Integrated Water Resources Management

And the domestic water and sanitation sub-sector

Thematic Overview Paper

By: Patrick Moriarty (IRC) and John Butterworth (NRI) and Charles Batchelor
Reviewed by: Annette Bos and Frank Jaspers (IHE)

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Introduction

As populations and demands on water resources continue to grow, professionals working in domestic water supply and sanitation (WATSAN) are faced with a range of critical questions. How to develop reliable sources with sufficient water for domestic supplies? How to ensure adequate water quality, and protect sources from pollution? And how to minimise the impacts of water abstraction and wastewater pollution on other water users? Finding answers to these questions, and putting in place processes that lead to sustainable solutions, is of increasing importance as we continue to see more conflicts over access to water affecting domestic supplies, more systems failing due to source problems, and rising infrastructure and treatment costs.

The WATSAN sub-sector's[1] primary challenge, reaching the 1.1 billion without adequate water and 2.4 billion without proper sanitation, is clearly about much more than water resources but these do have a crucial role to play. This TOP provides an introduction to water resources issues for the WATSAN sub-sector, with a focus on how the widely talked about 'integrated water resources management' (IWRM) approach can help.

IWRM has emerged during the last decade as a response to the 'water crisis': the widespread and well-articulated concern that the planet's freshwater resources are coming under increasingly unsustainable pressure from rising populations, growing demands for water and increasing pollution. In Vision 21 (WSSCC, 2000) the WATSAN sub-sector signalled acceptance of IWRM. But what exactly does this mean for WATSAN? What does IWRM offer for WATSAN practitioners and organisations in their work?

The most fundamental consideration for the sub-sector is that IWRM means a move away from traditional sub-sector based approaches (WATSAN, irrigation, industry, etc) to a more holistic or integrated approach to water management[2] based upon a set of agreed key principles. Taken together, the principles offer a framework for analysing, and subsequently managing multiple uses of water in situations of increasing competition and conflict and where water resources are scarce (or polluted). These actual or potential conflicts often threaten the security of supplies for WATSAN and, as will be argued in this paper, IWRM has a great deal to offer in this context.

IWRM also provides a framework for WATSAN activities to better consider and manage their own impacts on other water users, especially inadequate sanitation and wastewater treatment. Throughout the South, low sanitation coverage and widespread discharge of untreated wastewater have considerable impacts on downstream (and underground) water quality, users and the environment.

[1] Throughout this TOP we refer to water sub-sectors such as WATSAN, irrigation, and industry. The assumption being that these are all parts of a larger 'water sector'.
[2] We use the term (water) management in this TOP to refer to an entire management cycle that includes planning, implementation, monitoring and evaluation etc.

What this TOP is about

IWRM is being promoted by many organisations, implemented in some areas and piloted in others. A huge effort involving the reform of water laws, institutions and capacity building is underway based upon the IWRM 'recipe'. However, in much of the world, it remains business as usual. And often the WATSAN community are not at the forefront of IWRM. This Thematic Overview Paper (TOP) aims to support the WATSAN community in engaging in the IWRM debates and to help bridge the gap between talk and practice.

Therefore, this TOP looks at the challenge of IWRM from the point of view of the WATSAN sector and those working within it. It examines why it is critical for WATSAN professionals to become involved in IWRM, but also what it means to do so, and what are the key activities that *you* can start to undertake in *your* work. To do this, the TOP provides analysis and explanation of the major challenges and trends in IWRM, successful examples of where practical approaches to IWRM generated good solutions to WATSAN problems, and also links to further sources of information, tools and approaches that can be used by WATSAN professionals in their work.

Contents

The TOP is divided into five sections. Readers may wish to follow the whole document, or dip into the sections of greatest interest by following the links below.

Section 1: An IWRM primer: provides a brief overview of **what** IWRM is, where it originated, and the key concepts, principles and definitions that underlie it.

Section 2: **Why** IWRM is important for WATSAN: makes a case for stronger involvement of the WATSAN community within IWRM, but also discusses what IWRM principles can offer to address some key problems facing the sector.

Section 3: Identifying solutions: here practical approaches are identified that can help address **how** to apply IWRM principles to issues affecting WATSAN and contribute to better management of water resources.

Section 4: Summary and **conclusions**

Section 5: TOP resources: Provides **links** to TOP books, articles and manuals (annotated) and references, TOP websites, and TOP contacts.

Section 1: An IWRM primer: background to the concept, its history and future development

Origins, principles and definitions

IWRM is about integrated and 'joined-up' management. It is about promoting integration across sectors, applications, groups in society and time based upon an agreed set of principles

IWRM is a global movement driven by a perception of crisis, both current and future. The so-called global water crisis (Box 1) is underlain by a mixture of largely unavoidable development factors (population growth, increasing wealth and demand). However it is increasingly realised that the heart of the water crisis is poor management or governance. With careful management and wise selection of priorities there is no reason that even in the driest parts of the world there should not be sufficient water to go around, and viable solutions exist to many of the problems faced. IWRM seeks to tackle some of the root causes of the management crisis, namely the inefficiencies and conflicts that arise from un-coordinated development and use of water resources. Many of these problems and conflicts will be familiar to those working in the WATSAN sector: problems like those listed in Box 2.

Box 1. The water crisis

The Stockholm Environment Institute has estimated that, allowing for predicted population growth and assuming moderate projections of development and climate change, the proportion of the world's population living in countries of significant water stress will increase from approximately 34% in 1995 to 63% in 2025. Those living in poorer countries in Asia and Africa, with low and unreliable rainfall and high levels of utilisation of the total water resource, will be most at risk of water stress impacting severely on their lives and livelihoods.

Predicted decline in per capita availability of water resources, by region, 1995–2025

Region	Annual renewable water resources (m^3 per person)		
	1995	2000	2025
Asia	4,000	3,400	2,300
Europe	4,200	3,900	3,900
Africa	5,700	4,500	2,500
North America	17,000	15,400	12,500
South America	38,000	33,400	24,100
Australia & Oceania	84,000	75,900	61,400

Source: Comprehensive Assessment of the Freshwater Resources of the World, (Stockholm Environment Institute, 1997).

Box 2. Examples where IWRM has a role to play in WATSAN issues

- **Groundwater management:** in many parts of rural Andhra Pradesh in India, successful development of groundwater for irrigation has resulted in reduced poverty but also in overexploitation of aquifers with less water available for village drinking water supplies (Rao et al, 2003).
- **Conflict resolution:** in Cochabamba, Bolivia, a planned privatisation of the city's domestic water company was perceived as a threat to the irrigation water rights of peri-urban farmers and was a major cause of violent conflicts (Bustamante et al, 2004).
- **Poverty reduction:** in rural Limpopo Province, South Africa, nobody plans for productive water uses at the household level like backyard gardens, or keeping a few livestock. This contributes to illegal connections to domestic water systems that in turn mean many people receive no water at all (Pérez de Mendiguren et al., 2003).
- **Pollution control:** pollution of surface water sources from untreated wastewater poses major problems in much of rural Colombia, increasing treatment costs and reducing water quality at the tap (Smits, 2002).
- **Reducing health hazards:** in parts of Andhra Pradesh (and elsewhere in India) where fluoride is a natural contaminant of drinking water wells, pockets of better quality groundwater are often used for irrigation while water with high fluoride levels is supplied for drinking (Butterworth et al, 2004).

Until relatively recently, even many developed world cities relied on the self-cleansing potential of either rivers or coastal waters to deal with effluent from their cities and this helped keep sewage disposal costs low. The work of management was restricted to getting the waste from people's houses to the river or sea. While population densities were low, this was acceptable. But once the growth of new towns and cities, who in turn required clean water for their own drinking supplies, reached a certain point, it ceased to be so. Equally, as our understanding of the environmental impacts of untreated effluent on riverine and coastal ecology (and eventually people) has improved, and better quality water for recreational use has become important, further demands are made in terms of meeting quality standards. The resulting shift in perceptions, underpinned by new legislation, has led to water and sewerage utilities undertaking the investments required to improve sewage treatment (see for example the European Urban Waste Water Treatment directive of 1991 (EC 1991) which mandates that all towns of >2,000 population must have at least primary and secondary treatment of wastewater by 2005).

As in this example, IWRM comes out of an attempt to tackle and avert problems or crises. Its conceptual backbone is provided by a set of four core principles, agreed upon by the Dublin Ministerial Conference that preceded the first world summit on sustainable development in Rio de Janeiro in 1992. IWRM is therefore the water community's contribution to the sustainable development dialogue that has been running since Rio (and

before). And its principles of holism, decentralised control, and respect for the environment are clearly recognisable as such. While the principles have been further refined and added to during subsequent conferences of the water community in the 1990s and 2000s (see Box 3), they remain the commonly accepted starting point for IWRM, and are set out in full in Box 4.

Box 3. Key meetings in the emergence of IWRM as an approach

Websites linked to the following conferences all contain numerous documents on IWRM.

