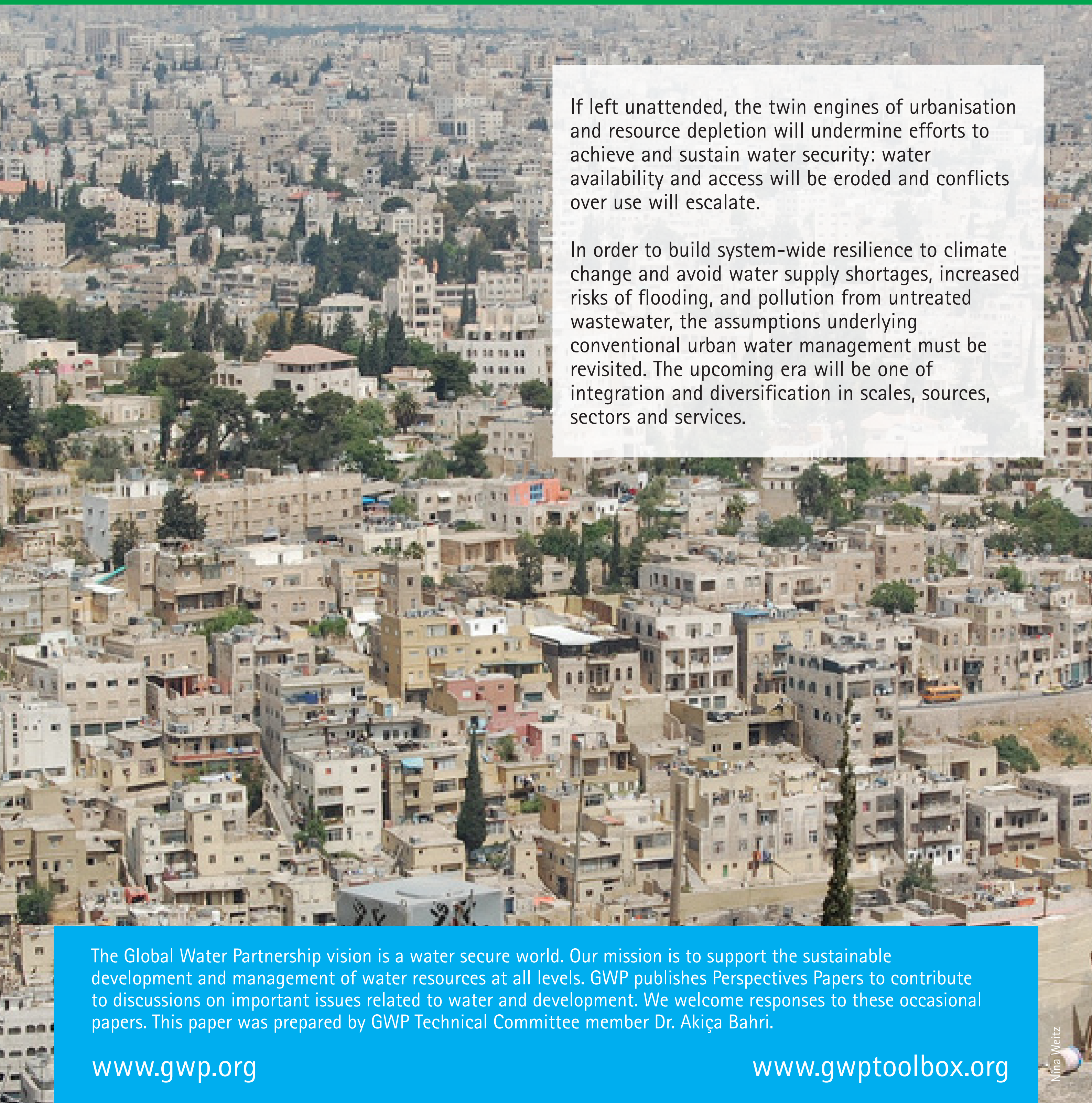
PERSPECTIVES PAPER

Global Water Partnership

# Towards Integrated Urban Water Management



Nina Weitz

If left unattended, the twin engines of urbanisation and resource depletion will undermine efforts to achieve and sustain water security: water availability and access will be eroded and conflicts over use will escalate.

In order to build system-wide resilience to climate change and avoid water supply shortages, increased risks of flooding, and pollution from untreated wastewater, the assumptions underlying conventional urban water management must be revisited. The upcoming era will be one of integration and diversification in scales, sources, sectors and services.

The Global Water Partnership vision is a water secure world. Our mission is to support the sustainable development and management of water resources at all levels. GWP publishes Perspectives Papers to contribute to discussions on important issues related to water and development. We welcome responses to these occasional papers. This paper was prepared by GWP Technical Committee member Dr. Akiça Bahri.

www.gwp.org www.gwptoolbox.org

Given the projected rates of urbanisation, and the concomitant pressures on water resources, cities are becoming increasingly important units of integrated water management. Although cities occupy less than 1 percent of most countries' land area (Angel et al., 2011), they account for 5-20 percent of water consumed (Shiklomanov, 1998). By 2025 urban water consumption is likely to at least double along with size of the world's urban areas.

