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Institutions for Integrated Water-Resources Management in River Basins

An Analytical Framework

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International Water Management Institute

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Summary

In recent years, Integrated Water-Resources Management (IWRM) has captured the attention of policymakers and policy analysts. A lot has been written, most often in a disparate way about institutions for IWRM. However, there has been limited success in bridging disciplinary boundaries (social versus physical sciences) with the result that conceptual inconsistencies persist with regard to our understanding of institutions for IWRM. This paper reviews IWMI research on IWRM in Asia and highlights drawbacks in contemporary approaches to the study of institutions for IWRM in river basins. The paper then outlines key features of an alternative analytical framework. In doing so, it discusses certain novel features of the alternative approach: emphasis on transparent policy processes of State parastatals, modes of water-service provisioning and conditions for collective action in the management of common-pool resources in river basins and its implications for sustainable rural livelihoods.

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). Others meanwhile 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, are not static systems but adaptive and dynamic systems. 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 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 (Barker and Molle 2002).

This paper is an attempt to outline an analytical framework for analysis of institutions for IWRM in river basins. The next section reviews IWMI research in the area of IWRM in Asia and is based on the review in the previous section. Section 3 highlights certain drawbacks of contemporary approaches to the study of IWRM institutions. Based on this discussion, an alternative analytical framework is outlined. Section 4 discusses the main conclusions of the paper.

2. How Institutions Matter for IWRM in River Basins: Evidence from Rural Asia

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, 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; Upper Pampanga, Philippines) with three other basins that have made considerable progress with adopting IWRM (Murray-Darling, Australia; Brantas, Indonesia; Omono-gawa, Japan).

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 square kilometers, the Fuyang basin 22,814 square kilometers, Brantas 11,800 square kilometers and Omono-gawa 4,952 square kilometers. The area of the Deduru Oya basin in Sri Lanka is large enough to contain seven major reservoirs and 1,560 tanks (table 1). 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 1).

Figure 1. Hypothetical development stages of a river basin.

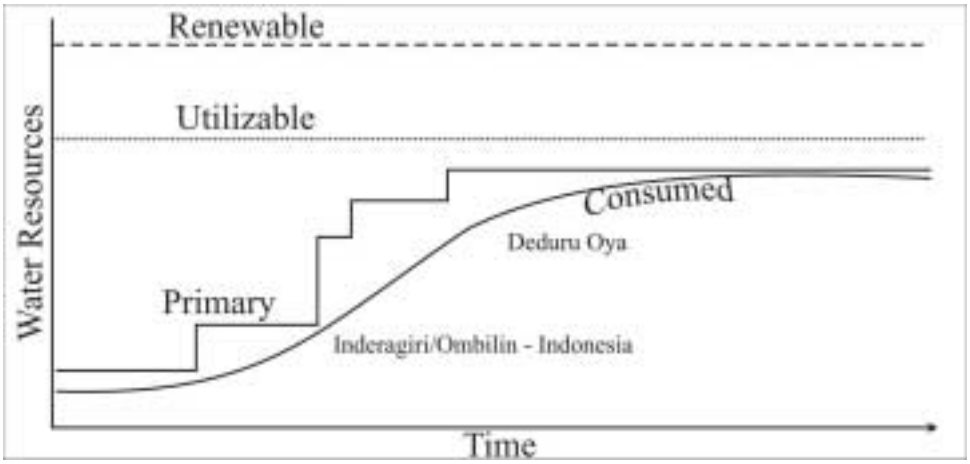


Table 1. Salient characteristics of the river basins selected for study.

Basin characteristics	Fuyang	Singkarak-Ombilin subbasin	East Rapti	Upper Pampanga	Deduru Oya
Country	People's Republic of China	Indonesia	Nepal	Philippines	Sri Lanka
Catchment area (sq. km)	22,814	2,210	3,315	3,742	2,623
Location : Province	Hebei	West Sumatra	Not applicable	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		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, 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

Table 1. Continued.

