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Institutional Analysis of Integrated Water Resources Management in River Basins

A Methodology Paper

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International Water Management Institute

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Contents

Summary

Integrated Water Resources Management (IWRM) has in recent years captured the attention of policy makers and policy analysts. A lot has been written on this topic, most often disparately, 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 outlines key features of an analytical framework for the institutional analysis of IWRM in river basins. The novelties of the analytical approach include 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. The paper then discusses certain methodological concerns with regard to the operationalizing of various elements of the analytical framework. In particular, the paper discusses issues related to defining the scope of analysis, scale of water use and management and collective action for the management of common pool resources in a river basin. The paper also discusses the process by which the comparative analysis of IWRM may be undertaken by highlighting the importance of problem specification, hypothesis generation and methods of data collection.

1. Introduction

In recent years, river-basin planning or watershed-management approaches have gained prominence in the agricultural sector. Using geo-hydrological 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). Integrated Water Resources Management (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, 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 the implementation of NRM strategies by external agents (state parastatals/ NGO's) and variations in beneficiary participation in water allocation, conflict resolution, ISF collection and routine maintenance" (Barker and Molle 2002:19).

The 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 are adaptive and dynamic. IWRM's potential contribution to increasing water productivity lies in its ability to approach natural resource 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, co-ordination of surface and groundwater use and linkages between water use and environmental needs (Barker and Molle 2002).

This paper attempts to highlight certain methodological concerns for the institutional analysis of IWRM in river basins. The paper is organized as follows. Section two outlines an analytical framework for the institutional analysis of IWRM while section three discusses key methodological concerns for institutional analysis of IWRM in river basins. Section four highlights the main conclusions of the paper.

2. Institutions for IWRM in River Basins—An Analytical Framework

Institutions for IWRM are complex and may evolve over time in response to forces of natural resource degradation and poverty. The analysis of IWRM institutions must therefore be based on a comprehensive framework that acknowledges multiple factors— bio-physical, socio-economic and policy related. Our analytical framework essentially views IWRM institutions as being the product of three factors (figure 1):

