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Institutions for Integrated Water-Resources Management in River Basins

A Synthesis of IWMI Research

Mathew Kurian

International Water Management Institute

FUTURE HARVEST
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Summary

In recent years Integrated Water Resources Management (IWRM) has gained widespread support in policy circles. Integrated management poses the challenges of coordinating the use of both natural systems (characterized by multiple land uses) and social systems (characterized by competing end uses of natural resources). Viewed in the context of geohydrological boundaries shaped by river basins, IWRM can place enormous demands on institutions to synchronize the use of natural and social systems to produce optimum results in the form of lower levels of resource conflicts, reduced deforestation and soil erosion in catchment areas and improved livelihoods of the rural populations. Research by the International Water Management Institute (IWMI) on IWRM institutions carried out in a diversity of biophysical and socioeconomic settings around the world contributes towards understanding the complexities of natural-resource use in river basins. Water-accounting indicators allow us to visualize seasonal water balance in a river basin while appreciating the historical process of economic development that allows for a particular trajectory of institutional evolution. More recently, IWMI research has highlighted some equity concerns inherent in discussions surrounding Participatory Irrigation Management (PIM). In this context studies have highlighted the influence of poverty, market development and community organizations for enhanced provision of irrigation services.

1. Introduction

In recent years, river basin planning or watershed management approaches have gained prominence in the agriculture sector. Using geohydrological boundaries as a guide, policy planners and students of rural development have attempted to understand the underlying causes of land and water degradation (Brooks et al. 1992). IWRM has been proposed as a strategy to increase water productivity and improve water quality in a river-basin context. Some have even argued that developing countries may benefit by drawing lessons from the IWRM experience in developed countries (Turral 1998). Meanwhile, others have been less optimistic of IWRM by pointing out that the approach neglects the political dimension through reification of "natural boundaries" and the emphasis on "neutral" planning and participation (Wester and Warner 2002, 65).

We refer to IWRM by adapting Jonch-Clausen and Fugl's conceptualization of people-nature interactions in a river-basin context. "In the natural system integration typically involves land and water; surface water and groundwater, water quantity and quality. However, equally important, but less traditional, is the integration of the human system involving; upstream-downstream water-related interests and head end-tail end equity issues. Institutional issues are central to IWRM considering that sustainability in all its forms, organizational and environmental, has to be ensured in the context of multiple land uses, multiple uses of water, over-time changes in State policies, spatial differences in implementation of NRM strategies by external agents (State parastatals/NGOs) and variations in beneficiary participation in water allocation, conflict resolution, ISF collection and routine maintenance" (Barker and Molle 2002, 19).

Evolution of institutions in the context of IWRM is influenced by the stage of water-resources development. Institutions evolve depending on the nature of water-resources issues that a river basin faces and, in that sense, they are not static systems but are adaptive and dynamic. IWRM's potential contribution to increasing water productivity lies in its ability to approach natural-resources-management problems in an integrated fashion. For instance, Barker and Molle (2002) identify four issues that IWRM attempts to address as an approach to natural-resources management: inter-sectoral competition for water, integration of water management at farm, system and basin levels, coordination of surface water and groundwater use and linkages between water use and environmental needs.

This paper is an attempt to synthesize findings of IWMI's research on IWRM institutions. This paper focuses primarily on the findings of a five-country study on IWRM carried out by IWMI in Asia. Wherever pertinent, reference is also made to findings of IWMI studies undertaken elsewhere. The five countries covered by the study included China, Indonesia, Nepal, the Philippines and Sri Lanka. This paper contrasts evidence from four basins at the initial stages of introducing IWRM frameworks (East Rapti, Nepal; Singkarak Ombilin, Indonesia; Fuyang, China; Deduru Oya, Sri Lanka and Upper Pampanga; the Philippines) with three other basins that have made considerable progress with adopting IWRM (Murray-Darling, Australia; Brantas, Indonesia and Omono-gawa, Japan). In the process the paper highlights issues like basin size, water-resources development, multiple uses of water and land, influence of poverty and market development, coordination failures and conflicts over natural-resources use.

Section 2 of this paper provides a description of the embedded nature of river-basin institutions and makes a distinction between the use of terms “organizations” and “institutions.” Section 3 describes the methodology adopted by the study. Section 4 discusses the main findings of the study. Section 5 outlines the main conclusions of the synthesis of IWRM institutions in a river-basin context.

2. Institutions for IWRM in River Basins

New Institutional Economics (NIE) makes a distinction between *institutions* and *organizations*. Institutions are defined as the "rules of the game" or regularized patterns of behavior (North 1990). Institutions are made up of formal laws, informal constraints and enforcement characteristics of formal and informal rules. Ostrom (1990) points out that institutions exist at multiple levels: constitutional choice rules, collective choice rules and operational rules. On the other hand, organizations provide a structure to human interaction. They include youth groups, water user organizations and trade unions. Organizations represent groups of individuals bound by some common purpose to achieve objectives. However, what organizations come into existence and how they evolve are fundamentally influenced by the institutional framework.