Size and location of cities to some extent determine the types of threats that accelerated urbanisation poses and the types of solutions that are possible, as described in Box 1.

## Why conventional urban water management is failing to deliver

Conventional urban water management has been found wanting in its ability to address key challenges for growing cities such as increasing competition for water, sanitation and stormwater managment, and water resources protection. Why? In general, the management of water supply, sanitation and stormwater has not occurred in concert; instead, each has been planned and delivered as an isolated service – thus interconnections among problems and potential solutions are missed.

*Overall, urban water issues often remain disconnected from broader urban planning processes on the one hand, and basin-level management on the other.* Urban master plans have not accounted for the various infrastructural components of urban water management (water supply, wastewater, non-waterborne sanitation, stormwater drainage facilities and solid waste management). Furthermore, although water supply, sanitation and urban settlement planning may be incorporated into basin-wide management plans, these often neglect to acknowledge *the cross-scale interdependencies in*

**Box 1: Accelerated urbanisation threats and opportunities**

**For megacities:** Most big cities or megacities are already facing acute water situations. One-third of megacity inhabitants, who reside in arid and semi-arid areas, rely on water of marginal quality that under most circumstances would be considered unusable unless first treated (Abderrahman, 2000). Much of urban growth is expected to come from unplanned settlements or slums in and around megacities. Unless growth in these areas can be controlled and water and sanitation services can be provided, water security will be compromised not only for people living in these areas – who face elevated risk of waterborne diseases and bear the brunt of water-related disasters, such as floods – but also the water security for the city as the whole, from the impacts of unplanned development and untreated wastewater.

**For coastal cities:** Half of the world's population live within 100 km of the sea and three-quarters of all large cities are located on the coast (UNEP & UN-Habitat, 2005). Urbanisation in these areas often leads to pollution of coastal waters, salinisation of aquifers, and the destruction of ecosystems, such as mangroves, that serve as barriers to erosion, storm surges and tsunamis. These environmental impacts extend beyond the boundaries of the city itself. For example, in Maputo, Mozambique, pollution due to industrial activities, poor sewage management, mangrove destruction and coastal erosion, combined with agricultural and shipping activities, are threatening fisheries, tourism and quality of life around Maputo Bay.

**For cities in transboundary basins**: The water situation for large and growing cities becomes even more challenging in the case of transboundary basins. Two in every five people live in water basins that are shared by more than one country (UNDP, 2006). Sharing of common water bodies by cities poses a special threat to freshwater quality and aquatic ecosystems, as in the case of Lake Victoria. Border cities are also often affected by pollution problems due to industrial growth, urbanisation, and agricultural development in the upper part of the basin.

**For small and mid-sized cities:** The growing numbers of emerging small and mid-sized cities will have significant impacts on water resources in coming decades (UN WWAP, 2009). Here there is an opportunity to embed integrated urban water management practices into institutional arrangements and urban planning from the outset.

*freshwater, wastewater, flood control and stormwater* (Tucci, 2010).

*The traditional urban water management model has failed to distinguish between different water qualities and to identify uses for them.* As a result, high-quality water has been diverted to indiscriminate urban water needs, in the process contributing towards resource scarcity (Van der Steen, 2006). Moreover, a range of authorities, each guided by distinct policies and pieces of legislation, continue to oversee water sub-sectors at the city level. As urban governments become more complex and specialized, sectoral integration within government and scalar integration between levels of government is becoming increasingly important.

## Why Integrated Urban Water Management is needed

The idea behind Integrated Urban Water Management (IUWM) is to address the entire urban water system as part of a coherent framework (Srinivas, 2009). Figure 1 describes some of the interrelated activities that IUWM brings together.

How is IUWM different than conventional urban water management?

- It encompasses *the different water sources* that are present within an urban catchment (surface water, groundwater, rainwater, wastewater, desalinated water, stormwater, transferred water, virtual water).
- It considers the *quality of different water sources* (including reclaimed water) and attempts to match them to the quality required for different needs.
- It looks at *the processes for water storage, distribution, treatment, recycling and disposal as part of one cycle* instead of discrete activities, and plans infrastructure accordingly.
- It plans for the *protection, conservation and exploitation of water resources at their source.*
- It takes into account *the range of other users* and landscapes that depend on the same water bodies as the city.
- It accounts for the *range of formal (organizations, legislation and policies) and informal (norms and conventions) institutions* that govern water in and for cities.
- It seeks to balance economic efficiency, social equity and environmental sustainability.

