Beyond the Rhetoric of Integrated Water Resources Management: The Case of the Tungabhadra Sub-basin

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Although Integrated Water Resources Management, as a concept, has gained currency in the global discourse on water, it does not seem to have made much headway in the Indian context. The paper examines the case of Tungabhadra sub-basin in south India and finds that it has made little progress in practical terms with regard to intra- and inter-sectoral allocation of water. The concept of IWRM in Tungabhadra is relatively new and water management has been performed mainly at the state level. As a result, Karnataka and Andhra Pradesh have their own set of different water governance regimes – water policies, laws and legislations, institutions and practices – with relatively little interaction between them.

The need to establish a balance between economic growth, social equity and protection of the environment in water management inspired the emergence of Integrated Water Resources Management (IWRM) which gained added momentum at the International Conference on Water and the Environment in Dublin in 1992.[1] IWRM seeks to apply a systems approach (Petit and Baron 2009), whereby the component parts of the system are understood in the context of interrelationship with each other, and also other systems, rather than in isolation. The concept of integration also includes the involvement of those affected by the water resource management decisions; hence the participation by stakeholders forms a central element of IWRM. During the last few decades, IWRM has been embraced as a popular and appealing ideology by international agencies, regional bodies and individual countries seeking to protect natural resources and alleviating poverty.[2]

In contrast to the sectoral approach which, to a large extent, still prevails in practice; the latter is oriented towards promoting coherence between policies, budgeting and resource allocation within a single sector, but it has been argued that this leads to fragmented and uncoordinated management of resources (Funke et al 2007). Proponents of IWRM argue that the philosophy and principles underlying IWRM offer a highly sustainable solution to the challenge of efficient and equitable allocation of water resources (Beukman 2002; Funke et al 2007) through an integrated and holistic approach to water management.

In this paper, we seek to assess the strengths and weaknesses of IWRM framework in the Tungabhadra sub-basin (TBSB) in south India. The TBSB is important as an interprovincial case in India where there exists a large number of such river basins. A major challenge facing TBSB is the protection and provision of sufficient quantity of water of high quality at affordable prices while still maintaining the various functional roles of ecosystems. The paper highlights the scientific challenge in terms of water use and allocation, water use related conflicts, pollution, land use changes and impacts of those changes on the river basin. Further, we assess in this paper, keeping in view the active involvement of stakeholders, policymakers, decision-makers and civil society the five selected components of IWRM principles through the project period which are specifically vital to the overall goal of sustainable development. These five components include: (1) protection of the catchment and the environment; (2) measures to ensure efficient and equitable use of water; (3) institutional support system and stakeholder involvement in water management; (4) capacity-building; and (5) transboundary issues. Furthermore,

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the paper evaluates what extent IWRM principles have been followed in the light of evolving strategies and methodologies being evolved for improved IWRM. A few main recommendations for the advancement on the path of IWRM are presented. The present paper is based on the European Commission-funded STRIVER project, "Strategy and Methodology for Improved IWRM – An Integrated Interdisciplinary Assessment in Four Twinning River Basins", 2006-2009"[3] (Stålnacke et al 2009).

1 Context of the Tungabhadra Sub-basin

Tungabhadra, shared by the two southern states of Karnataka and Andhra Pradesh, is a tributary of the larger river system Krishna. It originates in the Western Ghats with a catchment area of 71,417 km^2, of which 57,671 km^2 falls in Karnataka. Broadly, the biophysical context of the Tungabhadra basin can be distinguished into two parts, the upper and middle catchment, in Karnataka, and the lower portion of the catchment, in Andhra Pradesh. Prior to development of large dams and reservoirs, the downstream regions of Tunga and Bhadra (the two main tributaries of Tungabhadra) comprised mostly of arid and semi-arid regions. The average annual rainfall in the catchment is about 1,200 mm. According to the official statistics, farmland is the main land cover in the Karnataka state as of 2004-05, accounting for more than 55% of the geographical area. Others such as trees and groves, fallow land and cultivable waste add up to 12.5%. Forests and natural vegetation cover 16% of the area, while around 5% constitutes permanent pastures; 11% of the territory is not available for cultivation or for natural vegetation as it is dotted with decentralised, localised water harvesting systems called tanks. The middle and lower portions of the basin, in Andhra Pradesh are characterised by lower rainfall, drought conditions and a sharp delineation between rain-fed and canal-irrigated areas, served by the large dams built across Tungabhadra. The cropland accounts for 38% of the territory, with a higher proportion of fallow land (16%) and non-cultivable land (17%) due to harsher climatic conditions in the area. The forest or natural vegetation covers 23% of the territory.