In the case of IWRM, the institutional framework may be broadly defined with reference to three functions: constitutional function, organizational function and operational function. The constitutional function basically relates to establishing laws and framing policies. The organizational function concerns river-basin management: allocating river flows, assimilative capacity, infrastructural construction (dams or canals), ecosystem maintenance, etc. Finally, the operational function includes water uses and water users: designing rules for allocation among different uses or users, collection of irrigation service fees (ISF) or undertaking routine maintenance (Hofwegen 2001, 140).

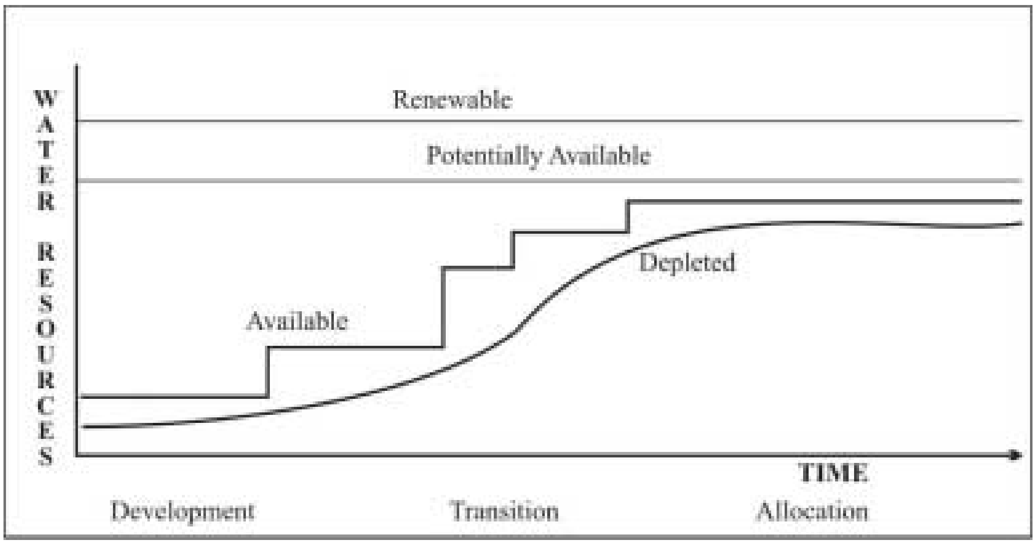
A river basin may be understood as a "geohydrological unit that drains at a common point" (Brooks et al. 1992). From the perspective of planning development of natural resources, river-basin development essentially envisages an integrated view of different land uses: forestry, agriculture and grazing pastures. When used as a planning framework a river basin highlights the externality aspects of natural-resources use. Conventionally, it is argued that upstream resource use—either through changes in land use from forests to agriculture or excessive fodder or fuelwood collection—can have deleterious effects on human and animal populations downstream. These effects may be reflected in problems like soil erosion, silting of irrigation infrastructure or flooding of agricultural fields (Dixon 1997).

In this context, it is important to point out that, in addition to multiple uses, a forest may offer multiple products like fuelwood, fodder grass, timber and water that, in turn, have multiple end uses. For instance, fodder grass may be used as cattle feed, thatch or for house construction. Similarly, water from forest areas may be used as drinking water for livestock or, if harvested, for irrigation. In response to economic growth competition for water among competing uses may be exacerbated among industrial, household, municipal or environmental sectors (Turral 1998). Some scholars point out that the economic value of a river basin may be increased when institutional mechanisms evolve to synchronize inter-linkages of different land uses and inter-sectoral competition for water (Gottfried 1992).

Water resources institutions evolve based on the stage of socioeconomic development in a basin. "As population and economic activity increase in river basins, they evolve from an 'open' to a 'closed' state. In the open state there is sufficient water to meet demands even in the dry season, and primary water supplies of freshwater flow out of the basin into salt sinks. But as growth continues in the basin, water supplies progressively tighten. Most of the primary supply is diverted to meet demands, and an increasingly large percentage of the drainage water is captured and reused. A progressively smaller quantity of water, of diminishing quality, flows into the sinks in the dry season. Eventually, either all of the water is evaporated upstream leaving no dry-season flow into sinks, or the flow is so polluted that the water is not usable. At this point, the river basin becomes completely closed" (Seckler 1996).

Water resources development in a river basin closely follows the stage of socioeconomic development. In response to growing demands for water exerted by economic development, infrastructure is built, cost-recovery mechanisms are established and greater emphasis is placed on efficient use of water resources. Sakthivadivel and Molden (2002) characterize the stages of river-basin development into three stages: development, transition and allocation stages. In the development stage, institutions are heavily concerned with building infrastructure whereas in the utilization stage managing supply of water to various uses is a primary concern (figure 1).

Figure 1. Phases of river basin development.