- Physical attributes
- Economic and social attributes, and
- State policies

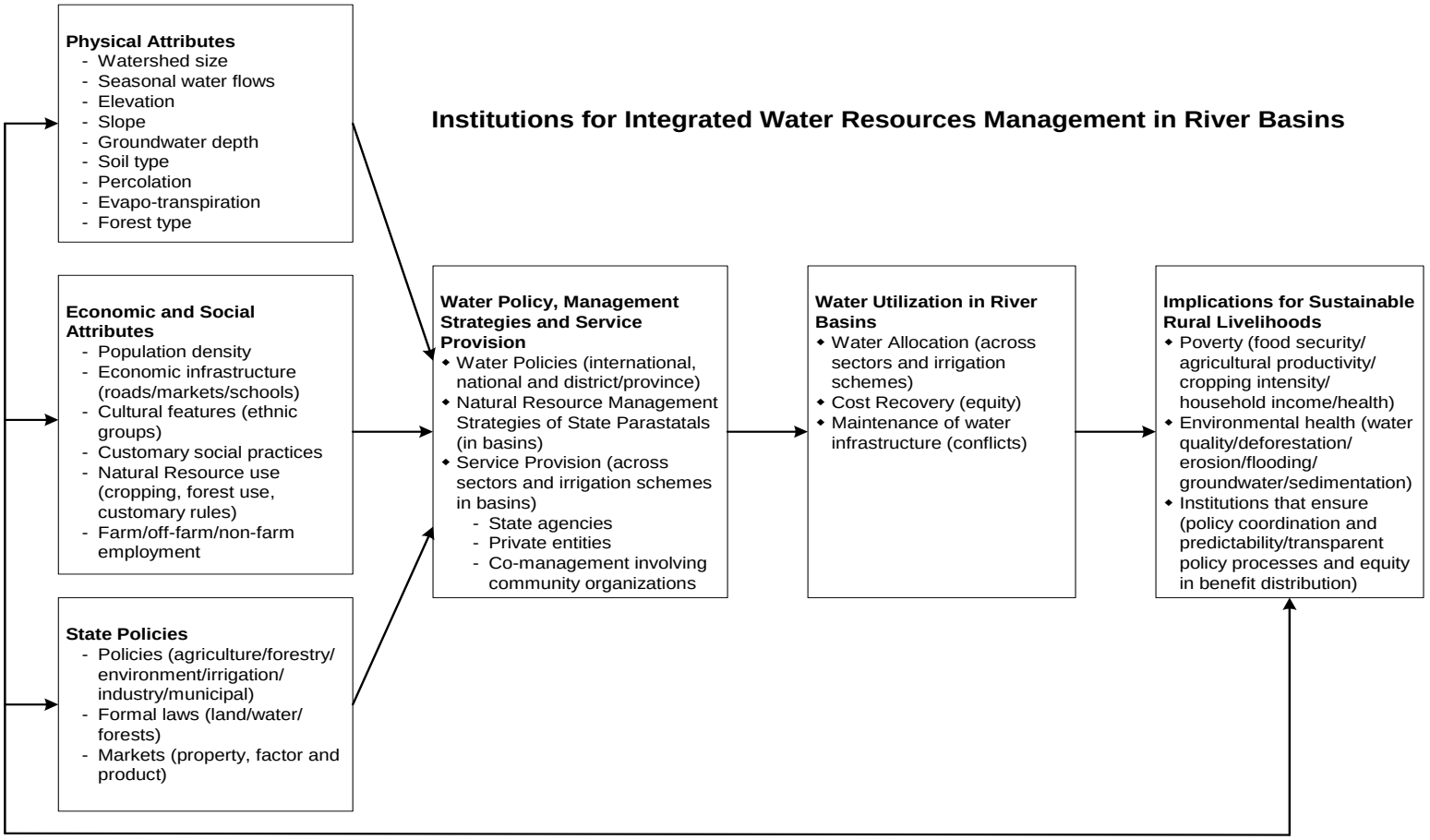
Physical attributes may include factors like watershed size, seasonal water flows into river basins, topography, soil and forest type, groundwater depth, rates of percolation and evapo-transpiration. Economic and social attributes may include factors like population density and the level of infrastructure development like roads, schools, markets or water resources. Other economic and social attributes may include ethnic groups, customary social practices, cropping patterns, forest use and customary rules of natural resource use, farm, off-farm and non-farm 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 and management strategies of state parastatals and modes of service provision. They may also have implications for rural livelihoods—the extent of poverty, environmental health and nature of institutions for water resource management. The analysis of water policies should be layered, focusing on processes of policy formulation at national level. The influence of transnational strategies of water management and its influence on national water policy formulation together with the constraints placed on implementation capacity at lower levels (district or province) must be acknowledged by 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.

Water service provision modes may take three broad forms:

- Provision by Government parastatals (irrigation or agriculture departments)
- Private entities (water companies or large NGOs)
- Co-management involving collaboration between community organizations (Water User Associations/ Catchment Protection Groups) or individual farmer entrepreneurs and government parastatals or private entities

Figure 1. Institutions for Integrated Water Resources Management in river basins—An analytical framework.



The above modes of water service provisioning may occur either at the level of various sectors—agriculture, household, municipal, industry—or the 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), physical attributes and 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 section two leads us to hypothesize three broad trends in water service provisioning:

- Low levels of market development, lower levels of natural resource degradation and a 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 resource degradation and increasing resort to privatization of previously common property resources in river basins
- Relatively higher levels of market development, high levels of natural resource 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

Water policies, natural resource 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. 2004a). In this context we adopt a framework that assumes that stakeholders at the level of river basins, irrigation system or household 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 (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 that 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 an environmental crisis that weathers itself out over time only to return at a later stage.
- Institutions: these 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 mode of water service provisioning in operation in river basins (Clausen and Fugl 2001). Institutions are bound to be affected by levels of cost recovery and the extent of investment in the routine maintenance of water infrastructure. 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 (Samand and Vermillion 1999).