**Box 2. Components of IUWM**

- Alignment of water sub-sectors within cities and beyond
- Water conservation and efficiency efforts
- Water sensitive planning and design (including urban layout and landscaping)
- Stormwater and wastewater source control, pollution prevention, and flow and quality management
- Use of mixtures of ecological solutions and infrastructure
- Use of non-structural tools such as education, pricing incentives, regulations and restriction regimes

IUWM is nested within the broader notion of Integrated Water Resources Management (IWRM). The conventional hydrological unit of analysis and management of IWRM is the catchment or watershed. Given that cities are significant elements of their catchments, IUWM needs to be linked to IWRM plans and management processes in the broader basin context to allow the alignment of the urban water sector with others beyond the urban boundaries, such as rural water supply, agriculture, industry and energy. Thus, IUWM is not an end in itself. Rather, it is *a means of overseeing a sub-system of a basin in pursuit of water security: improved availability of and access to water and minimized conflicts-of-use and water-related risks.*

## Policy and institutional arrangements for IUWM

Implementing IUWM requires creating favourable institutional contexts, with the appropriate mix of public and private actors who are supported by coherent legislative and policy frameworks.

While concerted action at all levels of decision-making is needed to secure the availability of and access to water and avoid conflicts among users, city governments are going to play increasingly prominent roles in paving the way for sustainable urban development. It is imperative that water managers and decision-makers in cities take action now to:

- develop comprehensive policies and strategies for prioritising, sharing and managing available water resources, taking into account multiple stakeholder demands while balancing equity and efficiency goals;

- keep water use sub-sectors engaged in analyses, choices and decisions related to sustainable management of the resources;
- ensure that choices around new water sourcing for megacities do not adversely impact the water needs of the rest of the country and social equity and economic development goals;
- foster a culture of long-term planning that looks beyond short-term financial calculations and takes seriously the implications for sustainable environmental management;
- invest in both 'soft' (institutional development and capacity-building) and 'hard' (large and small infrastructure) sustainable solutions, especially closed-loop systems; and
- implement more effective monitoring systems with improved quality of data, and reliable information sources for regulation and policy direction.

### *A more holistic approach*

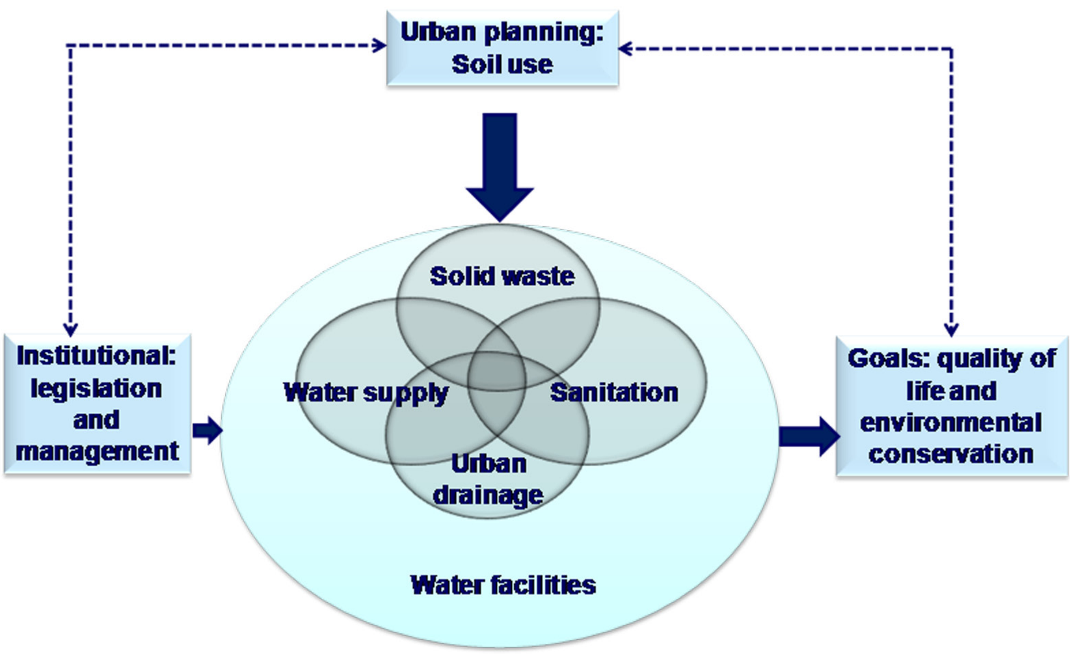
But ensuring water security will require action beyond the water sector alone. It will demand measures to ensure that policies on housing, energy, land- and waterscape design, agriculture (both urban and rural) and waste management are aligned and contribute to optimal use of water resources, and ultimately water security.