- International Conference on Water and the Environment, Dublin,1992 (http://www.wmo.ch/web/ho,s/documents/english/icwedece.htm)
- United Nations Conference on Environment and Development, Rio de Janeiro, 1992 (see http://www.un.org/esa/sustdev/ for more information)
- 2nd World Water Forum, The Hague (http://www.worldwaterforum.net/)
- World Summit on Sustainable Development, Johannesburg, 2002 http://www.johannesburgsummit.org/
- 3rd World Water Forum, Kyoto, 2003 (http://www.world.water-forum3.com/)

Box 4. Guiding principles from the Dublin Statement

Principle No. 1: Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment
Since water sustains both life and livelihoods, effective management of water resources demands a holistic approach, linking social and economic development with protection of natural ecosystems. Effective management links land and water uses across the whole of a catchment area or ground water aquifer.

Principle No. 2: Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels
The participatory approach involves raising awareness of the importance of water among policy-makers and the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the planning and implementation of water projects.

Principle No. 3: Women play a central part in the provision, management and safeguarding of water
This pivotal role of women as providers and users of water and guardians of the living environment has seldom been reflected in institutional arrangements for the development and management of water resources. Acceptance and implementation of this principle requires positive policies to address women's specific needs and to equip and empower women to participate at all levels in water resources programmes, including decision-making and implementation, in ways defined by them.

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Principle No. 4: Water has an economic value in all its competing uses and should be recognized as an economic good
Within this principle, it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognize the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources (WMO 1992).

Given this recent history, IWRM is still an evolving concept, and several definitions are given in Box 5. The first of these is that used by the Global Water Partnership, the (self appointed) international 'custodian' of the IWRM concept. Three key concepts which in one form or another are present in all definitions of IWRM are: equity, efficiency and sustainability. IWRM aims:

- to promote more equitable access to water resources and the benefits that are derived from water in order to tackle poverty.
- to ensure that scarce water is used efficiently and for the greatest benefit of the greatest number of people, and
- to achieve more sustainable utilisation of water, including for a better environment.

Box 5. Some definitions of Integrated Water Resources Management (IWRM)

IWRM is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (GWP, 2000).

IWRM is a process of assignment of functions to water systems, the setting of norms, enforcement (policing) and management. It includes gathering information, analysis of physical and socioeconomic processes, weighing of interests and decision making related to availability, development and use of water resources (van Hofwegen and Jaspers, 1999).

IWRM involves the coordinated planning and management of land, water and other environmental resources for their equitable, efficient and sustainable use (Calder, 1999).

IWRM expresses the idea that water resources should be managed in a holistic way, coordinating and integrating all aspects and functions of water extraction, water control and water-related service delivery so as to bring sustainable and equitable benefit to all those dependent on the resource (EC, 1998).

A fourth key concept is that of *process.* IWRM is a process of getting from some existing state to some envisaged and preferred future state, by achieving commonly agreed principles or best practice in managing water through the involvement of all relevant stakeholders.

IWRM is the application of the Dublin principles

IWRM *is*, at its heart, nothing more than the process of implementing the Dublin principles. It is about people (professionals and users) talking to each other more; about joint planning activities across sectoral boundaries; about integrated planning at the basin, but also at the community level. Critically IWRM is about information, and communication; about good planning based on a sound, and broadly based understanding of people's wants, and needs, but also their abilities and the constraints imposed by working with a finite resource. The IWRM paradigm is now widely accepted as conventional wisdom, and the principles have been widely accepted (see for example Solanes & Gonzalez-Villarreal, 1999 who track the inclusion of the Dublin principles in national water legislation) with few but important exceptions such as widespread debate on the 'water as an economic good' principle (Box 6).

However, while widely recognised as 'a good idea', practical implementation of IWRM, and mainstreaming the IWRM principles into worldwide water management practice still requires a massive international effort ranging from reforms of water management laws, institutions and regulatory systems to capacity building at a whole range of levels. This effort has hardly begun, as the World Bank underlines in its recent sector strategy (World Bank 2003), which seeks to set out some of these challenges from the Bank's and its clients' perspective.

Moving forward - IWRM as a process

Implementing IWRM can often seem daunting given the scale and complexity of the changes needed to *fully* implement it (Butterworth & Soussan, 2001). However, this is where the importance of understanding IWRM as a process comes in. Any improvement in coordination or planning of water resource development represents a step in the process, **and in many cases local level agreement and capacity-building on better sharing and use will have greater impact than new national laws or international level treaties**.

IWRM must not (especially in the context of developing nations) be viewed as a body of complex legislation, or an expert control system in which, to be effective, all aspects of water resources supply and use are integrated into a complex centralised system under the control of one 'super-agency'. The process vision sees IWRM as a way of thinking (or a paradigm), where instead of attempting to control all aspects of water management through one system, the task is to help many different water managers to understand and take account of the wider implications of their actions and to collaborate more effectively.

Following this latter approach, the next section critically assesses the role of WATSAN in IWRM and vice versa. There are simple steps, based upon the principles identified above, that all water professionals can apply in their work. Ways forward are identified that are practical, that are consistent with immediate needs and priorities for improved water supplies and sanitation (ensuring resource availability, reducing costs of treatment etc.), and that will also contribute to a longer-term, more comprehensive approach to the water sector as a whole.

Box 6. Understanding 'Water as an economic good' (and why it is not the same as cost recovery in WATSAN)

Undoubtedly the most contentious of the Dublin principles is that water be treated as an 'economic good'. Misunderstood in many ways in the WATSAN sector, this principle often becomes confused with issues of cost recovery and privatisation of water utilities. It is particularly important to realise that the economic value of water, and the costs of managing and supplying it are very different.

Treating water as an economic good means trying to promote higher value uses of water (under conditions of water scarcity). This could mean favouring industrial uses over agriculture. Or promoting higher value crops under irrigation. Or deciding to import high water use crops from countries with higher rainfall rather than trying to grow them at home. However, it is crucial in this discussion to be clear that a full economic analysis must take into account the social costs and benefits of different water uses and not just, for example, the value of production per unit of water used. These social costs should be accounted for in a proper economic analysis and recently, to emphasise the importance of this full accounting, it has become more common to talk of managing water as an 'economic and social good'. On this understanding it is commonly recognised that the highest value use of water is always going to be domestic supply, and there are high costs for the economy (e.g. in health) when supplies fail.

Another important point is that treating water as an economic good, or recognising the value of its use, does not necessarily mean that this value should be passed on to all water users as a direct tariff. Values and charges (tariffs) are different things. Water always has an economic value, regardless of whether this value is recognised in some formal setting such as a market for water. Tariffs should as much as possible reflect the objectives of water resource managers, while ensuring that access by vulnerable communities for domestic or irrigation water is protected through mechanisms such as variable tariffs and targeted subsidies.

Based upon a study in the Subernarekha River Basin in India (Rogers *et al*., 1998) the following table illustrates how, in this example, tariffs charged to consumers for both urban supply and irrigation are much less than supply costs (i.e. there are high levels of subsidy), and that the value of water use in both cases exceeds costs of supply (but this excludes opportunity costs and environment impacts). However, the tariffs provide no economic incentive to allocate water to where it is of most value i.e. urban supply.

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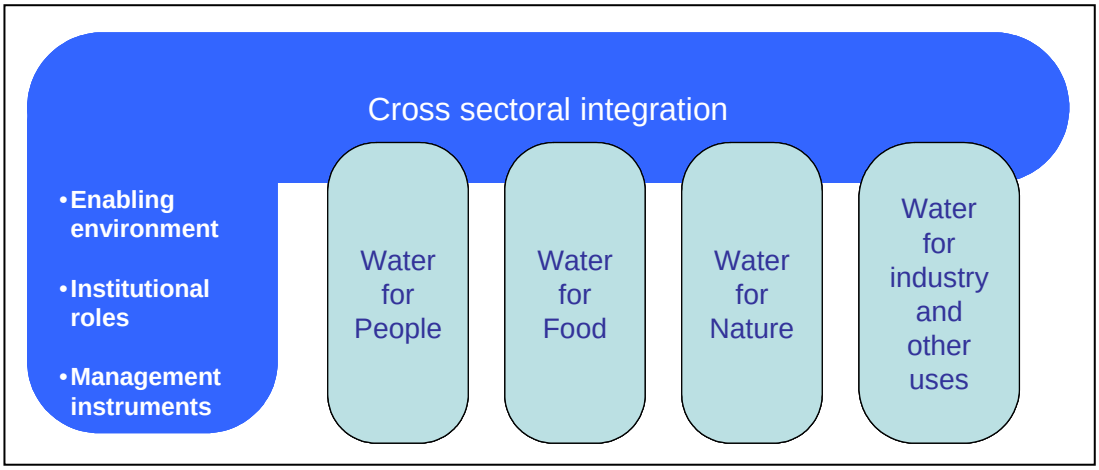
	Urban supply (US cents per m^3)	Irrigation (US cents per m^3)
Value	25	9.7
Supply cost	6.6	5.5
Tariff	1.2	0.1

The total costs of water supply are always paid by someone: whether by consumers through water utility charges, farmers paying for irrigation water, subsidies from the state, or impacts on the environment. The 'economic good' principle in water management is therefore not synonymous with calls for higher levels of cost recovery in water supply. These calls for cost recovery usually have other justifications, for example, seeking to improve sustainability in supply systems (see Cardone & Fonseca, 2003 for more information). Of course water institutions and water supply systems need to be funded, and this may sometimes be done directly through water user charges.