Novel Features of the Proposed Framework

The analytical framework we outlined attempts to establish linkages between physical and social systems and their 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-resource 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 (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. Examining the costs and benefits of co-operating among farmers is critical to 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 has to do with sustainable rural livelihoods. Previous analysis has tended to view outcomes of water utilization in terms of equity and efficiency of water use and environmental impact (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, 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 as reflected in factors like food security, access to household incomes and agricultural productivity.

3. Institutional Analysis of IWRM in River Basins—Key Methodological Concerns

Scope of Analysis

The discussion in the previous section focused attention on livelihood outcomes of a particular institutional configuration. In our view, the institutional analysis of IWRM may focus on three issues: poverty, environment and institutions. Our analysis of the above three issues may proceed at three analytical levels: policy formulation, management strategies and benefit and cost distribution arising from a particular mode of service provision. These three analytical levels may in turn correspond broadly with the three spatial categories of river basin, village or irrigation system and plots (households) within an irrigation system (table 1).

The poverty analysis of IWRM may focus on issues such as food security, agricultural productivity, cropping intensity, household income or health. These issues may be examined across sectors (agriculture, industry, household etc) within a river basin or across irrigation schemes within a river basin. The analysis of environmental issues may include the examination of water quality, deforestation, ex-situ impacts in terms of soil erosion, downstream flooding, groundwater recharge, or sedimentation of water infrastructure. These issues may be examined across sectors (agriculture, industry, household etc) within a river basin or across irrigation schemes within a river basin.

Table 1. Choice of Scope and Unit of Analysis.

Level	Intervention Category	Spatial Category	Research Priorities
Level 1	Legal/ Policy Framework	Watershed	Policy-formulation and Co-ordination
Level 2	Program Implementation-Natural Resource Management Strategies	Village/Irrigation System	Transparency and accountability mechanisms
Level 3	Project Evaluation-Monitoring and Evaluation	Household	Equity in distribution of costs and benefits of natural resource management

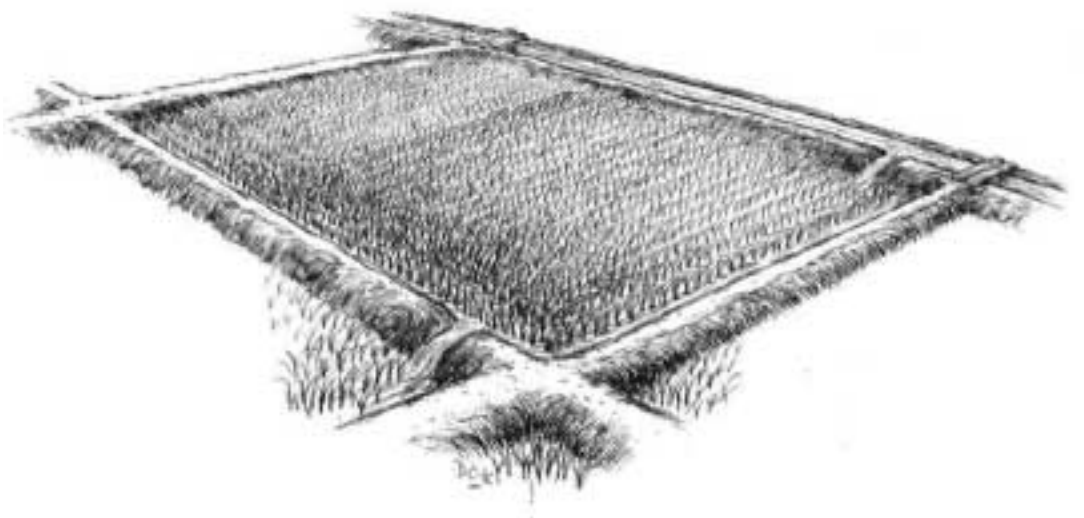
Institutional analysis may focus on identifying conditions under which objectives of poverty reduction and environmental management may best be achieved. Particular attention will be paid to three issues:

- Predictability in policy formulation and inter-sectoral coordination of policies
- Transparent and accountable policy processes
- Equity in distribution of benefits and costs of collective action in the management of common pool resources within river basins. Particular emphasis will be placed on the analysis of issues of intra-household bargaining for access to benefits of environmental management

Scale of Water Use and Management

Water management is carried out on a variety of different scales. “Farmers applying water to their vegetable crops are managing water; ditch tenders distributing water among farms in an irrigation scheme are managing water; and engineers overseeing releases from dams are managing water” (Molden and Merry 2002:142). But it is important to remember that water management at different scales poses its own challenges (figures 2A & 2B). For instance, interventions that make sense at a local level have profound unintended consequences on higher scales, and the types of interventions appropriate for micro-scales are totally different from those that are appropriate for higher scales. It is important to realize that in addition to spatial issues, scale considerations are apparent in temporal terms. “For instance, the construction of a reservoir to service irrigation schemes or cities in a given area is a once-in a lifetime event. Sometimes farmers plan for water delivery events lasting a period of days. Other times, seasonal plans are made, while occasionally, long-term strategic plans are developed. It is therefore clear from these examples that temporal scale plays an important role in water resources management” (Molden and Merry 2002:147).

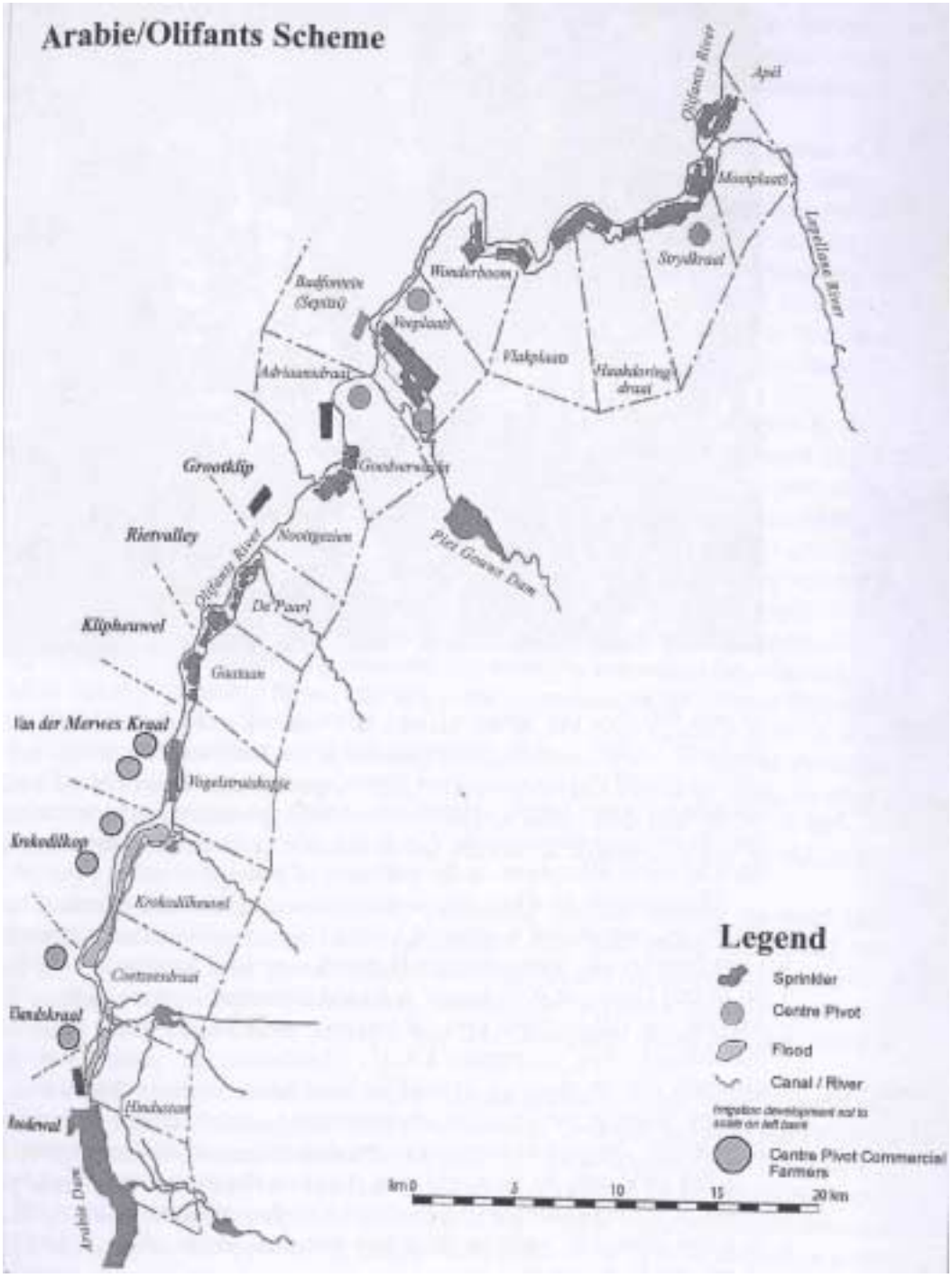
Figure 2A. A field scale perspective.