IWMI's Gediz river-basin study in Turkey pointed to heightened competition for water between urban and industrial uses. "There have been a few cases of conflicts over access to water between municipalities and small-scale irrigation systems. In the case of the Gurle, near Manisa, potential conflict was averted with the municipality paying for lining of canals and then allocating the saved volume for urban water supply" (IWMI 2000, 15-16). In response to greater demands for limited water resources, water conservation and saving, improved management of water deliveries, and maintenance and management of already built structures become important objectives. Efforts are placed on increasing the productivity or value of every drop of water. An important means of accomplishing this is to reallocate water from lower- to higher-value uses. Institutional issues during the allocation stage include allocation, conflict resolution, full-cost pricing and environmental preservation (Wester et al. 2000).

3. Methodology

This cross-country synthesis of river-basin management primarily focuses on a five-country study carried out by IWMI with support of the ADB (table 1). The seven-country study collected information on a host of variables that may be categorized under five broad headings: physical system, water accounting, socioeconomic situation, organizational structure and institutional constraints. For purposes of the synthesis of river-basin studies we outlined the key institutional attributes of the eight basins under the five broad headings described above. We also described institutional attributes of three advanced basins—Murray- Darling, Brantas and Omono-gawa. We then identified case-specific institutional strategies adopted and discussed them in the context of degree of water-resources development in each of the eight river basins.

From a methodological standpoint the IWMI study imposes certain limitations on institutional analysis of river-basin management. We identify four limitations with a view to clarifying what this paper does not attempt to achieve.

- The main focus of the study is on the institutional arrangements, and it stops short of proceeding to assess the effectiveness of management functions (Bandaragoda 2002, 14).
- The study notwithstanding its stated objective of examining IWRM in a river-basin context focuses on institutional structures for irrigation management (see Bandaragoda 2002, 14). As a result, the scope for analysis of factors like environmental linkages between water and multiple land uses, like forests, is limited.
- The study did not address issues such as secular changes in the prices of agricultural crops, availability of nonfarm employment or access to alternative irrigation like groundwater. Instead, the focus seems to be singularly on irrigation management. As a result, the study does not acknowledge the nested nature of IWRM institutions and the potential or limitations they impose on addressing issues of water scarcity.
- This study does not address issues of river-basin management. As a consequence, livelihood outcomes of a particular institutional configuration are overlooked, a serious omission in institutional analysis of IWRM.

Table 1. Salient characteristics of the basins selected for the study.

Basin characteristics	Fuyang	Singkarak-Ombilin subbasin	East Rapti	Upper Pampanga	Deduru Oya
Country	Peoples Republic of China	Indonesia	Nepal	Philippines	Sri Lanka
Catchment area (km^2)	22,814	2,210	3,135	3,742	2,623
Location: Province	Hebei	West Sumatra	Inapplicable	Nueva Ecija	North-Western
District/s	Shijuazhang, Handan, Xingtai	Solok, Tanah Datar and Sawah Lunto Sijunjung	Makawanpur Chitwan	Bulacan Pampanga	Kurunegala Puttalam
No. of urban centers	345	4	3	3	2
No. of villages	9,092	400	Not known	325	2,663
Average annual rainfall:					
Normal year	570 mm	2,025 mm	3,576 mm	1,994 mm	1,494 mm
Dry year	200–300 mm	1,163 mm	1,778 mm	1,100 mm	1,152 mm
Per capita water availability (m^3)	868	Na	9,034	3,630	1,046
Facilities /Assets No. of irrigation schemes (surface irrigation)	3 major and a number of small storage systems	None (Ombilin subbasin)	214	37	3,4 and 3,596, major medium and minor systems respectively
No. of lift irrigation units (groundwater and river lift)	185,527 (groundwater)	14 pumps and 184 waterwheels (Ombilin subbasin)	Shallow tube Wells = 589; Dug wells = 1,809; Treadle pumps = 47	9	Shallow wells = 2,450
Domestic water supply schemes	41	2 (Ombilin subbasin)	45	17	37 pipe-borne 1,199 tube wells

Table 1.Continued.

Basin Characteristics	Fuyang	Singkarak-Ombilin subbasin	East Rapti	Upper Pampanga	Deduru Oya
No. of hydropower plants	14	1 Hydroelectric, 4 micro hydroelectric power plants	None	2	None
Land use and agriculture cultivated area (ha)	1,239,000	130,291	85,578	254,490	201,585
Grassland/Savannah (ha)	--	11,234	10,500	4,117	55
Forest land (ha)	119,000	45,498	120,959	37,425	8,035
Area covered with water bodies (ha)	223,800	1,956	17,275	9,600	1,410
Surface irrigated area (ha)	150,000	32,180	32,388	98,222	47,150
Groundwater irrigated Area (ha)	875,000	--	7,743	25,135	1,515
Main irrigated crops	Wheat, corn, cotton, rapeseed	Rice, mungbean, groundnut	Rice, maize, wheat	Rice, vegetables, corn, onion	Rice, chili, pulses, vegetables
Annual cropping intensity (%)	155	Rice irrigation = 200 Other field crops = 38	274 = irrigation from main river 257 = irrigation from tributary	156 = surface irrigation 200 = ground water irrigation	133-165 = surface irrigation 180-300 = groundwater irrigation
Irrigated area	45	14.8	12.8	33	18.5