IWRM and the WATSAN sector – where we fit in

According to Figure 1 IWRM occurs at the intersection of the different water sectors – at the point where these interact with each other. Many feel that this interaction is best assessed and managed at the scale of the river basin or catchment, and the basin is undoubtedly a critical unit for large scale integration. Nonetheless, too much attention to the large, basin, scale can obscure the fact that, as we will see later, IWRM is relevant and can also be adopted at other physical and institutional scales.

Figure 1. Cross-sectoral integration: the space for IWRM



Source: GWP, 2000

The domestic water cycle and IWRM

In essence the domestic water (and sanitation) cycle interacts with IWRM at two points – inlets and outlets. While IWRM principles can be of great use in ensuring good practice within a domestic water supply system (for example when applied to decentralised management), IWRM is most obvious at those points where water for domestic use (and sewage disposal) directly interacts with other uses and the environment. The classic domestic water cycle has the following stages: abstraction, water treatment, supply to households and, where waterborne sewerage exists, removal from the household through sewers, wastewater treatment and discharge to a water body. In this cycle the most critical elements from the IWRM viewpoint are the abstraction from the source (quantity, quality, and reliability issues), and discharge into watercourses (quantity and quality issues) or, indeed, leakage to groundwater:

- **Quantity**: Typically the quantity of water needed for domestic use is a small part of the total annual water available for a catchment or river basin. However, the need for a very high reliability and security means that it can sometimes represent a large part of available water. It is also important to recognise the difference between 'real' and 'paper' water losses. A lot of water used for domestic supply is returned (albeit polluted) as wastewater and is only a loss 'on paper', whereas most water abstracted for irrigation is lost by evaporation and no longer available (a 'real' loss).
- **Quality**: The quality of domestic water is critical to the principal aim of the WATSAN sector – to preserve life and maintain health. Quality is assured by treatment, but also by the quality of the source. The lower the quality of the source, the higher the treatment costs. At the wastewater end of the cycle, poor treatment impinges on domestic and other users' needs for quality.
- **Reliability**: Domestic supplies must be highly reliable. Shortages of domestic water, for even a few days, have major impacts. Supplies must therefore seldom fail, with the implication that sources must also be highly reliable and be protected from competing uses. Failure to keep water supply pipelines pressurised (24 hours a day) also allows polluted water to force its way into leaky pipes.
- **Wastewater treatment and discharge**: A major source of pollution of domestic water supplies is the discharge of untreated human waste from sewage systems. Collecting and treating wastewater is expensive and therefore often not done.

There are a number of exceptions to this domestic water cycle. Water is often not treated or put through pipe networks – for example handpumps on boreholes are used to supply water to millions in rural areas in developing countries. More importantly using precious water to float human excreta down sewers is increasingly seen as wasteful and inappropriate in dry countries and regions, and on-site solutions such as septic tanks, and various forms of dry disposal are becoming increasingly popular. Finally, the discharge of either treated or untreated waste to water courses is increasingly being replaced by direct re-use – often for agriculture - although this practice is not free of environmental hazards (see for example IWMI, 2002).

Three critical issues

Before concluding this 'primer' on IWRM a few further key issues have been identified that are often misunderstood:

- **Scale issues**
  Water resources issues are strongly scale dependent, both in terms of the physical processes driving the hydrological cycle, and the social and economic processes controlling water use. Competition and potential conflicts can take place at a range of spatial scales from international to local. The demands of mega-cities may have impacts that extend across state or international boundaries. But many (probably most) conflicts are more local, centring upon local aquifers or watercourses. One key scale is the river basin scale at which water resources planning is normally focused, although even these can range enormously in size from country to country. Solutions at one scale can of course easily become problems at another (see Box 7) People taking a 'catchment' approach in headwater catchments for example, might not always take into account the rights and needs of downstream users at some larger catchment scale.

- **Boundaries**
  Closely linked to understanding scale is the issue of boundaries. While the first Dublin principle, and a rapidly growing body of practice accepts that water should be managed on the basis of hydrographic units (basins, catchments, and less commonly aquifers), these seldom exist at the same scale or with the same boundaries as institutional and administrative units. WATSAN is normally planned on the basis of administrative units such as municipalities and districts. An important challenge is ensuring proper linkages across different boundaries. Water for domestic use – particularly where large piped schemes are the norm – will often be used in a different hydrographical unit to the one in which it was sourced. Catchments and aquifers may even cross international borders. This issue is returned to in the next section, where a methodology for dealing with such mismatches in boundaries is proposed.

- **Temporal variability**
  A third critical parameter to get to grips with, is that of temporal variability. Water availability is rarely constant. Water exists in a constant state of flux. It is always (or almost always) moving from somewhere to somewhere else. Across the seasons and years, water is available in different quantities. Rivers in their natural state go from a flood to a trickle and back to a flood. Aquifers are recharged and then drain into rivers. Much demand for water, however, particularly for domestic use, is by its nature more or less constant on longer timescales (although there can be large peak demands for example, in summer). Planning for water use needs to take account of availability over time, and, critically the reliability of sources.

Box 7. A solution and problem at different scales: water harvesting in India

Water harvesting is being widely promoted in India to capture runoff and help recharge aquifers that are being heavily exploited for irrigation. Small structures across seasonal streams, known as check dams, can very successfully increase the yield of irrigation wells nearby. But this runoff is then no longer available downstream, especially to replenish the larger and traditional tanks that are common to almost every village in southern India. This can be a major problem for users of the tanks including irrigation farmers (who themselves may be able to switch to groundwater), fisherfolk, livestock keeping and often the village drinking water supply.

Sources: Batchelor et al., 2002; Reddy & Renuka, 2003

Section 2: Why IWRM is important for WATSAN

The water sector is divided into many sub-sectors (agriculture, urban and rural water supply and sanitation, industry and mining, environment and tourism, fisheries, energy, transport, etc.). All these water users (and polluters) have the potential to impact upon each other, both positively and negatively. When overall demand for water use is well below the available resource and the amounts of polluted water to be disposed of are limited, these sectors can, within reason, operate independently of each other without causing too many negative impacts. However, once demand gets close to resource availability and volumes of polluted water rise, the need for some form of larger vision and integration effort becomes critical. This section considers the issues of **why** IWRM is important for the WATSAN sub-sector in more detail under four main headings:

- WATSAN needs are not trivial
- Mechanisms to prioritise domestic water use often fail
-
- Not just domestic supplies: meeting water needs for productive uses
- Impacts of WATSAN on other water users

To date we believe that the WATSAN community has often failed to engage adequately in IWRM. IWRM initiatives are often driven by other sub-sectors even though domestic water supply and sanitation is recognised as the priority user of water. The statement on IWRM in Vision 21 (WSSCC 2000) is relatively weak limiting itself to the comment that domestic needs must be accorded primacy in allocation.

WATSAN needs are not trivial

Domestic water demands are almost always given priority in national water policies, but in practice are too commonly assumed to be trivial with respect to the use by other sectors. This is a major mistake. Domestic uses do typically accounts for less than 10-20% of water use in the south (see Box 8), while agriculture uses more like 60-80%, but there are some important caveats that must be made.

Box 8. Water resource availability, and withdrawals

	Annual renewable water resources (1995) (m^3/ person)	Annual withdrawals (m^3/person)	Sector withdrawals (%)		
			Agriculture	Industry	Household
Africa	5700	325	61	4	9
Asia	4000	680	80	9	8
Latin America	38000	1140	57	12	21

Source: *Comprehensive Assessment of the Freshwater Resources of the World*, Stockholm Environment Institute 1997

First, there are huge variations, and in places domestic water needs do account for a large proportion of the available resources in both urban (just ask the water supply managers of any rapidly expanding city in the drier parts of the south) and rural areas. Second, as discussed in Section 1, supplies for WATSAN need to available every day. So while domestic needs may look relatively small when considered in terms of total resource availability over a year, they can look very significant in the driest months of the year, and represent an even larger share during droughts (see Box 9 for an example).