Examining Potential for Collective Action

An important issue related to the institutional analysis of IWRM has to do with the identification of conditions for collective action for the management of common pool resources in river basins (Kurian and Dietz 2004b). Collective action is important to sustain mechanisms for the fair distribution of benefits from the management of common pool resources and to reduce aggregate levels of poverty. A rural differentiation framework that we described above can potentially highlight two issues of relevance to the discussion on collective action. First, a rural differentiation framework may identify conditions under which different modes of service provision (state provision, private sector or co-management) may flourish and the associated benefits and costs of adopting them. Second, a rural differentiation framework may identify conditions under which compliance with rules regulating access to and maintenance of common pool resources may be achieved.

Figure 2B. Arabie/Olifants scheme.



From a methodological point of view, adopting a rural differentiation framework may entail two approaches. First, the construction of standard measures based on the empirical analysis of socio-economic (endowments) and edaphic variables (groundwater depth, slope) that can potentially explain collective action and its application across a wide variety of schemes within a river basin. Second, the stratification of households within irrigation schemes or micro-watersheds to understand how benefits and costs of river-basin management are distributed across different socio-economic categories. A combination of both these approaches through the selective use of survey and case study approaches may help situate a particular external intervention within a particular socio-ecological and policy context. Moreover, such an approach can potentially highlight issues of social norms and historically defined patterns of social exchange that have implications for collective action in river basins.

Establishing Linkages between Aspects of Human Behavior and Bio-physical Change

One of the challenges of the institutional analysis of IWRM in river basins is combining the examination of socio-economic and bio-physical factors. Establishing linkages between aspects of human behavior and bio-physical change is dependent on the proper selection of variables to construct a sensible line of argument that explains the nexus between water, poverty and the environment. One of the stylized arguments used with regard to river-basin management has been that un-regulated human interference in upland forests can set off a string of adverse occurrences like soil erosion and sedimentation of water infrastructure with implications for the livelihoods of downstream populations (Dixon, 1997). However, in recent years, the careful empirical examination of causes of land and water degradation in Africa have paved the way to assertions that posit a linear relationship between people's land-use patterns and soil erosion (Stocking 1996).

Variables of relevance to the analysis of people-nature interactions in river basins may be found at multiple levels. For example, the relationship between *deforestation* in upland areas and *soil erosion* may be explained by behavioral variables like *foraging of cattle.* Further, *groundwater depletion* in agricultural areas of a river basin may be explained by behavioral variables like *cultivation of water intensive crops* using private tubewells. Such forms of behavior may in turn be influenced by policy level variables like *agricultural terms of trade* for particular crops or *fuel subsidies* to power private tubewells (Kurian 2003a). On the other hand, access to reliable secondary information on the role of state agencies in the management of natural resources and its juxtaposition with case study evidence from micro-watersheds may serve to reveal some of the perceived benefits of collective action in reversing degradation of land and water resources in river basins.