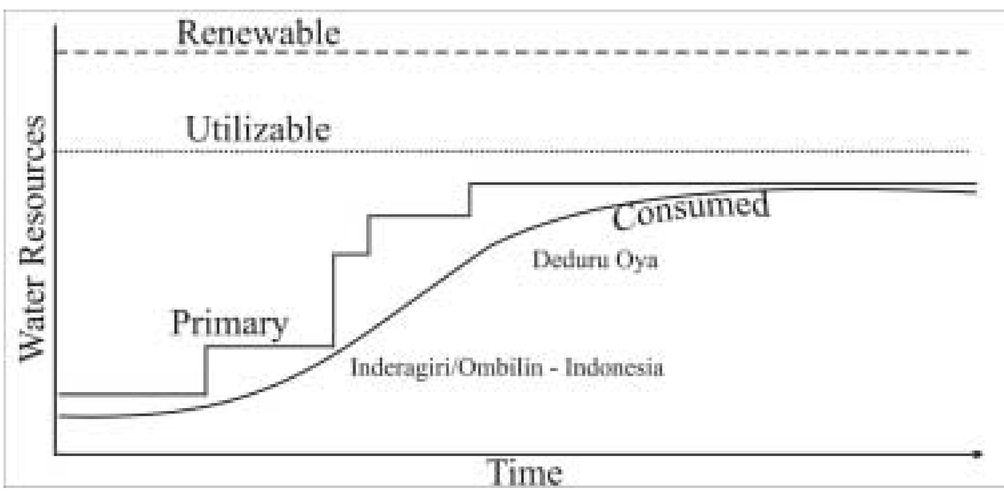
4. Discussion of Study Findings

The Physical Context: Basin Size and Degree of Water-Resources Development

Most of the basins covered by this study are large. The Murray-Darling basin covers 1 million km^2, the Fuyang basin 22,814 km^2, Brantas 11,800 km^2 and Omono-gawa 4,952 km^2. The area of the Deduru Oya basin in Sri Lanka is large enough to contain seven major reservoirs and 1,560 tanks. In the case of Indonesia, seven major rivers discharge into the Ombilin basin. Basins with higher levels of water-resources development are characterized by the presence of physical infrastructure like reservoirs, tanks and diversion dams (figure 2).

This is especially the case with basins like Deduru Oya (Sri Lanka) and Upper Pampanga basin (the Philippines). The higher dispersion of physical infrastructure has led to qualitatively different problems like salinity and sedimentation. This fact is borne out by findings from the Murray-Darling and Omono-gawa basins, which have problems of salinity and flooding, respectively. In contrast, in basins like Ombilin and East Rapti with relatively lower levels of water-resources development one finds the absence of problems like salinity, flooding and sedimentation. This may be because of the lower dispersion of water-control infrastructure. Interestingly, the Philippines case suggests that problems like sedimentation are bound to be exacerbated, especially in the context of the State's abrogation of its responsibility to invest in O&M, which has led to a visible deterioration in the infrastructure.

Figure 2. Hypothetical development stages of a river basin.



Multiple Uses of Land and Water

The East Rapti study highlights the fact that there are differences in elevation between the origin of the river and the point where it moves out of the basin. An array of land uses are also found at different elevations in the basin. For instance, at higher elevations forests predominate while agriculture is carried out in lowland areas and in some portions of upland areas. In the Omono-gawa basin, forests and homesteads cover 85 percent of the basin area. Temperature and soil types also differ depending on elevation and land use in different portions of the basin. The Philippine study also suggests that water quality may differ at different elevations of a basin. For instance, water in the upper Pampanga river is fit for municipal use while water in the lower reaches of the basin is fit primarily for irrigation.