The Tungabhadra reservoir has steadily lost its water storage capacity over the decades much to the concern of the Karnataka and Andhra Pradesh state governments,[4] while about 50 years ago, the capacity of the reservoir was 3,766.161 mm^3, now with accumulation of silt due to mining, dust, soil erosion, debris, the reservoir has lost its storage capacity by as much as 849.51 mm^3 of water. The amount of rainfall has also decreased in the past few years resulting in the reservoir not getting filled up. With the introduction of small-scale, individual and community lift irrigation schemes across the main river and its tributaries, the problem of water scarcity has got further accentuated. Conflicts between Karnataka and Andhra Pradesh are generally related to increasing the storage capacity and water use in the upstream part of the basin, while in lean years in terms of rainfall and river flow, little water reaches Andhra Pradesh. Access to water is a precondition in this farmland area with total of 80% of the population depending on agriculture for their livelihoods. Irrigation is provided through canal systems, while in rain-fed regions, farmers extract groundwater through bore wells. The major crops grown include paddy, jowar, sugar cane, cotton and finger millet. Although the area is ideal for semi-arid crops, the major crops grown are water-intensive crops like paddy and sugarcane. The spread of water-intensive crop cultivation throughout the basin has dramatically altered the water sharing balance, leading to major conflicts between demand for water for cash crop cultivation and staple food production on the one hand, and for irrigation, industrial and drinking water needs on the other. Hence, there is a significant difference between those farmers with access to land and irrigated water, and those without access, on the ground that those with an access to irrigation can obtain higher incomes. The presence of inequity is reflected in conflicts between head end/tail end, upstream/downstream users.

Encroachment of public lands for cultivation is commonly observed resulting in more land being brought under cultivation at the expense of tree cover. Forest degradation is resulting from rampant felling of trees and mining activity, along with the destruction of the habitat of highly threatened flora and fauna. This also causes flash floods and a high degree of pollution of rivers and the land surrounding the watercourse. These cascading ecological effects on the adjoining forests are spread over a larger area.

During the last two decades there has been an increasing trend in the number of small towns and industrial areas, a change, which has made the competing demands for water more complex. While increased industrialisation and growing urban areas have facilitated improved standards of living for some, the same activities have caused pollution and land degradation, thereby increasing the conflict levels among water users in the basin. There has been a mismatch between keeping pace with development activities on various fronts and providing sanitation and water supply infrastructure for resource-poor sections of the communities, both in small towns and rural areas, while population pressure and increased urbanisation have added to these problems. Thus, the socio-economic aspects are of very high relevance to water use management as the differences in standards of living between various social classes can influence water sharing. The TBSB is a politically sensitive basin as renegotiations between the riparian states concerning water allocation are presently going on.[5] Conflicts within and across sectors are common, apart from interstate disputes, due to the transboundary nature of the river.

2 IWRM Principles Chosen for Assessment

The four IWRM principles we have selected for assessment relate to different aspects of sustainable development – environmental, social, economic and institutional – as well as the factor that is particularly crucial in many countries of the south: implementation capacity. The first of these, "protection of the catchment and the environment", relates primarily to the environmental dimension, and requires an adequate understanding of terrestrial and aquatic ecosystems in the basin, as well as measurement and monitoring of components and characteristics of the environment affecting surface and groundwater quality and quantity. We assess the principle with a focus on two central issues, namely, pollution extent and pollution monitoring, and the conservation

of natural ecosystems. The emphasis on this principle is vital, since the well-being of humans depends not only on adequate supplies of good quality water, but also on the many forms of life to which water is home. The second principle, "measures to ensure efficient and equitable use of water", concerns the socio-economic dimension. It relates to the principle that water should be seen as an economic and social good (McNeill 1998). Past failure to recognise the economic value of water has led to wasteful and environmentally damaging uses of the resource.

Viewing water as a social good implies ensuring equity in allocation: that all users should have an access to adequate supply of clean water at affordable prices. Economic instruments are expected to play an important role in providing incentives to consumers for reaching the objectives of social equity, ecological sustainability, financial sustainability and economic efficiency (encouraging conservation of water and shifting from low to high value uses). Policy instruments such as measures for reuse, as well as pricing strategies, are assessed in this study. The third principle, "effective governance" related to the institutional dimension includes inter-sectoral integration and coordination – two crucial elements of IWRM. To secure the coordination of water management efforts across water related sectors as well as the entire water basins, both formal mechanisms and means of cooperation and informal exchange need to be established. Participation of stakeholders also forms part of this integration process, in order to create awareness, among policymakers and the general public of the importance of water use management. Governance in respect of IWRM is thus concerned with integration, coordination and stakeholder participation – that is the information and access to decision-making process.

The fourth topic addressed in this paper concerns capacity-building, which is not only important for effective implementation but also the way it relates to the third principle, as capacity-building might as well ensure effective public participation. For instruments of policy, the legal framework, financing systems and organisational frameworks to function effectively, the different actors involved need to possess not only sufficient information, but also expertise and incentives. To achieve this, capacity-building may be needed at many levels – water professionals in both public and private water organisations, local and central governments, water management organisations and regulatory organisations, as well as in civil society. Table 1 presents the main important IWRM issues in the Tungabhadra basin.

