Framing Research on Water Resources Management and Governance in Cambodia: A Literature Review

Working Paper 37

A CDRI Publication

CDRI
Cambodia's Leading Independent
Development Policy Research Institute
May 2008

ISSN 978-99950-52-22-5

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Layout and cover design: Oum Chantha, Kim Chettra and Chhin Sithy
Printed and Bound in Cambodia by Print Master Enterprise, Phnom Penh

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Acknowledgements

The authors of this paper would like to express their deepest thanks to AusAID for providing financial assistance, and appreciation for the AusAID program-based funding approach. This five year funding by AusAID, unlike other types of funding arrangements, has enabled us to conduct research on issues of water management in Cambodia in ways that that enable us, as Cambodians, to explore and realise our own research interests on the issues of water management in Cambodia. If development is really meant to be "for the people, and by the people" or from the "bottom up" as some would say, we cannot help but recognise that AusAID's financial support and funding approach can ensure the greatest degree of sustainable development through its promotion of a sense of development ownership and participation.

All authors would like to sincerely thank Dr Top Neth, research manager of Natural Resource and Environment Unit of CDRI, Dr Brett Ballard, research technical adviser of CDRI, and Dr Hossein Jalilian, research director of CDRI, for their comments and advice to the research team to improve this paper. Thanks are also given to Mr Sébastien Balmisse, International Technical Expert in MOWRAM, who spent his valuable time to review this literature review paper and gave a great deal of valuable feedback to the team regarding water and irrigation management.

Finally, the authors wish to acknowledge the excellent ideas gained from a wide range of hydrology, governance and other subject books and articles related to water resources management from the CDRI and University of Sydney libraries.

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Phnom Penh, *March 26*, *2008*

List of Abbreviations

ADB	Asian Development Bank
CBM	Community Based Management
CNMC	Cambodia National Mekong Committee
D&D	Decentralisation and Deconcentration
DK	Democratic Kampuchea
FA	Forestry Administration
FAO	Food and Agriculture Organization of the United Nations
FWUC	Farmer Water User Community
GWP	Global Water Partnership
ICEM	International Centre for Environmental Management
ICWE	International Conference on Water and the Environment
IMT	Irrigation Management Transfer
IO	International Organisations
ISF	Irrigation Service Fee
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
JICA	Japanese International Cooperation Agency
KR	Khmer Rouge
MAFF	Ministry of Agriculture, Forestry and Fisheries
MLMUPC	Ministry of Land Management, Urban Planning and Construction
MoE	Ministry of Environment
MoI	Ministry of Interior
MOWRAM	Ministry of Water Resources and Meteorology
MRC	Mekong River Commission
MRD	Ministry of Rural Development
MWVA	Ministry of Women's and Veterans Affairs
NSDP	National Strategic Development Plan
O&M	Operation and Maintenance
ODI	Overseas Development Institute
PDOWRAM	Provincial Department of Water Resources and Meteorology
PIMD	Participatory Irrigation Management and Development
SA	Social/institutional Assessment
TSWCA	Tonle Sap Water Catchment Area
TWGAW	Technical Working Group on Agriculture and Water
UNDP	United Nations Development Programme
WB	World Bank
WCD	World Commission on Dams
WSM	Watershed Management
WWC	World Water Council

Executive Summary

The Water Resources Management Research Capacity Development Programme (WRMRCDP) focuses on research capacity development and knowledge dissemination in the field of water resources management in catchment areas surrounding the Tonle Sap Lake, Cambodia. The programme is running for five years (July 2006 to June 2011), and is being implemented by the Natural Resources and Environment Unit (NRE) of the Cambodia Development Resource Institute (CDRI), with financial support from AusAID, and involvement from collaborating research partners: the University of Sydney (USyd), the Royal University of Phnom Penh (RUPP), the Ministry of Water Resources and Meteorology (MOWRAM) and the Ministry of Agriculture, Forestry and Fisheries (MAFF).

This working paper is the first large publication of WRMRCDP. This literature review provides a preliminary assessment of water resources management in Cambodia and has been prepared by the water team of WRMRCDP in connection with ongoing capacity building and development activities. The paper examines the existing literature on water resources management in terms of its physical basis, governance/institutional arrangements and legal frameworks, and draws on experience at the international, regional and in-country levels.

Physical Basis for Water Resources Management

It is important to understand the physical basis of a catchment before looking at water governance and other issues related to water management. Within a catchment, water is found in a series of interconnected "reservoirs". These reservoirs include surface water (overland flow, stream-flow, lake, and floodplain wetlands), groundwater, and atmospheric water sources. WRMRCDP focuses on two of these reservoirs – surface water and groundwater resources. Surface water and groundwater continually move between reservoirs, and both within and between catchments. Activities undertaken in any individual reservoir can have extensive impacts on other reservoirs within the system, and failing to recognise these impacts in advance can result in unforeseen consequences. Early recognition of the interconnected nature of catchment processes improves the likely success of water development projects, increasing the potential for such projects to become economically and environmentally sustainable.

Three interconnected components of the hydrological environment are analysed within this literature review. These three components are: fluvial and groundwater processes (surface and subsurface interactions), longitudinal variations, and catchment processes (including lateral processes and floodplains). Understanding the mechanisms underlying these three components is vital to ensuring the sustainability of Cambodia's future water management strategies.

This paper also examines ways in which human activities contribute to the deterioration of river environments, primarily through their impact on river discharge. For example, placing a dam on a river causes a decrease in discharge downstream, which reduces the transport capacity of the flow. Human activity also has biophysical impacts, as the extraction and/or impoundment of water can have profound impacts on both upstream and downstream aquatic ecosystems. Most aquatic organisms have adapted to a relatively narrow range of environmental conditions (e.g. temperature, stream chemistry, the timing and duration of flooding, etc.). Extraction and impoundment of water invariably alters this delicate balance.

In addition, dams act as physical barriers to migratory aquatic species and to nutrients sourced from upstream sites.

Catchment processes include fundamental interconnected activities observed laterally between the constituents of in-channel flows and adjacent floodplain zones. Human activities have significantly disrupted the important exchanges between river and floodplain, effectively disconnecting the river channel from its adjacent landscape. The major consequence of such disruptions has been a reduction in ecologic diversity—both within the channel and on the floodplain. Although humans have traditionally adopted management approaches that prevent flooding this can come at a cost to ecosystem health, potentially reducing the sustainability of floodplain activities such as irrigated agriculture.

Governance/Institutional Arrangements for Water Resources Management

Governance has become a key consideration in the international literature on water governance and development. For example, The United Nations' *World Water Development Report* (2003) states that the water crisis is mainly a crisis of governance. The 1992 *Dublin-Rio Statement* acknowledges that water is massive in volume but "finite" in nature. The volume of water available is limited, and increasing use, fuelled by rapidly increasing population and economic growth, thus creates scarcity in relation to demand. Water governance addresses key issues that arise when promoting the public good. Access to water resources has a big impact on the rural poor. Access to clean water promotes public well-being. For poor, rural farmers in Cambodia, irrigation serves as insurance against crop failures during dry spells and provides opportunities for farmers to grow two, or even three, rice crops a year. However, there are dilemmas with seeing water as a scarce resource on the one hand, and the need for water provision as a development goal, on the other. The tensions between these two concerns are central to this project. Tensions arise between the push to develop water infrastructure to achieve development goals, and the risk of undermining economic and environmental sustainability, social equity and ecosystem values on which rural livelihoods are based. It is the concepts of physical scarcity (i.e. scarcity of water as a physical resource in relation to demand for it) and economic scarcity (i.e. scarcity of resources for investment that allow water to be mobilised to meet human needs) that are most relevant in this context.

How is water governance defined? The Global Water Partnership defines water governance broadly as "the range of political, social, economic and administrative systems that are in place to regulate the development and management of water resources and provision of water services at different levels of society". Increasingly we see universalistic governance concepts applied to water. For example, the ADB flags governance as "promoting sound development management" and defines it as "the manner in which power is exercised in the management of a country's social and economic resources for development". It identifies accountability, participation, predictability and transparency as key elements in good governance. For the purposes of this study, water governance is referred to as the societal arrangements around water, including structures and processes of authority, collective action, accountability, transparency and participation that both facilitate and constrain improved management. Good governance is often understood to comprise the rule of law, effective state institutions, transparency and accountability in the management of public affairs, respect for human rights, and the participation of all citizens in the decisions that affect their lives. Governance implies management and regulation of the public good that goes beyond the centralised, monolithic nation-state.

The ways in which water is perceived has significant implications for the ways in which it is governed and managed. Changing perceptions in recent years have shifted the dominant paradigm in water governance away from water as a public good toward water as a scarce

commodity, but the shift is not complete or linear. Water is perceived both as a public good and as an economic good. As a public good, water is not just a good we consume but is also vital to life. No one can or should be excluded from using water: everyone can use it and no one can have a monopoly over its use. Perceiving water as a public good and the subsequent logic of it being free to all does create a few problems. The state is often unable to respond to the needs of citizens due to an excess of bureaucracy and rules and regulations. Management of water by public institutions is prone to failure as employees primarily pay attention to rent-seeking opportunities, often at the expense of effective service delivery. Seeing water as a public good can also lead to wasteful use as it is free and wastage incurs no cost. Supplying water at no cost in Cambodia could make some water projects unviable in the long term, especially without an assured governmental budget.

Perceiving water as an economic good raises the question of whether water should be free, or whether the use and management of water resources should be subject to pricing mechanisms and other market forces. Past failure to recognise the economic value of water has led to wasteful and environmentally damaging uses of the resource. The notion of water as an economic good holds that private markets can respond to the needs of the people faster than the state. This approach may lead to the establishment of cost recovery schemes for construction, maintenance, and operation of infrastructure, so that irrigation and drinking water projects are sustainable and achieve a level of ownership and management by the user group/community. However, this idea of water as an economic good has also been criticised as socially unacceptable, with market-based water allocation putting the poor, in particular, in a disadvantaged position.

Between the two extremes, there is a growing movement, the hybrid perspective, which sees water as both a public good and an economic good. The hybrid perspective, attempting to achieve both pro-poor accountability and sustainability of water management, tries to ensure that everyone has the right to water, especially drinking water, and argues that there should be more private investment in water development to meet the need for water in growing economies. However, the hybrid perspective faces some challenging questions around issues such as price setting and the state's responsibility to ensure minimum water rights and maximum allowable water use to ensure fairness and sustainability.

For many years, the dominant paradigm of water management was large-scale water projects. This paradigm held until the 1990s when alternative development approaches began shifting to smaller scales. Critiques of large-scale projects were centred around issues such as lack of responsiveness to local needs and disproportionate social and environmental impacts. Unlike large-scale schemes, a small-scale approach is usually more decentralised, and better enables people to communicate their needs to local officials and service providers. Principles of subsidiarity encourage decision making at the lowest appropriate level, with full public consultation and involvement of users in the planning and implementation of water projects. People are more likely to accept public policy if they are involved in the planning of policy, as this involvement gives them a sense of ownership. Small-scale schemes are seen to have a greater likelihood of success in this regard.

Integrated Water Resources Management (IWRM) takes a basin-wide approach to water management, and is increasingly seen as an important tool for sustainable exploitation of water resources for development. IWRM seeks to address problems of sectoral and geographical fragmentation of water resource management in its river basin or catchment context. IWRM focuses on issues such as the impact of upstream development on downstream water use in terms of the quantity and quality of water, and of preventing conflict between upstream and downstream users. Integration of catchment management with other development and conservation sectors is essential. Both poverty alleviation policies and catchment management policies need to be taken into account when planning IWRM.

Water Resources Management in the Mekong Region and in Cambodia

The Mekong River Basin is a diverse region of 70 million people living across six countries: Cambodia, Thailand, Laos, Vietnam, Burma and Yunan in China. As part of these countries' push for rapid economic growth and development, there is pressure to increase access to water to generate electricity and agricultural irrigation, and to provide water to urbanisation and industrial development. Development is uneven. China, Thailand and Vietnam are investing more on generating electricity to support local production and urbanisation while Cambodia, Laos and Myanmar are still in the process of investing on basic irrigation systems for agricultural production. Intensification of water use in Cambodia has the potential to take Cambodia from being a relatively open catchment system toward a "closed" system. Closure brings a need for governance arrangement that do not arise in more open systems, as with different users water requirements become progressively interlinked and competitive.

Co-riparian states tend to be more cooperative when dealing with water resources management than other resources, but the degree of cooperation still depends on self-interest and the capacity of individual states to accommodate individual development interests. Although international cooperation and negotiation to ensure equal rights to water access for individual countries' development is recognised and institutionalised through the Mekong River Commission, it remains partial and weak. Despite increased private investment in the water sector, little effort has been made to include the private sector in the process of coordination and conflict mitigation in basin-wide approaches.

Another challenge of regional cooperation to consider in Cambodia's case is the cost of upstream effects on ecological systems downstream. Article 7 of the 1995 MRC *Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin* requires each co-riparian state to make every effort to avoid, minimise and mitigate harmful effects that might occur to the environment, especially the water quantity and quality, the aquatic (eco-system) conditions, and the ecological balance of the Mekong River Basin water resources or discharge of wastes and return flows. However, Laos and Vietnam, for example, have been dam-building in the upper catchment of the Sekong River Basin, to generate electricity for sale to Thailand and Vietnam. These hydroelectricity dams affect hydrological flows and the livelihoods of the people who live along the Sesan and Srepok rivers, the Sekong's tributaries, and the flow into the Mekong, affecting aquatic eco-systems, fish and fish production in the Tonle Sap. Internal limitations have constrained the capacity of the Cambodian government to voice its concerns over the negative impacts, and it has been left to donors and NGOs to voice concerns about the ecological and environment impacts of dam building on downstream activities in Cambodia.

A key issue within Cambodia concerns the challenges of cooperation between agencies. By nature, a river basin cuts across many territorial boundaries. However, overlapping responsibilities amongst stakeholders make for inefficient management. There are many ministries involved in the management of water resources in Cambodia, but there is no framework for the management of water resources that integrates all the various sectors involved.