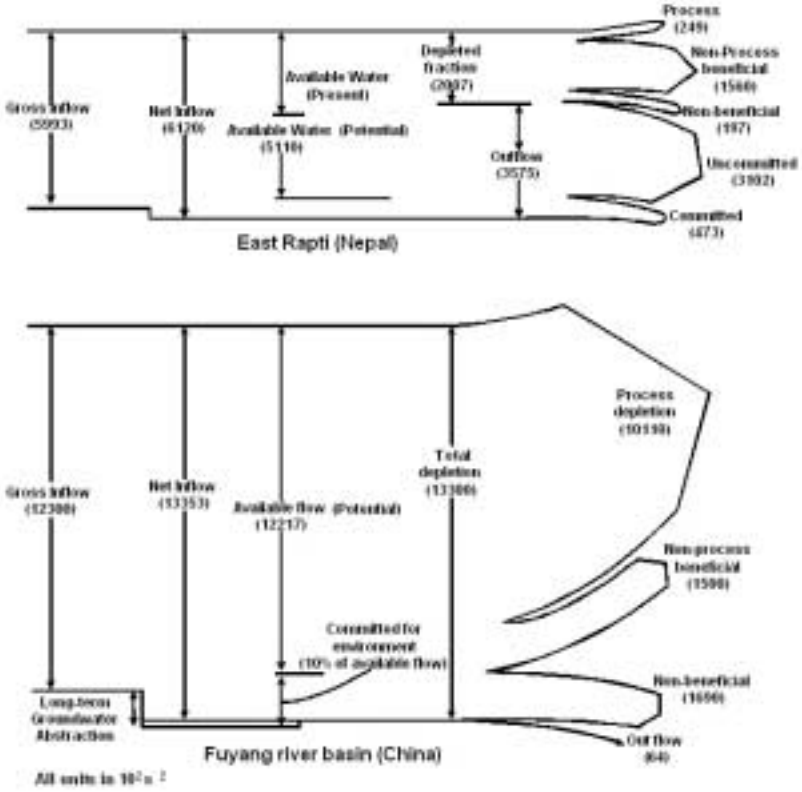
Basin characteristics	Fuyang	Singkarak-Ombilin subbasin	East Rapti	Upper Pampanga	Deduru Oya
Domestic water supply schemes	41	2 (Ombilin subbasin)	45	17	37 pipe-borne 1,199 tube wells
No. of hydropower plants	14	1 hydroelectric, 4 micro hydroelectric power plants	None	2	None
Land use and agriculture					
Cultivated area (ha)	1,239,000	130,291	85,578	254,490	201,585
Grassland/Savannah (ha)	-	11,234	10,500	4,117	55
Forestland (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 OFCs =38	274=irrigation from main river 257=irrigation from tributary	156=surface-water irrigation 200=groundwater irrigation	133-165=surface-water irrigation 180-300=groundwater irrigation
Irrigated area (%)	45	14.8	12.8	33	18.5

This is especially the case with basins like Deduru Oya (Sri Lanka) and Upper Pampanga basin (Philippines). Higher dispersion of physical infrastructure has led to qualitatively different problems like salinity and sedimentation. This observation 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 that has led to a visible deterioration in the state of its infrastructure.

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. There is an array of land uses 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 differ 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.

Figure 2. Water accounting finger diagrams.



Water-accounting studies undertaken in the river basins highlight the importance of multiple uses of water and competition that exists for the resource (figure 2). 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 the current outflow from the basin is insufficient to maintain sustainable water use in downstream areas where the competition for agricultural water use will increase as a result of increasing demand for water 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 infrastructures like reservoirs may facilitate regulation of water flow to meet downstream demand. The Indonesia study of the Ombilin river basin, on the other hand, suggests that factors like industrialization and growth of markets for agricultural crops are bound to place pressure on water resources through the adoption of newer technologies like lift irrigation, tube wells and thermal power generation. By contrast, the East Rapti basin in Nepal, which 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.

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 the 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

Table 2. Salient demographic features of the 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

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

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).

In situations with a 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 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, 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 (see 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.