Sustainable urban development calls for new objectives for urban resource management that recognise the mutual benefits of aligned water resources, energy and land use management. In terms of land use, this could mean removing concrete and restoring green belts to replenish aquifers, improve water quality, minimize flood risks and enhance the habitat. For wastewater, it could mean reconceptualising treatment plants from energy consumers to resource generators that can produce methane to be used as a fuel source or fertilizers to be used in agriculture.

### *The role of central government*

For the past two decades, market-led approaches have dominated efforts to meet the basic needs of urban communities. These approaches arose as alternatives to publicly provided services, which were deemed inefficient and unresponsive. Market-led strategies, on the other hand, were expected to improve efficiency, create new financial flows and deliver greater accountability (UNDP, 2006). According to UN-Habitat (2009), however, the present global financial crisis has clearly shown some of the limits of market-based approaches. For instance, although the corporate sector

**Figure 1. Integrated urban water management**




Source: Tucci, 2009



Global Water Partnership

has in places improved the efficiency of service delivery, it has been less capable of meeting equity goals. While there is resistance to recreating the bureaucratic systems that characterized past government interventions in basic service provision, the current circumstances have reignited interest in stronger government involvement in ensuring that basic needs are met.

In order to maintain equilibrium between economic efficiency, social equity and environmental sustainability, central governments may opt to enact legislation that makes water a state property and provides a unified framework for water allocation. On this basis, governments can grant water withdrawal permits as elements of a formal water economy. Legislation in itself is not, of course, enough. This must be accompanied by enforcement and monitoring capacities in order to curtail the exploitation of unequal power relations (UNDP, 2006).

Hydrological boundaries rarely coincide with administrative ones. Urban catchments – overseen by city authorities – may lie within basins that cross state, or even national borders. *Central governments can mediate the articulation of country-wide perspectives on urbanisation and water management that encompass the entire urban-rural continuum.* In choosing to make policy for broad economic areas that integrates villages, towns and cities, central governments can even out the differences in living standards between rural and urban areas (AfDB, 2011).

Central governments are also in a position to define the status of urban development and water management on a nation's political agenda and to delegate responsibilities to particular ministries or departments. Because irrigation, municipal water supply, rural water supply, energy, industrial production and transport all have a stake in urban water management, it is important to avoid a fragmented institutional context, which may overlook potential conflicts among social, economic and environmental objectives and users. Typically, central governments have the authority to convene all stakeholders for deliberations on resource management.

### *The role of municipal government*

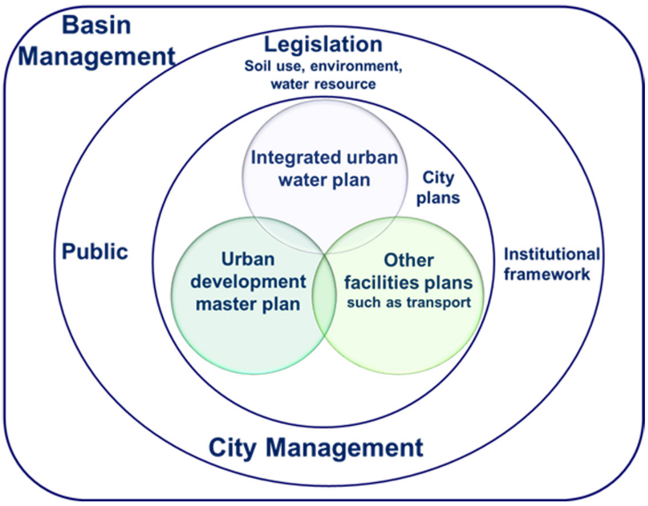
Although central government does have an important role to play, decisions on urban planning issues should be made as close as possible to those affected by them. This demands full realisation of decentralisation; beyond the devolution of administrative functions, local government must also be empowered in political and fiscal terms. This will enable the forging of new and stronger relationships between urban and rural authorities, national- and local-level decision-makers, and the public and private sectors.

Managing the rapid growth of cities sustainably will require effective local governments, greater capacity in terms of urban planning professionals, more resources at the local level, and reconsideration of municipal boundaries in areas where urban development has outgrown older administrative limits. In particular, IUWM requires the development of planning and management components of urban water services: water and sanitation, stormwater and total solids.

These services are interconnected. Institutional management of these facilities usually constitutes a central difficulty. In many parts of the world, urban planning forms a separate department within municipalities, giving rise to the problem of achieving integration between planning and other departments. This has resulted in the urban space becoming highly fragmented and inefficient. There needs to be a much higher level of integration between spatial plans and infrastructure plans. Within municipalities, coordinating structures and forums need to be established to ensure communication between departments, between levels of government and with communities and stakeholders (Figure 2).