Following the shift in the water management paradigm from large centrally managed schemes to small locally managed schemes, the ADB in 1999 introduced Participatory Irrigation Management and Development (PIMD) to Cambodia. This involves people at all levels, especially locals who are directly concerned with irrigation water, in the planning, development and management of water. However, donors come into an area with a new idea and try to instil it into the local community and it seems not to have been a great success. The success of PIMD depends largely on participation, but the required participation is often limited. Farmer Water User Communities exemplify the problems of achieving effective participation in decentralised water management for irrigation and other purposes.

Institutions are essential in the management of water resources as they provide and enforce the rules governing the behavior of all actors to ensure predictability and certainty. However, institution building is a lengthy process, often taking generations to complete, and even then the outcome is unpredictable. Cambodian institutional performance has never been strong as Cambodia has been through difficult times for more than three decades. The most destructive time for institution building was when Cambodia was under the Pol Pot regime between 1975 and 1979. Aside from historical factors, it can also be argued that institutional performance in Cambodia is poor due to unclear definition of roles and responsibilities. For example, water-governing institutions in Cambodia have been operating in a vacuum, with comprehensive water law not coming into existence until May 2007.

Legal Framework

Related to the issue of water governance is the rule of law, and the legal frameworks put in place to regulate water. The starting point for the analysis of a regulatory framework as it pertains to water resources management is firstly to identify and secondly to evaluate the existing domestic and international legal frameworks. Research initially needs to determine what the rules are, and when and how these rules apply. To achieve the key objectives of sustainable development and equitable outcomes any regulatory framework for water management should address the triple concerns of appropriate implementation, enforcement and conflict resolution mechanisms. Customary legal systems are also important in water management. Customary legal systems are those based on existing norms and practices, whereas formal legal systems are those backed up by law and state apparatus. Both are important in the context of water resources management internationally.

Laws and policies related to water resources management in Cambodia:

On the domestic front the sources for water law in Cambodia are many and varied. They include:

- The New Constitution of the Kingdom of Cambodia 1993, Articles 58 and 59 (Jennar, 1995);
- The Law on Environmental Protection and Natural Resource Management 1996, Article 8 (Sok & Sarin, 1998);
- The Land Law 2001, Articles 144–146, Article 155–159, Article 49 (East-West Management Institute, 2003);
- The Law on Fisheries Management and Administration 2005
- Circular No.01 (11 January 1999) on the "Implementation Policy of Sustainable Irrigation Systems", and
- The Law on Water Resources Management 2007.

Reform in natural resource management in Cambodia more broadly has focused on strengthening three important pillars: sustainable forest management policy; natural resources and biodiversity protection; and community forestry development promotion. The policies and regulations related to natural resource management in Cambodia include:

- The Royal Decree on Protected Area Management, 1993
- The Law on Environmental Protection and Natural Resources Management, 1996
- The Royal Decree on Watershed Management, 1999: The Royal Decree gave the Ministry of Agriculture, Forestry and Fisheries (MAFF) a mandate to administer, manage, and improve forests within the watersheds and to coordinate inter-ministries and other agencies in this respect of activities.

- Subdecree on Watershed Management by MAFF, 2000
- Sustainability of Operation and Maintenance of Irrigation System Policy, 2000
- Land Law, 2001
- National Water Sector Profile, 2001
- Forestry Law and Regulation/Policy, 2002
- Subdecree on Community Forestry Management, 2003
- Natural Water Resource Policy, 2004
- Strategic Framework for Decentralization and Deconcentration Reform, 2005
- Law on Water Resources Management, 2007

There are many commentaries on the impediments to the enforcement of laws in Cambodia. Some of those hurdles are related to the provisions of law and enforcement which may be the result of jurisdictional overlap, the absence of transparency mechanisms and a lack of political will. It is also important to clarify the regulatory framework as it applies to the legal agreements for water use ownership rights, especially at the local level with the Farmer Water User Community (FWUC).

Conclusions and Ways Forward

This paper reviews international, regional and in-country experiences relevant to water resources management from physical, governance and legal perspectives. Through a combination of this literature review and a field-based social/institutional assessment, the Water Resources Management Research Capacity Development Programme (WRMRCDP) seeks to draw on concepts derived from the several disciplinary approaches reviewed to pose relevant questions in two main contexts: *irrigation development and management*, and *managing water in its catchment context*. These contexts are closely related, in the sense that isolated irrigation scheme management needs to be considered with reference to the wider water supply and project impact issues.

This literature review shows that in order to manage water effectively, it is imperative to consider both the physical attributes of water within its catchment context, and the socio-economic factors including governance, law and the wider developmental context in which water is being used. The three areas of literature reviewed in this paper provide an important background for research geared to help achieve agricultural production increases and sustainable uses of water resources in Cambodia A fuller literature review would also incorporate economic dimensions. The key research questions, derived in part from this literature review, and supplemented by the field-based social/institutional assessment, will focus on six key issues: coordination, scarcity, allocation, participation, evaluation process and assumptions in project appraisal, and impact. To deal with these key issues, physical, governance, economic and legal dimensions are considered in the research framework of the WRMRCDP.

Chapter 1. Introduction

Water resource management in Cambodia is at an important juncture. On the one hand, international experience shows the need for more sustainable approaches to the development and management of water resources. On the other, rapidly intensifying demands for water and for increased investment in the water sector to meet development needs give a new urgency to the need for proper and coordinated management of water resources in Cambodia. While much attention to date has focused on the technical and financial aspects of water resource development, there is also a need to build expertise and understanding through empirically grounded and conceptually informed research in the area of water governance across all levels.

Before undertaking research, it is important to review existing work in the field in order to learn from experience elsewhere and to build on the existing knowledge about water resource management issues and challenges in Cambodia. Good research practice requires a review of the literature. This working paper should be treated as work in progress, an important step in the framing of well-targeted research that meets the needs of Cambodian researchers, policy makers and water users. The paper is an early product of the Water Resources Management Research Capacity Development Program (WRMRCDP), a collaborative project between CDRI, the Royal University of Phnom Penh and the University of Sydney and supported by AusAID. This literature review provides a preliminary assessment of water resources management in Cambodia and has been prepared by the water team of WRMRCDP in connection with ongoing capacity building and development activities.

Two contextual bases for water resources management frame the research capacity building program and hence also this paper. The first is irrigation development and management, since the government's *Rectangular Strategy* places priority on the agricultural sector, and in turn this involves major plans for irrigation development. The second is managing water in its catchment context, which provides the most important geographical framework for integrated water resources management.

An important aspect of water resources management is its cross-disciplinary nature, encompassing as it does a range of issues from the natural to the social sciences. Accordingly, this paper addresses physical processes, institutional arrangements, and law and governance as key areas for water resource management research. Other important areas, for example the economics of irrigation schemes and the use of geographical information (GIS) in catchment management, are outside the scope of this paper, but will be addressed in later publications.

As an early product of an innovative program of WRMRCDP designed to address water management issues in Cambodia through increasing research capacity, this paper draws on relevant literature to outline experiences from international, regional and Cambodian contexts of water resource management. In so doing, the paper seeks to identify specific topics for research and to provide the conceptual background for framing such research.

The literature review is structured into five chapters. Following this introduction, chapter 2 provides an international overview of water resources management and governance. This chapter includes subsections on the physical basis for water resources management and governance, a definition of water governance, a look at changing perceptions of water management, an overview of the concept of Integrated Water Resource Management (IWRM) and a summary of the international legal framework related to water resources management.

This is all discussed within a framework of sustainability in terms of institutional arrangement, the importance of the physical process of catchments, and the governance of water resources.

Chapter 3 goes on to look at water resources management from a regional perspective. It begins with an overview of the challenges to regional cooperation found in the Mekong Basin, then looks at the issues of scarcity and conflict in the region, and finally gives a brief outline of some of the regional laws pertinent to water resources management in the Mekong.

The fourth chapter outlines water resources management in the Cambodian context. After a brief introduction to the geographical context, this section looks at the physical processes of catchments in Cambodia, then moves onto policy, irrigation management and development, Farmer Water User Communities (FWUC), institutional challenges, the role of law in water resources management and governance, and conflict resolution.

Each section addresses particular aspects of *water resources management* and *water governance*. By water resources management, we refer to the technical, financial and institutional arrangements established to achieve efficient use of water resources in pursuit of stated development goals, including material benefits, equity, sustainability and economic growth. By water resources governance, we refer to the societal arrangements around water, including the structures and processes of authority, collective action, accountability, transparency and participation that both facilitate and constrain improved management.

Finally, the literature review concludes with chapter 5 on "ways forward", which provides a brief analysis of where we can go from here in regard to water resources management in Cambodia. The literature review has shown us that in order to manage water effectively we must understand the catchment hydrology. Hydrology consists of three components: sub-surface, surface and atmospheric water. Under the framework of this study, however, we are looking only at the management of surface water. Water flows across and between catchments, and across and between different administrative boundaries. However, human activities upstream may restrict or impede this flow, for example through dams, causing impacts downstream. Therefore, to achieve the programme goal of increasing agricultural production and at the same time to achieve the sustainable use of water resources in Cambodia, three aspects are important in this regard: institutional strengthening at scheme and catchment levels, understanding of the physical process of the catchment, and good water-governance.

This literature review provides a stepping stone on the way to establishing in-country experience and research concepts that can be used by Cambodian institutions to support water resources management that serves the country's development needs in an equitable and sustainable manner. This paper is aimed at those involved in water sector development such as engineers, researchers (including academics), policy makers and government officials.

Chapter 2.
International Overview of Water Resources Management and Governance

This literature review looks at water resources management from three key perspectives: physical, governance/institutional and legal. Chapter two highlights key findings from the international literature across these areas. The chapter starts with an analysis of physical process in relation to water resources management, and then moves on to look at water governance and institutions, and finally the legal framework behind water resources management.

2.1 The Physical Basis for Water Resources Management and Governance

It is imperative to understand the physical basis for water resources management before moving to look at other issues associated with water management such as governance and institutional arrangements. This section looks at hydrology and catchments from a physical perspective, drawing on the international literature to highlight key concepts such as interconnectedness within catchments, the importance of understanding fluvial and groundwater processes, and the River Continuum Concept.

From a physical perspective, the catchment (watershed or drainage basin[1]) is generally considered to be the fundamental hydrologic unit for managing water resources. A catchment is typically defined as an area of land that is drained by a surface water body such as a river or creek, although the term is also relevant for subsurface water bodies. This definition indicates that catchments are landscape units comprising not only the soils and rock materials but also the water, air and biota (both plants and animals) within a defined region. In a simplistic sense, catchments are most easily managed as closed systems despite the fact that materials and energy freely move between separate systems.

The hydrologic component of catchments (i.e., the water) is located in a series of interconnected "reservoirs".[2] From a management perspective, these reservoirs can be classified into three types, to include surface water (e.g., overland flow, streams, lakes, floodplain wetlands), groundwater and atmospheric water. Of these three, management activities have major impacts on the first two and, to a lesser degree, can alter the third (e.g., by changing evaporation rates in ponded supplies). Significantly, water is continually moving between these reservoirs (both within and between catchments) and thinking of them as disconnected units is misleading. Activities undertaken in any individual reservoir can have extensive impacts on the other components in the system and failing to recognise this in

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[1] Much of the FAO and other literature refers to "watershed" management. In many respects, 'watershed' and 'catchment' can be used interchangeably. However, watersheds sometimes refer to small-scale catchments, and often the term watershed is used mainly to refer to the upper parts of catchments. Occasionally, watershed refers to the dividing line between catchments. Hence we use catchment as the generic term to refer to an area drained to a common end point by a network of streams and rivers, except when referring specifically to literature that uses the terms watershed or drainage basin.

[2] "Reservoir" in this case refers to a stock of water in a discrete part of the hydrological cycle. This should not be confused with the more common use of the term "reservoir", which is a human construction that holds water behind a dam.

advance can result in unforeseen consequences (e.g. extraction of floodplain waters can lead to reduced flows in adjacent rivers, lowered groundwater tables in one area and raised water tables in another). In addition to the interconnections evident between the reservoirs themselves, the movement of water across and through the landscape delivers nutrients, sediments and water that facilitate the development of healthy aquatic ecosystems and fertile soils. Disruptions to flows can cause detrimental impacts on these interconnected physical and biological systems. Thus, water management initiatives need to consider these numerous and complex interrelations early in the planning phase to limit potential impacts.

Early recognition of the interconnected nature of catchment processes will help improve the likely success of water resource development projects, increasing the potential for such projects to become economically and environmentally sustainable. The following review addresses some of the major issues that are likely to be important in future management strategies, particularly with respect to identifying some of the interconnections evident in the hydrologic environment.

2.1.1 Fluvial and Groundwater Processes

Surface and Subsurface Interactions:

Although surface and subsurface water supplies are often considered independently they are intimately connected. Indeed, many water resource management programs focus on the development of *either* surface *or* subsurface water resources and ignore the potential impacts to the other system. For example, perennial rivers are typically gaining streams, indicating that the majority of their flow comes from groundwater reserves. The pumping of groundwater at a rate in excess of recharge, therefore, can result in the loss of water from nearby stream channels due to the drawdown (or lowering) of the water table (Hunt, 2003). Working on a small stream flowing over coarse sand and gravel deposits in Denmark, Nyholm et al. (2003) observed that, on average, regional streamflow volumes were reduced by approximately 40 percent of the groundwater pumping rate. Thus, groundwater extraction programs should not be established without giving consideration to adjacent surface water resources.

The implications of such studies, however, extend well beyond issues of groundwater pumping. Any alteration to the supply of subsurface water will effect a hydrologic response in the catchment and this may also occur through alterations to surface water resources. The collection of water in dams, for example, will raise water tables in the vicinity of the dam itself, potentially increasing flows to local surface water reservoirs and causing the flooding of low-lying areas. At the same time the water that has ponded on the surface has been removed from another reservoir in the system, potentially disrupting its natural functioning (e.g., drawdown of a groundwater reservoir at some distance from the dam that would normally have been recharged by the water that is now stored in the dam). Likewise, alterations to the vegetation in catchments will affect the rate at which water infiltrates into the soil, altering the relative rates of surface and subsurface flows (Neave and Abrahams, 2002; Rao et al., 1998). Thus, changes to either the surface property conditions of a catchment or the water reservoirs within a catchment can disrupt the natural linkages that operate between the surface and subsurface water resources.