2.1 Protection of the Catchment and the Environment

Protection of the catchment and the environment requires integrated management, including the conservation and protection of aquatic and water-related biodiversity resources. Yet a river basin-oriented management plan is still missing, despite the fact that the National Water Policy 2002[6] and state policies (Karnataka State Water Policy 2002)[7] have included IWRM as one of the objectives. Based on the experience so far in the TBSB, river basin planning per se is not a practice. Pressures on land use can be linked to competing demands for water uses across sectors – their allocation and usage, new technologies, and institutional roles which influence land use significantly; and changes in land use/cover impact on environment and people's livelihoods.

Pollution Sources, Pollution Treatment and Monitoring: The principal sources of pollution in the Tungabhadra river basin are: (a) run-off from agricultural fields; (b) industrial effluents; (c) sewage from urban settlements; (d) mining activities; and (e) over-exploitation of groundwater.

Irrigated agricultural lands suffer from water-logging and salinity problems apart from the extensive use of fertilisers in crop production. In particular run-offs of phosphorus is a problem, leading to eutrophication of water bodies causing taste and odour in the water supplied to the public; and excess algae growth leads to deoxygenation of water and fish kills. In fact, across the TBSB, fertiliser consumption increased to 700 tonnes in 2001-05 from 510 tonnes in 1995-96 indicating nutrient loss in the soil systems. The problems related to irrigated agriculture are mainly seen in the downstream of the river basin (Koppal, Raichur and Bellary districts) due to intensive cultivation and excessive use of fertilisers. Bellary district accounts for 19,170 heactare (ha) affected by salinity. Water-logging is also observed high in Raichur, Bellary and Koppal. The excessive use of fertilisers has also affected groundwater quality with high nitrate concentrations in the groundwater. However, there have been no systematic studies carried out with respect to these non-point pollution sources.

Industries are another key source of pollution in Tungabhadra and there are about 77 large-scale industries (27 functioning and 50 under implementation). Major types of industries include iron and steel, paper and pulp, chemical and sugar. Major industries permitted to discharge treated effluents into the river as per the

Table 1: Some Important IWRM Issues in the TBSB

Institutional Issues	Stakeholder Issues	Environmental Issues
Lack of inter-sectoral and inter-departmental integration/coordination	Absence of a river basin organisation	Non-availability and access to reliable data at appropriate scales to the public
Absence of a nested institutional framework and a river basin organisation	Lack of institutional space for stakeholder participation in governance issues except for efforts towards PIM	No integrated management plans as per IWRM principles adopted although specified in the national and the state level water policies
Lack/poor coordination across stakeholders and institutions in spite of competing water demands and conflicts	In adequate attention given for training and capacity-building of stakeholders.	Lack of information on pollution and its impacts on ecology, environmental flows and health
Lack of basin-wise information and data base	Marginal stakeholders are neglected affecting livelihoods	Lack of a holistic approach in addressing pollution issues
Lack of proper allocation norms and procedures for different sectors and users	Poor interaction among stakeholders	Lack of integration across different scales (like no integration of groundwater and surface water, no integration of tanks and other larger surface water bodies)

Source: Modified from Nesheim et al (2008).

law are: Vishweshvaraiah Iron and Steel Industries, Harihara Polyfibres, Gwalior Rayon Silk Manufacturing Industry, two sugar and two distillery units. Following the public protests regarding the discharge of 6,000 tonnes of molasses into the river that led to fish kills on a large scale in 1984, the government instructed the distillery unit to discharge only treated effluents into the river. Apart from large-scale industrial units, there are 2,543 small-scale industrial units operating (as of 2006-07). The water consumption by industrial units in the Thungabhadra basin works out to 172.733 mm^3 per day (Tunga – 129.125 mm^3 and Bhadra – 43.608 mm^3) (Raju and Manasi 2006).

Also two major iron mining areas, i e, Kudremukh and Hospet, exist in the river basin; however, there are no proper mining standards followed in iron ore extraction. The mining of iron ore at Kudremukh and Manganese in Sandur has seriously affected the stability of the catchments in the form of soil erosion and silting of several small reservoirs, traditional tanks and the Tungabhadra reservoir, and thus conflicting with irrigation needs of the region. Further, these mining activities have adversely affected water tables besides causing iron contamination of water (Patel 2005). Air pollution due to the transportation of iron ore in open trucks and truck movements cause dust nuisance. Agriculture in the region is also affected because of mining-induced dust pollution as the dust gets deposited on crops. Polluted water affects river basin ecosystems while downstream fish kill which is frequent, affects the livelihood of fishing families. The number of fish species has reduced over the years with several local varieties of fish becoming extinct. According to fishermen, around 50% of the local breeds have disappeared or decreased over time (Sekhar et al 2008). During the field study of the STRIVER project, many fishermen expressed concern over increased use of chemical fertilisers in agriculture; 47% of the fishermen believed polluted water killed fish stock (ibid).

With regard to urban settlements, a majority of the "urban local bodies" and town municipalities do not have underground drainage system and treatment facilities in place for collecting and treating the municipal sewage (Fazi et al 2009), and as a result, the sewage directly enters the river system or agricultural fields. In the rest of these settlements such treatment is only partial, affecting around 75 villages. Domestic and industrial pollution, combined with deforestation, use of pesticides and fertilisers have affected water quality extensively making it unfit for consumption (Raju and Manasi 2006).