Under circumstances in which a range of informal actors provide basic services, government also has an important regulatory role to play. In Africa, 60% of urban jobs are filled by the informal labour force (UN-Habitat, 2009). Providers operating in the 'informal economy' are often better placed to extend water, sanitation, and energy and waste management services to disadvantaged city dwellers than those in the formal economy. *As such, regulation should serve to promote equitable pricing and improved quality; not to cut off informal service provision.* As a whole, government measures complement – and do not replace – the strides that are made through private efforts, whether formal or informal, community, NGO or corporate-led.

**Figure 2. Institutional framework for municipal land and water planning**




Source: Adapted from Tucci, 2010

## *Stakeholder participation*

The reach and relevance of basic services entails the enrolment of all user groups in the design of new systems or restructuring of existing ones. In order to move beyond rhetorical commitments, legal mechanisms can define the role and enhance the authority of participatory forums. They can also set the conditions for the involvement of groups that have not traditionally been viewed as relevant for urban decision-making (UN-Habitat, 2009). Engaging upstream farmers' associations, industry representatives or energy utilities in the management of the urban water sector, for instance, can influence the sustainability of wastewater irrigation in downstream cities (UNDP, 2006). Laws guaranteeing the right to wastewater not only encourage farmers to install appropriate irrigation infrastructure, they also establish standards for water quality and monitoring authority for public health purposes.

Water users typically have varied agendas that are rarely articulated in the open. Even where the different perspectives are made known, the skills needed to reconcile them are missing. Capacity to resolve disputes must be accompanied by transparency.

Participatory planning at the project level can result in more appropriate design and significant resident contributions, leading to improved living conditions in low income settlements. Participation by residents in planning and implementation of practical improvements in the areas where they live and work, in municipal budgeting and in local plan preparation has positive outcomes and can be scaled up to play a role in city level planning.

Managing urban water resources and integrating all aspects of water source and quality will require public education and collaboration to realise the necessary cultural and behavioural changes (Najjar and Collier, 2011) as well as coordination among land and water management entities, resource and regulatory agencies, local governments, and non-governmental organizations at various levels in order to enhance integration in urban water management planning (Watson *et al.*, 2011).

## *Fostering a new cross-sectoral culture of urban water management*

It is clear that *a paradigm shift from conventional to integrated urban water management is needed to respond to the changing context of cities and water.* This is likely to demand institutional capacity-building: updating and integrating know-how in the natural sciences, engineering, environmental biology alongside economics, finance and sociology; according authority alongside responsibility; and changing professional cultures to reward cross-sectoral and cross-scale cooperation. Such transformations must be accompanied by robust monitoring mechanisms that regularly inform authorities, service providers, and users on progress and by adaptive management approaches that support nimble urban water management systems that can respond to unexpected changes.

### *Reducing vulnerability to climate change*

To address climate change, only a coordinated approach and actions at global, regional, national and local levels that integrate city requirements and environmental management capacities can lead to success. Many cities are already taking the lead to reduce their impact on the global climate. This will require finding the right balance between the range of social, economic and political challenges and a variety of 'soft' institutional instruments that can complement 'hard' infrastructural solutions (Sadoff and Muller, 2009). For instance, resilience against floods can be achieved by building protective infrastructure (flood barriers in coastal cities, sea walls and dykes, movable barriers, etc.) or through planning that restricts settlement in vulnerable areas.

## Management approaches and tools

There is no one-size-fits-all IUWM model; rather, each context will demand a different mix of management approaches. So what are some of the options for sustainably meeting the water needs of growing cities and reducing their impact on the environment?

### *Water reclamation and reuse*

'Closed-loop systems' represent best practice in water reclamation and reuse. These harvest and treat waste- and other water quality types, and beneficially reuse the reclaimed water and inorganic and organic materials in agriculture, industry and other sectors (Bahri, 2009). In the process, they contribute to the improvement of the human and environmental health of cities while supporting their own economic activities (Brown, 2009). This creates a multiplier effect whereby a given volume of water can be made to work harder and become more productive. Treating and reusing reclaimed water for food production in peri-urban areas is one option to increase food security and to re-imagine the rural-urban continuum while regulating some ecosystem services such as disease regulation and filtering of pollutants (ISET-Nepal, 2008). Technological innovations are enabling water reclamation and reuse in novel ways. Advanced membrane and nanotechnologies are increasingly lower-cost and energy-efficient, and offer leapfrogging opportunities to exploit reclaimed water for various reuse options.

Closing the cycle requires source separation and management of industrial and land use pollutants. Industrial emissions and land use waste flows may impair the natural environment and the quality of water supplied to urban areas and, hence, interfere with the management of urban water. Source control is therefore essential for separate collection and treatment of different fractions of wastewater inflow (i.e. segregation of industrial wastewaters). Industrial pollutants should be removed at the source and, to the extent feasible, be retained in closed-loops and reused within

Raniel José M. Castaneda

the industry by which they are produced. Treatment at the source is then required to minimise costs and environmental exposure to hazardous materials and to protect the integrity of municipal wastewater treatment systems. Realistic regulations for the discharge of industrial wastewaters have to be set up and, moreover, enforced.