Facilitating Comparative Analysis of IWRM across River Basins

Agrarian change is at the heart of institutional evolution. Therefore institutional analysis of IWRM cannot afford to overlook the underlying causes and drivers of agrarian change. A comparative analysis of IWRM must, in our view, focus on three levels of analysis:

- Physical, economic and social attributes and state policies at national (and in relevant cases, international levels)
- The regional context in terms of how state policies are implemented by state parastatals, variations in infrastructure development and peculiarities of physical and economic and social attributes

- The village or irrigation system and households within river basins and how benefits of external interventions are received based on differences in physical and economic and social attributes

In the discussion below we highlight seven key concerns in the process of undertaking comparative institutional analysis of IWRM across river basins:

(1) *Problem Statement:* Reconnaissance visits to proposed study-sites, discussions with local officials and the review of secondary information (statistics handbook) help to identify a problem statement. Identifying a problem statement is key to designing a comparative research framework for IWRM. A problem statement could refer to a knowledge or information gap. For example, the lack of an analytical or methodological framework may refer to an information gap. On the other hand, the lack of baseline socio-economic or bio-physical data to undertake a comparative analysis may refer to an information gap (Kurian 2003b).

(2) *Hypothesis Generation:* Familiarity of the proposed study-sites through prior reconnaissance visits can help in framing a research hypothesis. For research to be effective, especially when undertaking comparative research across watersheds that are far apart both in spatial or temporal terms, hypotheses should be fairly general to begin with. For example, while proposing to undertake comparative research on IWRM in river basins in Thailand and Lao PDR, we hypothesized that "sustainable reductions in poverty may be achieved when institutions evolve to ensure international/ inter-sectoral policy co-ordination, transparent policy processes and equity in the distribution of benefits and costs of natural resources management" (Kurian 2004c).

(3) *Identify Key Words in the Hypothesis:* Once we identify a hypothesis, the next step in the process of operationalizing research is the identification of key words. For example, in the case of the above hypothesis we identified the following key words: sustainable, poverty, policy co-ordination, transparent policy processes and equity. Key words are the bridge between abstract thinking and hands-on field-based research.

(4) *Identify Variables for each Key Word:* The next step in the process of operationalizing a research program is to identify variables for each key word. Variables may be both bio-physical and socio-economic. For some variables (for example. soil erosion rates) information may be available while for others (for example. changes in demography) information has to be collected. In some cases, information may be available from one site for only one year while for another, site information may be available for a longer period (Kerr and Chung 2001). In one site, information may be available from only one village in a river basin while in another, it may be available for all villages in a river basin. How does one reconcile such differences in the choice of variables? Does one completely drop off additional information and focus on only what is comparable? Or does one use qualitative information to make up for the lack of data in intervening years to make it possible to undertake a comparative analysis. If so, how well can such an approach be defended on scientific grounds?

(5) *Data Types and Sources:* A systematic analysis of IWRM may in our view focus on three levels—physical, economic and social attributes of watersheds and state policies at national and in relevant cases, international levels. The second level may include the

analysis of how state policies are implemented by state parastatals by considering differences in infrastructure development across regions. The third level of analysis may include the village or irrigation system and households within river basins and how benefits and costs of external interventions are received based on differences in social and economic attributes and variations in ecology. For the first two levels, a number of guidelines have been formulated regarding the types of data that need to be collected (GTZ 1996).

- National environmental strategies, environmental action plans, Environmental Impact Assessment guidelines, sector development plans such as the agriculture development plan, the water master plan, the nature conservation plan and land policies
- Regulations and Standards—health protection laws and regulations, (for example, with regard to hazardous materials and occupational risks), conservation laws, water laws, land use and tenure laws (formal or customary)
- Socio-economic development data—demographic and economic statistics at national and district level, land use and tenure data, public health
- Natural resources data—national reports on the state of the environment, sector analysis: agriculture, forestry, hydrology, nature conservation, climate/air, soils and water resources
- Provincial Organizations—regional planning units, state irrigation or forestry agencies, water user groups or planning agencies

(6) *Data Collection Methods:* Data collection for the third level of analysis—"village or irrigation system and households within river basins"—may require the adoption of a variety of different approaches. These may include group discussions[1] with groups of three to four individuals, key informant interviews,[2] structured interviews with questionnaires and focused case studies[3] on select topics (Kurian 2004d). If time is short and statistical analysis is not required, the creative sampling[4] of households to include in group discussions or structured interviews may yield interesting results. However, if statistical analysis is required, a minimum of 35 cases are needed. Depending on the availability of monetary resources, research assistants and time, data collection may cover a larger number of cases.