The Karnataka and Andhra Pradesh state pollution control boards being responsible for monitoring water quality, have initiated action plans to prevent river pollution in four towns under the National River Action Plan, introduced by the National River Conservation Directorate of the Ministry of Environment and Forests, Government of India. There are various standards set up for allowable concentrations of and parameters related to pollution, of which the most relevant is the drinking water standards specified by IS 10500: 1991. In spite of these regulatory measures, implementation has not been very effective in controlling pollution levels. The role of the state pollution control boards is limited to sample testing, warning polluters and issuing showcause notices indicating institutional constraints. What is important to keep in view, however, is that such issues cannot be the responsibility of the regulatory authorities alone as a strong political will is also required to bring in the required changes.

Protection of the Natural Ecosystem: Mining and rampant clearing of forests have led to degradation, flash floods and destruction of the habitat complex of highly threatened flora and fauna. These cascading ecological effects are spread over a larger area forming a basis for social conflicts among different water user groups in the TBSB. Various initiatives taken by institutions, both government and private, at different levels for the protection of riparian zones and the surrounding ecosystems include national parks and protected sites, but there are no specific plans in place. The Karnataka Biodiversity Board was set up in 2003 with the main objective of ensuring conservation, sustainable utilisation and equitable benefit-sharing. It has set up over 575 biodiversity management committees. The fisheries department and the local religious institutions are protecting endangered fish species in four locations where fishing is prohibited. However, the presence of these natural parks and protected areas to preserve the ecosystem and biodiversity are not sufficient as they represent only a small fraction of the river basin, though elsewhere, the resources are managed in a non-sustainable way (Raju and Manasi 2006).

Reforestation and afforestation programmes, carried out by the Karnataka Forest Department are the main drivers behind an increase in the forest cover in the TBSB. According to the government statistics, over 7.5 million acacia, eucalyptus and other exotic trees have been planted, not realising that such monoculture forests are not an ideal substitute for the diverse and unique natural habitats. The trends in land use/land cover have been different in Andhra Pradesh, where the most noticeable trend relates to a reduction of waste lands and pastures in favour of fallow and crop lands. A significant reduction in the area under permanent pastures (-44%) has also been observed. However, although forest and land laws specify that deforestation is not permitted, it still continues due to poor monitoring and implementation of the laws by government agencies.

2.2 Ensuring Efficient and Equitable Use of Water

Viewing and managing water both as an economic and social good is an ideal way of ensuring efficient and equitable use, and of encouraging conservation and protection of water resources. The original concept of "water as an economic good" has been expanded to include water as a "social good", an aspect which reflects the importance of social justice in terms of ensuring access to an adequate supply of clean water at affordable prices for all sections of the society. Failure, on the other hand, to recognise the economic value of water can lead to wasteful and environmentally damaging uses of the resource. In general, economic instruments encompass the use of prices and other market-based measures as a means of providing incentives to all water users for using water carefully, efficiently and safely. The double benefit of considering water resources as having both an economic and a social value is only partly recognised in the basin.

Efficient Use of Water: Financing for water supply with no proper institutional mechanisms in place to determine charges is a major concern. The institutions unable to cope with low investments and low collection of finances for operations and maintenance have led to the dysfunctional structures. Pricing of water exists for industries, drinking water and irrigation; however, water still remains a largely underpriced commodity, a matter of serious concern. Furthermore, a rather inefficient practice exists, where users pay irregularly at different time intervals or on a flat rate basis as a consequence of the lack of metering system at many locations. Water users are encouraged by the local corporations to make a shift from paying on a flat rate basis to paying on volumetric basis, but much needs to be done in this regard, as this system is dependent upon a metering system which is only installed in a few sectors and locations. Besides the ones discussed, other reasons for inefficiency in water management relate to unaccounted water usage. There are huge losses caused by leaking pipes or misuse of water that ranges between 40% and 50% of the total losses in the urban areas.

However, some initiatives taken to improve water efficiency exist and efforts could be scaled up by adopting best practices prevalent elsewhere. For instance, the World Bank initiated project for providing 24/7 water supply, which is part of a public-private partnership at selected cities in Karnataka (Hubli, Dharwad, Belgaum and Gulbarga) that includes social mobilisation with pro-poor approaches, has been considered a successful initiative.[8] Water usage is metered with people paying for water. Jala Samvardhana Yojana Sangha, a separate department, established for rejuvenating tanks is another such initiative for deriving economic, social and environmental benefits (Raju et al 2003; Paranjape et al 2008).