Box 9. Situations where domestic water demands start to add up

In areas of relative water scarcity – particularly the more arid regions of the world – even relatively small per capita domestic water demands may account for a large proportion of the available resource in 'rural' catchments. For example, Batchelor *et al.* (2000) show that domestic water requirements (supplied from groundwater) in two rural watersheds in Karnataka, India can represent a relatively large percentage of the groundwater recharge and available resource (around 10% at present, but rising to 20% over the next 30 years). To provide secure resources (requiring a buffer) in drought prone environments, an even greater share of the groundwater balance needs to be set aside

Mechanisms to prioritise domestic water use often fail

While as mentioned WATSAN needs are typically given first priority in policies for allocation, the mechanisms to protect domestic water sources in the context of increasing competition for water are often either lacking or toothless. The importance of this issue is just beginning to be appreciated with the implication that addressing domestic water supply provision in isolation from other water uses is unlikely to succeed, or will be prohibitively expensive. In many areas with strong competition for limited resources – including catchments with large urban population centres, rural areas with high population densities, and areas with high demands for irrigation and other non-domestic water uses – urban and rural water supplies can no longer be improved solely through reliance on the development of new sources and infrastructure. Across all water sub-sectors the limitations of supply driven approaches are starting to be recognised, along with the need for an integrated approach to shift from supply augmentation to demand management and making better use of limited water resources. But, as practice remains behind policy and rhetoric, the WATSAN sub-sector will increasingly have to compete for its water resources and needs, and get involved in promoting better management to mitigate its impacts on other water users (Box 10).

Box 10. Urban footprints

In a rapidly urbanising world, cities rely upon the mobilisation of water resources far beyond their hinterlands, and urban water users (for domestic use, urban agriculture, formal and informal sector industries and services) increasingly compete with other needs such as irrigation or environmental use. The following example illustrates the problems faced, particularly the devastating affect that uncontrolled irrigation use can have on the availability of urban domestic water. The report explains that the population of Kurnool had seen their water supply reduced from 60 to 15 litres per person per day due to a combination of drought, poor management, and competition for water resources. As is so often the case it is the poor who suffer most, in this case through high tariffs charged by private tanker operators:

"It was only when the dry river bed was noticed that the KMC (Kurnool Municipal Council) began making efforts to draw water from other sources." … "Though the collector (i.e. senior district administrator) later ordered the irrigation department to divert about 60 cusecs of water …., only about 10 cusecs reached the town as farmers en-route diverted the water to their fields." … "Meanwhile, Kurnool …. is supplying drinking water to the most affected areas through 20 water tankers …. However, these are not adequate to meet the demand with the result that private operators are making a killing supplying water at high cost."

Source: Times of India, 2001

A good example of competition for limited water resources and unforeseen impacts on domestic water supply has been the dash for groundwater in South Asia. Since the 1980s, there has been a big shift towards groundwater as the preferred resource for (rural) domestic water supply and irrigation, especially in drier zones. Made possible by improvements in drilling and pumping technologies, as well as by subsidised electricity, using groundwater makes sense. Variability in availability throughout the year is less than for surface water, it is more often available locally without the need for expensive infrastructure (dams), and groundwater is often of better quality than surface sources meaning that expensive water treatment is rarely required. Overall this strategy has had very positive impacts on WATSAN. It has enabled increased coverage to be achieved at lower cost; reduced transmission of disease; improved health; and reduced the time and effort required to access water. However the dash for groundwater has been associated with some major problems for WATSAN, including arsenic and fluoride poisoning, and overexploitation of, and competition for, this finite resource (Box 11). Competition between irrigation and domestic use has become intense in many places. These are problems that might have been avoided had good IWRM principles been applied.

Box 11 Overexploitation of groundwater in India

In many Indian villages, domestic water supplies drawn from traditional wells and boreholes have been severely affected over recent decades (especially during the 1990s) by widespread over-abstraction for irrigation. Irrigated areas and the amount of groundwater abstracted have increased dramatically, associated with policies to increase food production, subsidies and loans for farmers to sink wells and purchase pumps, and incentives such as free or cheap electricity and support prices for certain crops.

While the reduction of poverty through increased and improved use of groundwater was a good and positive development, it happened against a background of a lack of effective policies and mechanisms to manage groundwater, either at community or any other level. Key surface water resources, such as tanks (reservoirs), had generally had complex webs of traditional management rules in place, leading to many operating successfully for hundreds of years. However, under effectively open-access regimes, where there are no rules to manage abstraction and use, groundwater has suffered from uncontrolled development, inefficient use of the abstracted water and widespread declines in groundwater levels (see for example Moench et al, 2001, and 2003).

A shift from traditional large-diameter dug wells for domestic water supply, to deeper borewells (chasing the water table with the farmers) has still failed to provide sustainable sources. Many village water supplies now fail routinely during the dry season, and they are increasingly vulnerable to periods of drought. Tankering of supplies is a costly emergency solution, is unpopular with communities (but attractive to tanker owners, some local politicians, and farmers selling water to the tanker owners) and is often wasteful of the scarce water that is available.

Unable to develop reliable local groundwater resources for domestic water supply, district government and state development agencies have often sought large-scale engineering solutions to harness surface water resources from far away. Many schemes have been driven by engineers, and corrupt decision-making has also played a major role in the choice of technology. Large dams, water treatment works and extensive pipelines (each often serving hundreds of villages) have been given priority. However many disadvantages associated with this approach have emerged, and often such schemes cannot be sustained. Regional piped water supply schemes have suffered from poor and unreliable infrastructure, and as responsibilities are decentralised, even the high operation and maintenance costs cannot be afforded.

Local solutions are now being sought again by the WATSAN community to manage groundwater resources better, and secure sustainable resources at affordable cost.

The example of groundwater overexploitation in India illustrates how one of the impacts of uncontrolled local competition for water with other sectors can be increased costs of future provision of water services. Costs are higher as pipelines have to be constructed to reach more distant sources, and as more elaborate treatment processes are required to remove pollutants. In many places, the need for water savings may be minimised by demand management measures and improvements in efficiency in other sectors (such as less wasteful irrigation techniques), but also in the WATSAN sector itself where issues such as unaccounted-for water often represent huge potential gains. But this will not happen automatically, and there is a clear need to have active policies (e.g. energy and water pricing) and programmes to improve irrigation efficiency, influence crop combinations, ensure effective and fair allocation mechanisms, and so on. Even these types of actions are unlikely to be sufficient in the most pressured situations, and difficult choices (measures which impact negatively on farming communities are particularly controversial and politically difficult) will need to be made in the allocations between sectors if domestic water needs are to be met at an affordable cost. This is especially so if a more equitable distribution of water to meet the need for greater small-scale household level utilisation of water for income-generating activities is desired.

Not just domestic supplies: meeting water needs for productive uses

As well as the critical contribution to health and wellbeing that access to a reliable source of domestic water supply brings, the contribution to peoples livelihoods of productive activities dependent upon household water supplies (like backyard irrigation or keeping a few livestock) is now increasingly being recognised, particularly for women and the poor (Moriarty & Butterworth, 2003; and Box 12). The amount of water available to support these activities can be a key constraint to enabling diversification of livelihoods, improving income levels, and reducing poverty. One implication of promoting provision for productive activities is that 'domestic' water supply needs then become higher than is often assumed. Total household water requirements for poor people including water for productive uses are likely to be in the range 50-200 lpcd, compared with the commonly accepted norms for a solely domestic water supply of around 25-50 lpcd.

Box 12. Mixed uses of water supply systems in Colombia

Although Colombia is rich in water resources, scarcity (especially scarcity of adequate water quality) increasingly affects water supply. This is the case in the Department of the Valle del Cauca in the 'Ambichinte' micro-catchment (13 km^2) located on the western slopes of the Andes. In the Municipality of Dagua, 5,600 people live in five communities. Complex migration patterns have resulted in fractured and individualistic communities with little social cohesion, and a wide breadth of wealth strata.

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This individualism is reflected in the high demand for private water supplies, a challenge taken up by the institutions in charge of issuing water use concessions and investing in water supply infrastructure. The result is a patchwork of overlapping systems, individual and communal. Today, there are seven gravity-fed community-managed systems supplying drinking water to the five different communities, as well as a large number of individual systems and some smaller communal systems.

However, none of the systems delivers water of adequate quality, due to lack of treatment facilities. The economies of scale necessary to make treatment affordable are not met by these fragmented small scale systems. As a result, a large percentage of the inhabitants use alternative water sources, such as springs, bottled water and other water supply systems for drinking.

In addition to domestic household uses, water is also used for productive uses such as irrigation, poultry and pig rearing, fish ponds and recreational purposes (watering of gardens and swimming pools). These uses make up to about a fifth of all water use in the area and contribute directly to the economic well being of more than 25% of the population. The vast majority of people using water for such purposes are willing to pay to maintain their access to this water, women even more so than men. Improvements in water supply systems need therefore to both provide water of adequate quality for drinking and of sufficient quantity for productive use.

Source: Perez et al., 2003

Impacts of WATSAN on other water users

WATSAN activities can have major negative impacts on other water users, including the environment, that need to be considered and regulated. Impacts might be the result of dam construction, increased groundwater abstraction, pollution from wastewater, etc. IWRM provides a good framework for better understanding these potential impacts and determining appropriate measures for avoidance or mitigation. Two key issues are briefly considered here: impacts of abstractions on the access to water by other users; and, the impacts of wastewater discharges and reuse on the environment and human health.