On the Hebei Plain in China increased water use has resulted in a drop in the water table that threatens the social and economic sustainability of the region (Xu et al., 2005). The Hebei Plain is situated within the North China Plain, an area that produces 20 percent of China's grain. As this is a semiarid environment, the agricultural sector is largely supported by groundwater fed irrigation. But the rate of groundwater extraction on the Hebei Plain has far exceeded the recharge rate and, consequently, between 1990 and 2000 the water table dropped by up to 0.71 m. This drop has resulted in a series of consequences including land subsidence, reduction of river flows, degradation of riparian ecosystems and saltwater

intrusions (Xu et al., 2005). All of these impacts reduce the developmental potential of the region and threaten the ability to grow certain crops. Indeed, crop selection is fundamental to the problems occurring on the Hebei Plain with crops such as millet and soybean using only about 30 percent of the water required to grow winter wheat. Understanding and identifying links between surface and subsurface water supplies, therefore, is fundamental to the sustainable development of resources.

2.1.2 Longitudinal Variations

Exchanges of water between surface and subsurface reservoirs represent one form of hydrologic connectivity. Another is the physical linkage of water, sediment and nutrients in the downstream direction along river channels. As water flows from the headwater of a river to its mouth it collects, transports and deposits a range of materials, including soil particles, organic matter and dissolved nutrients. The rate at which this material is entrained and transported depends upon the energy of the flow which is primarily a function of discharge and channel slope (Knighton, 1998). In humid-zone rivers, discharge tends to increase in the downstream direction (reflecting an increase in the area of the catchment feeding the channel) and slope decreases. The transport capacity of the flow at any point down a river, therefore, will reflect a delicate balance between these two (although the actual load transported by a flow is also influenced by the availability of entrainable materials). Thus, the rivers must be considered dynamic systems that will readily respond to changes in discharge and/or slope.

Human activities along rivers primarily impact on discharge, although systems typically respond to human induced changes in flow by adjusting their channel slope. One of the obvious ways that humans have a direct impact on discharge is through the placement of dams. Dams effect a decrease in discharge downstream of the structure, which reduces the transport capacity of the flow, although the pattern of discharge reduction varies depending upon the design purpose of the dam. Some dams allow virtually no flow below them while other smaller structures might have only a minimal impact on the downstream flow regime (Brandt, 2000). In general, however, dams reduce both total and peak discharges on rivers and can dramatically alter seasonal flow patterns (Magilligan and Nislow, 2005). In association with the forced ponding of water, dams act to trap sediment. In rivers with naturally high sediment loads or in regions experiencing substantial hillslope erosion this can significantly reduce the storage capacity of the structure. Silt accumulation over a twenty year period behind the Benji Dam in Zimbabwe, for example, raised the bed of the reservoir by up to one-third of the original height of the dam wall (Tafangenyasha, 1997). Likewise, based on present rates of sediment accumulation, over 20 percent of large dams in India will have lost approximately 50 percent of their storage capacity by 2020 (Naidu, 2000). Managers of these structures are faced with a series of options, the most common of which include dredging the sediment, increasing the height of the dam wall, positioning sediment traps on the upstream reaches and allowing released flows to flush the sediments (Tafangenyasha, 1997, Brandt, 2000). All of these options, however, come with a price—either economically and/or environmentally—and provide only temporary solutions to the problem of siltation.

With respect to longitudinal impacts, flows below dams are often sediment starved, which can result in the downstream scour (or erosion) of the channel bed and banks (e.g. Phillips et al. (2005) reported channel scour for a distance of 60 km below the Livingston Dam on the Trinity River in Texas, USA). However in certain environments the reduced flows result in rivers becoming choked with sediment which leads to channel contraction (Brandt, 2000). For example, the Rio Grande below Elephant Butte Reservoir in New Mexico, USA, is now filled with coarse sediment that would naturally have been flushed by large peak flows (Graf, 2006). The multiple conflicting responses to dam emplacement indicate the complexity of fluvial systems and point to the need for adequate scoping during the planning phase. This is further complicated by the fact that dams can also impact on rivers in the upstream direction through the alteration of the water surface slope.

The extraction and/or impoundment of water can also have profound impacts on both upstream and downstream aquatic ecosystems. Most aquatic organisms are adapted to a relatively narrow range of environmental conditions (e.g., temperature, stream chemistry, the timing and duration of flooding, etc.). Extraction and impoundment (behind weirs or dams) of water invariably alters this delicate balance. In addition, dams act as physical barriers to migratory aquatic species (e.g., brown trout) and to nutrients sourced from upstream sites. The importance of longitudinal interconnections along rivers to the health of aquatic ecosystems is exemplified by theories such as the River Continuum Concept, as described by Vannote et al. (1980). The River Continuum Concept describes "typical" changes in the physical, chemical and biological constituents along a river and identifies that certain organisms, such as aquatic invertebrates and fish, exhibit longitudinal gradients that reflect these changes (essentially responding to the availability of food and shelter at different points down the system). Disruptions to the downstream transportation of nutrients and organics imposed by dams, therefore, can substantially impact upon the survival of these aquatic ecosystems.

Once again, it is imperative to identify the importance of longitudinal variations along river systems to ensure adequate management of these features. For example, the Murray–Darling is the most heavily utilised river system in Australia and currently has over 3,500 dams and weirs within its catchment. A recent study by Thoms et al. (2007) indicates that these structures, along with associated land use changes, have resulted in moderate to severe degradation of ecosystem health for nearly all of the rivers in the catchment. Evidence of this decline in health includes: losses of key native fish species, drastic reductions in the number and diversity of native aquatic organisms and a rise in the number of invasive species within the Murray–Darling river system. The severity of these impacts is so profound that in many areas the costs of rectifying the problems associated with water resource development (particularly, irrigated agriculture) have far exceeded the benefits derived from those developments. Today, however, degradation on the order of that observed in the Murray–Darling Basin can be avoided if adequate planning (with the dual objectives of long term economic prosperity and environmental sustainability) is undertaken during the early stages of water resource project development.

2.1.3 Catchment Processes

Lateral Processes and Floodplains:

The River Continuum Concept highlights the importance of the longitudinal interconnections between physical (e.g., channel width, depth and slope) and biological components in rivers. Similar fundamental interrelations, however, can be observed laterally between the constituents of in-channel flows and adjacent floodplain zones. Floodplains are low relief depositional features that border stream channels and that are subject to inundation during high flow (flood) events (Bridge, 2003). They are composed of alluvium (sedimentary material deposited by rivers) and are typically described as being formed from both in-channel (point bar) and overbank (flood) deposits (Knighton, 1998).

Today, lateral exchanges of water and sediment between river channels and floodplains are recognised as being fundamental to the natural functioning of river systems. Traditionally, however, human activities have significantly disrupted these important exchanges, effectively disconnecting the river channel from its adjacent landscape. The major consequence of such disruptions has been a reduction in ecologic diversity—both within the channel and on the floodplain. Kingsford (2000), for example, investigated the ecologic impacts of reduced flooding on the health of floodplain wetlands in the Murray–Darling Basin. His study revealed that reduced flows to four large wetlands (i.e., reduced overbank events) caused a reduction in the health of aquatic biota, as evidenced by declining numbers of waterbirds, native fish and invertebrate populations in the wetlands. In addition, Tockner et al. (1999)

examined temporal and spatial patterns in organic matter and nutrient exchanges between the Danube River and its floodplain. Their work indicates that high levels of dissolved organic carbon and algal biomass are exported from the floodplain to the river during flood events. These materials serve as important food sources for the in-channel biota. These two studies indicate that rivers and floodplains should be thought of as integrated units that depend upon each other for their sustained health.

Although humans have traditionally adopted management approaches that prevent flooding this can come at a cost to ecosystem health, potentially reducing the sustainability of floodplain activities such as irrigated agriculture. For example, one consequence of reduced flooding in semiarid environments has been an increase in floodplain soil salinity levels. This has been observed to occur along the lower River Murray where large flood events traditionally flush salts from the soil (Jolly et al., 1993). Since the 1920s, however, the frequency of large flood events has been reduced by a factor of approximately three leading to the accumulation of salts at the soil surface. As many plants are capable of surviving in only narrow bands of salinity, this poses problems for the growth of both native and imported crop species. Thus, lateral connectivity is fundamentally important to ensuring the sustained health of fluvial systems.

2.2 Water Governance

The previous section highlighted the importance of understanding physical processes when looking at water resources management. Another key area to look at when considering water resources management is the issue of governance. Governance refers to societal arrangements around an entity, for example, the structures and processes of authority around water. This section looks at governance in a number of key dimensions: governance and development, definitions of water governance, perceptions of water, shifting paradigms, managing scarcity and conflict, and Integrated Water Resources Management (IWRM).

2.2.1 Key Considerations in Water Governance and Development

Water is necessary for life, and is a seemingly free and abundant good. Yet because it is so common, water is often taken for granted. The traditional view of water is that it is "nature's gift", so ubiquitous as to be unaffected by human activity. However, recently, there has been growing concern about water sustainability as the demand for water increases. Water is being used more and more for domestic, agricultural and industrial purposes. According to the 1992 *Dublin-Rio Statement* (Anon 1992), water is massive in volume but "finite" in nature. That is, the amount of water available is limited, and thus increasing use, fueled by rapidly increasing population and economic growth, could spell disaster in the future. As a result, terms such as "dying rivers", "dried-up rivers" and "water wars" have captured the popular imagination and instilled an increasing sense of urgency around water issues.

Access to public goods is seen as a necessary means to reduce poverty (Baumann, 2002). Access to water resources has a big impact on the rural poor: access to clean water promotes public well-being. For the rural poor, especially in developing countries, irrigation serves as an insurance against crop failures during dry spells and provides opportunities for farmers to grow two or three rice crops a year. Increased awareness of the importance of water has prompted the establishment of many world institutions such the World Water Council (WWC), the Global Water Partnership (GWP), the World Commission on Dams (WCD), the International Water Management Institute (IWMI) and the Mekong River Commission (MRC). These institutions, together with other world players such as the World Bank (WB) and the Asian Development Bank (ADB), are actively engaged in devising and promoting policies fundamental to sustainable management and development of water.

Water in development has become the subject of some major international position papers in recent years. These papers look at the twin concerns of water as a scarce resource on the one hand, and the need for water provision as a development goal, on the other. The tensions between these two concerns are central to the WRMRCDP. Tensions arise between the push to develop water infrastructure to achieve development goals, and the risk of undermining economic and environmental sustainability, social equity and ecosystem values on which rural livelihoods are based. There is also a risk of creating or exacerbating scarcity. It is the concepts of physical scarcity (i.e. scarcity of water as a physical resource in relation to demand for it) and economic scarcity (i.e. scarcity of resources for investment that allow water to be mobilised to meet human needs) that are most relevant in this context (Molden, 2007).

2.2.2 Defining Water Governance

Today, water governance has taken centre stage in discussions of water and development. The United Nations' *World Water Development Report* (2003) states that the water crisis is mainly a crisis of governance, while the Global Water Partnership defines water governance broadly as "the range of political, social, economic and administrative systems that are in place to regulate the development and management of water resources and provision of water services at different levels of society" (GWP, 2002: 2).

For the purposes of our study, we refer to water governance as the societal arrangements around water, including structures and processes of authority, collective action, accountability, transparency and participation that both facilitate and constrain improved management. Good governance is often understood to comprise the rule of law, effective state institutions, transparency and accountability in the management of public affairs, respect for human rights, and the participation of all citizens in the decisions that affect their lives. Governance implies management and regulation of the public good that goes beyond the centralised, monolithic nation-state.

While at one level there is apparent consensus over the need for better governance of water, the multiple criteria involved and the different interpretations of efficiency, equity and sustainability ensure that water governance reform remains a highly contested arena. The ADB flags governance as "promoting sound development management" (ADB, 1999) and defines it as "the manner in which power is exercised in the management of a country's social and economic resources for development". It identifies accountability, participation, predictability and transparency as key elements in good governance.

Amongst other principles, the mainstream discourse on good governance tends to emphasise:

- Decentralization to local government and principles of subsidiarity (countering top-down control);
- Enhanced roles for civil society (countering bureaucratic control);
- A place for the market (rolling back of the state's micromanagement and allocative inefficiency to a more enabling/regulatory role through law, policy, administration);
- Participation, accountability, transparency (countering closed and corrupt decision making);
- Transboundary management (countering geographical fragmentation); Holistic/whole-of-government approaches (countering the "silo" effect).

As part of this emphasis on governance, a number of institutional changes have become apparent in the water sector in recent years (Saleth and Dinar, 2000), reflecting something of a new development orthodoxy that is implicitly universalised through the notion of "best practice". The emphasis here includes commodification, privatisation, decentralization,

bioregional administration (managing water in its catchment context), holistic approaches under the rubric of whole-of-government approaches, Integrated Water Resources Management, Integrated River Basin Management, and a move from supply-driven orientation to demand-side management, and hence from construction to allocation.

2.3 Changing Perceptions of Water

The ways in which water is perceived also has significant implications for the ways in which it is managed and governed. Changing perceptions in recent years have shifted the dominant paradigm in water governance away from water as a public good toward water as a scarce commodity, but the shift is not complete or linear. Discussion of the institutional arrangements of water resources management, whether formal or informal, cannot be complete without consideration of how people perceive water.