Equitable Use of Water: Local political priorities and social equity aspects are implemented in terms of different price levels imposed on certain user categories and according to the average welfare level of the society. The policies extend irrigation a special consideration and required fees are more or less "political" fees to sustain the agricultural sector. However, both water quantity and quality issues lead to conflicts regarding inter-sector allocation. Categories exempted from paying are slums and also villages served with public taps (unless it is a piped water supply connected to households). However, provision of drinking water to townships is not planned well, particularly the small towns have serious access and equity-related issues, more so during the summer. Poor services have forced urban households to go in for private bore wells (Raju and Manasi 2006). Individual rights with respect to both surface water and groundwater are recognised only indirectly through land rights creating an access problem for the landless. The fact of de facto control by better-endowed persons only accentuates rural inequality and water use inefficiency. The control of groundwater at the ground is governed by a system of rights determined by farm size, the depth and number of wells, pumping capacity and economic power (Saleth 2005).

In the TBSB, there has been no water regulatory authority, no clear or enforceable water entitlements and water rights for the Tungabhadra basin as a whole. Performance of water sharing in the agricultural sector is poor with increasing head and tail ender conflicts. The main reasons for these problems lie in the violation of the cropping pattern wherein farmers at the head reach grow water demanding crops and illegal diverting of water to fields falling outside the command area. Participatory Irrigation Management (PIM) has not been effective since effective participation is limited to a small elite group while other members remain outside the process.

Another equity problem in the basin is related to the fisheries that support livelihoods of a large population, directly and indirectly. It was observed that this sector largely supports fisherfolk at a subsistence level only. Various departments including fisheries, irrigation and agriculture do not share a common management strategy for addressing the problems and needs of respective sectors and also there is a lack of integration between relevant policies, departments (state and local agencies). A number of policies and institutions already exist in TBSB that facilitate the entry of fisheries but these need to be implemented properly.

2.3 Institutional Analysis and Stakeholder Involvement

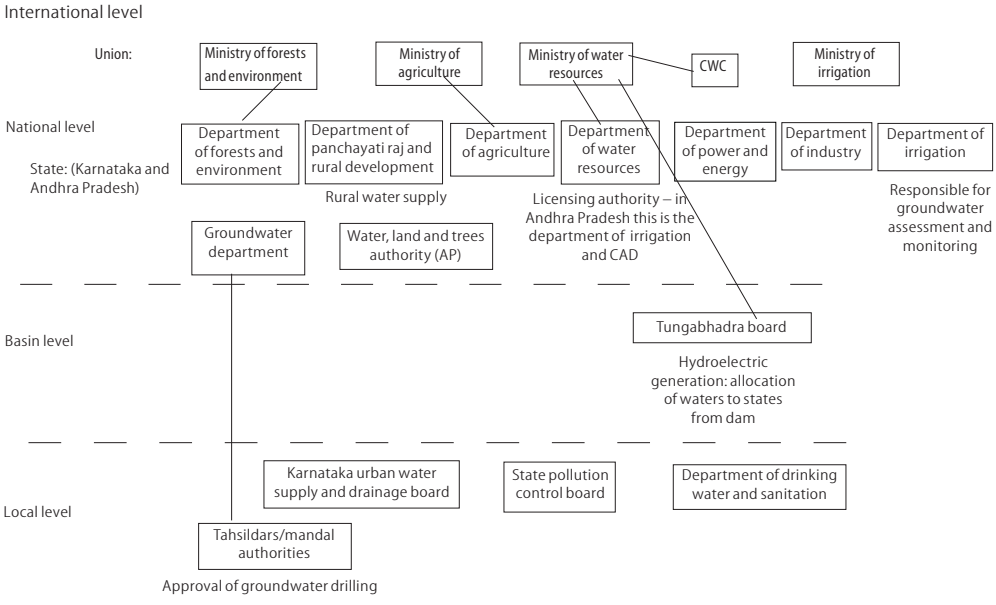
Institutional Structure: Water is not a subject coming under the jurisdiction of the union government[9] but a state subject. The two riparian states in the TBSB, namely, Karnataka and Andhra Pradesh, have their own set of water governance regimes – water policies, laws and legislations, institutions and practices.

The Karnataka State Pollution Control Board constituted by the Government of Karnataka in 1974 is the enforcing authority of the various environmental legislations including control of water pollution, with other regional pollution control boards located at five districts in the TBSB. Water abstraction in Karnataka and Andhra Pradesh is controlled by a department of water resources in each state. These departments are technically responsible for water resources and their allocation across different uses and users including storage and conveyance of water, pricing, maintenance, etc. State pollution control boards are responsible for the periodic collection, testing and monitoring of water quality and imposing penalties for non-compliance with pollution control standards. Besides, different state agencies look after drinking water, sanitation, smaller water bodies, groundwater, etc.

The interstate Tungabhadra Board with members from both states controls water allocation and power output from the Tungabhadra dam to the basin states. The board is not a licensing body, but set up for implementing the provisions of the Krishna Water Dispute Tribunal award. The Bachawat Award agreed upon in the mid-1990s stipulates a fixed scheme of water allocation in the Krishna basin, including the TBSB. The interstate TB Board is in charge of the operation of the Tungabhadra reservoir and the award, since it lapsed, has been under revision since 2005 and the newly constituted tribunal gave the new award in January 2011. The riparian states are planning to appeal against the award as it has not satisfied them.