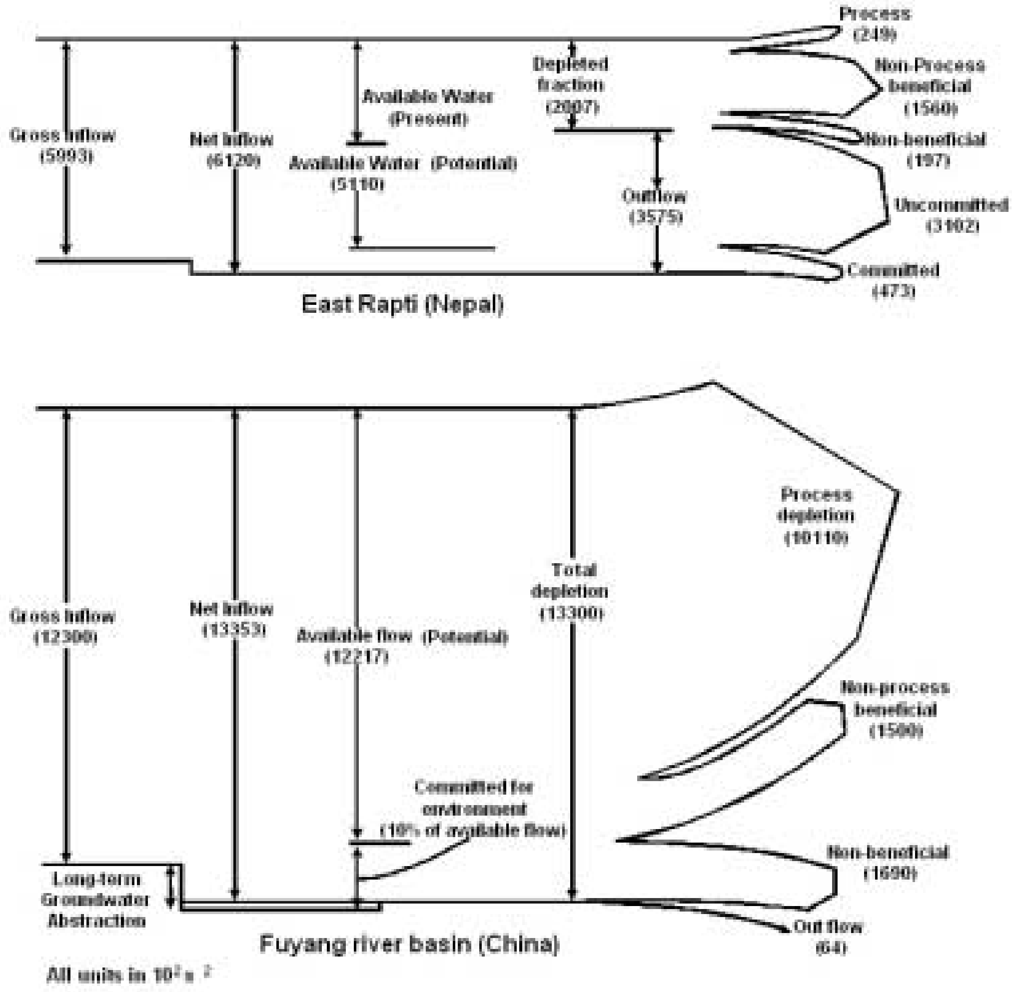
Water-accounting studies undertaken in the river basins highlight the importance of multiple uses of water and the competition that exists for the resource (figure 3). All the five river basins except for the Fuyang basin in China are open basins, implying that potential exists for improving the efficiency of water use. The China study indicates that current outflow from the basin is insufficient to maintain sustainable water use in downstream areas where the competition for agricultural water use will increase from domestic and industrial sectors. The

Philippine study indicates that pressure on water resources may be alleviated due to higher levels of rainfall that lead to replenishment of underground aquifers. Further, the presence of water-storage infrastructure like reservoirs may facilitate regulation of water flow to meet downstream demand. On the other hand, the Indonesia study of the Ombilin river basin suggests that factors like industrialization and growth of markets for agricultural crops are bound to place pressure on water resources through adoption of newer technologies like lift irrigation, tube wells and thermal power generation. By contrast, the East Rapti basin in Nepal that is relatively isolated from markets and has lower levels of agricultural productivity and industrialization is characterized by lower levels of groundwater exploitation and inter-sectoral competition for water (Ghimire et al. 2000).

Poverty, Locality and Market Development: Implications for IWRM

In all five river basins that were studied the incidence of poverty was high (table 2). In Deduru Oya, for instance 60 percent of the population was below the poverty line. In the Ombilin river basin one-fourth of households were classified as poor. It is interesting to note that the incidence of poverty increased in parts of the river basin that were in the dry zone or during the dry season. For example, in the Deduru Oya basin “poverty is more pronounced in the midstream area of the basin situated in the drier region, where acute scarcity of water has resulted in lower agricultural productivity and cropping intensity” (Samad 2001, 46). Further, in the case of the East Rapti river basin it was noted that rural livelihood approaches differed depending on where populations were located. For instance, agriculture was mainly rain-fed in the hills while irrigation facilities were more forthcoming in the plains. It was also observed that populations in the plains attempted to diversify their income-earning sources by adopting animal husbandry (Samad 2001, 48).

Figure 3. Water-accounting finger diagrams.



In situations with high incidence of poverty equity issues assume importance. In particular ensuring access to irrigation (by addressing upstream-downstream or head-end-tail-end considerations) and access to markets for agricultural crops and nonfarm labor can go a long way in alleviating the impacts of rural poverty. In the case of the Fuyang river basin, for instance, we note that access to markets for wheat, maize and cotton sustained interest in agriculture. In the case of Deduru Oya, we observe that paddy, coconut and rubber sustained interest in agricultural operations (table 3). Robust market prices for agricultural crops may even persuade farmers to expand private groundwater exploitation with adverse implications for collective management of water resources (Samad 2001,53). On the other hand, evidence from the Omono-gawa river basin suggests that in the face of expanding markets for nonfarm jobs, people may rely less on agriculture and thereby reduce pressure on water resources within a basin.

Table 2. Extent of poverty in selected river basins.