In the case of agriculture, the question is how to reconcile the public health and environmental resource protection interests of a city with the farming community's desire to maintain an agricultural way of life in the watershed region. In order to reduce nonpoint source pollution from agriculture, the City of New York entered into a partnership with the watershed farm community to carry out an enhanced watershed protection program for the City drinking water supply (BPIA, 2010). Uses of clean production and energy- and water-saving processes and technologies have to be promoted. Changes in attitudes and consumption patterns as well as innovative, efficient and sustainable ways for waste management are needed. Urban water management can no longer engage in 'end-of-pipe' problem-solving alone – solutions should start at the source.

### *Stormwater management*

In developing countries, many parts of cities and in particular some low-income built-up areas are experiencing extensive flooding during periods of intense rainfall. There are options for urban stormwater management that can reduce negative impacts and increase the availability of water resources locally. These include using retention ponds, permeable areas, infiltration trenches and natural systems to slow the water down. Lodz and Belo Horizonte are using such systems, and Birmingham is experimenting with green roofs to achieve the same effect (SWITCH, 2011). Green areas that take up water can benefit cities with high risk of flooding and provide ecosystem services involving lower costs compared to conventional stormwater drainage systems (Bolund and Hunhammar, 1999). Those conventional systems may include cleaning up urban runoff and stormwater in order to reduce pollution and increase the availability of water resources locally. The value of natural and constructed wetlands and swamps in urban water retention and purification is increasingly recognized.

### *Rainwater harvesting*

Flow- or roof-water harvesting can be a means of increasing local water supply and groundwater recharge whilst simultaneously alleviating flooding problems in some areas. These measures may be an immediate solution to accompany long-term infrastructure improvements in water supply and drainage. Although flow- or roof-water harvesting systems have been implemented in some cities, there has been no comprehensive documentation of design criteria used, costs and benefits, impacts and constraints to large scale adoption. Such an evaluation would allow out-scaling such practices.

### *'Green infrastructure'*

Incorporating ecological functions into landscape design can also extend beyond stormwater management. They include natural or nature-mimicking systems to treat polluted water (Asano, 2005; Brown, 2009). By combining flexible treatment technologies with functional landscapes, they allow various cost-effective approaches to restoring the integrity of urban ecosystems (Brown, 2009).

### *Payment for ecosystem services (PES)*

PES is another tool that has proved useful, particularly in protecting urban water supplies from upstream activities. Here, land owners and users are given incentives (often monetary) to engage in land-use practices that lead to an ecological service. Within the water sector, payment models are designed within the context of watersheds. Conventionally, downstream communities pay upstream water users to refrain from practices that can undermine the integrity of natural resources in general, and river flows and water quality in particular. PES is intended to compensate rural (often poor) water-users to manage a collective ecosystem, even if they are not the immediate beneficiaries of such actions (ISET-Nepal, 2008). PES, thus, amounts to a tool for joined-up management of natural resources across the urban-rural continuum.

### *Efficient water use*

This can involve reducing losses and encouraging more efficient practices on the part of water users. Domestic water supply systems often face major water losses, with leakage percentages of over 50 percent. Efficiency of water use should minimize water losses during treatment, transport, storage and use. Reducing water loss involves aspects related to design, construction and operation and maintenance of systems, as well as user behaviour. Singapore and Phnom Penh achieved significant reductions in unaccounted-for water over the last decade. In Zaragoza, Spain, the municipality instituted a demonstration on water loss management with the installation of water saving devices and with the monitoring of flows and pressures through a supervisory control and data acquisition system, linked to a geographic information system and simulation model (SWITCH, 2011).

## Economic and financial instruments

Efforts to promote IUWM must address the question of capital availability, including appropriate financial tools and cost sharing. Investments by national governments in water resources development have traditionally been overshadowed by those for transport, energy, telecommunications and the military. Functional responsibility for water services has tended to rest on the shoulders of local government (Serageldin, 1994; as cited in Rees, 2006). However, in the Global South, local government revenue streams are often inadequate. As a result, they often lack the financial means to maintain investments in line with demographic change and physical development. At the same time, the cost-recovery potential of commercial service providers is constrained by low average incomes among user groups. Water pricing and application of the polluter pays principle can be important components of encouraging more efficient resource use as well as providing funding for IUWM functions. Other financial strategies, including fiscal transfers and cross-subsidies, should be deployed in order to tackle resource depletion and inequality (UNDP, 2006).