Understanding rights to water

Increased water utilisation as a result of WATSAN projects may impact severely on the access of other water users to the same or linked resources, and in this context it is necessary to understand what rights other downstream users have to the resources, and what the implications of these rights are. Rights to water vary according to legal systems in different countries and often overlap. They may include:

- administrative rights (where licences have been allocated e.g. by a river basin authority)
- riparian rights linked to rights to land adjacent to watercourses or above aquifers
- rights linked to prior appropriations (first use), and
- other traditional/ customary rights based upon local laws or norms

Wastewater and pollution issues

The decline in the quality of surface and groundwater resources from, principally, industrial discharges and poor sanitation, is a major concern throughout the South, especially where cities are growing rapidly. As well as being a finite resource, domestic water supplies and aquatic ecosystems are at increasing risk of pollution. This increases the scarcity of good quality water and harms habitats. One solution to the downstream pollution problems associated with wastewater disposal, especially in areas where water for irrigation is scarce, is to use wastewater for cultivation of crops. Wastewater use presents both opportunities to be productive and severe health risks for farmers using this resource (Box 13).

Box 13. Wastewater provides opportunities, and health risks

In the twin cities of Hubli-Dharwad in southern India approximately 60 million litres of wastewater is generated every day. This flows, untreated, from sewers and wastewater *nallahs* (open drains) into the natural watercourses that flow into the city's hinterland. In this semi-arid climate, where monsoon rains are erratic and unreliable, the wastewater is an extremely valuable resource for urban and peri-urban farmers and many abstract it from the *nallahs* and underground sewer pipes to irrigate their crops. This is considerably cheaper than constructing a borehole, which makes the practice more accessible to poorer farming families. The wastewater also provides an irrigation source during the dry season, when farmers can sell their produce for three to five times the monsoon season prices and the high nutrient load increases crop yields and also reduces the need for costly fertiliser inputs.

While this farming practice alleviates poverty for many urban and peri-urban farmers, it simultaneously places them, the consumers of their products and the environment at risk. The farmers have repeated close contact with the untreated wastewater, which is a major source of pathogens, and the high levels of anaemia found amongst farmers can be attributed to water-borne parasitic diseases and worm infestation. The wastewater also contains potentially injurious bio-medical waste (including disposable needles and syringes), which after tilling operations becomes half buried in the soils creating hazardous conditions in the fields. Unregulated and continuous irrigation with wastewater also leads to environmental problems such as salinisation, phytotoxicity (plant poisoning) and soil structure deterioration, which in India is commonly referred to as 'sewage sickness'.

Source: Bradford *et al.*, 2003

Section 3: Practical solutions: towards implementing IWRM

As we have seen, the inadequacies of past sectoral analyses and interventions have become increasingly apparent. This section of the paper now identifies some of the key 'solutions', especially those most relevant to the WATSAN sector, in order to put IWRM principles into practice for better water management. It starts with a brief discussion about two rather different approaches to applying IWRM. It then looks briefly at how integrating WATSAN into IWRM can provide a crucial entry point for improved participation in water resource development and management. This is followed by an exploration of the potential of taking a rights-based approach to both WATSAN and IWRM. The final two sections deal with two tools or frameworks for collecting and analysing information to make good water resource development decisions.

Being pragmatic: tailoring IWRM to meeting capacities and contexts

This section offers a framework for identifying what approach to IWRM will suit your work, along a spectrum from full to light.

The main management challenge is not a vision of integrated water resources management but a "pragmatic but principled" approach that respects principles of efficiency, equity and sustainability …,
(World Bank, 2003, p. vii)

There is increasingly consensus that true IWRM can take place only where the necessary platform has been created, usually at the basin level (see for example Jaspers, 2003). While this view has much to support it, we prefer to see this as being one end of a spectrum of application of IWRM. Insisting on the prior creation of a suitable enabling environment with a whole new tier of institutions, can become disempowering for individuals and projects trying to find a way to engage with IWRM in their own work at their own level. This is especially true in much of the South, where institutional capacity for IWRM is limited and will take years to develop. The best examples of 'implemented' IWRM are from 'northern' countries like the Netherlands and France, although a major OECD report found that even the most advanced countries are very far from full compliance with the Dublin Principles' (OECD, 2003). In addition the 'basin' view risks ignoring the many cases where that level is NOT where the most severe water resource problems are found. This exclusive emphasis on the basin scale tends to overlook the second Dublin principle of *management at the most appropriate level*. A good example of this is local-level competition for groundwater in hardrock areas where the resource is highly localised, as is the case in much of south-central India, and there are many situations where local communities effectively manage water based upon traditional and customary laws – arrangements that could be jeopardised by new basin institutions and water allocation mechanisms.

We therefore believe that basin-level IWRM by representative bodies in which all stakeholders are fully and fairly represented should be seen as the target, or endpoint, for achieving IWRM. This indeed is how it is increasingly being picked up in water legislation around the world, for example the European Framework Directive, which says that all European countries must have identified principle hydrological units (basins) and a competent 'authority' for each of those basins by 2003, with basin management plans in place by 2009 (EC, 2000). Nevertheless, we also believe that the strength of the IWRM paradigm, is that real and significant improvements in water management can be made at all levels – from the household to the international basin - **by individuals and institutions applying the Dublin principles in to the context of their own abilities and opportunities**.

To explore this further we create here an admittedly artificial difference between what we have previously called 'full' and 'light' IWRM (Moriarty et al., 2000). The latter is the application by individuals, and within sub-sectors, of the Dublin principles, while 'full IWRM' concerns wholly integrated activities based upon legislative and institutional reform and implementation of cross-sectoral activities at a catchment or basin scale.

Full IWRM

There are a growing number of examples from around the world of governments attempting to adopt IWRM through reforms to a) the policies and laws that define the basic character of water resources management and b) government and other institutions that put these policies and laws into practice. Many of the examples of 'full' IWRM are from the North but a good example from the South (while still a middle-income country with lots of capacity relative to other states) is South Africa. South Africa adopted a new National Water Act in 1998 based upon IWRM principles and is in the long-term process of establishing new institutions at the catchment level to manage water resources. The act included novel concepts aimed at protecting resources for basic domestic water supply and the environment. Around the same time the 1997 Water Services Act (WSA) provided a new framework for the provision of water and sanitation services to which people are entitled. These two acts thus provide a comprehensive framework covering both water management and WATSAN and setting out rights for everyone to both basic WATSAN services (at least 25 lpcd as an initial minimum), and to access water resources.

The key change introduced in the South African National Water Act is that custodianship of all surface and groundwater resources is vested in the state, with access and entitlement to water resources to be allocated to users according to licences agreed by new and representative Catchment Management Agencies. This provides the opportunity to allocate water according to the IWRM principles outlined earlier. **Equity** is a key issue in South Africa due to the historical legacy of racially skewed patterns of land ownership, which also mean that previously disadvantaged racial groups have less riparian access to water. A system of compulsory licensing (in catchments where all water resources are fully allocated) will enable more equitable access to water. More **efficient** use of water is being promoted especially through economic instruments i.e. charges for water. And a more **sustainable** water environment is ensured by recognising the environment, together with

domestic, as one of the two priority water users, and protecting the resources (including the needs for periodic flood flows and droughts) upon which aquatic environments including wetlands depend.

A key instrument for implementing such 'full' approaches to IWRM is an effective planning, monitoring and decision-making platform (the Catchment Management Agencies), with mechanisms to develop binding catchment management strategies and plans. In the South African case, these strategies are developed based upon a national water resources management strategy and 'local' consultation and decision-making. These plans focus mainly on 'water resources' issues but a high-level of importance is also given to WATSAN issues through links to other planning processes.

The implementation of these radical reforms is costly, time consuming and dependent on a high level of capacity and commitment to change. Only now, is South Africa about to announce the formation of the first Catchment Management Agency and effective operation of these new institutions across the country will surely take several more years yet (for further background on the South African water management situation see Pollard et al, 2002, and the website of the Department of Water Affairs and Forestry: http://www.dwaf.gov.sa).

Light IWRM

In situations where the kind of over-arching legal and institutional frameworks for river basin planning and allocation of water resources discussed earlier are either missing or ineffective, then 'light' IWRM based on the application of key principles to sub-sectoral activities (such as WATSAN) provides an alternative approach. 'Light' approaches aim to develop guidelines, based on the application of IWRM principles at all stages of the project cycle. The idea behind taking a 'light' approach, is that if all sub-sector actors try to apply good IWRM practice at their own level, in their own work, this will in turn lead to the emergence of better local level water resource management, and will be an important first step in the process of IWRM. It is however, important to realise, that 'light', sub-sector level IWRM is unlikely to be able to make all the hard decisions discussed in the section on 'full' IWRM.

An example of an environment where a light IWRM approach could be usefully applied is in India, where water resources management legislation and regulation of water users is weak. As we saw earlier, groundwater exploitation is a particularly serious problem. Arguably the greatest potential for better water management in these circumstances (although reforms to laws and policies must be pursued) is at the micro-watershed level where established and widely-replicated watershed development projects to promote better natural resources management attract huge government funding. But to date these projects have generally ignored groundwater related issues such as competition between farmers, or the impact of irrigated farming on village drinking water supplies (Kakade *et al*., 2002). The current focus of these projects is rather on encouraging water harvesting and recharge, i.e. to augment 'supply' (Box 14).