Institutional integration demands a close coordination between institutions whose decisions affect the quantity, quality or flow of water resources and dependent ecosystems; while in Karnataka and Andhra Pradesh, the pollution control is separated institutionally from abstraction management in the TBSB. Traditionally, water

Figure 1: An Organogram Providing the Institutional Structure for Water Management in the Tungabhadra Basin



Source: Campbell et al (2008).

management has remained quite sectoral in character with major emphasis on the creation of infrastructure (dams, irrigation channels) and other technological interventions. There is a multiplicity of state institutions and departments looking after various aspects of water management with very little interaction or coordination between them. The departments exhibit conflicting interests often making it difficult to integrate their interests with a common goal. In fact, there is also a reluctance observed with respect to sharing of data by the two riparian states and even different departments within a state with each department functioning in isolation often leading to turf wars between different departments (Figure 1). Furthermore, water management is not dealt with at the basin level, but at the state level with limited interaction with the users. This raises concerns that the environmental component required of IWRM is perhaps less effectively managed in the Tungabhadra context rather than the way it should be.

The non-state agents or stakeholders also comprise a very wide variety of interest groups. First among these are the direct users of water (farmers, fisherfolk, rural artisans for livelihoods, rural and urban population for drinking and domestic use), then there are the organisations and interest groups like water users' associations (WUAs), academic and research institutions engaged in the study of water and water use, and lastly the different types of civil society organisations concerned with water issues and water rights. The direct users are mostly unorganised with no access to data and are not involved in the production of knowledge and formulation of policies. There is no legal and institutional space for stakeholder participation in these spheres, though sometimes consultative meetings are held with NGOs and representatives of various interest groups and organisations.

Access to Information for Stakeholders: Stakeholders do not have an access to information and data, and stakeholder consultation and dialogue is not mandatory, except for Environmental Impact Assessments (EIAs). In relation to EIA, the department concerned is supposed to organise public hearings where any stakeholder can put forward his/her viewpoint. The experience so far, however, is that EIAs are not organised properly in an impartial manner. As the Tungabhadra does not have a basin-wide plan, interest groups have to rely on the detailed project reports which mainly outline project design, cost estimates, planned water use and designated cropping pattern. These documents do not usually contain information on governance issues. With respect to information on water resources assessment, some information is available with separate agencies, but for the moment, it is not integrated and is not available to the public. Records are also maintained on general aspects but often people do not get access to data and information. Often there is no consistency in data sets maintained by different agencies, causing difficulties in negotiations concerning interstate rivers, as states use different data sets. A commonly agreed data set is an important condition for stakeholder involvement (Joy et al 2008). The Karnataka State Water Policy, 2002, states that a data information centre is to be set up and data protocols developed to remedy the situation, but though eight years have lapsed, this is yet to be set up. However, the situation has slightly improved with the Right to Information Act now in place in most of the states.

Decision-making Process: There is a trend observed towards increasing involvement of users and stakeholders, though there is no stakeholder involvement in the formal sense. Currently, water rights are governed by the National Water Policy of 2002 and Irrigation Acts of the respective states. However, there are no clear legal frameworks specifying water rights even though various acts have provisions for defining such rights. The National Water Policy provides for the establishment of river basin organisations, and for the development and management of river basins or sub-basins, wherever necessary. Water policy documents and legislations, such as the Participatory Irrigation Management Act and The National Water Policy, 2002 contain clauses to support stakeholder participation like, "planning", "participatory approach to water resources management". Similarly, in the Karnataka State Water Policy, 2002, the word stakeholder appears in the context of participatory irrigation management and WUAs for managing irrigation water. Although the National Water Policy, 2002, the Karnataka State Water Policy and the Andhra Pradesh State Water Policy 2009, do mention stakeholder involvement, not much has been done on the ground. In Andhra Pradesh, the state government has passed a legislative act: Andhra Pradesh

Farmers' Management of Irrigation Systems Act, 1997, making participatory management of irrigation water as part of the official policy of the government. It also established more than 10,000 WUAs immediately after this Act was passed. Although no such Act exists in Karnataka, the state did encourage setting up of WUAs on a voluntary basis and made suitable amendments to the Karnataka Irrigation Act, 1965, 2000 and 2002 (Nesheim et al 2008)

Through WUAs, watershed development committees (WDCs) and self-help groups (SHGs), there exist some opportunities for civil society participation with financial support provided for their attendance at meetings. However, these organisations play a limited role, as the officers of the respective departments take most of the decisions, often with political considerations in mind. Issues related to a particular WUA are discussed at a local level, while issues of policy, etc, are discussed at the state capital with very little participation by the stakeholders or users. The public are not involved in problem identification even though public hearings are compulsory for clearing projects with respect to environmental and displacement-related issues; however, the experience of many stakeholders and civil society organisations has not been encouraging because these public hearings are often manipulated to suit the interests of the proponents of the project and the hearings often do not make any significant impact on the final outcome. The only area where involvement of the stakeholders is sought is the area of irrigation water management as part of the sectoral reforms; thus almost all documents mention user participation in irrigation water management. In the drinking water sector, efforts are being made to involve users in the management schemes, both in the urban and rural areas. Micro-watershed development is a major programme in the rural areas, funded by the ministry of rural development, the ministry of agriculture and multilateral and bilateral agencies. Based on guidelines for community participation, institutions such as village councils, WDCs and SHGs that include the poor and women are involved in programme implementation. Thus, in all the three major sectors – irrigation, drinking water and watershed development efforts are being made to promote people's participation.