2.3.1 Water as a Public Good

A large body of literature on water resources management is dedicated to discussion of how water should be seen as a good or a resource. One school of thought argues that water should be treated as a public good, for example as declared by the United Nations Committee on Economic, Cultural and Social Rights in its *General Comment on the International Covenant on Economic, Social and Cultural Rights* in 2002 (www.who.int/mediacentre/news/releases/pr91/en). Water is not just a good we consume, but is also vital to life. Therefore, everyone, rich or poor, old or young, should have access to it. The former United Nations Secretary-General Kofi Annan backs this view, stating: "Access to water is a fundamental human need and therefore a basic human right" (http://www.righttowater.org.uk/). The Law on Water Resources Management of the Kingdom of Cambodia (2007) also states that water, ponds, lakes and rivers belong to the state. This means that no one can or should be excluded from using water: everyone can use it and no one can have a monopoly over the use of water.

But treating water as a public good and the subsequent logic of it being free to all does create a few problems. The first is the inability of state institutions to respond to the needs of citizens. Perry et al. (1997) argue that the state is by its nature slow to respond to people's needs due to an excess of bureaucracy, and rules and regulations. Red tape significantly reduces the speed at which institutions can respond to the needs of local people. This is made worse by the fact that incentive is often divorced from performance. At the same time, Wade (1982) also argues that management of water by public institutions is prone to failure as employees primarily pay attention to rent-seeking opportunities, often at the expense of effective service delivery.

Secondly, treating water as a public good can lead to wasteful use as it is free and wastage does not incur any cost. Additionally, treating water as a public good and supplying water for free can make some water projects unviable in the long term, especially without an assured governmental budget, something often lacking in poor countries such as Cambodia (Savenije & Zaag, 2001). This is because of the costs of setting up an irrigation scheme, for example, and of the operational costs, which may include administration and maintenance.

2.3.2 Water as an Economic Good

So should water be free? Who is going to take care of water? These questions lead to alternative perspectives on water. It can be argued that water should indeed not be treated as a public good, but rather as an economic good (Perry, Rock & Seckler, 1997; Savenije & Zaag; 2001 ADB, 2004; Global Water Partnership, 2002; ICWE, 1992). Unlike the public good paradigm, this school argues that the management of water should be left to market forces. Principle Number 4 of the *Dublin Statement* says:

> *Water has an economic value in all its competing uses and should be recognized as an economic good. Within this principle, it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognize the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water (Anon 1992: 4).*

Donors such as the World Bank and the Asian Development Bank are also actively promoting the concept of water as an economic good. The ADB, for example, explicitly states in its water policy that: "water is a socially vital economic good" (ADB, 2003: 13). The *International Conference on Water and the Environment*, held in Dublin in 1992 also called for the treatment of water as an economic good.

Treating water as an economic good, it is argued, is useful for two main reasons. First is the scarcity value of water: pricing can be part of a demand management approach whereby incentives are put in place to conserve and to shift water use to higher value activities. Water is used efficiently which, it is assumed, can be achieved only when management of water is left to market forces. The forces of supply and demand should determine consumption levels. Under this scenario, people have to pay to use water, and because people are usually interested in maximizing profit, they only use enough water to satisfy their immediate needs. Thus water is used efficiently and optimum allocation of water between sectors takes place (Perry, Rock & Seckler, 1997).

Secondly, markets can respond to people's needs faster than the state (Perry, Rock & Seckler, 1997), which, it is argued, cannot manage water as efficiently. As discussed earlier, state institutions are slow to respond to local demand. If left to the market, water resources management can respond to local needs, and at the same time there is incentive for individuals and/or private companies to invest in water infrastructure (Savenije & Zaag, 2001). This approach may lead to the establishment of cost recovery schemes for construction and maintenance of infrastructure, so that irrigation and drinking water projects are sustainable and achieve a level of ownership and management by the user group/community (Nicol, 2000).

However, the idea of treating water as an economic good has also come under strong criticism. Treating water as an economic good is probably economically viable, but can also be socially unacceptable, with market-based water allocation putting the poor in particular, in a position of disadvantage (Ojendal, 2000). Water pricing is the central issue here. Treating water as an economic good means, for example, that farmers have to pay to use water to irrigate their fields, an arrangement that has seldom existed previously. Ojendal (2000) warns that managing a resource by putting a price on something that has previously been free can be risky and can work against the poor in particular.

At this point, the two schools of thought (public good verses economic good) collide with each other. However, the main contention is probably not the issue of whether water is a public good and therefore is free, or whether it is an economic good and people should pay to use it. Rather, the problem seems to lie in how access to water and its purpose are defined. The argument for water as a public good tends to focus on the domestic use of water, in particular viewing water as a basic necessity for life (e.g. safe drinking water), while at the same time, the water as economic good argument seems to refer more to the use of water for productive purposes (Hoekstra, 2006). In Cambodia, productive use of water is for subsistence as well as for marketed products, so the distinction between water as public good and as economic good can be blurred.

2.3.3 Hybrid Perspective

Between the two extremes, there is, however, a growing movement that sees water as both a public good and an economic good. This is a hybrid perspective. In an attempt to achieve both pro-poor accountability and sustainable water management, this perspective tries to ensure that everyone has the right to water, especially drinking water, and argues that private investment in water development should increase to meet the need for water in growing economies.

However, the hybrid perspective is faced with two challenging questions, the first concerning price setting. Although most water analysts agree that there should be a fee to use water, there have been differences over what is an appropriate price for water. Water is not simply an economic good but is also a social good, which must be affordable by all, including the poor. Therefore, simple market theory can not apply (Savenije & Zaag, 2002). Although there is a price tag, the pricing of water should be set in a way that ensures long-term financial sustainability only (Savenije & Zaag, 2002). So, how do you set an optimum price for water to ensure efficiency, sustainability and social equity all at the same time?

Secondly, it is generally agreed that to ensure macro stability, social equity, and environmental sustainability, the state should play a strong regulating role through meaningful and opportunistic interventions, which, some argue, include establishing minimum water rights and maximum allowable water use to ensure fairness and sustainability (Hoekstra, 20006). Hughes (2006) suggests that the state can stay at arms-length from the market but this does not mean that water management is completely unregulated. The state should intervene strategically (Polanyi, 1944).

2.4 Shifting the Paradigm from Large-Scale to Small-Scale

For over two decades from the 1950s to the 1970s, the dominant paradigm of water management was large-scale water projects. Large-scale projects such as the Tennessee Valley scheme in North America and the Jingtai Chuan Irrigation Scheme in China were designed, financed, and managed by the state. These schemes were promoted as they were seen by many states and development experts as a means to rapid economic growth, benefiting a large number of people in the agricultural sector and producing cheap electricity for industry (Ojendal, 2000).

However large-scale irrigation schemes often suffered from inadequate operation and maintenance systems leaving them unable to respond to the needs of local people (Peter, 2004). These schemes also came under criticism from social activists and academics concerned about impacts on the environment and benefits being measured solely in terms of financial imperatives. The construction of large-scale schemes does offer potential for irrigating large cultivated areas, improved transportation and cheap electricity. However, large-scale schemes also tend to cause disruption to the regional ecosystem, resulting in environmental destruction and affecting local residents (IWMI, 2006a). Adams highlights some of the common social consequences of large-scale projects, including problems of unequal benefit, social exclusion, elite development, one-dimensional improvement, and conflict creation (cited in Ojendal, 2000).

During construction of large-scale water projects, planning and cost benefit analyses are often undertaken solely by technical people and economists, and thus the resulting projects tend be of a “one-size-fits-all” nature. Since the 1990s, however, as criticism of large-scale irrigation schemes became stronger, alternative development approaches have been sought. These new approaches have tended to focus on small-scale schemes. Unlike large-scale schemes, a small-scale approach is usually more decentralised, and better enables people to communicate their needs to local officials and service providers.

According to Brooks (2002: 1) "local community-based water management seems to be an old idea whose time has come again. For too many years, the role of local people has been, if not totally ignored, at least down played". A small-scale approach also appears to be more politically and socially acceptable these days (Schumacher, 1973; McDonald & Key, 1988; Ojendal, 2000) as it requires decisions to be made at the lowest appropriate level, with full public consultation and involvement of users in the planning and implementation of water projects (Global Water Partnership, 2002). Moote, McClaren and Chickering (1997) suggest that people are more likely to accept public policy if they are involved in the planning of policy, as this involvement gives them a sense of ownership.

Involving local people in the management and development of water resources also brings added value in terms of incorporating local knowledge. The knowledge brought in by local people can be of major practical value for the efficient and sustainable management of water resources, whether it be water harvesting, river-basin management or irrigation. In his study of water harvesting on a desert area in Egypt, Narain (2006) points out that the local method of water harvesting is significantly more effective than the large-scale and centrally managed methods.

2.5 Integrated Water Resources Management (IWRM)

Integrated Water Resources Management (IWRM) takes a basin-wide approach to water management, and is increasingly seen as an important tool for the sustainable exploitation of water resources for development. IWRM seeks to address problems of sectoral and geographical fragmentation of water resource management in its river basin or catchment context. IWRM focuses on issues that include development in upstream areas, impacts on downstream water use in terms of quantity and quality of water, and prevention of conflict between upstream and downstream users. For example, empirical studies (ADB, 2005b) and Phillips et al., 2006) show that changes in land use patterns upstream eventually affect downstream development, the living environment and the ecosystem.

The integrated nature of catchment resource systems has put Integrated Water Resources Management (IWRM) at the centre of catchment governance. Much of the literature indicates that integration of catchment management with other development and conservation sectors is essential. Integrated management of water resources entails involving all water sub-sectors, planning and coordination of development efforts within a catchment, and river basin planning and action frameworks. IWRM as a crosscutting mechanism requires regional and international collaboration. Water-related development at one point of a river basin will affect livelihoods and economies of all other co-riparian states or communities.

To date, concerns among academia and IWRM policy makers have focused on the broad concept of a basin development approach. That is, going beyond simply building stand-alone hydroelectricity dams or large irrigation schemes, to insisting upon cooperation amongst stakeholders to avoid conflict over competition for water and to encourage benefit sharing amongst co-riparian states and between intra-national administrative boundaries and communities. This approach is seen as necessary to protect river systems and to maintain the quantity and quality of water for all living environment and development purposes. Both poverty alleviation policies and catchment management policies need to be taken into account when planning IWRM.

FAO (2006) quotes King (1977) who in his research on integrated watershed management effectiveness argues that:

> *In the formulation of watershed management plans, both the attributes of the land and water resources and the socio-economic factors which affect the development of the human being in the area in general, and land-use practices in particular, should be taken into account. Moreover, there should be provision for perpetual operational support. Without adequate social control of the use of the world's land*

> *and water resources, their technological overdevelopment can lead in the long run to regional or national underdevelopment. Furthermore, there must be an awareness of the total soil and water resource system, both upstream and downstream, and of the interrelated benefits that can be obtained by the wise application of modern technology, (FAO 2006: 42)*

Another challenge for IWRM concerns water rights as a concept of public good – that is changes in perceptions of water from a customary right or "free gift from the natural hydrological cycle" to water rights conceived as "rights to pay for access to water". The success of IWRM depends on the ability to gear water-related development activities toward sustainable use of water resources and to encourage all water related stakeholders to follow the conventional and agreed rules in ensuring equal rights of assess to water.

IWRM has been applied in a catchment framework through Integrated Catchment Management. Recognition of the integrated nature of resources within catchments has led to the adoption of more holistic water resource management approaches. There is an obvious need to understand and plan for the complex array of interconnectivities that occur within fluvial systems, and Integrated Catchment Management (ICM) represents one opportunity to do this. The goal of most ICM programs is to expand the focus from managing individual components within rivers and catchments (whether that represents small spatial units, individual aspects such as soil salinity or individual projects) to managing the *entire* catchment within an integrated framework that considers economic, environmental *and* social values (Jakeman and Letcher, 2003). For the sustainable development of irrigated agriculture, for example, it is imperative that non-agricultural stakeholders be included in decision-making processes and that the objectives of projects extend beyond the expansion of crops (Batchelor, 1999). But precise mechanisms for instigating successful ICM programs are difficult to define due to the large spatial and operational scales over which such programs aim to function. Thus, many ICM programs have begun with strongly worded ideals but have failed to deliver at the implementation phase. Some common features of successful ICM programs, however, include: the definition of a natural resource management strategy with clearly defined objectives, mechanisms for achieving those objectives, and a monitoring schedule; the inclusion of local communities in decision making activities and the implementation of action across several scales including catchment-wide, regional and local; and the establishment of mechanisms and policies that enable long-term support (Batchelor, 1999). Involvement of local communities in catchment-wide management continues to be one of the biggest challenges. Falkenmark (2004) identifies that the arenas of water policy, management and scientific investigation have traditionally operated with separate (often conflicting) agendas and that one goal of ICM, therefore, should be to enable the free exchange of information that will enable a balance of resource usage between humans and the environment.

The underlying premise of ICM programs is that water resources should be managed in order to find a balance between humans and ecosystems. Where economic/social expansion is driving management programs there is often a tendency to dismiss environmental needs. However, it is important to recognise that healthy ecosystem functioning provides benefits to *all* users of fluvial systems—including humans. For example, the long-term profitability of irrigated agricultural activities on floodplains depends on users having ongoing access to adequate water supplies and on the maintenance of healthy soils. Healthy aquatic ecosystems function to improve water quality while overbank events rejuvenate floodplain soils. Individual water resource development programs that do not recognise the benefits of these natural processes run the risk of implementing unsustainable programs that will require substantial maintenance costs in the future and that may have drastic negative effects on other users in the system, such as downstream fisheries.

2.6 Managing Scarcity and Conflict

The *Human Development Report* is an annual publication of the United Nations Development Program that takes a key theme each year. The 2006 *Human Development Report* was entitled *Beyond scarcity: Power*, *poverty and the global water crisis* (UNDP 2006), reflecting the growing concern with water as a key environmental and developmental concern at a global level. It takes the concept of water scarcity as a defining challenge. Scarcity is presented as an outcome of policy and human actions rather than as simply a naturally occurring event, hence it becomes a situation to be managed rather than ignored. The report makes a plea for greater political and international attention to be given to water. It also warns of the impending intensification of competition for water, and the danger that this may lead both to loss of access by the poorest and most vulnerable, and also that it will lead to growing tension and conflict at different levels – including across borders – unless water is properly managed and governed with the poor in mind.