Characteristics	Fuyang (China)	Inderagiri-Ombilin (Indonesia)	Upper Pampanga (Philippines)	East Rapti (Nepal)	Deduru Oya (Sri Lanka)
Total population (million)	15.6	0.7	1.5	0.6	1
Population density (persons/km^2)	686	396	450	212	378
No. of urban centers	4	4	3	3	22
No. of villages	9.1	400	325	na	2,807
Urban population (%)	28	na	36	25	10
Rural population (%)	72	na	64	75	90
Per capita availability of water (m^3)	868	na	3,630	9,034	1,046
Urban households having piped water (%)	97	na	27	36	21
Rural households having piped water (%)	77	na	na	na	09
Proportion employed in agriculture (%)	67	59	61	79	40
Proportion of population living below national poverty line (%)	6	na	39	42	60

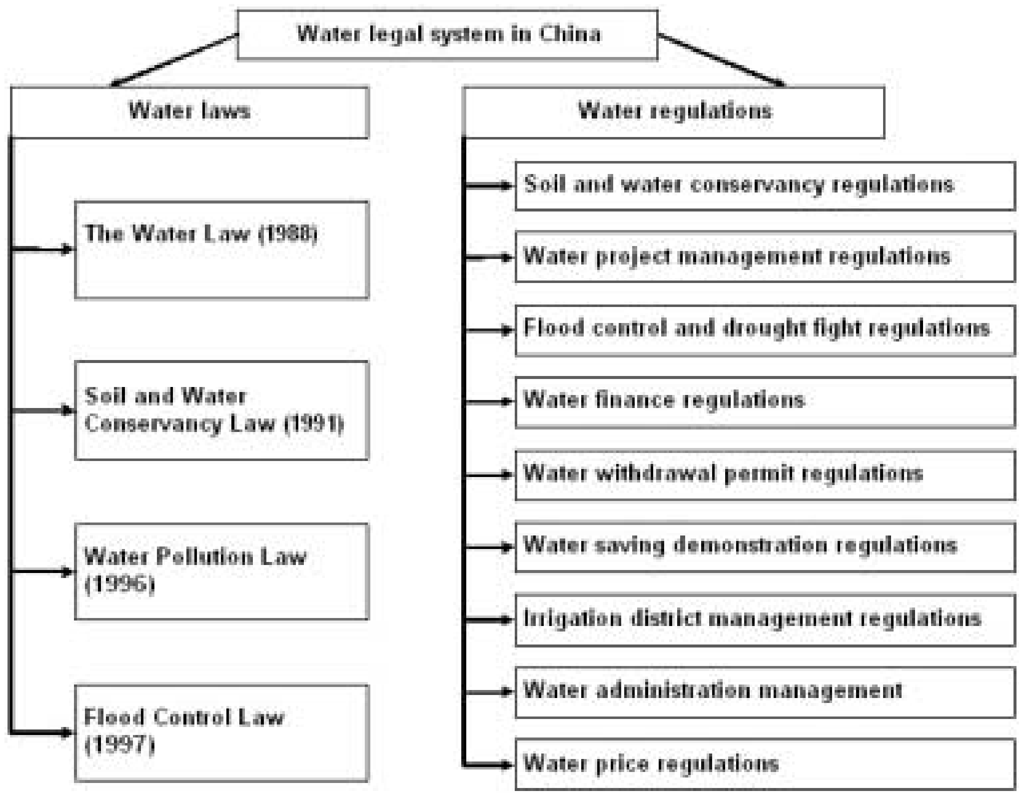
Organizations for River-Basin Management

Management of water resources in the five basins is vested with the Ministry of Water Resources. The organizational structure is hierarchical with the Ministry of Water Resources being the apex body with water resources bureaus and water management stations forming lower parts of the structure as in China (figures 4A & 4B). In the case of Sri Lanka, there are approximately 20 agencies involved in water-resources management that include the Mahaweli Authority, National Environmental Authority and Agrarian Service Boards. In most cases, these agencies are responsible for fund management and delineation of water rights. For example, in the case of the Fuyang basin in China, the Ministry of Water Resources is responsible for allocation of funds for maintenance. In the case of the Ombilin river basin, Indonesia, the government is involved in allocating water rights. Here water rights are given in the form of use rights and allocated in the form of licensing. No license fee is required for noncommercial uses of water.

Table 3. The agriculture sector in the five river basins.