Also, specific strategies are needed to focus public resources on leveraging resources from local authorities, consumers and the private sector (see Box 3). Successful microfinance, output-based aid and loan-financed approaches may be adopted as core strategies particularly in the sanitation sector. Conventional public sector financing of water and sanitation services frequently doesn't reach the poor and vulnerable and specific strategies are needed, many of which involve alternate funding sources (Bahri *et al.*, 2010).

**Box 3: Leveraging Small-Scale Private Finance**

Business opportunities exist along the entire water, sanitation and reuse value chains (Bahri et al., 2010). Private, often informal, entrepreneurs already provide the bulk of on-site sanitation services, such as latrine construction, maintenance and desludging. In Malawi, private, on-site service providers are giving credit to households unable to build composting toilets against future 'manure' sales.

Green Water Credits are a type of Payment for Ecosystem Services that bridges the incentive gap through taking regular compensation from water users to water providers for specified water management services. It builds a link between sectors of upstream land management and downstream water supply, and creates a market in water management services of supporting rural livelihoods (Bahri *et al.*, 2010).

Business opportunities are expanding as more people demand improved water and sanitation products and services. Food security is at present heavily dependent on the supply of phosphate, a major component in artificial fertilizers. Recent increases in the price of artificial fertilizers and dwindling phosphate reserves have generated a market opening for organic fertilizers from animal manure, human excreta and other biowastes. In Burkina Faso, the demand for urine for agricultural use is outstripping supply. These activities contribute towards 'closing the loop' in managing nutrients, land and water. Business opportunities increase when one considers value along the whole chain. Encouraging small-scale entrepreneurs to seize these business opportunities through provision of credit and information may also enhance the sustainability of services.

## The future of urban water management – improved urban water governance

Sound urban water governance is fundamental to ensuring human and environmental health. It requires robust national policies, plans and programmes, as well as instruments to measure and benchmark progress. There are many dimensions to urban water governance, and several developing countries are already taking steps to improve the overall management of their water resources, services and institutions.

Urban areas need to move from the status of water users to that of water suppliers and managers. Indeed, various water quantities and qualities can be managed more effectively and efficiently for different purposes within the resource management structure, i.e. the urban area. There is a range of technology and management options that can be implemented.

Every mix of approaches should aim to deliver water to specific users in appropriate quantities, qualities and at appropriate times, without compromising the availability of the resource for others. It should pay due attention to tackling existing or preventing otherwise impending water scarcity by promoting water use efficiency, and alternative sources of water, including wastewater. IUWM management strategies should also account for new methods for the transfer of water, as urban areas develop further away from catchments. Likewise, increasing population density, coupled with urban sprawl and the need to revert to green energy technologies in the face of climate change, call for new concepts in the collection and transport of sewage to treatment plants.

Urban planning has an important role to play in assisting governments to meet the urban water challenges. It can help overcome fragmentation in public policy formulation and decision-making, through linking planning with the activities of other policy sectors, such as infrastructure provision. Urban planning and management can be improved through the adoption of collaborative approaches that involve all key stakeholders, and enable agreement on priorities, actions and the allocation of responsibilities between relevant agencies.

Improved coordination for better service delivery is needed. Cooperation among the different agencies and sectors involved in the process is required with cross-sectoral collaboration at the national and local levels. This may involve new methods for interagency coordination and control of water use, such as a new institutional body or executive committee that has the authority and capacity to properly regulate and enforce standards and procedures.
Integrated urban water policies based on participatory, democratic and pluralistic governance can secure sustainable development. Integrated urban water management could help avoid many negative impacts, particularly if governments adopt clear urban policies as an integral part of their economic policies (UNEP, 2002). Changes will be necessary to shift individuals' attitudes, and stimulate innovative, efficient and sustainable ways of water management and governance. Ultimately, the urban water management paradigm will shift.

## References


Abderrahman, W. (2000) 'Urban Water Management in Developing Arid Countries', *Water Resources Development* 16 (1): 7–20.

AfDB (2011) *Rapid Urbanisation and the Growing Demand for Urban Infrastructure in Africa.* African Development Bank Market Brief. Vol. 1, Issue 1, pp. 1-12.

Angel, S., Parent, J., Civco, D.L., and Blei A.M. (2011) *Making Room for a Planet of Cities*. Policy Focus Report. Cambridge, USA, Lincoln Institute of Land Policy.

Asano, T. (2005) 'Urban water recycling'. *Water Science & Technology*, 51/8 (2005): 83–89.

Bahri, A. (2009) *Managing the Other Side of the Water Cycle: Making Wastewater an Asset*. GWP TEC Background Paper No 13. Global Water Partnership, Stockholm.

Bahri, A., Cross, P., Nelson, E., Pensulo, C., Zhang, W. (2010) 'Ensuring Human and Environmental Health'. Presentation from the 2009 World Water Week in Stockholm. Overarching Conclusions. pp. 23-27.