The challenge in these kinds of situation is to bring together diverse groups of stakeholders with often competing interests and persuade them of the benefits to all of entering into binding agreements with each other about the use of shared water resources. For an example of how this was done in one pilot project see Box 14.

Box 14. Applying IWRM principles locally

In the village of Battuvani Palli in Anantapur in southern India the community face severe fluoride problems (the 'improved' water supply contains more than 4 ppm fluoride, compared to the WHO permissible limit l of 1.5 ppm). As part of a pilot project to consider a wider-range of water-related options in watershed development projects (including WATSAN issues) the community identified a number of possible solutions. Some of these were later discarded during village-level discussions, such as developing a new domestic water source in a disputed area that borders the neighbouring village. The preferred solution was to develop a new source on temple land near the village tank, and to improve and protect this source by improving tank inflows by putting gates in upstream structures that currently impede runoff. The community are developing rules and resolutions for management of these gates, and a ban on any new agricultural wells near to the temple land.

The first borewell drilled on the temple land was dry. The second had a good yield but unfortunately it also had a high fluoride content. The decision of the village was then to develop resolutions and legally-binding agreements to connect the village water supply to an agricultural borewell (with good quality water) close to the tank, and for the current user of that source to be compensated with a new borewell. This solution still involves improving the tank inflows as these, particularly during low rainfall/runoff years, are needed to ensure sufficient groundwater recharge and protect the new domestic water supply.

Two useful examples of using guidelines based on the Dublin principles to implement 'light' IWRM at project or sub-sector scales are the working principles for IWRM in WATSAN developed by Visscher et al. (1999) and, with a broader focus, the 1998 EC guidelines for water management. Visscher et al. (1999) developed their principles from field research involving eight WATSAN and three IWRM projects in seven countries where the principles were used as part of a process of self assessment and improvement of IWRM practice (Box 15). The EC guidelines were developed by the European Commission for use in planning, implementing and assessing water projects in the south (primarily Africa) and the heart of the tool is a series of detailed checklists that, for each stage of the project cycle, ensure that best IWRM practice is adopted.

Box 15. Working principles for WATSAN and IWRM

1. Catchment management and source protection are essential to ensuring sustainability of supply
2. Water use efficiency and demand management must be addressed to minimise the need for new source development
3. Multiple uses of water should be acknowledged and encouraged
4. All stakeholders should be involved in decision making, but particular emphasis should be put on the active participation of users
5. Gender and equity issues must be addressed throughout the project cycle
6. Water provision should be priced so as to discourage wasteful use, while ensuring the right to access of a necessary minimum for all

Source: Visscher *et al*., 1999

WATSAN as an entry point to increased participation

One solution to the problem of weak participation in IWRM is to build upon the role of the WATSAN sector

Participation in decision making about water resource development and management is a key pillar of IWRM. Yet identifying how to involve people, at what levels, and for what decisions remains a huge challenge. Efforts to create a more representative model of water resource management that caters to the needs and rights of all users, such as the catchment scale approach adopted in South Africa, risk being seen as unjust if they fail to take into accounts the rights of large sections of the population. Yet it is clearly not possible to have direct participation of hundreds of thousands (or millions) of people in basin level decision making. Equally, involvement in decision making about resources risks being seen as irrelevant while many remain without access to the basic minimum of WATSAN services to meet their basic requirements.

WATSAN is the only 'water' issue that affects 100% of the population and treating it comprehensively in catchment management plans provides an opportunity to provide people with a reason and motivation to become involved in IWRM. Equally, the institutions responsible for WATSAN service delivery provide an obvious source of representation for the large numbers of small-scale water users who would otherwise play no part in large-scale resource management decision making. A good example is the Save the Sand project in Limpopo Province, South Africa (www.award.org.za) where development of community water supplies has been integrated with programmes focusing on catchment-scale water resources and environmental improvement. As part of this, local government (the responsible agent for WATSAN services) is being actively involved in establishing a catchment level management forum. As in this case, WATSAN activities may often be an appropriate entry point for area-based management initiatives, such as Integrated

Catchment Management (ICM) and watershed development projects, as it solves peoples most pressing water related needs, providing immediate benefits, but more importantly giving people a stake in water resource management related issues. In this case, integration of WATSAN may potentially be a means to an end, to address other pressing development or environmental issues. In India, the widely implemented watershed development approach has now also started to seriously consider WATSAN in some pilot projects (see earlier section on 'light' IWRM).

The critical point on participation is that the issue of service delivery and water resource management can not be de-linked. A 'right' to water without the infrastructure to bring it to where people need it, remains an abstract concept, and not one in which people will invest valuable time and other resources to 'manage'.

Rights-based approaches and WATSAN

Rights-based approaches can be a powerful advocacy tool for the role of WATSAN in IWRM.

Rights-based approaches provide another possible entry point or point of leverage for advocating and strengthening the role of the WATSAN community in IWRM (see WHO, 2003 for example). There is serious contemporary argument over whether a 'right to water' should be explicitly recognised in global human rights and/ or environmental legislation in addition to national laws such as in South Africa (Scanlon *et al*., 2003). A globally recognised right could strengthen the current efforts to improve water supplies, and to ensure a safe water environment – so is central to linkages explored in this paper between WATSAN and IWRM. A right would also provide a potential legal mechanism for redress to people who were deprived of water or became victims of water pollution, and to hold governments accountable for ensuring access to sufficient, good-quality water.

Scanlon et al. (2003) argue that a human right to water does exist, since water is essential to life, and 'the right to life' is widely recognised, but that this right has not been clearly defined and expressly recognised in international law. It remains merely an implicit component of other fundamental human rights, or is only expressly included in non-binding instruments. The World Summit on Sustainable Development together with the recent World Water Forums (in the Hague and Kyoto) failed to expressly recognise a fundamental human right to water. A proposed scope and definition of such a right is summarised in Box 16.

Box 16. Elements of a proposed right to water

Scanlon et al. (2003) propose that a right to water should include:

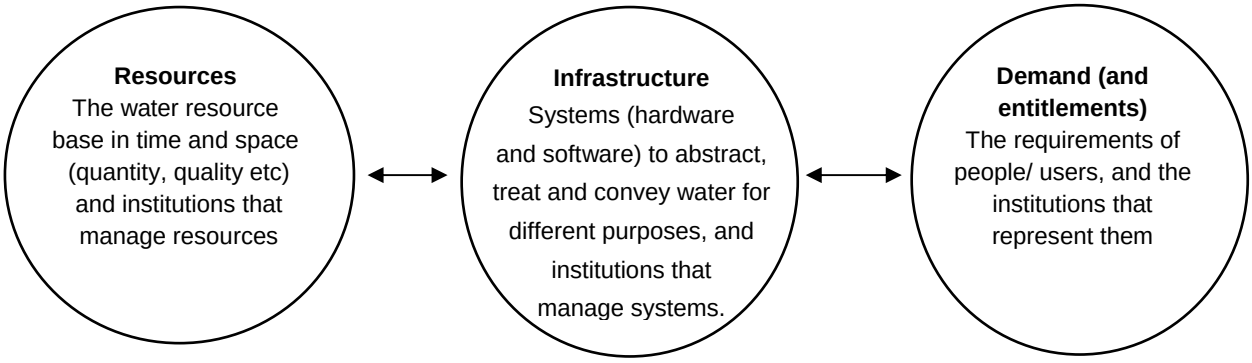
- accessibility - entailing three elements - water must be:
    - within safe physical reach for all,
    - affordable for all, and
    - accessible to all in law and in fact;
- adequate quality - water for personal or domestic use must be safe;
- quantity - water supply must be sufficient and continuous for personal and domestic uses

Resources, infrastructure, demand and entitlements (RIDe)

RIDe is a framework to examine water resources and WATSAN issues in an integrated way, and to help users understand and deal with the different scales and boundaries involved, it is an analytical framework that can help to guide the use of water audits and other light IWRM tools..

RIDe is a simple framework with generic application. It is based on the understanding that water resources are linked to people by supply (and disposal) infrastructure, and that each of these three system elements (resources, infrastructure, users) normally has its own set of institutions, boundaries and other characteristics (Figure 2).