Organizations for River-Basin Management

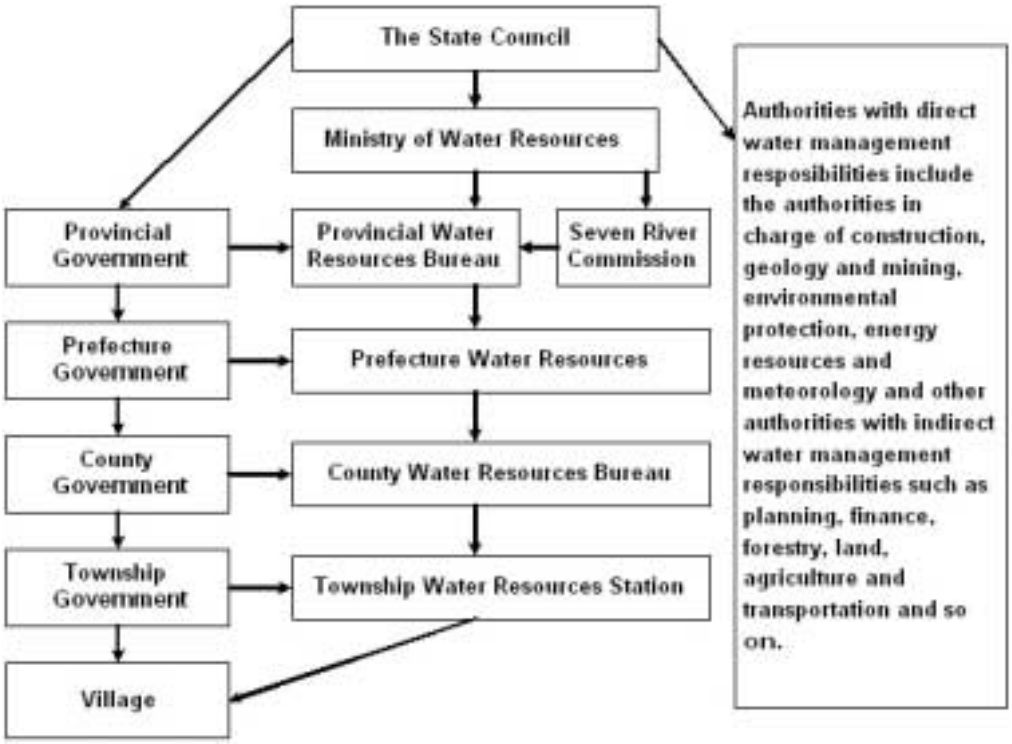
Management of water resources in the five basins is vested with the Ministry of Water Resources. The organizational structure is hierarchical, the Ministry of Water Resources being the apex body, with water-resources bureaus and water-management stations forming lower parts of the structure as in China (figure 3A and 3B). In the case of Sri Lanka, there are approximately 20 agencies involved in water-resources management that include the Mahaweli

Figure 3A. Legal systems for water in China.

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 in 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.

In recent years, there has been a trend towards devolving management of water resources to farmers' organizations (FOs). 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, the management of the National Irrigation System is the joint responsibility of both the National Irrigation Authority (State agency) and Irrigators' Associations (i.e., FOs). The study of the Omono-gawa river basin in Japan indicates that, more often than not, such trends towards devolving responsibility to FOs 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 section 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 3B. Structure of water management institutions in China.



IWRM: From Turnover to Service Provision

We notice that in all five river basins covered by this study, 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 permit and small-scale water conservancy projects have been experimented with. The financing and management of small-scale rural-conservancy projects have also 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):

- Increase in cropping intensity rates.
- Increase in rice productivity.
- Increase in command area of the irrigation system.
- Increase in reliability of water supply.
- Reduction in 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 FO by agency staff.
- As a result of increased farmer consultation farmer's needs are addressed in the planning process.
- Local-level leadership developed as a result of capacity-building programs.

By 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.
- The 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. For instance, the Omono-gawa study reveals that protectionist policies relating to the import of rice greatly influenced farmer cooperation in the 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. The study reveals that too much of emphasis on full cost recovery, without thorough appraisal, could lead to conflicts (see also Merrey 1997).

Coordination Failures and Conflicts over Resource Use

All river-basins studies showed evidence of a range of institutional constraints. These constraints basically refer to coordination failures that result in poor implementation of natural-resources management strategies. Coordination failures may be caused by a number of factors. Interestingly, the nature of coordination failures was related to the level of water-resources development. For example, in the Fuyang river basin (closed basin) there was a multiplicity of organizations engaged in the management of basin resources. By contrast, coordination failures in the East Rapti basin (open basin) were rooted in a complete lack of formal river-basin management institutions. In the case of the Upper Pampanga river basin, an elaborate institutional arrangement had been established for management of NIS by the NIA and IAs. In contrast, in the Ombilin river basin, which is more open than the Pampanga river basin, there was a lack of hydrological data and gaps in formal regulations and policies dealing with water-resources management.