BPIA (2010) *New York: New York City and Seven Upstate New York Counties – Effective Watershed Management Earns Filtration Waiver for New York*. Bureau of Public and Intergovernmental Affairs, New York. Available at: http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/casestudies/upload/Source-Water-Case-Study-NY-NY-City-7-Upstate-Counties.pdf

Brown, P. (2009) 'The Changing Face of Urban Water Management'. *Water 21*. February 2009, pp. 28–30.

ISET-Nepal (2008) *Re-imagining the Rural-Urban Continuum: Understanding the Role Ecosystem Services Play in the Livelihoods of the Poor in Deskota Regions Undergoing Rapid Change*. ISET-Nepal, Kathmandu.

Najjar, K.F. and Collier, R. (2011) 'Integrated Water Resources Management: Bringing It All Together'. *Water Resources Impact*, 13(3): 3-8.

Rees, J. (2006) *Urban Water and Sanitation Services: An IWRM approach*. TEC Background Paper No. 11. Global Water Partnership, Stockholm.

Sadoff, C. and Muller, M. (2009) *Better Water Resources Management: Greater Resilience Today, More Effective Adaptation tomorrow*. GWP TEC Perspectives Paper. Global Water Partnership, Stockholm.

Serageldin, I. (1994) *Water Supply, Sanitation and Environmental Sustainability. Directions in Development*. World Bank, Washington D.C.

Shiklomanov, I.A. (1998) *World Water Resources: A New Appraisal and Assessment for the 21st Century*. A Summary of the Monograph. United Nations Educational, Scientific and Cultural Organization, Paris. Available at: http://webworld.unesco.org/water/ihp/publications/waterway/webpc/world_water_resources.html

Srinivas, H. (2009) 'Urban Water Resources Management: An Integrated Urban Water Strategy'. Global Development Research Center. Available at: http://www.gdrc.org/uem/water/urban-water.html

SWITCH (2011) SWITCH 2006-2011, *Managing Water for the City of the Future*. UNESCO-IHE Global Partnership. Available at: www.switchurbanwater.eu.

Tucci, C.E.M. (2009) *Integrated Urban Water Management in Large Cities: A Practical Tool for Assessing Key Water Management Issues in the Large Cities of the Developing World*. World Bank.

Tucci, C.E.M. (2010) 'Integrated urban water management in the humid tropics'. Chapter 1, pp. 1-23. In Parkinson, J.N., Goldenfum, J.A., and Tucci, C.E.M. (Eds) *Integrated Urban Water Management: Humid Tropics*. UNESCO-IHP, Urban Water Series. United Nations Educational, Scientific and Cultural Organization, Paris and Taylor and Francis, Leiden.

UNDP (2006) *Human Development Report 2006. Beyond Scarcity: Power, Poverty and the Global Water Crisis*. United Nations Development Programme, New York.

UNEP (2002) *Global Environmental Outlook 3*. Earthscan, London and United Nations Environment Programme, Nairobi.

UNEP and UN-Habitat (2005) Coastal pollution: The role of cities. Available at: http://www.unep.org/urban_environment/PDFs/Coastal_Pollution_Role_of_Cities.pdf

UN-Habitat (2009) *Planning Sustainable Cities: Global Report on Human Settlements 2009*. United Nations Human Settlements Programme, Nairobi and Earthscan, London.

Van der Steen, P. (2006) 'Integrated Urban Water Management: Towards Sustainability'. Paper presented at the first SWITCH Scientific Meeting, University of Birmingham, UK, 9-10 Jan 2006.

Watson, A., Prickett, R., Taghavi, A. and West, T. (2011) 'California's IWRM Program: A Regional Framework for Integrated Water Resources Management'. *Water Resources Impact*, 13(3): 9-13.

WWAP (2006) *Water: A Shared Responsibility. The United Nations World Water Development Report 2*. United Nations Educational, Scientific and Cultural Organization, Paris and Berghahn Books, New York.

The Global Water Partnership's vision is for a water secure world. Its mission is to support the sustainable development and management of water resources at all levels.

GWP was founded in 1996 by the World Bank, the United Nations Development Programme (UNDP), and the Swedish International Development Cooperation Agency (SIDA) to foster integrated water resource management (IWRM).

IWRM is the coordinated development and management of water, land and related resources in order to maximise economic and social welfare without compromising the sustainability of ecosystems and the environment.

The network is open to all organisations involved in water resources management: developed and developing country government institutions, agencies of the United Nations, bi- and multi-lateral development banks, professional associations, research institutions, non-governmental organisations, and the private sector.



**Global Water Partnership (GWP) Secretariat**
Drottninggatan 33
SE-111 51 Stockholm, SWEDEN
Phone: +46 8 522 126 30
Fax: +46 8 522 126 31
Email: gwp@gwp.org
Websites: www.gwp.org, www.gwptoolbox.org

Global Water Partnership