Scarcity and conflict are two issues that are closely related, particularly in "closed" river basins where water is already more or less fully allocated for human use or to maintain basic environmental requirements. Further development of water resources in such cases can easily lead to a situation of "robbing Peter to pay Paul". Molle et al. (2004) provide an excellent example of such a case from Iran, with lessons not only for water resources development and management, but also for case study design in water resources management research in Cambodia. The role of local and wider politics is integral to understanding the costs, inequities, sustainability questions and potential for conflict in such situations.

2.7 Legal Framework

Related to the issue of governance, is the rule of law. The rule of law refers to legal frameworks put in place to regulate an entity, in this case, the use of water. This section looks at the international regulatory framework surrounding water resources management, taking into consideration issues such as customary and formal legal systems and the land/water interface (i.e., the relationship between land tenure rights and water rights). This section endeavours to provide an introductory overview by intertwining these themes with reference to selected literature.

The starting point for the analysis of a regulatory framework as it pertains to water resources management is to firstly identify and secondly to evaluate the existing domestic and international legal framework. In the first instance, research needs to ascertain what the rules are in addition to when and how these rules apply.

To achieve the key objectives of sustainable development and equitable outcomes, any regulatory framework for water management should address the triple concerns of appropriate implementation and enforcement provisions and suitable conflict resolution mechanisms. These issues represent the fundamental principles for an effective regulatory regime.

A number of policy documents from international agencies provide us with background to the international influence on the water regulatory framework. Much of this literature is inextricably linked to the concept of "good governance". Several United Nations reports develop these issues. For example, the United Nations World Water Development Report 2, *Water, a shared responsibility* (2006) includes a section on "Water Governance in practice – trends in reforms and rights", which includes descriptions of customs and traditions pertaining to water rights. In addition, published under the auspices of the United Nations Development Programme's (UNDP's) *Human Development Report 2006*, Tropp et al. (2006) provide a range of insights into water governance challenges surrounding the dilemma involved with the resource in a climate of increasing competition and scarcity.

2.7.1 Customary and Formal Legal Systems

Customary legal systems are those based on existing norms and practices, whereas formal legal systems are those backed up by law and state apparatus. Both are important in the context of water resources management internationally.

For a useful perspective on the collision between pre-existing, or customary water rights, and emerging, newer legislative provisions for water resources management a paper emanating from the United Nations Food and Agricultural Organization's (FAO) on-line legal series is worth perusing. Burchi (2005) analyses the extent to which customary systems are integrated into legislative approaches and scrutinises the different methods to reconciling these rights. In conclusion, he marks future issues in the ever-emerging transition (the "modernisation" process) from customary water rights to more formal, legally based, administrative obligations.

From a legal perspective Tropp et al.'s section on water rights and customary water rights in the UNDP publication *Water governance challenges: Managing competition and scarcity for hunger and poverty reduction and environmental sustainability* (2006) is also particularly useful for crystallising these issues.

2.7.2 Land/Water Interface

The relationship between land tenure rights and water rights is another important issue for the international regulatory framework surrounding water. An FAO publication by Stephen Hodgson (2004) provides a comprehensive overview of this issue. The investigation addresses the issue of defining land tenure and water rights; then, using a global perspective, this paper provides a comparative analysis of land tenure and water regimes. The paper also examines the linkages between land tenure and water rights. In defining land tenure, Hodgson goes beyond strict concepts like "ownership" to usufruct rights. On the issue of water rights this paper makes the very important point that they "frequently go beyond an entitlement to a mere quantity of the simple chemical component which is water: the flow of the water is also an important component of a water right" (p.9). This is a comprehensive paper covering many issues, including an evaluation of the themes surrounding "security", "charging", "administration", and "international law". In the observations on "key aspects of the rights interface" (part 6), issues surrounding "irrigation" (pp. 43–48), "groundwater" (pp. 50–53), "rights created under customary law" (pp.55–62) and "tradable water rights" (pp. 63–64) are articulated systematically.

Chapter 3.
Regional Overview of Water Resources Management and Governance

This chapter moves away from an international focus on water resources management, to assessing water management in the region. The Mekong region is a diverse region of 90 million people living across six countries: Cambodia, Thailand, Laos, Vietnam, Burma and Yunnan in China. Rice is the principal livelihood of people in the region. Water and its management is of vital importance not just to each country individually but also to the region as a whole.

This chapter looks at the challenges of Integrated Water Resources Management (IWRM) in the region, scarcity and conflict, and regional arrangements for the management and governance of water, including transboundary agreements and national water law.

3.1 Challenges of Regional Cooperation in the Mekong

IWRM in the Mekong River basin is being driven by increased demand for water to serve economic development in the region. After slow economic growth and social development during the colonial and cold war periods, the Mekong riparian states are at a critical stage of economic growth and development, poised to catch up with the fast economic growth of neighbouring countries. The co-riparian states require increased access to water for generating electricity, agricultural irrigation, and to provide water for urbanisation and industrial development. For example, China, Thailand and Vietnam will, in the future, need more electricity to support local production and urbanisation, while Myanmar, Lao PRD and Cambodia are in the process of increasing investment in basic irrigation systems for agricultural production. Intensification of water use in Cambodia, as Molle, Wester and Hirsch (2007) point out, has the potential to take Cambodia from being a relatively open catchment system, towards a "closed" system. Closure brings a need for governance arrangements that do not arise in more open systems, as different users' water requirements become progressively interlinked and competitive.

The progress of IWRM in the Mekong Basin so far has been subject to international politics and negotiation. The emphasis has been on international and institutional relationships and coordination compliant with the *MRC 1995 Agreement* and individual national water policies and water laws. Strengthening institutional capacity and utilizing good cooperation to enforce water policies and laws are seen as good tools to ensure equal rights and access to water through an IWRM approach.

While co-riparian states tend to be more cooperative when it comes to water than other resources, the degree of cooperation still depends on self-interest and the capacity of the individual states to accommodate individual development interests. Each country needs to strictly implement internal and international environmental codes of conduct and make sure every water-related development project is compliant with human water rights. This requires stronger transboundary coordination and negotiation mechanisms including enforcement of agreed institutional arrangements, and laws and regulations for equal rights of access and sharing benefits from the Mekong River. Lebel et al. (2005) and MRC (2006) further reaffirm that while international cooperation and negotiation to ensure the equal rights of water access for individual countries' development in the context of hydrological and environmental

protection is seen as essential, in practice it remains partial and weak. For each riparian state in the Mekong River basin, it is always a trade off between the claim for the right to maximum water use for the individual state's development and environmental conservation or hydrological maintenance and ecological balance.

Francois Molle's (2005) report on current policies and discourses around water management in Mekong countries makes an important statement about the continuing divide between international influence on policy making, and local realities and involvement. In his review of current policy on water and irrigation in each of the Mekong countries, he looks critically at the establishment of "apex" bodies that have relatively little articulation with water management at wider governmental and community levels. The report calls for more research on water governance, recognizing the many divides that exist between rhetoric and policy, on the one hand, and grounded realities and local aspirations on the other.

At the whole of basin scale, another publication relevant to water governance in its regional institutional context is a report on *National Interests and Transboundary Water Governance in the Mekong*, carried out by the Australian Mekong Resource Centre in collaboration with Danida (Hirsch and Jensen 2006). This report looks critically at the role of the Mekong River Commission from the point of view of engagement at both senior political levels and at the level of civil society and the Mekong public. The question of governance is found to be fundamental in taking an institution that has largely been concerned with knowledge production into a role of supporting integrated water resource management in its proper sense of stakeholder involvement. The report is also significant in looking critically at the roles of donors in supporting better water governance that is enmeshed with social and political realities.

There has been an increase in private investment in the water sector in the Mekong Region (MRC 2006). But so far, little effort has been made to include the private sector in the process of coordination and conflict mitigation in basin wide approaches. For example, in the case of hydroelectricity dam building, private investors, to date, have often refused to participate in conflict mitigation or damage compensation (MRC, 2006). The government then has to bear the cost of damage and conflict mitigation post-construction. Enforcement of rules and regulations is often weak or slow and bias is often toward rapid growth in developing countries such as Cambodia. Affected communities are often the losers in the process. Since the private sector is playing a larger and more critical role in the growth of developing economies, the engagement of the private sector in a basin wide approach may be an effective way to ensure benefit sharing between the powerful elite and powerless riparian communities.

Another challenge of regional cooperation to consider in Cambodia's case is the cost of upstream effects on ecological systems downstream. Article 7 of the 1995 MRC *Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin* requires each co-riparian state:

> *To make every effort to avoid, minimise and mitigate harmful effects that might occur to the environment, especially the water quantity and quality, the aquatic (eco-system) conditions, and ecological balance of the river system, from the development and use of the Mekong River Basin water resources or discharge of wastes and return flows.*

However, Laos and Vietnam, for example, have been dam-building in the upper catchment of the Sekong River Basin, to generate electricity for sale to Thailand and Vietnam (MRC 2006). These hydroelectricity dams have affected, in the case of the Yali Falls dam in Vietnam (Swift 2006), and will affect, in the case of a series of future dam-constructions planned in Lao PDR, the hydrological flows and the livelihoods of the people who live along the Sesan and Srepok river, the Sekong's tributaries, and the flow into the Mekong, affecting aquatic eco-systems, fish and fish production in the Tonle Sap. Internal

political conflicts have limited the capacity of the Cambodian government to voice its concerns over the negative impacts and it has been left to donors and NGOs to voice concerns about ecological and environment impacts of dam building on downstream activities in Cambodia (MRC 2006).

3.2 Scarcity and Conflict

As introduced in the previous section, scarcity and conflict are two important issues to consider when it comes to water resources management. This section outlines particular issues related to scarcity and conflict that are pertinent to the Mekong region.

The *Comprehensive Assessment on Water Management in Agriculture* is a large-scale multi-institutional exercise managed by the International Water Management Institute (see http://www.iwmi.cgiar.org/assessment and Molden 2007). The overall purpose of the exercise is to assess the experiences of the past half century of water resources development, for agriculture in particular, so that further water infrastructure built to meet development goals can learn from the lessons of the past. A key issue underlying the report is the need to use and manage water to fulfill human needs and to maintain fundamental environmental functions. It seeks to find an appropriate position between those who push aggressively for continuing development of water resources infrastructure without concern for physical limits and social impacts, and those who call for an end to water resources development without concern for the human need for basic water provision. Among the many themes covered, the assessment addresses the question of scarcity. There is a broad division between what is termed "physical scarcity", when natural water supply is simply insufficient to meet demands made on the resource in a sustainable manner, and economic scarcity, when it is lack of infrastructure that creates difficulty in accessing water for human needs.

Svendsen (2005) presents the dilemma of managing water as a scarce resource when there are mounting pressures both within agriculture and from beyond the agricultural sector where returns to water use are often higher. Case study material is drawn from six countries in both the developed and developing world, including some from the Mekong region. Issues of river basin institutional approaches are raised in several sections, and a key question is the suitability of developed country models being transposed to developing country contexts (see also Miller and Hirsch, 2003).

Managing competing demands for water through allocation mechanisms is also a key governance challenge. Svendsen et al. (2005) present the case of Vietnam's Dong Nai Basin showing the current and potential allocation mechanisms in a basin-wide context. More often than not, allocation is project or scheme specific. However, a word of caution is in order, in the sense that many of the ideas on water trading and market-based allocation are still in their infancy, at best, at an applied level, even in well-developed market economies. Many issues remain unresolved (Young and McColl, 2004).

3.3 Regional Water Laws

In order to understand the legal framework surrounding water in Cambodia, it is useful to first look at regional law. This section highlights some of the water laws in place within the Mekong region.

For a useful practical perspective, a report by the Chief Technical Adviser to the Ministry of Agriculture and Rural Development (Danida Water Sector Program) in Vietnam is enlightening. Anderson (2003) was involved in establishing the by-laws to implement Vietnam's national legislative framework set out in their 1999 *Law on Water Resources*. His introduction provides an overview on issues of water availability, surface water availability/demand and groundwater resources/demand. Part three of this paper articulates the laws associated with water resources in Vietnam. The author identifies that the guiding policies and principles of water management and development are articulated in the 1999 *Law*

on Water Resources, and suggests that this instrument also clearly incorporates the issue of water rights. Anderson describes the introduction of specific water laws as a step-by-step and "learning by doing" process. The paper helpfully describes the process of testing the registration and permits for groundwater abstraction decisions in selected regions. The description of how an emerging legislative process evolved, integrating public participatory approaches, is interesting for comparative analysis.

Another useful regional perspective on water law issues can be gleaned from a working paper from the Office of Natural Water Resources Committee of Thailand (2006). Of particular interest is the section committed to "Management Challenges: Stewardship and Governance" (pp. 396 – 400). The report is based on analysis of the Chao Phraya basin in Thailand. This paper informs us that pre-existing informal water allocation systems have varied across the basin (divided into topographically distinct northern, middle and southern sections). The current system allows both individual and organisational users in each province an allocated number of days for water withdrawal from the basin. Enforcement is the responsibility of the provincial authority while the Ministry for Interior coordinates the system. From an ineffectiveness point of view this report observes:

> *Compliance with the water allocation plan is good among the agencies represented on the working group but not among farmers*, *the central reason for this being that farmers can earn more income by planting a second rice crop in defiance of the plan. There is no enforcement because disobeying the water allocation plan is not illegal. Accordingly*, *efficiency and equity are low (p.397).*

This comment may be a particularly interesting observation to dwell upon in light of the need to effectively develop water law in Cambodia.

Chapter 4.
Local Overview of Water Resources Management and Governance

The previous chapters of this literature review have looked at international and regional perspectives on water resources management from physical, governance/institutional and legal viewpoints. This chapter goes on to look at all these issues with specific regard to Cambodia.

The chapter starts with a brief introduction to the geography of Cambodia and then moves onto the specific physical processes at play in Cambodia. The chapter then discusses policy surrounding water resources management in Cambodia, the role of the Ministry of Water Resources and Meteorology (MOWRAM), irrigation development and management in Cambodia, Farmer Water User Communities (FWUC), institutional challenges in Cambodia and, finally, the role of law in Cambodia.