Coordination failures are reflected in a number of different dimensions. For instance, in the Upper Pampanga there was an obsession with ISF collection with scant regard paid to the farmers' ability to pay ISF in the wake of changes in the wider political economy. In the Philippines, expertise and funds for maintenance of canals remained under NIA control. In Nepal, all planning is carried out on a project basis. Very little attention is paid to the sustainability of project interventions, especially those that emphasize O&M by FOs. In the East Rapti the absence of legal recognition for WUAs compounds the problem of ensuring sustainable farmer participation in O&M. In the case of Deduru Oya and East Rapti basins the lack of financial resources with State parastatals and undue political interference have weakened the government's implementation capacity. The weak implementation capacity of State parastatals and poor participation of FOs have compounded coordination failures in river-basin management. In particular, coordination failures have resulted in weakness of WUAs, outbreak of conflicts over natural-resources use and deterioration of physical infrastructure.

3. Institutions for IWRM in River Basins: Key Elements of an Analytical Framework

This cross-country synthesis of river-basin management primarily focuses on a seven-country study that IWMI carried out with ADB support. 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 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 for three advanced basins: Murray-Darling, Brantas and Omono-gawa. We then identified case-specific institutional strategies adopted and discussed them in the context of the degree of water-resources development in each of the eight river basins.

Limitations

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 the need for an improved analytical framework.

- 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 (ibid.). 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.

Towards an Alternative Analytical Framework

The above discussion highlighted the fact that institutions for IWRM are complex and may evolve over time in response to forces of natural-resources degradation and poverty. Therefore, analysis of IWRM institutions must be based on a comprehensive framework that acknowledges multiple factors: biophysical-, socioeconomic- and policy-related. Our analytical framework essentially views IWRM institutions as being the product of three factors (see figure 4):

- Physical attributes
- Economic and social attributes
- State policies

Physical attributes may include factors like watershed size, seasonal water flows into river basins, topography, soil and forest type, groundwater depth, rates of percolation and evapotranspiration. Economic and social attributes may include factors like population density, level of infrastructural development like roads, schools and markets or water resources. Other economic and social attributes may include ethnic groups, customary social practices, cropping patterns, forest use, customary rules of natural-resource use, and farm, off-farm and nonfarm employment. State policies may include formal stipulations relating to sectors such as agriculture, industry, environment or municipal water and sanitation. State policies also have the potential to influence patterns of market development: property rights for land and water, markets for labor or capital and markets for agricultural and forest products.

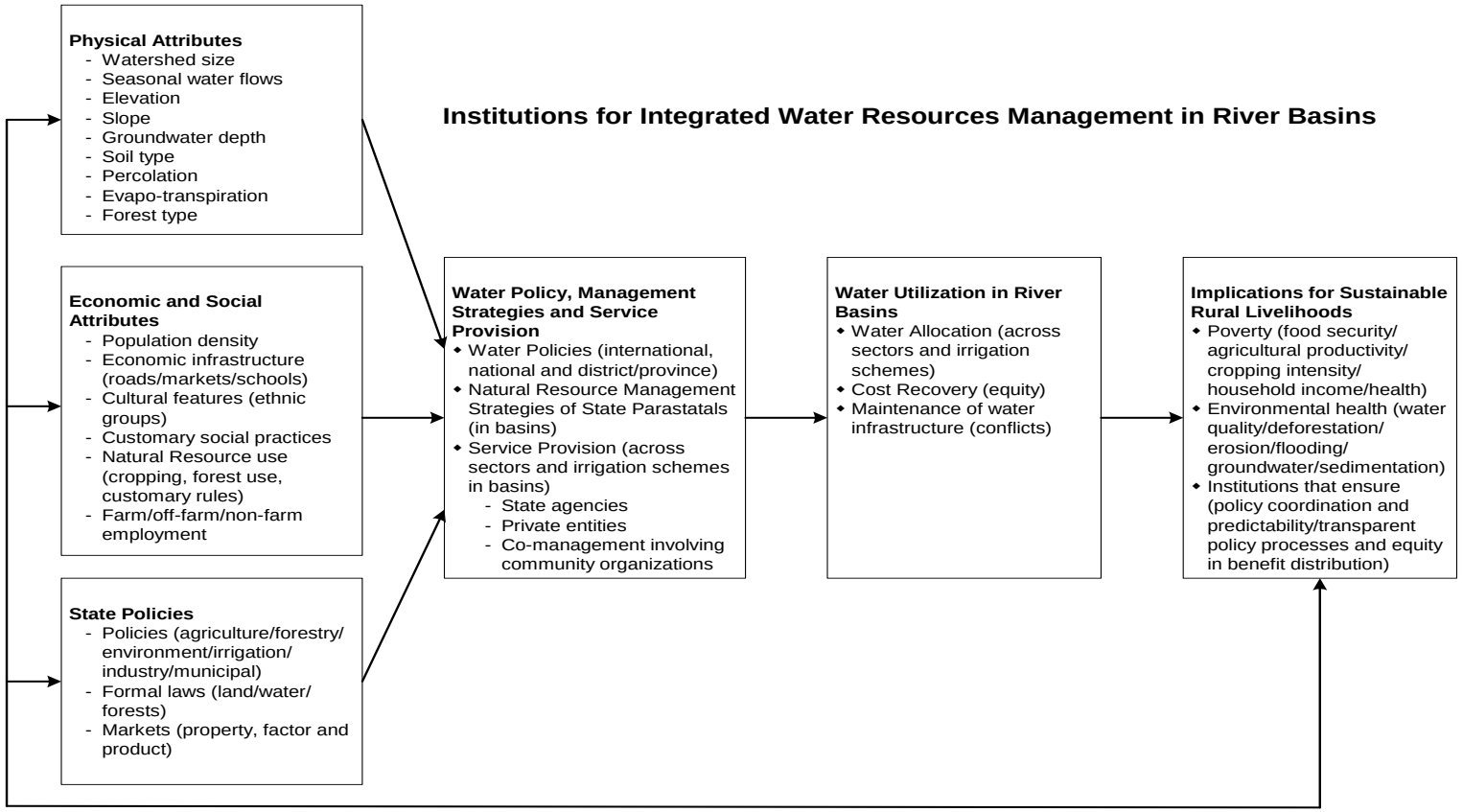
Physical, economic and social attributes and State policies in turn influence water policy, management strategies of State parastatals and modes of service provision. Physical, economic and social attributes and State policies may also have implications for rural livelihoods: extent of poverty, environmental health and nature of institutions for water-resources management. Analysis of water policies should be layered, focusing on processes of policy formulation at the national level. The influence of transnational strategies of water management on national water-policy formulation together with the constraints placed on implementation capacity at lower levels (district or province) must be acknowledged by the analyses of water policy. In addition, we emphasize the importance of mapping out modes of water-service provision across sectors or irrigation schemes within river basins. Modes of water-service provision may take three broad forms:

- Provision by government agencies (irrigation or agricultural departments)
- Private entities (water companies or large NGOs)
- Comanagement involving collaboration between community organizations (Water User Associations or Catchment Protection Groups) or individual farmer entrepreneurs and government parastatals or private entities.

The above modes of water-service provisioning may occur at the level of various sectors: agriculture, household, municipal, industry or environment within river basins. Water provisioning may also occur within irrigation schemes in the agriculture sector. Very often, State policies (policies, formal laws and markets) and physical, economic and social attributes may influence the extent of provisioning by each of the above three modes in different sectors and/or within irrigation schemes in the agriculture sector. Our discussion in chapter 2 leads us to hypothesize three broad trends in water service provisioning:

- Low levels of market development, lower levels of natural-resources degradation and substantial role for communal organizations or State parastatals in the management of land and water resources in river basins.
- Relatively higher levels of market development, growing levels of natural-resources degradation and increasing resort to privatization of previously common-property resources in river basins.
- Relatively higher levels of market development, high levels of natural-resources degradation in the context of inequity in benefit distribution, declining government revenues and budgets for forestry and irrigation resulting in forging of public-private partnerships for river-basin management.

Figure 4. Institutions for IWRM in river basins: An analytical framework.



Water policies, natural-resources management strategies of State parastatals and modes of service provisioning may in turn influence water utilization in river basins. In our conceptualization, water utilization may include:

- Patterns of water allocation (across different sectors or irrigation schemes in a river basin).
- Patterns of cost-recovery with implication for equity in distribution of benefits and costs of water use.
- Patterns of investment in maintenance of water infrastructure with implications for conflicts in river basins.

Patterns of water utilization may have implications for sustainable rural livelihoods. The livelihood impact of water utilization in river basins may be examined from three perspectives:

- Poverty-food security/agricultural productivity/cropping intensity, household income/ household health arising from levels of water quality (Kurian et al. 2004). In this context, we adopt a framework, which assumes that stakeholders at the levels of river basins, irrigation systems or households are differentiated in their access to the benefits of poverty reduction. Factors like gender, caste or class may influence how the benefits and costs of projects aimed at poverty reduction are distributed across a range of stakeholders (see Koppen 2002; Walle and Gunawardene 2001).
- Environmental health-water quality/deforestation in upland areas/ex-situ impact in terms of soil erosion, flooding or sedimentation of water infrastructure/groundwater recharge. In this context, we adopt a framework, which assumes that the environment is differentiated both spatially and temporally (Leach et al. 1999; Leach and Mearns 1996). Environmental problems in river basins may be exacerbated by factors like slope, soil type or seasonal water flows. Further, certain areas may experience environmental crises that weather themselves out over time only to return at a later stage.
- Institutions that ensure international or inter-sectoral policy coordination and predictable policies/transparent policy processes relating especially to implementation by State parastatals and equity in benefit distribution arising from the mode of water-service provisioning in operation in river basins (Clausen and Fugl 2001). Institutions are bound to be affected by patterns of water utilization in a river basin. In other words, mechanisms for inter-sectoral policy coordination, transparent policy processes and collective action are bound to be supported by higher levels of cost recovery and investment in routine maintenance of water infrastructure (see Samad and Vermillion 1999).

Novel Features of the Proposed Framework

The analytical framework we outlined attempts to establish linkages between physical and social systems and its influence on water-policy formulation, water utilization and sustainable rural livelihoods. We believe that the framework introduces a considerable amount of novelty in conceptualizing people-nature interactions in river basins. In particular, the framework highlights the importance of natural-resources management strategies of State parastatals in river basins. Most previous work has pointed to issues of poor capacity. In addition, we argue that issues of corruption and transparency are worth discussing (see also Wescoat et al. 2000).

There are disparate accounts of service provisioning by State parastatals, private entities and community organizations. But very little of this analysis actually examines the relative merits and drawbacks of different service options in a river-basin context. This is important given the recent discussion surrounding public-private partnerships in the provision of water services. A related issue is that of understanding the conditions for collective action to emerge in the management of common-pool resources, such as irrigation systems. Understanding how costs and benefits of cooperating among farmers is critical for understanding the potential for service provision and compliance with institutional rules relating to water distribution and contribution towards routine maintenance.

Another novel feature of the analytical framework is to do with sustainable rural livelihoods. A previous analysis tended to view outcomes of water utilization in terms of equity and efficiency of water use and environmental impact (see Rosegrant 2002, 180). However, we argue that efficiency and equity of water use are essentially functions of institutions. For institutions to ensure efficiency, equity and positive environmental outcomes in a sustainable manner, they must guarantee inter-sectoral policy coordination and predictable policy guidelines, and emphasize transparent and accountable policy processes. In addition, they must ensure equity in benefit distribution among different stakeholders (men and women within communities and households, government functionaries or service providers across sectors) in a river-basin context. Ensuring equity in benefit distribution would presuppose that attention is paid to issues of poverty and environmental protection as reflected in factors like food security, access to household incomes and catchment management.

4. Conclusions

In recent years, IWRM has held the attention of policymakers and policy analysts. IWRM is attractive because of its ambitious attempt to address issues of poverty and environmental degradation in a holistic manner. However, for IWRM to become entrenched in systems of natural-resources management, adequate attention must be given to institutional change. To date, a lot has been written, most often in a disparate way about institutions for IWRM. However, there has been limited success in bridging disciplinary boundaries (social versus physical sciences) with the result that conceptual inconsistencies persist with regard to our understanding of institutions for IWRM.

This paper reviews IWMI research on IWRM in Asia and highlights certain key findings with regard to institutional analysis. Based on a comprehensive review, the paper discusses some drawbacks of the research approach. The notable drawbacks discussed included an excessive focus on irrigation management in river basins at the expense of other land uses like forests in catchment areas. Issues of environmental impact and water management are overlooked. Further, implications of a particular pattern of water utilization in a river basin are not examined in terms of their implications for sustainable rural livelihoods. Based on a discussion of drawbacks of previous approaches, the paper outlines an improved approach to the study of IWRM institutions in river basins.

The alternative analytical framework for IWRM institutions outlined in this paper has certain novel features. First, the approach attempts to integrate analysis of both biophysical and socioeconomic factors in river-basin management. Second, the approach acknowledges the role of State policies in influencing development of markets for factor and product markets and its potential to influence modes of water-service provisioning in river basins. The approach also emphasizes the importance of transparent policy processes of State parastatals in implementation of policy strictures with implications for patterns of water utilization in river basins. Where implementation capacity is poor, water allocation and distribution may be characterized by conflicts, cost-recovery may disadvantage the poor and those without assets and maintenance of water infrastructure may be limited. Such patterns of water utilization may have serious implications for sustainable rural livelihoods: extent of poverty, environmental health and sustainability of processes of institutional reform.

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