Figure 2. The RIDe framework



- **Resources**
  Resources are the water resources needed to meet the demand of users. Abstraction and supply of this water depends upon the infrastructure that sits between water resources and users, so we can also talk of meeting the demand of water supply infrastructure. Because of conveyance losses and other losses such as illegal abstractions from pipelines or canals, the infrastructure demand may be quite different from the estimated demand of users. Resources can be assessed in a number of ways, but typically as some combination of availability (quantity and quality) in space and time. Given that access to, or use of, water resources may be regulated, assessment of water resources needs also to take account of water policy and the institutions that have responsibility for managing and regulating use of water resources. Other factors that need to considered when assessing resources include the potential impacts of short or long-term land use and/or climate change and the potential impacts on water quality of agricultural intensification, demographic change and industrialisation.
- **Infrastructure**
  Infrastructure is the means by which water is conveyed from the resource to users, and returned (often at lower quality) to the resource base[3]. It refers to both the physical infrastructure (hardware) and systems and institutions (software) necessary to make this happen, to maintain hardware and, where appropriate, to recover costs. Hardware may be handpumps on bore wells, or sophisticated reticulation systems with hundreds of kilometres of pipes and connections. Infrastructure can also be a system for trucking water from a treatment plant to users. Abstractions are the interface between resources and infrastructure and can always be represented as a point demand on a resource.
- **Demand (and entitlements)**
  Demand (and entitlements) capture the requirements for water by users at a certain time and place. Users can be considered as individuals, or groups. They may require water for irrigation, domestic, industrial or other uses. The environment is also a user, with specific needs of its own. Looking at user requirements will typically involve dealing with a range of (frequently fuzzy) figures. These may include: legally or policy-driven minimum entitlements to domestic drinking water; entitlements established by abstraction licences or water rights; minimum ecological flows; actual water use; unsatisfied demand; etc. Demand and entitlements are constrained by legal, economic, and social barriers. Demand is also hugely variable across users and time, and importantly, the water use of any single user is impacted by the demands of other users.

Moriarty et al. (2004) includes examples of application of the RIDe framework in India and South Africa.

[3] Return flows can include raw or treated waste water from domestic systems, irrigation return flows, drainage from mining operations etc.

Water audits

Water audits offer pragmatic approaches to assessment of water resources and demands.

Water audits, under various different names, are being promoted increasingly as a key step towards effective and sustainable IWRM. For example, the International Water Management Institute (IWMI) has taken a lead in advancing the case for water accounting and in developing relevant definitions and procedures (Molden, 1997; Molden et al, 2001; IWMI, 2002b). Similarly, the Global Water Partnership (GWP) has stressed the importance of water resource assessments as part of integrated water resource management (GWP, 2000). Although there are some subtle differences between the methodologies that are being promoted by different organisations, the overall objectives of the different approaches are similar (see Box 17).

The concept of water auditing is based on the argument that knowledge of the current status of water resources and trends in demand and use is a precondition for successful water management. Equally important, an understanding of factors affecting patterns of access and entitlement to water resources is fundamental in any projects that seek to improve and protect the livelihoods of poorer social groups. Effective water auditing implies a holistic view of the water resources situation and its interaction with societal use. This includes: 1) Addressing the occurrence of surface and ground water, in space and time, and, in particular, assessing levels of sustainable use and the frequency of extreme events such as droughts and floods; 2) Providing a tentative assessment of the trends in demand for different uses; 3) Identifying the main driving forces influencing demand and use (e.g. government policy, societal behaviour); 4) Assessing the functionality and effectiveness of institutions charged with developing and managing water resources; and, 5) Understanding factors that affect access and entitlements to water for both domestic and productive uses.

A risk of trying to apply IWRM tools such as water audits too rigorously is that there is never ‘enough’ information, and hence it is never possible to make a decision. It is important to approach all tools (water audits, light IWRM tools, etc.) in a pragmatic fashion based on ‘optimal ignorance’ and ‘maximum permissible uncertainty’. All of the questions posed in these tools can be answered in as much or little detail as the user requires. The skill is in knowing the minimum information needed to make a decision of adequate quality. Often this means gathering existing information (reports, etc.) rather than spending money on expensive new primary data collection.

Box 17. Why carry out a water audit?

Because a water audit can:

- Identify the current status of water resources at different scales and trends in demand and use;
- Provide information on access and entitlements to water and the trade-offs that have resulted or will result from different patterns of water use;
- Provide information on social and institutional factors affecting access to water and reliability of water supplies;
- Help identify the externalities which become apparent when the patterns of water use are considered at the macro temporal and spatial scales;
- Provide information that is required for assessing efficacy of existing water-related policies;
- Identify opportunities for saving or making more productive and/or equitable use of water;
- Identify the effectiveness of current drought and flood-coping strategies;
- Identify potential problems resulting from competing or multiple uses of water;
- Assess the accuracy of government statistics;
- Identify the extent to which decision making is based on hydrological myths or misconceptions.

Source: Rama Mohan Rao *et al*., 2003

For two good examples of how to implement water audits, see Batchelor *et al*. (2000), and Rama Mohan Rao *et al*. (2003).

Section 4: Summary and conclusions

- In the growing number of situations where water resource constraints are impacting severely upon the WATSAN sector, due to problems of accessing both sufficient quantity and adequate quality of water, IWRM offers a set of principles and tools to address problems in coordination with other water users. It provides a way of minimising costs, maximising benefits, avoiding (or minimising) conflicts and promoting sustainability.
- Building better links between WATSAN and IWRM dialogues is vital, both to ensure that the policy primacy given to water resources development and management for basic human needs is realised, and to strengthen grassroots participation in IWRM. Since all people are domestic water consumers, building on WATSAN service delivery is an obvious way to strengthen participation. Responding to wider 'domestic' needs such as small-scale productive uses of water is one concrete way to achieve this.
- Importantly, IWRM should be seen as a process based on a set of commonly agreed principles, and not as a single (and blunt) tool or a prescribed set of activities. The principles are applicable at all scales and to all activities to do with water' ranging from trans-boundary management issues to rooftop rainwater harvesting. All WATSAN professionals are able to take some steps to implement these principles in their work.
- It is recommended that the WATSAN community become more actively involved in IWRM in the cases where IWRM is being driven by other agencies, for example Irrigation Departments and Ministries of Water Resources and especially in countries where WATSAN is located in other line departments. To address these issues the WATSAN sector requires capacity building in IWRM so that it can engage fully in IWRM processes.
- The TOP identifies different situations where 'full' and 'light' approaches to IWRM are currently most applicable. 'Full' IWRM involves the complete updating of policy, legislation, institutions and capacities to manage water holistically at all levels from national down. But achieving 'full' IWRM requires major investments and other pre-conditions to be fulfilled. It needs a high level of technical capacity, well-functioning institutions and strong government generally. Many countries in the South will struggle to implement 'full' IWRM quickly but this does not mean that IWRM is irrelevant to the issues faced in those countries. 'Light' IWRM, the application of IWRM principles and best practice in sub-sector projects and programmes, and where possible, the promotion of bottom-up multiple stakeholder management and conflict resolution offers an alternative.
- A wide number of tools and approaches are available for applying IWRM in relation to WATSAN. These include checklists of modified principles for the sub-sector, conceptual tools like RIDe which is a useful way of bringing together other tools and approaches to focus on water resource issues affecting WATSAN, and water audits.

Section 5: TOP Resources

The following list of publications includes recommended sources of further information on the issues covered in this paper. A list of selected websites, other references to material cited in this paper, and contacts of the authors then follow.

TOP Books, manuals, articles and papers

Calder, I.R. 1999. *The blue revolution: land use and integrated water resources management*. Earthscan, London.
This accessible book focuses on interactions between land use and water, and is particularly valuable in explaining some of the myths around deforestation and impacts on water, showing us that these interactions within catchments are often more complex and context-specific than they may seem at first glance. Includes a list of IWRM web links.

EC. 1998. *Towards sustainable water resources management: a strategic approach*. European Commission, Brussels.
These guidelines aim to facilitate implementation of projects (with a focus on EC project approaches) that are consistent with integrated water resources management principles. They include a useful checklist-based approach to planning and assessing domestic water supply projects to ensure that they incorporate core IWRM principles.
[online] Available at
http://europa.eu.int/comm/development/body/publications/water/en/frontpage_en.htm

GWP. 2000. Integrated Water Resources Management. TAC Background Paper No. 4, GWP, Stockholm, Sweden This paper provides a good general overview to IWRM from its main proponents, the Global Water Partnership.
[online] Available at **www.gwpforum.org/gwp/library/Tacno4.pdf (accessed 14 July 2003)**

Moench, M., Caspari, E. and Dixit, A. (eds.). 2001. *Rethinking the Mosaic: Investigations into Local Water Management*, Nepal Water Conservation Foundation, Kathmandu, and the Institute for Social and Environmental Transition, Boulder, Colorado, USA
An excellent book that is not widely available but is well worth seeking out, on the vast problems faced in managing local water resources better, especially groundwater, in South Asia. Includes well-illustrated examples and case studies from Nepal and three different Indian states.

Moench, M., Dixit, A., Janakarajan, M., Rathore, S., Mudrakartha, S 2003. *The fluid mosaic, water governance in the context of variability, uncertainty and change,*

A follow up to the research reported in rethinking the mosaic (above). This book is available as a .pdf file http://web.idrc.ca/uploads/user-S/10492953541Fluid_Mosaic21.pdf (accessed 17 March 2004)

Moriarty, P., & Butterworth, J. 2003. The productive use of domestic water supplies: how water supplies can play a wider role in livelihood improvement and poverty reduction. IRC Thematic Overview Paper, Delft, Netherlands [online] Available at www.irc.nl/page.php/256 (accessed 5 August 2003)
This paper tackles some important issues relating to the household-level use of water supplies for activities like backyard irrigation, keeping livestock and micro-enterprises. This issue links IWRM and WATSAN, particularly because of the equity issues around access to water by the poor for productive uses, and the water resources management implications of greater household-level water use if these needs are to be met.