4.1 Geographical Context of Water Resources Management in Cambodia

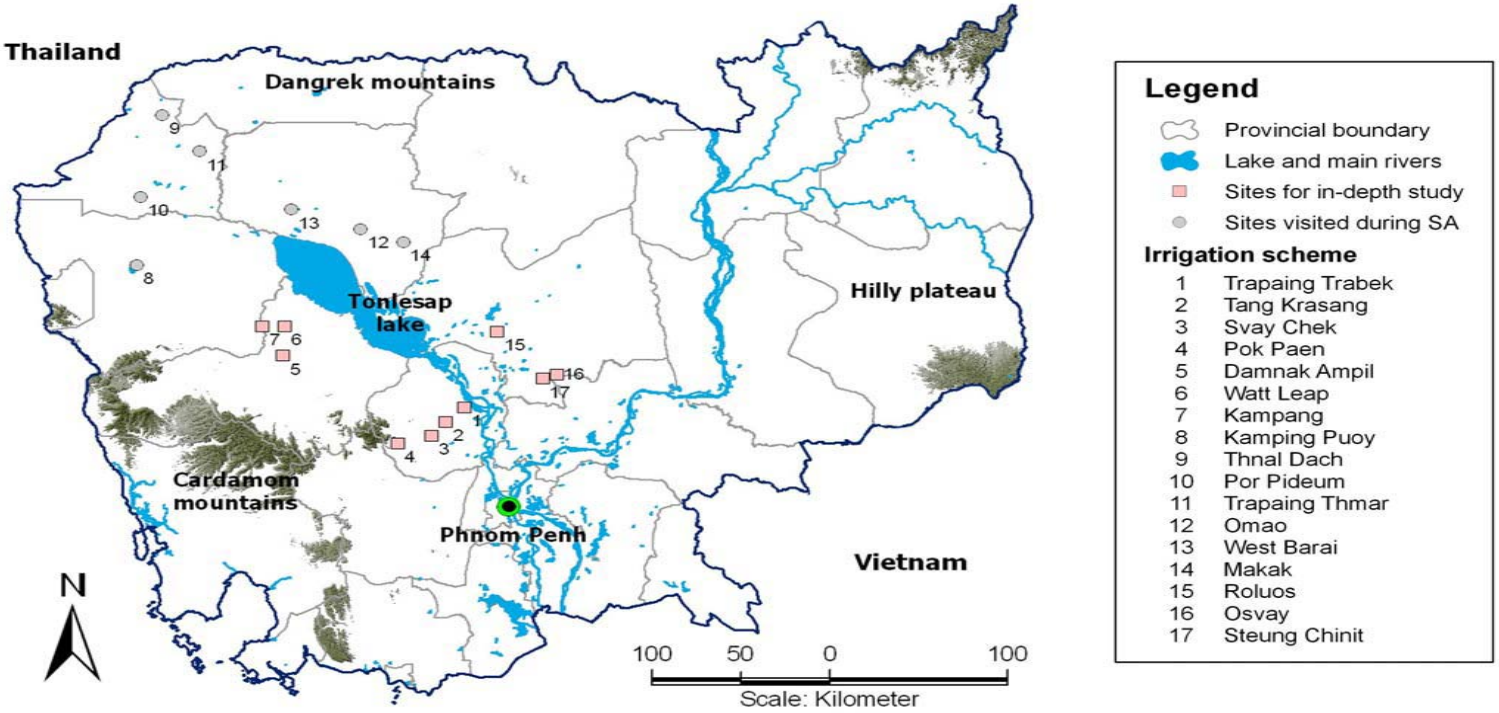
Cambodia and the Mekong River

Cambodia covers an area of 181,035 km^2 of the Lower Mekong Basin[3] (LMB) in Southeast Asia (Figure 1). Its geographical landscape consists of the Cardamom Mountains in the west, the Dangrek Mountains in the north, a hilly plateau in the east, coastal areas in the southwest, and a central plain. Regional water resources are dominated by the Mekong River and its various tributaries, including the Tonle Sap River that connects the Tonle Sap Great Lake with the Mekong River. Eighty-six percent of Cambodia's land area drains to the Mekong Basin, with the remaining 14 percent draining directly to the Gulf of Thailand. This diverse geography provides a range of ecological niches, generating a rich biodiversity and conditions suitable for growing a variety of crops. In terms of agricultural development, Cambodia can be categorised into three geographical areas: (i) upland, (ii) lowland, and (iii) floodplain. The central plain consists of a combination of lowland and floodplain regions and has high population densities in comparison to the upland and coastal areas. The central plain also has a rich ecological diversity with large potential for the development of agriculture and fisheries, while the southern coastal region is covered with forests which also serve as an important natural resource.

The Mekong River has a length of about 4,800 km, making it the twelfth longest river in the world and the eighth largest in terms of water discharge. It starts on the Tibetan Plateau in China and then flows through Myanmar, Thailand, Lao PDR and Cambodia before discharging into the South China Sea in Vietnam. The Mekong is the world's second most biodiverse river in terms of fish species, and supports an annual catch several times higher than that of most other river basins. The Mekong River enters Cambodia at the Lao PDR border and then continues south through Steung Treng, Kracheh, Kampong Cham, Phnom Penh, crossing Kandal and Prey Veng provinces, towards the South China Sea.

[3] The Greater Mekong is divided into two parts: the upper basin in Tibet and China (where the river is called *Lancang Jiang*), and the Lower Mekong Basin from Yunnan, downstream from China to the South China Sea (MRC, 2005).

Figure 1: Map of Cambodia



The Cambodian section of the Mekong River is 486 km in length (JICA, 2006) and contributes about 20 percent of the total Mekong catchment area of 795,000 km^2 (MRC, 2005). In addition to the main channel, the numerous tributaries along the river (Table 1) provide fresh water for domestic and industrial purposes, fisheries, navigation, agricultural development, hydropower and forestry products.

Table 1: The Mekong River and its Tributaries in Cambodia

Name	**Total Catchment Area (km^2)**	**Catchment Area in Cambodia (km^2)**
Mekong River	795,000	156,000
Sesan River	17,968	7,773
Sekong River	29,600	514
Srepork River	30,240	12,762
Tonle Sap Great Lake		
Water Surface Area Water quantity Wet season (May–October)		2,600 km^2 (dry season) 15,000 km^2 (wet season) 70,000 million (CBM) 80 percent of annual rainfall falls in the wet season

Source: Japanese International Cooperation Agency (2006)

The Tonle Sap Great Lake (aka the 'Great Lake') forms the heart of the Lower Mekong Basin. The Great Lake is the largest freshwater lake in Southeast Asia and connects to the Mekong River through the 110 km-long Tonle Sap River, at Chatomouk, in Phnom Penh. Six Cambodian provinces along National Roads Numbers 5 and 6 surround the Great Lake: Kampong Chhnang, Pursat, Battambang, Banteay Meanchey, Siem Reap and Kampong Thom. Kampong Cham, Kandal and Kampong Speu provinces also drain part of their area into the lake, and a small part of the upper catchment of the Tonle Sap Lake is in Thailand.

In the wet season (May to October) the Great Lake expands its surface area up to 15,000km^2. Water flows from the Mekong River into the Great Lake through the Tonle Sap River from late May to late September. The flow in the Tonle Sap River then reverses in October, with water flowing back from the Great Lake into the Mekong River. The regular annual flooding regime along the Mekong River allows water to submerge swamps, forests and shrubs adjacent to the Great Lake and on the Mekong floodplain, providing breeding grounds and nurseries for fish that subsequently travel back into the Mekong River with the receding floodwaters.

Situated within a tropical monsoon zone, Cambodia's climate is subject to extreme wet and dry seasons with temperature variations between 10°C and 38°C. The wet season, characterised by heavy rain, runs from May to October, while the dry season, when there is little or no precipitation, runs from November to April. The extreme seasonality in rainfall generates corresponding variability in water supply with flooding in the wet season and water shortages in the dry season. Thus, the development of irrigation and flood control facilities (e.g., water storage reservoirs, floodwater drainage canals and hydraulic water regulating structures) are perceived as very important in the context of water sector planning and development in Cambodia.

JICA (2006) identifies five key ways in which Cambodia can benefit from proper planning and management of water resources. These include:

1. Improved livelihoods and food security from agricultural development;
2. Reduced risk associated with droughts and flooding;
3. Increased availability of safe drinking water for animal feeding, sanitation, bathing, recreation and other domestic needs;

4. The development of sustainable inland fresh capture fisheries; and,
5. Increased transportation facilities for people and goods.

4.2 Physical Processes in Catchments Specific to Cambodia

The development of water resources in Cambodia will both influence and be influenced by the longitudinal connectivity of river systems and the interrelations between surface and subsurface hydrologic processes. The emplacement of dams and the extraction of water by countries in the upstream reaches of rivers that flow into Cambodia will inevitably alter flow regimes and patterns of sediment and nutrient transport. In addition, expansion of programs in Cambodia will have the same consequences within the country. The implications of such activities are that downstream users will not necessarily have the same access to water as their upstream counterparts and that certain downstream activities (such as fishing) will be seriously degraded.

Previous studies have classified the Mekong River Basin in Cambodia into several catchments, classified in terms of management priorities and action needed. According to the MRC, there are 22 water catchments in Cambodia: Prek Thnot, Siembok, Prek Chhlong, Prek Te, Prek Kampi, Sre Pok, Prek Krieng, Prek Preah, Se San, O Talas, Stung Sreng, Stung Sisophon, Stung Mongkol Borey, Stung Sangker, Stung Dauntri, Stung Pursat, Stung Baribo, Stung Chinit, Stung Sen, Stung Staung, Stung Chikre, Stung Siem Reap (MRC, 2000).

The Tonle Sap Great Lake is one of the largest catchments of the Lower Mekong Basin (LMB). The Tonle Sap and its tributaries also form one of the most important catchments of Cambodia and the Mekong River. The Tonle Sap catchment comprises of several smaller water catchments including Stung Baribo, Stung Chinit, Stung Sen, Stung Staung, Stung Chikreng, Stung Siem Reap, Stung Sangker, Stung Mongkol Borey, Stung Dauntri, and Stung Pursat (MRC, 2000).

The Sre Pok and Se San catchments, along with the Tonle Sap catchment area, have been prioritised as ecologically fragile catchments (MRC 2000). According to Carmen et al. (1998), there are numerous factors leading to catchment degradation: physical alteration of inland water systems, habitat degradation through deforestation, mining, heavy grazing, agriculture, soil erosion, industrialisation and urbanisation, excessive water withdrawal especially for agriculture, population, fisheries mismanagement, introduction of alien species, and the loss of freshwater biodiversity. Cambodia also faces problems of unsustainable development such as commercial timber exploitation in upstream catchments and forest land conversion, which cause soil erosion to downstream areas (Hansen and Top, 2006).

Problems of particular concern within the Tonle Sap water catchment area (TSWCA) are:

- Degradation of the forests of uphill water catchments: the Cardamom mountain range, the Dang Rek mountain range, and the Prey Long lowland forests.
- Population increase in the surrounding areas of the TSWCA: especially along National Roads Numbers 5 and 6, which surround the great lake.
- Increasing use of agrochemical fertilizers in the agricultural areas of the TSWCA which threaten surface water quality and aquatic lives of the Tonle Sap Lake and the Mekong River (ICEM, 2003:115).
- Sedimentation of the Tonle Sap due to soil erosion in upland areas of its catchments (Vanhan, 2000).

The Tonle Sap also plays a crucial role in sustaining fisheries in the Mekong Basin. It is a breeding, nursing and feeding area for migratory fish. Inland fisheries provide over 85 percent of the protein intake of Cambodians. Recently, the catch per fisher, as well as the share of large- and medium-sized and higher-value fish has declined. Although a number of

national measures to regulate sustainable and equitable access for fishing have been issued and implemented since 2000, fisheries in Cambodia is still being adversely affected by water-related development in the Mekong Basin (Sour and Viseth, 2005).

4.3 Policy on Water Resources Management

The stated long term goals of the Royal Government of Cambodia are poverty alleviation and economic growth, with an emphasis on enhancement of the agricultural sector. Water is given high priority by the Government as a means to achieve development goals whilst also ensuring it sustainable use. Under the mandate of the Ministry of Water Resources and Meteorology (MOWRAM), a number of policies on water management have been issued since 1999, when the ministry was formed. Notably, *Prakas* Declaration 306 in 2000 which provides a framework for the development of Farmer Water User Committees (FWUC); *National Water Resources Policy* (2004); *MOWRAM Strategy 2006–2010*; and the *Law on Water Resources* (2007).

Water in Cambodia is an issue that has been considered from many different perspectives by Cambodian ministries and agencies, and international and national non-government organisations operating in Cambodia. To ensure water resources management which meets both the needs of people and sustains biophysical resources, arrangements are necessary to reconcile the physical and socio-economic realities. Progress has been made in formulating water related policies and law in Cambodia, but poor enforcement, ambiguity and lack of coordination efforts are still fundamental challenges for achieving integrated water resources management.

After the fall of the Khmer Rouge regime in January 1979, Cambodia set out to rebuild the nation through reshaping the political structure to adopt democratic rules, improving food security by enhancing the agricultural sector and ensuring sustainable use of water resources by means of improving water resources management policies, improving education systems and strengthening landownership and security of land tenure. However, the legacy of the Khmer Rouge regime and more than three decades of civil war had destroyed the Cambodian economy and decimated the population, leaving Cambodia with limited financial, technical and institutional capacities. Most water resource management works were in dire straits, lacking both financial and technical capacities. Technical design and financial investment were heavily dependent on support from international organisations (IOs) and from international aid programmes of the United Nations.