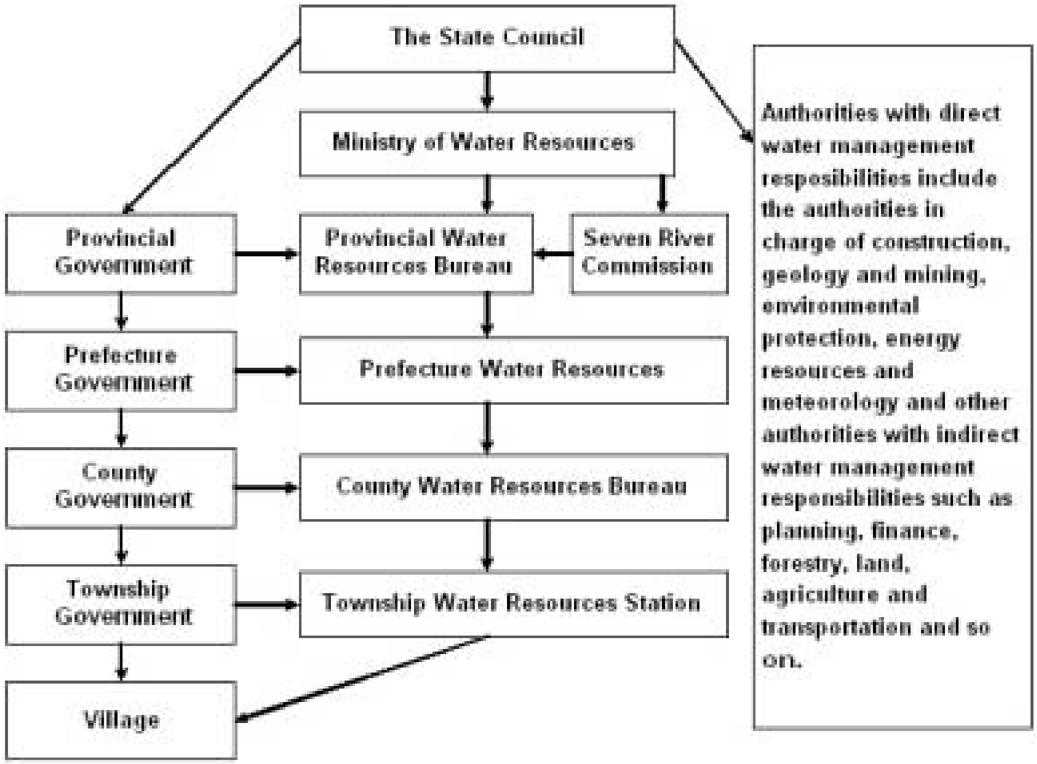
Characteristics	Fuyang (China)	Ombilin (Indonesia)	East Rapti (Nepal)	Upper Pampanga (Philippines)	Deduru Oya (Sri Lanka)
No. of surface irrigation schemes	3	184	214	37	3,600
No. of groundwater irrigation schemes	185,527	14	2,445	9	2,453
Surface irrigated area (ha)	875,000	na	7,743	25,135	1,515
Main irrigated crops	Wheat, corn, cotton, rapeseed	Rice, mungbean, groundnut	Rice, maize, wheat	Rice, vegetables, corn, onion	Rice, chili, vegetables
Annual cropping intensity (%)	155	na	na	156 Surface water 200 Groundwater	133-165 Surface water 180-300 Groundwater
Comparison of current crop yields with those 10 years ago	Decline in yield of all major crops	No change in yield of major crops	No change in yield of major crops	Drop in rice yield by 14-21%	Current yield of major crops is higher
Reasons for yield change	Water scarcity, institutional constraints;	Not relevant	Not relevant	Climatic changes; pest outbreak	Improved agronomy; better prices
Responsibility for O&M of groundwater schemes	individual farmer		WUAs		Smaller schemes WUAs; larger schemes, WUAs and Irrigation Agency
Responsibility for O&M of surface irrigation scheme	Local government authority	River lift schemes; waterwheels; individual owners	WUAs and Irrigation Agency	Irrigation Associations (WUAs) and Irrigation Agency	Individual owners
Multiple use of irrigation water	Yes	Yes	Yes	Yes	Yes

Figure 4A. Legal systems for water in China.



In recent years, there has been a trend towards devolving management of water resources to farmer's organizations. For instance, in the case of Sri Lanka, the 1987 Constitutional Amendment introduced decentralization of power and authority from central to provisional councils. In the case of Philippines, management of the National Irrigation System is the joint responsibility of both the National Irrigation Authority (State parastatal) and Irrigators' Associations (farmer's organizations). The study of the Omono-gawa river basin in Japan indicates that more often than not such trends towards devolving responsibility to farmer's organizations are rooted in a history of conflict. This was the case in Japan where conflicts among farmers over water use led to the formulation of the Land Improvement Act in 1949. However, it must be remembered that the Act alone was not responsible for conflict resolution. But more important, developments like expansion of markets for nonfarm jobs, a point we alluded to in the previous chapter were bound to have played an important role in fostering cooperation among farmers towards accomplishing tasks of water allocation, fee collection and routine maintenance of irrigation structures.

Figure 4B. Structure of water management institutions in China.



IWRM: From Turnover to Service Provision

An IWMI study of five river basins in Asia highlighted the fact that there have been attempts at institutional innovations to address problems of water-resources management. But it is apparent that the extent of reforms is determined by the extent of pressure on water resources. For instance, in Fuyang, a closed river basin, informal groundwater markets have been experimented with. Innovative institutional arrangements like water-withdrawal permits and small-scale water-conservancy projects have also been experimented with. The financing and management of small-scale rural-conservancy projects have been decentralized with devolution of authority from central to local governments. In China, the accent of the reform process clearly tends to be towards enhancing service provision. Emphasis on improving service is bound to impact positively on the local farm economy and participatory processes in government departments. An IWMI study highlighted the following positive effects of PIM (IMWI 2003):

- Increases in cropping-intensity rates.
- Increase in rice productivity.
- Increase in command area of irrigation system.
- Increase in reliability of water supply.
- Reduction in the government's budgetary burden in the short run.