Despite this, decision-making process, in general, is dominated by public officials particularly engineers; and multistakeholder fora are not in place. Various studies indicate that there is a large gap between the official/policy rhetoric and practice. There is no consultation amongst different stakeholders on the question of inter-sectoral water allocation; instead, allocation decisions are taken by the government departments.

2.4 Capacity-Building

According to the Global Water Partnership (2000), capacity-building is a process of development and strengthening of the abilities of people, institutions and societies to perform functions, solve problems, and set and achieve objectives. In this way, a community equips itself to undertake the necessary functions of governance and service provision in a sustainable fashion. Capacity-building can take place at different levels like the central political institutions, central government institutions and departments, NGOs and civil society, small businesses, etc.

The Karnataka State Water Policy, 2002, does not say anything about improving IWRM competency. But it does mention that efforts should be made to develop integrated management of water. Although capacity-building is officially one of the main focus areas and part of many water policies and strategies in Tungabhadra basin, it is evident these official statements are seldom operationalised to any larger degree, especially in respect of the entire spectra of IWRM themes. Some examples of transparency (e g, access to information), public participation and information campaign brochures for the public, training programmes for certain sectoral groups are, however, noted and usually initiated by NGOs. The relevance of this issue will vary according to the general state of knowledge/education and the extent to which the people interact with public officials.

The PIM process in Karnataka also includes training of farmers and managers which is essential for its implementation. In most water projects, capacity-building is included as part of the project activity, though it is not specifically mentioned as an exercise for improving the IWRM competence. A certain amount of budget is allocated to training, but this is not adequate to meet the entire training needs in the basin. During farmers' interviews in Tungabhadra, a majority of farmers expressed their desire to attend more training programmes in water management. The Water and Land Management Institute located in Hubli-Dharwad has been assigned a specific role in educating and training water managers, farmers and policymakers so as to get used to their new roles in decentralised water management. In the states of Karnataka and Andhra Pradesh the government has made training of farmers with WUAs as a part of the new PIM programme. Each year, policymakers, water managers and farmers undergo training programmes designed to improve their skills in water management. The farmers' survey in Tungabhadra also reveal that, nearly half of the farmers interviewed had gone through some kind of training programme by the training institutions, or attended workshops or farmers meetings related to water management. In addition, WUAs have regular meetings organised where farmers participate and discuss water management problems. Officials from the water resources department also participate in the meetings organised at different levels. In addition, there are also public hearings organised by NGOs, and organisations like Jalaspandana, though only very few in numbers, train farmers and managers on water-related issues.

2.5 Transboundary Issues

The management of transboundary waters has always been a complex issue involving national legislations and international conventions in complex institutional contexts. While such agreements take place at the regional level, the actual policy changes, reforms and implementation of reforms need to happen at the national level. As mentioned earlier, the main issues at stake in the TBSB relates to the utilisation of water for agricultural, urban and industrial uses, hydroelectric projects and pollution from industries, urban areas and agriculture. The Krishna Water Disputes Tribunal, from the early 1970s, has remained the main agreement for the use of water, and the so-called Tungabhadra

Board oversees the distribution of the Tungabhadra reservoir water to the two states of Karnataka and Andhra Pradesh. Allocation of water for hydropower generation is also part of the agreement. The board has on its staff engineers from both states. On 4 August 2004, a new Krishna Water Dispute Tribunal was constituted which gave its verdict in January 2011. The main problem facing the implementation of these agreements is that there are no practical procedural arrangements for solving controversies. In the case of short-term and crisis management response to issues there are many players, including local authorities and user organisations. Each state has an obligation to notify and consult each other of planned measures as per the Inter-State Water Dispute Act. However, while project proposals are accompanied by technical data, there is a Central Water Commission which checks procedures. Data exchange between states is not fully implemented, nor are there any statutory requirements for states to exchange data and information in general.