Most irrigation works undertaken during the 1980s to 1990s were constructed as a matter of urgent priority without considering long-term sustainability or taking into consideration an integrated management approach. Large areas of the country were still unsecured during this time and there was a lack of coordination between donors. As a result, many irrigation schemes rehabilitated during the 1980s and 1990s were never made fully operational, with most of them only partially completed. This has caused complications for water management today, such as changed river flow conditions, and deterioration of the river system affecting irrigation. After 1999 (when MOWRAM was established), policies for sustainable development were implemented according to national development plans. These plans include the Government's *Rectangular Strategy*, *2003–2008*; the *National Strategic Development Plan (NSDP)*, *2006–2010*; the *Poverty Reduction Strategy*; the *Strategic Plan on Water Resources Management and Development*, *2005–2008*; the *National Biodiversity Strategy and Action*; and the *Water Law*, approved by the National Assembly in 2007. These policy documents stress irrigation development and extend water management to also include promotion of agricultural production and rural economy to achieve government targets of halting poverty by 2015.

The key agencies actively involved in watershed management in Cambodia include:

1. The Forestry Administration (FA) and the Department of Planning, both belonging to the Ministry of Agriculture, Forestry and Fisheries (MAFF),
2. The Department of Water Resources Management and Conservation of the Ministry of Water Resources and Meteorology (MORAWM),
3. The Department of Nature Conservation and Protection of the Ministry of Environment (MoE),
4. The Department of Land Management and Construction of the Ministry of Land Management, Urban Planning and Construction (MLMUPC),
5. The Ministry of Rural Development (MRD),
6. The Ministry of Women's and Veterans Affairs (MWVA),
7. The Department of Administration of the Ministry of Interior (MoI),
8. The Cambodia National Mekong Committee (CNMC).

Management of aquatic resources in Cambodia operates according to complicated institutional arrangements. Responsibility for different types of aquatic resources is splintered amongst several departments across various ministries, and management issues are dealt with sectorally where legal and institutional mandates exits. This has led to the creation of a piecemeal and somewhat indirect approach to management. Some of the legislation is conflicting and could even promote activities which lead to the loss of aquatic resources.

Spatial planning for the whole of Cambodia is the responsibility of the Ministry of Land Management, Urban Planning and Construction (MLMUPC). However, there are gaps and inconsistencies between responsible ministries when it comes to effective watershed management. Bunnara (2004) states that the concept of integrated watershed management has yet to be taken into consideration in Cambodia, but some activities have been unintentionally conducted in line with watershed management principles, such as community forestry and fisheries, participatory land use planning, and community-based natural resource management.

In some of the legislation pertinent to watershed management (WSM) in Cambodia, there are currently some provisions for increased participation. Whether a more participatory approach is adopted is a matter of political will, resources and capacity. Decentralization has been occurring sporadically through government sponsored programs such as Seila. De-concentration, however, presents an even greater challenge for Cambodia. The *Commune Administration Law* and the *Law on Commune Elections* provide a form of local democracy and introduce an element of local control and accountability to the decision making process. But it has been observed that there is little interaction between commune councils (Smoke, 2003) and this implies a great challenge for the management of water resources, as water tends to cut through different geographical and administrative boundaries. Also, some aspects of natural resources management (NRM) that are particularly relevant to WSM (forestry and logging) in particular, remain under tight central control. Civil society presents a means to challenge or advance these processes but is fairly limited in Cambodia.

Impact monitoring of watershed management in Cambodia is also currently in the early stages. Current impact monitoring is concerned mainly with individual projects and serves mostly to fulfill accountability requirements of external funding agencies. Related information is usually not made available to the public. Cambodia is currently in a good position to learn from the experiences of watershed management in neighbouring countries, and may be able to avoid some of the difficulties and problems already faced by these countries.

4.4 Ministry of Water Resources and Meteorology (MOWRAM)

To address pressing development needs and to respond to water-related development issues, the Ministry of Water Resources and Meteorology (MOWRAM) was formed as an independent ministry in 1999. This ministry, by constitutional obligation, is responsible for coordinating water-related development activities. MOWRAM is expected to take the lead in water-related development activities to ensure social and economic development, equitable and sustainable use of water for livelihoods, and enhancement of environmental quality. MOWRAM works closely with donor communities to achieve five major objectives: i) water resources management and development; ii) flood and drought management; iii) water-related legislation and regulation; iv) water resources information management; and v) administration, management and human resources development.

Some of MOWRAM's achievements to date have been a water vision action plan: *Strategic Plan on Water Resources Management and Development 2005–2008*; formation of a Technical Working Group on Agriculture and Water; and a *Water Law* approved by the National Assembly on 22 May 2007. MOWRAM is also a member of the World Commission of Water for the 21st Century, the World Commission on Dams (WCD), and the Mekong River Commission (MRC).

MOWRAM works in conjunction with key agencies to jointly govern and manage the optimal and sustainable use of water resources to promote economic growth and poverty reduction through increasing irrigated land for enhanced agricultural productivity and rural income generation. However, the primary role of MOWRAM is to protect the hydrological cycle (surface and underground storage and flow), and water quality for consumption.

Despite its achievements, MOWRAM still faces many challenges. For example, MOWRAM is still a new agency relative to similar institutions of the other co-riparian Mekong countries. There is still the need for extensive capacity building. It is inexperienced in dealing with transboundary water cooperation, conflict prevention and protecting the development interests of Cambodia (Öjendal, 2000). Government officials often have limited knowledge or skills, and they tend to sway watershed management and conservation to their own mandates. Cambodian officials need training in water catchment management knowledge and skills. As mentioned by Bunnara (2004), the experiences of the neighboring countries should also be thoroughly studied, learnt, and used in Cambodian watershed management, if Cambodia wants to avoid some of the difficulties and problems faced elsewhere in the past.

There are also problems with the inter-ministerial set up – a lack of cooperation being the critical issue. Institutional structures and arrangements in Cambodia are highly compartmentalised. The achievement of objectives is often constrained by a lack of clear definition of the regulatory and development functions in terms of duplicated responsibilities of line-ministries. A number of institutions are currently competing for roles in the management of natural resources and WSM. The roles and responsibilities of the relevant agencies and the mechanism by which they contribute to watershed management are still unclear (Bunnara, 2004).

Although there is no significant conflict regarding water-related development activities initiated by these key players, they lack mechanisms for coordination and feedback among key agencies engaged in water resources development and management activities. To deal with the coordination issue, a Technical Working Group on Agriculture and Water (TWGAW) was established in 2000 to jointly plan and coordinate the water and agriculture development programme. This TWGAW has proposed a *Medium Term Strategy for Agriculture and Water (2006–2010)*, which was approved by MOWRAM and MAFF on 30 March 2007.

Finally, most of MOWRAM's main activities are funded or operated by donor or NGO programmes. Although these projects are principally under the supervision and coordination

of MOWRAM, they are operating in a piecemeal fashion and have yielded limited impacts on institutional capacity building for MOWRAM. According to Godfrey et al. (2000), projects compete with each other for scare resources (finance and manpower) and are running parallel government units of operation.

4.5 Irrigation Development and Management in Cambodia

According to the ADB (2005a), in the Tonle Sap area, irrigation schemes are largely designed to manage floodwater to supplement rainfall for wet season rice production at the start and/or the end of the wet season from May to November. Only a few schemes are designed to divert water from the Mekong or Tonle Sap catchment for dry-season crops during the main part of the dry season or for flood-recession irrigation early in the dry season.

MOWRAM and MAFF, with support from TWGAW, are working to increase investment in irrigation and research to promote agricultural production for poverty reduction. MOWRAM has shown a strong commitment to increase the size of irrigated area in Cambodia by 20,000 hectares per year. Increasing investment in irrigation to increase rice production and encourage agricultural diversification for food security and higher value-added crops is essential, but these are not the only goals of water resources management. Water resources management also provides for agriculture, fish production, biodiversity, water supply and sanitation, and transport and hydropower; thus it is crucial that basin wide management issues are taken into consideration when planning irrigation development.

4.5.1 Participatory Irrigation Management and Development (PIMD)

Following the shift in the water management paradigm from large-scale, and centrally managed schemes to small-scale and locally managed schemes (as outlined in chapter 2), in 1999 the ADB introduced Participatory Irrigation Management and Development (PIMD) to Cambodia. PIMD, as it suggests, involves people at all levels, especially local people who are directly concerned with irrigation water in the planning, development and management of water (Peter, 2004). However, the problem with this mode of operation is that donors come into an area with a new idea and try to instill it into the local community as if the old system never existed (IWMI, 2006).

The success of PIMD depends largely on people's participation, but people's participation is often limited (Kim and Joakim, 2007). A large body of research literature has been dedicated to understanding why Cambodians do not want to take part in development planning for their community. Participation is a new concept for Cambodians. People in Cambodia also tend to see participation differently to those in the West. In western liberal democracies, "participation" means "involvement in decision making". However, Cambodian citizens have a rather passive definition of participation. According to their study of the progress of decentralization and deconcentration (D&D), Rusten et al. observe that local Cambodians interpret "participation" as "to be there and listen" (Rusten et al., 2004). Cambodian people are also more used to "directive from top" (Rusten et al., 2004) – that is, being led rather than participating. Contact with state representatives, except those who are friends, is often perceived as threatening by Cambodians, and therefore should be avoided (Hughes, 2003).

4.5.2 Farmer Water User Community (FWUC)

Central to PIMD in Cambodia, has been the establishment of Farmer Water User Communities (FWUC), set up to take over management of irrigation schemes from the government. The Farmer Water User Communities are in charge of everyday management of irrigation schemes, which includes regulating access to water, fee collection and monitoring, interdiction and prosecution of those who violate the FWUC statue.

In 1999, the *Government Circulation No 1* on the implementation policy for sustainable irrigation systems was released. It offered five scenarios for financial support for FWUC Operation and Maintenance in the community after construction of irrigation schemes:

Table 2: Financial Support for FWUC O&M

Year	Government contribution	Community contribution
One	80%	20%
Two	60%	40%
Three	40%	60%
Four	20%	80%
Five	0%	100%

The Government of Cambodia transferred the responsibility of Operation and Maintenance (O&M) to FWUCs by *Prakas 306* in June 2006 (Perera, 2006) with the stated functions and responsibilities as below:

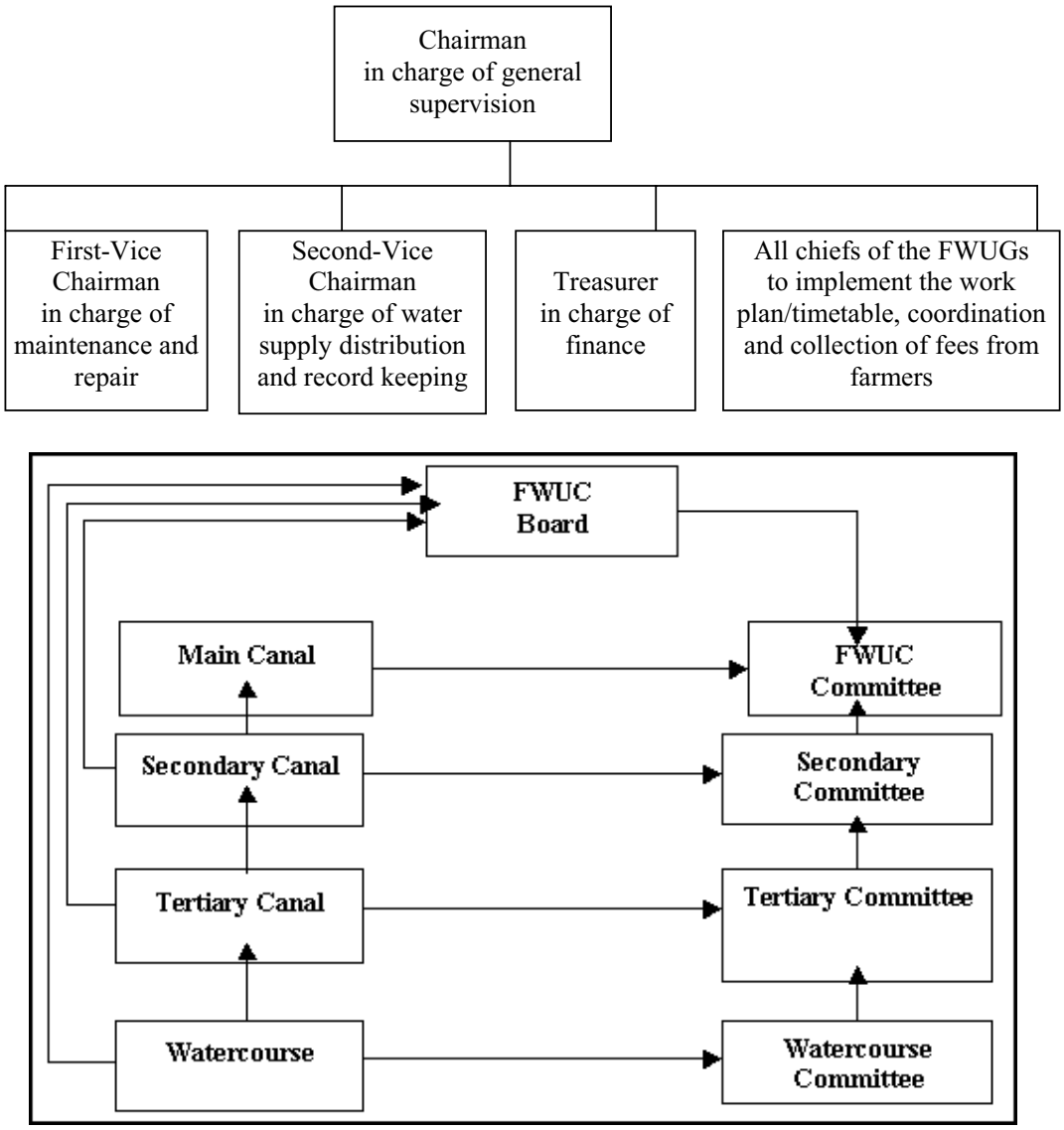
FWUC's Functions:

- Manage irrigation schemes;
- Collect Irrigation Service Fee (ISF) to cover the cost of service delivery and O&M;
- Bring together farmers who have farming land in an irrigated area and form a group to facilitate the supply of irrigation water to them;
- Supply adequate water for irrigation to the members;
- Acquire knowledge of management, O&M of the irrigation system and financial affairs;
- Increase the yields and seasonal cropping;
- Facilitate support from the government.