(7) *Creation of Checklists and Interview Schedules:* It is useful to have a checklist drawn up based on all the information that is required to be collected. The checklist may identify information by types—secondary and primary data. Further, it is useful to identify the

[1]Group discussions are useful to map land uses in a watershed, collect data on changes in prices for different products and clarify issues raised during structured household interviews.

[2]Key informant interviews are useful in understanding village power structures, historically defined patterns of social exchange and the role of the local government bureaucracy in development.

[3]Case studies of select topics are useful in collecting a lot of data, mostly of a qualitative nature. Case studies are useful in complimenting information collected during household interviews since they can potentially highlight local level processes relating to gender division of labor on farms, costs and benefits of groundwater use and non-farm employment patterns.

[4]The criteria for sampling may be influenced by the objective of the study. For example, in a comparative study of institutions for the management of upper catchments in Southeast Asia, we sampled households depending on size of family, size of arable land and location of farm plots on sloping land, for which we had time series data on erosion rates.

type of method that will be used to collect information—review of secondary records, group discussions of interview. The best mode of data collection and the sequencing of each type of data collection requirement in a mission (i.e. household interviews parallel with group discussions or otherwise) need to be clarified in consultation with other members of a research team.

(8) *Data Compilation and Storage:* Enough time should be available to review filled-in questionnaires with research assistants. It is also imperative that local terms referring to currencies and weights and measures are converted to a standard measure (i.e. either US dollars or kilos etc). The pre-testing of schedules with research assistants greatly helps in improving efficiency with which data are collected and stored. In particular, entries referring to zero or "Not Applicable" should be clarified. All data collected should be compiled in legible handwriting and properly labeled. Once a software that permits comparison across study sites and easy updating of data has been identified, data coding should begin and the data entered. Back-up copies of all data sets should be stored in a safe place, preferably other than the workplace.

4. Conclusions

Integrated Water Resources Management has in recent years captured the attention of policy makers 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 resource 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 argues that a major reason for inconsistencies in our understanding of IWRM in river basins has to do with methodological drawbacks in institutional analysis. Based on a discussion of an analytical framework for the institutional analysis of IWRM, we identify three focus areas—poverty, environment and institutions. We argue that from a methodological point of view, it is important to define the scope of analysis. This would entail proper specification of spatial and socio-economic levels of analysis. For instance, the three analytical levels of policy formulation, management strategies and benefit and cost distribution arising from a particular mode of service provision may correspond broadly with the three spatial categories of river basin, village and plots within an irrigation system. We also highlight issues of geographical scale in the discussion on the scale of water use and management.

We also discuss the issue of collective action—an issue seldom addressed in the institutional analysis of IWRM. We argue that collective action would benefit by adopting a rural differentiation framework. Such a framework would go a long way in identifying conditions for collection action in the management of common pool resources in river basins. From a methodological point of view, such an approach would entail innovation with regard to the development of standardized measures of socio-economic and edaphic variables. Further, stratification of households within irrigation schemes may allow us to understand how benefits and costs of river basin management are distributed across different socio-economic categories.

This paper identifies seven issues that merit attention with a view to facilitating the comparative analysis of IWRM in river basins. We emphasize the importance of problem statements based on reconnaissance surveys, hypothesis generation and choice of variables for comparative analysis. The paper also outlines the choices that have to be made by a researcher between the use of group discussions, structured interviews and case studies for the collection of socio-economic data. The merits of each approach are discussed and a case is made for the use of each approach in a manner that compliments the other.

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