3 Conclusions and Recommendations

The implementation of IWRM is at a fairly early stage and the many layers of integration required are not happening in practice. Although it is mentioned in the National Water Policy, 2002 that the principles of sustainable management be reflected through integrated water resources management, they are not translated into practice. Strategies and basin plans are generally either recent innovations, or currently under preparation. Policies are in part existent, but are rudimentary. Among the existing ones, regulatory mechanisms for implementing and enforcing them are limited or non-existent. In TBSB, management is based on administrative and not on hydrological boundaries resulting in various allocation, distribution and usage problems within and across sectors. There are several organisations across the basin working on various aspects; however, there is no single authority as river basin organisation in the TBSB. The low quality and the lack of an integrated approach related to environmental and social impacts regarding surface and groundwater management, upstream and downstream water-related interests have severe negative impacts on the water resources as a whole. Moreover, water management is usually in the hands of top-down institutions, the legitimacy and effectiveness of which have increasingly been questioned. The absence of a legal framework that can put IWRM in place means that the dominant water users are more likely to be able to control and skew water resource management in their favour, a situation of high relevance as the differences in the standards of living are so tremendous. There is an increased competition for access to water, but different uses of water are not always mutually exclusive.

Pollution from both point and non-point sources is apparent throughout the basin with impacts on land use changes, but there are few efforts observed to control these sources. With respect to towns, efforts towards establishing sewage treatment plants are unlikely to be implemented in the short-term due to financial constraints, poor governance and lack of political will, though sewage treatment plants are part of the plan. Pollution from agriculture practices in certain stretches, especially in the lower segment of the basin, is strong and remains uncontrolled causing excess algae growth and deoxygenation of water. Industrial pollution persists and is impacting human livelihoods and the environment with poor regulatory mechanisms to curtail its effects. It is important to adopt IWRM for improved water management – to prevent further degradation of water and promote sustainable water use. Several initiatives such as watershed development, renovation and regeneration of tanks and PIM across sectors should be integrated with adequate institutional and policy support.

3.1 Environmental and Socio-economic Management

- An estimation of the effects of the future land use changes on the water cycle should be part of any integrated water resources management.
- There is a need for working towards establishing a thorough data base for effective decision-making.
- Institutions, policies and programmes must be integrated to ensure that local fishermen and fishing societies benefit and get access to the fisheries.

3.2 Inter-Sectoral Integration

- An overall plan is required to envisage how the transformation can be achieved with a basin-wise management approach. Inefficient governance aggravates increased competition for the finite resource.
- Water management within the agricultural sector needs to address a wide range of issues, management of supplies and demands, increasing efficiency of water use, balancing competing demands, sustainability of agro-ecosystems and other water-dependent ecosystems.
- There is a need for integrating water management with the needs of other sectors such as fisheries. This will not only ensure the livelihoods of marginal communities such as small-scale fishers, but also increase water use efficiency in the basin.

3.3 Implementation and Stakeholder Participation

For IWRM to function properly, adequate institutional and policy support is important, in order to clarify entitlement and responsibilities, roles, allocations, legal status across users and water providers for sustainable use.

- There is a need for incorporating a participatory approach including governmental agencies and also the users and other stakeholders, in a decisive manner, in various aspects of planning, design, development and management of water resources schemes.
- WUAs and the local bodies such as municipalities and gram panchayats should be involved in the operation, maintenance and management of water infrastructures/facilities at appropriate levels, with a view to eventually transferring the management of such facilities to the user groups/local bodies.
- Capacity-building is needed for user organisations through training and technical support and communities and stakeholder participation must be empowered and public awareness created. Necessary legal and institutional changes should be made at various levels for this purpose so as to duly ensure an appropriate role for women.

NOTES

1 International Conference on Water and Environment, 1992 http://www.cawater-info.net/library/eng/l/dublin.pdf

2 Traces of IWRM can be found in the literature as early as the 1960s and 1970s (García 2008), and in the documents of the Mar del Plata conference, 1977.

3 More information on the IWRM assessment can be found in the STRIVER report (2008) which is based on individual basin reports prepared by researchers from the respective river basins.

4 Annual Report, Tungabhadra Board 2006-07, available at http://mowr.gov. in/index3.asp? subs ublinkid=780&langid=1&sslid=799)

5 In fact, the Krishna Water Disputes Tribunal has given its verdict in January 2011 and it has created fresh tensions amongst the three riparian states ,especially on the issue of raising the storage levels in Almatti dam on the main Krishna river .

6 National Water Policy, 2002, Government of India, available at http://mowr.gov. in/ writereaddata/linkimages/nwp20025617515534.pdf

7 Karnataka State Water Policy, 2002, Government of Karnataka, available at http://www.ielrc.org/content/e0205.pdf

8 Herald D 11/2/2008 24/7 Water project gets thumbs up. Indica Environmental Portal, Centre for Science and Environment. Published Second of February 2008. http://www.indiaenvironmentportal.org.in/node/44881? quicktabs_2 = 0. And also see World Bank 2010: Delivering 24/7 water service to three cities in Karnataka. http://www.worldbank.org.in/WBSITE/EXTERNAL/COUNTRIES/SOUTHASIAEXT/ INDIAEXTN/0,,contentMDK:22700251~menuPK:295589~pagePK: 2865066~piPK: 2865079~theSitePK: 295584,00.html accessed on December 2010.

9 In the case of interstate rivers, the union government can intervene if there is a dispute amongst the riparian states over allocation and utilisation of waters of a particular river and appoint a tribunal which would decide on the allocations. This power it has under the Interstate Water Disputes Act of 1956.

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