FWUC'S Responsibilities:

- Collect the ISF as determined by the FWUC;
- Prepare a work plan for the FWUC;
- Formulate statutes (constitution), contracts and internal regulations of the community;
- Maintain the irrigation system in good condition to enable the provision of irrigation for the whole season;
- Manage and distribute water to all members;
- Strengthen the use, management and improvement of the irrigation system in an efficient manner;
- Resolve problems occurring within the community

Figure 2: Organisational Structure of the Committee for FWUC



Source: Sinath, 2002

4.6 Cambodian Institutional Challenges

Institutions are essential in the management of water resources as they provide, and enforce, the rules governing the behavior of all actors to ensure predictability and certainty (Le Meur et al., 2005). However, institution building is a long process, often taking generations to complete, and even then the outcome is unpredictable.

Attention needs to be paid to the wider context of "institutions" in Cambodia. Cambodian institutional performance has never been strong as Cambodia has been under undemocratic regimes of one form or another until fairly recently. The most destructive time for institution building was when Cambodia was under Pol Pot's regime between 1975 and 1979. During that time, the progress of institution building was halted and it did not take long for the Khmer Rouge to dissolve the Khmer institutions. The markets were also dissolved and the national currency was no longer recognised (www.nbc.org.kh/history-nbc.asp). Citizens were stripped of all rights, even the right to live. Under these circumstances, people's attention was diverted from institution building to survival.

Aside from historical factors, it can also be argued that institutional performance in Cambodia is poor due to unclear definition of roles and responsibilities (Rusten et al., 2004; Smoke, 2003 & David, 2004). For example, water-governing institutions in Cambodia have been operating in a vacuum, with no comprehensive water law existing until May 2007. Smoke (2003) also argues that a lack of political will at the central level in Cambodia makes sectoral policy reform difficult, or even impossible. An example of this is forest protection. Community Forestry and commune councils work to protect community forest and have managed to influence the local people, reducing the rate of logging. However, Forest Committees are unable to stop large scale logging by powerful interests, as these powerful interests usually have connections with higher authorities such as the governor, the military or even officials from the central government (World Bank, 2006).

An example of institutional challenges faced by Cambodia today can be seen through looking at Farmer Water User Communities (FWUC). The ability of an institution, especially a new institution such as the FWUC, to carry out their designated tasks is compromised by many factors such as the country's history, human and financial resources. The establishment of FWUCs as a local body governing irrigation marks a fundamental change in the way farmers go about their business. Water now belongs to the state and is managed by the FWUC. Owning a plot of land does not meaning having permission to use water. Farmers have to apply for the right to use water. In addition, farmers are expected to attend meetings organised by the FWUC and to contribute to the maintenance of irrigation schemes. If not they will face a fine of an unspecified amount of riel. But it is doubtful whether FWUCs are equipped to implement these tasks: do FWUCs have the legal and political support to perform their tasks; do they have the technical and managerial capability to do so?

Under its statute, FWUCs are vested with the power to manage water in a scheme, and its tasks range from ensuring fair allocation to interdiction and enforcement of fines on those who violate the statute or harm the interests of the community. But this statute does not seem to have replaced the existing governance arrangement, and in fact, three separate ministries – the Ministry of Water Resources and Meteorology (MOWRAM), the Ministry of Environment (MoE) and the Ministry of Agriculture, Forestry and Fisheries (MAFF) – are involved in the management of water resources. The coordination between the three actors, which is currently seen as lacking (Ojendal, 2000), is essential for effective governance of water. The vertical accountability of ministries and their line departments is so strong that it usually overrides the horizontal accountability of line departments at the provincial level. Each line department, although having autonomy in principle, is closely attached to its ministry, creating a strong vertical-upward accountability. Some blame this vertical-upward accountability on the legacy of the centralised system in Cambodia (Ojendal, 2000). This leads to the question how much FWUCs can do.

4.7 The Role of Law in Water Resources Management and Governance in Cambodia

On the domestic front the sources for water law in Cambodia are many and varied. Here, some of the laws which, in various ways, are related to water management are identified:

- The *New Constitution of the Kingdom of Cambodia 1993*, in which Articles 58 and 59 vests ownership of water (inter alia) to the state and obligates the state to establish a plan of management (Jennar, 1995);
- The *Law on Environmental Protection and Natural Resource Management 1996*, which defines water as being a "natural resource" which "shall be conserved, developed, and managed [and] used in a rational and sustainable manner" (Article 8) (Sok & Sarin, 1998);
- The *Land Law 2001*with the sections on easements (Articles 144–146), the article on rights to water (Article 155), expelling excess irrigation water (Article 156), and articles 157, 158, 159 which deal with expelling water where structures have been

submerged or for placing pumping machinery on riverside locations and the social concessions section (section 5) which allows, in certain conditions, for the use of state owned land (Article 49) (East–West Management Institute, 2003);

- The *Law on Fisheries Management and Administration 2005*, which controls fishing and related activities in inland waters;
- Circular No.01 (11 January 1999) on the "Implementation Policy of Sustainable Irrigation Systems", and
- The *Law on Water Resources Management 2007*.

Reform in natural resource management in Cambodia more broadly has focused on strengthening three important pillars: sustainable forest management policy; natural resource and biodiversity protection; and community forestry development promotion.

The policies and regulations related to natural resource management in Cambodia include:

- Royal Decree on Protected Area Management, 1993;
- Law on Environmental Protection and Natural Resources Management, 1996;
- Royal Decree on Watershed Management, 1999: The Royal Decree gave the Ministry of Agriculture, Forestry and Fisheries (MAFF) a mandate to administer, manage, and improve forests within the watersheds and to coordinate inter-ministries and other agencies in this respect of activities;
- Subdecree on Watershed Management by MAFF, 2000;
- Sustainability of Operation and Maintenance of Irrigation System Policy, 2000;
- Land Law, 2001;
- National Water Sector Profile, 2001;
- Forestry Law and Regulation/Policy, 2002;
- Subdecree on Community Forestry Management, 2003;
- Natural Water Resource Policy, 2004;
- Strategic Framework for Decentralization and Deconcentration Reform, 2005;
- Law on Water Resources Management, 2007.

For a comprehensive review on the legal apparatus each legislative act requires careful criticism. Such an assessment should consider, amongst other things, the adequacy and appropriateness of enforcement provisions. This is a mere sample of the breadth of domestic provisions that have been enacted at the national level, which may apply to water issues. There are, in addition, a plethora of administrative, policy and guideline documents which also apply to water resources management.

4.7.1 Implementation / Enforcement

There are many commentaries on the impediments to enforcement of laws in Cambodia. "MOWRAM and its Provincial Department do not have the capacity to enforce effective regulation at present," observed International Development Enterprises Cambodia (2005: 1). Some of those hurdles are related to the provisions of law and enforcement, which may be the result of jurisdictional overlap, the absence of transparency mechanisms and a lack of political will (Archdale, 2004). It is outside the scope of this review to assess the Cambodian legal system per se. However, there are a number of details to be considered. In which jurisdiction does the regulatory framework exist – in other words – does the civil or criminal code apply or is it a mixture of both depending on the issue? In the formal legal system,

different processes apply depending on which code is the appropriate path for prosecution of a breach of the law (Neam, 1998).

It is also important to clarify the regulatory framework as it applies to the legal agreements for water use ownership rights, especially at the local level with the Farmer Water User Community (FWUC). Indeed, the Royal Government of Cambodia's Technical Working Group on Agriculture and Water (TWGAW), in their report of November 2006 identify that "enforcement remains theoretical", and that the "main difficulties concern water distribution (upstream/downstream), irrigation service fee payment and infrastructure protection" (2006, 13).

A lack of law and regulation, and a lack of willingness to implement laws and regulations are among the main challenges for relevant government agencies in watershed management and development (Bunnara, 2004). Another issue concerns the challenges of cooperation between agencies. By nature, a river basin cuts across many territorial boundaries. However, overlapping responsibilities amongst stakeholders make for inefficient management. For example, at present, there are many ministries involved in the management of water resources in Cambodia, but there is no framework for the management of water resources that integrates all the various sectors involved.

Bunnara (2004) recommends that the only way to successfully implement watershed management is to have all relevant organisations work together to enforce the existing laws and regulations. Regulations need to be in place and, in the Cambodian case, MAFF and MOWRAM need to cooperate more in regard to watershed management issues.

Some of the improvements needed are:

- Clarification of roles and responsibilities of each ministry;
- Increased cooperation amongst government agencies and donor communities;
- Reduction of overlap with regard to existing laws and regulations;
- Enforcement of existing regulations;
- Coordination of law enforcement amongst relevant government agencies. Improved governance and reduction in corruption in relation to watershed related natural resource management;
- Increase in political will;
- Prioritisation of watershed management in the *National Development Plan*: Sustainable watershed development and conservation to be made a top priority among the public, the government and private sectors;
- Capacity building for relevant agencies;
- Adequate financial mechanisms and incentives: the government should allocate more of the national budget for WSM, including development, capacity building, impact monitoring, and information sharing among public sectors.

4.7.2 Conflict Resolution

Effective implementation and enforcement provisions require the existence of an appropriate conflict resolution system.

The literature on conflict resolution in water management in Cambodia is very limited and not much is known about how water related conflicts arise and/or are resolved. For centuries Cambodians have relied heavily on rainwater to grow rice, and the management of water rested in the hands of local people and local leaders such as village chiefs and religious leaders. People see rainfall and water availability as the work of "Mother Nature", and if their

crops fail due to drought or flood they do not blame anyone. Sakhon and Lyda (1996) argue that there is no local institution and no procedure to solve water user conflicts.

As Cambodia undergoes rapid reforms in water management, as well as decentralization and deconcentration, it is expected that further conflicts of new types will arise. International experience shows that conflicts between water users often arise as a result of decentralization as more people become aware of the importance of water in their agricultural production. In his study of water management systems in Russia, Weinthal (2006) points out that there are more water conflicts in countries that are newly decentralized.

People's understanding of the right to water and the right to access water is thought to shape the dimension of conflict . UNDP (2006) argues that upstream users are generally less interested in sharing water with downstream users, as they do not benefit from it. This non-cooperative attitude often leads to upstream/downstream conflicts when there is no clear definition of right to water and right to access water. Often upstream people believe that they have the right to "own" their water; therefore, they can do whatever they want with it, including the total extraction of water that flows through their territory.

Chapter 5. Ways Forward

In this paper we have reviewed international, regional and in-country experiences relevant to water resources management from a number of perspectives. It is the nature of water resources management that an integrated approach is required for effective implementation, and a multi-disciplinary approach is similarly required for research. As we have seen, integrated water resources management has yet to be implemented comprehensively and to be proven as feasible and successful in most parts of the world. Similarly, multi-disciplinary research is challenging and its design needs to be adapted to the specific context to which it is targeted, to the research problem that it addresses, and to the research environment in which it is being carried out.

This literature review does not pretend to be comprehensive. Some key fields of analysis and data organisation have yet to be covered, notably economic analysis and the use of geographical information systems for water resources management in the context of irrigation development and management in their catchment context in Cambodia. The review is also constrained by the fact that relatively little well-conceptualised and firmly grounded research has been carried out that seeks to understand water resources management from multiple disciplinary perspectives, to draw lessons, to inform the policy process, and to feed into technical and institutional aspects of project design.

Through a combination of this literature review and social/institutional assessment conducted in six provinces around the Tonle Sap Lake, the Water Resources Management Research Capacity Development Programme (WRMRCDP) seeks to draw on concepts derived from the several disciplinary approaches reviewed to pose relevant questions in two main contexts: irrigation development and management, and managing water in its catchment context. These contexts are closely related, in the sense that isolated irrigation scheme management needs to be considered with reference to the wider water supply and project impact issues. The upcoming key research questions, as a result of the literature review and social/institutional assessment, will focus on six key issues: coordination, scarcity, allocation, participation, evaluation processes and assumptions, and impact. To deal with these key issues, physical, governance, economic and legal approaches are considered in the research-framework of the WRMRCP.

In regard to physical processes, the literature review has shown us that in order to manage water effectively we must understand the catchment hydrology. Hydrology consists of three components: sub-surface, surface and atmospheric water. Under the framework of this study, however, we are only looking at the management of surface water. Water flows across and between catchments, and across and between different administrative boundaries. However, human activities upstream may restrict or impede this flow, for example, through dams, causing impact downstream.

Therefore, to achieve the programme goal of increasing agricultural production and at the same time achieving the sustainable use of water resources in Cambodia, three aspects are important: institutional strengthening at scheme and catchment levels, understanding of physical process of the catchment, and good water-governance.

Economic analysis of irrigation is important in a number of respects: for evaluating the viability of irrigation schemes; for understanding the household level of water use, including issues associated with irrigation service fees; and in terms of the tools relevant to dealing with

both economic and physical scarcity. An economic baseline survey will be carried out as the baseline information for the next four years of the project. By this means, the economic impact assessment of irrigation will take place as an in-depth study. This will look at how the irrigation could contribute to the development of local economy at farm-household level.

How will we seek to understand the management of irrigation in terms of physical, governance, legal/institutional, community, and economic structures and processes? How will we consider the physical properties of catchments, the ways in which they are or should be governed, the legal and institutional requirements for enhanced management, and the economic implications of managing externalities and other key ways in which values are assigned and affected by different approaches to use and development? This literature review paper does not answer these questions, but it provides us with an important step toward framing relevant research questions and consolidating our multi-disciplinary methodological approach to asking, as well as seeking to answer, these questions.

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This working paper is the first large publication of WRMRCDP. The paper is a preliminary assessment of literature review of water resources management in Cambodia and has been prepared by the water team of WRMRCDP in connection with ongoing capacity building and development activities. The paper examines existing literature on water resources management in terms of its physical basis, governance/institutional arrangements and legal frameworks, and draws on experience at the international, regional and in-country levels.

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