Peet, J. 2003. Priceless: a survey of water. *The Economist*, 19th July 2003. [online] Available (for US$2.95) at http://www.economist.com
The overview to this survey of the water sector provides an easy-to-read summary of contemporary water problems from a free market economics perspective.

Visscher, J.T., Bury, P., Gould, T., & Moriarty, P. 1999. *Integrated water resource management in water and sanitation projects: lessons from projects in Africa, Asia and South America,* Occasional Paper 31, IRC, Delft, Netherlands [online] Available at www.irc.nl/products/publications/online/op31e (accessed 14 July 2003)
This report is based on work and inputs from all involved in the project "Promising Approaches in Water Resources Management in the Drinking Water Supply and Sanitation Sector". The project reviewed experience of the application of the principles for good water resources management formulated at various international fora. The report includes a modified set of principles (based upon the Dublin principles) to apply IWRM in WATSAN projects.

World Health Organization. 2003. *The Right to Water*. WHO, Geneva.
www.who.int/water_sanitation_health/rightowater/en/ (accessed 17th March 2004)
This book explores a human rights-based approach to water. It outlines: the scope and content of the legal definition of the human right to water and its relationship to other civil, cultural, economic, political, and social rights; implications for the roles and responsibilities of various stakeholders including communities; and the contribution the right to water can make towards making drinking water a reality for all.

WMO. 1992. The *Dublin Statement and report of the conference*. International Conference on Water and the Environment (ICWE): Development issues for the 21st century, 26-31 January 1992, Geneva Switzerland, World Meteorological Organization, Hydrology and Water Resources Department [online] Available at www.wmo.ch/web/homs/documents/hwrpdocs.html (accessed 8 August 2003)
The statement from this conference includes the four guiding principles, upon which approaches to IWRM have been developed.

TOP Web sites

The TOP is deliberately targeted at the WATSAN sub-sector. Readers wanting more wide-ranging guidance on the development of IWRM plans covering all sub-sectors, can find it in the April 2004 publication by the Global Water Partnership (GWP) Guidance in Preparing a National Integrated Water Resources Management and Efficiency Plan: Advancing the WSSD Plan of Implementation
http://www.gwpforum.org/gwp/library/IWRMGuidance.pdf

Global Water Partnership (GWP)

www.gwpforum.org
The GWP is an international network created to foster IWRM. A useful resource is the IWRM toolbox containing a range of tools and case studies including water and sanitation (these include tools on organisation, efficiency in water use and regulatory instruments). The toolbox can however be hard to navigate and some tools and case studies are of limited depth. An online library contains key papers and other resources, and there are links to a wider range of related web sites.

World Bank
www.worldbank.org/water and www.worldbank.org/watsan
These are two sites that will be of interest to readers of this TOP at the World Bank. One focusing on water resources management, and one on water supply and sanitation.

UNESCO
http://www.unesco.org/water/
Water portal for the United Nations Educational Scientific and Cultural Organisation which includes the World Water Assessment Programme site.

IRC International Water and Sanitation Centre
www.irc.nl/themes/iwrm
IWRM is one of the core themes on which IRC focus from a WATSAN perspective. This focus area takes a livelihoods-based approach to improving the impact of WATSAN services on poverty, and ensuring access by the poor to an equitable share of water resources. This thematic site includes links to related IRC publications, such as *Water, Households and Rural Livelihoods*

www.nri.org/whirl
This site includes outputs from a research project that specifically focuses on the links between (rural) water supplies and water resources management. It includes case studies from South Africa and India.

International Water Management Institute

www.iwmi.org

This site may not be familiar to WATSAN professionals, but IWMI increasingly takes a broad look at water management in contrast to its earlier focus on irrigated agriculture. Projects in recent years have included research on the role of domestic water supplies in irrigation systems.

EU water initiative

http://europa.eu.int/comm/research/water-initiative/index_en.html

Web site of the scientific research dimension of the European Union's Water Initiative.

European commission water policy site

http://europa.eu.int/comm/environment/water/index.html

Entry page to all the key policy developed by the European Commission regarding regulation and management of water within the European Union, including the urban wastewater directive and water framework directive.

CAPNET

http://www.cap-net.org/

The Capacity Building Network for Integrated Water Resource Management aims to make available a wide range of information and guidelines about capacity building and IWRM in one place. A recently developed, short, IWRM tutorial is ideal for both those interested in learning more for themselves, and also for trainers.

Department of Water Affairs and Forestry, South Africa

http://www-dwaf.pwv.gov.za/

This site is a good example of how a first step in taking IWRM to scale is making everything accessible. The site includes copies of new laws, strategy documents and much more.

Right to water

http://www.righttowater.org.uk/code/homepage.asp

This site was developed by WaterAid and Rights and Humanity, in cooperation with FAN, to: provide information on relevant policy commitments and explain the concepts and theories of human rights law with respect to the right to water; disseminate General Comment No 15 adopted by the UN Committee on Economic, Social and Cultural Rights confirming and interpreting the right to water; and promote the use of the right to water as a tool for community empowerment, advocacy and legal redress.

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TOP Contacts

IRC International Water and Sanitation Centre

http://www.irc.nl

IRC is an independent, non-profit organisation supported by and linked with the Netherlands Government, the United Nations Development Programme, the United Nations Children's Fund, the World Health Organization, the World Bank and the Water Supply and Sanitation Collaborative Council. IRC facilitates the sharing, promotion and use of knowledge so that governments, professionals and organisations can better support poor men, women and children in developing countries to obtain water and sanitation services they will use and maintain (new mission statement 2002). Using its web site, documentation, publications, IRC advocates change and aims to improve the information and knowledge base of the sector.

IRC International Water and Sanitation Centre
Contact person: Patrick Moriarty
P.O. Box 2869
2601 CW Delft
The Netherlands
Tel: + 31 (0)15 21 929 62
Fax: + 31 (0)15 21 909 55
E-mail: moriarty@irc.nl

Patrick Moriarty

Patrick Moriarty heads IRC's Knowledge Development and Advocacy section. His background is in Civil Engineering and Water Resource Management, with an emphasis on interdisciplinary work on local level water resource management issues. He currently specialises in aspects relating the water and sanitation sector to wider water resource management including productive uses of water, the role of domestic water supplies in livelihoods, and institutional reform for improved local level water resource management.

NRI Natural Resources Institute

http://www.nri.org/water

NRI is a specialist institute of the University of Greenwich, providing research, consultancy, training and advisory services to underpin sustainable development in the south. The institute's work involves interdisciplinary and cross-sectoral approaches to improving the quality of life of the rural and urban poor. NRI subscribes to the Millennium Development Goals and works with donor organisations to achieve them.

NRI plays an important role in capacity building in the south through its activities, and partnerships encompassing the full range of stakeholders in international development from donors to community-based organizations. The institute is a member of the consortium to provide the 'OASIS' resource centre in water resources management to the

UK Department of International Development.

NRI Natural Resources Institute
Contact person: John Butterworth
University of Greenwich at Medway
Central Avenue
Chatham Maritime
Kent, ME4 4TB
United Kingdom
Tel: +44 (0)1634 880088
Fax: +44 (0)1634 880066/77
Email: j.a.butterworth@gre.ac.uk

John Butterworth
John Butterworth is a water management specialist at NRI. He has previously worked for the UK Department for International Development, the Centre for Ecology and Hydrology, and Scott Wilson Resource Consultants on a range of projects and programmes, principally in southern Africa, India and Bolivia. His current research interests include: water resources management issues in relation to WATSAN and how these are reflected in integrated water resources management (IWRM) processes; the impacts of water supplies on livelihoods, optimising the potential of multi-purpose water supplies to reduce poverty; and the processes of negotiation in peri-urban water conflicts.

About IRC

IRC facilitates the sharing, promotion and use of knowledge so that governments, professionals and organisations can better support poor men, women and children in developing countries to obtain water and sanitation services they will use and maintain. It does this by improving the information and knowledge base of the sector and by strengthening sector resource centres in the South.

As a gateway to quality information, the IRC maintains a Documentation Unit and a web site with a weekly news service, and produces publications in English, French, Spanish and Portuguese both in print and electronically. It also offers training and experience-based learning activities, advisory and evaluation services, applied research and learning projects in Asia, Africa and Latin America; and conducts advocacy activities for the sector as a whole. Topics include community management, gender and equity, institutional development, integrated water resources management, school sanitation, and hygiene promotion.

IRC staff work as facilitators in helping people make their own decisions; are equal partners with sector professionals from the South; stimulate dialogue among all parties to create trust and promote change; and create a learning environment to develop better alternatives.

IRC International Water and Sanitation Centre
P.O. Box 2869
2601 CW Delft
The Netherlands
Tel. +31 (0)15 219 29 39
Fax. +31 (0)15 219 09 55
E-mail: general@irc.nl
Internet http://www.irc.nl