- Potential for private financing of system maintenance tapped.
- Reduction in government staffing levels noticed in the wake of a PIM program.
- Incidence of conflicts reduced through increased emphasis on consultation with farmers' organizations by agency staff.
- As a result of increased farmer consultation, farmers' needs are addressed in the planning process.
- Local-level leadership developed as a result of capacity-building programs.

In contrast, reform in other basins under study tends to be stuck at the level of formulation of laws, establishment of administrative bodies, turnover of irrigation management to IAs and the preparation of master plans for inter-sectoral priority setting for water use. A failure to successfully implement a PIM process may be explained by the following factors:

- PIM perceived as a threat to agency staff.
- Farmers expect the government to meet future needs of system rehabilitation.
- Structural features of rural communities like hidden tenancies and land fragmentation hinder full potential of PIM from being realized.
- Water rights remain unclear, creating potential for conflicts over resource use.
- Sustainability of PIM is in doubt because most programs are run in a pure project mode with little allowance for external changes in factor and product markets with implications for farmer management in the long run.
- Fee assessment system is arbitrary and farmers are seldom consulted.
- Replication of a single PIM model within a country may meet with failure.

Our five river-basin study suggests that the influence of external donor agencies has been considerable in agenda setting. For instance, three factors have been emphasized in the reform process: Irrigation Management Transfer (IMT), full cost recovery and IWRM. But success with reform along the lines suggested above has been limited. In China, for instance, our study reveals that actual success of local governments with ISF collection, volumetric pricing and maintenance has been limited. If evidence from advanced river basins is any guide there are two prerequisites for successful institutional reform of the water sector. First, inter-sectoral policy coordination is important (see Kurian et al. forthcoming). For instance, the Omono-gawa study reveals that protectionist policies relating to import of rice greatly influenced farmer cooperation in management of water resources. Second, the Murray-Darling case distinguishes between "regulatory role of government that is separate from water service provision." Essentially, the State sets the broad contours of a contract within which flexibility was permitted to experiment and evolve the most durable mode of service provision. The core attributes of an approach targeted at service provision were: water pricing and tradable water rights. But too much of emphasis on full cost recovery without thorough appraisal, the study reveals, could lead to conflicts (see also Merrey 1997).

5. Conclusions

This paper attempts a synthesis of a five-country study on IWRM in a river-basin context. Within the limitations imposed by the study methodology certain conclusions on IWRM institutions may be arrived at. For one, we point out that environmental problems like salinity and sedimentation may be exacerbated in river basins characterized by relatively high levels of water-resources development. Second, by adopting a river-basin perspective we observe that water-quality problems may differ depending on where analysis is carried out—upstream or downstream. Third, we find that multiple uses of water may exacerbate pressure on water resources within a river basin. Depending on the extent of storage infrastructure, however, some basins may be able to tide over seasonal water scarcity.

In all five river basins studied we find a high incidence of poverty. In such situations, we argued that access to markets offered a way of alleviating poverty. Markets for agricultural crops, nonfarm labor, agricultural inputs and groundwater offered ways of alleviating poverty. However, the mere presence of markets does not automatically guarantee poverty alleviation. Poverty alleviation in the context of the presence of markets is predicted on inter-sectoral policy coordination. In the case of IWRM, we argued that there was an obsession with ISF collection with little effort being made by State parastatals to understand the farmers' ability to pay in the context of changes in the wider political economy. Coordination failures are also apparent in a failure to provide legal recognition of WUAs and undue political interference. As a consequence of coordination failures WUAs have remained weak, conflicts over water use have occurred and physical infrastructure has deteriorated due to lack of funds for O&M.

This paper argues that water scarcity tends to provide an impetus for institutional reform. The Fuyang river basin in China offered a particularly interesting contrast to other river basins that were open in relation to availability of water. We observed that institutional reform in basins that were open tended to be stuck at the level of organizational reform that was more often than not dictated by external agencies—national governments, donors or NGOs. Reform in such situations focused on issues such as regulations to do with turnover programs, establishment of administrative bodies and inter-sectoral policy setting for water use. On the other hand, in situations of acute water scarcity where basins are approaching closure (as in China) the onus of reform was on improving service provision through innovative institutional changes that focused on water rights and water pricing. Evidence from advanced basins suggests that governments in such situations play a facilitative role by focusing on the provision of a regulatory framework that offers scope for inter-sectoral policy coordination and beneficiary participation in cost recovery, conflict resolution and maintenance of infrastructure.

This synthesis of IWMI research on institutions for IWRM highlights a number of development issues that are central to three large research programs in the water sector—the Challenge Program, Comprehensive Assessment and the Dialogue on Water and Food. Three development issues pertinent in the context of the three research programs are: rural development and poverty, management of cross-country interdisciplinary research and stakeholder consultation and negotiation in policy formulation. Therefore, in terms of future policy research one may emphasize the need for cross-country interdisciplinary research that can potentially trace the evolution of river-basin institutions in response to perceived changes in the natural environment as a result of pressures imposed by the development of markets for agricultural inputs and end products.

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