

FINAL REPORT
ON
INTEGRATED WATER RESOURCES
MANAGEMENT (IWRM 2005) STRATEGY AND
ROADMAPS IN CAMBODIA



Department of Water Resources Management and Conservation
Ministry of Water Resources and Meteorology

CONTENTS

CONTENTS	2
ACRONYMS AND ABBREVIATIONS.....	3
1. INTRODUCTION.....	4
1.1 Purpose	4
1.2 Strategy Development Process	4
2. VISION AND GOALS	5
2.1 Vision	5
2.2 Goals.....	6
2.3 Principles of Integrated Water Resource Management	6
3. SITUATION ANALYSIS.....	7
3.1 Current conditions	7
3.2 Scenarios for the future	9
3.3 Issues and Constraints	10
3.4 Institutional analysis.....	14
3.5 Legal Framework	17
4. IWRM IN THE CAMBODIA – STRATEGIC PRIORITIES	19
4.1 Economic development and poverty alleviation	19
4.2 Environment protection	22
4.3 Social development and equity.....	23
4.4 Flood and drought management	24
4.5 Integration through basin planning.....	25
4.6 Water Resources Information Management.....	26
4.7 Regional cooperation.....	27
4.8 Governance.....	28
5. IMPLEMENTATION.....	29
5.1 Roles and responsibilities	30
5.2 Partnerships	31
5.3 Financial mechanisms	31
5.4 Monitoring and evaluation	32
6. CONCLUSION	32
APPENDIX1: SECTOR ANALYSES	33
1.1 Agriculture and irrigation.....	33
1.2 Hydropower.....	34
1.3 Navigation	36
1.4 Fisheries.....	38
1.5 Tourism	39
1.6 Domestic and industrial water supply	40
1.7 Flood management and mitigation	42
1.8 Watershed management.....	43
APPENDIX2: WATER SECTOR ROADMAP	46
REFERENCES.....	51

ACRONYMS AND ABBREVIATIONS

ADB	: Asian Development Bank
ASEAN	: Association of South East Asian Nations
BDP	: Basin Development Plan (under MRC)
CDC	: Council for the Development of Cambodia
DSF	: Decision Support Framework
GMS	: Greater Mekong Sub-Region
GMS-SEF	: GMS Strategic Environment Framework
GWP	: Global Water Partnership
IFI	: international financial institution
IUCN	: International Union for the Conservation of Nature
IWRM	: Integrated Water Resources Management
IWT	: inland waterway transport
JICA	: Japanese International Cooperation Agency
LMB	: Lower Mekong Basin
M&E	: monitoring and evaluation
MDG	: Millenium Development Goals (under the UNDP)
MIME	: Ministry of Industry, Mines and Energy
MoE	: Ministry of Environment
MOWRAM	: Ministry of Water Resources and Meteorology
MPWT	: Ministry of Public Works and Transport
MRC	: Mekong River Commission
MRCS	: Mekong River Commission Secretariat
NGO	: non-government organization
NSDP-III	: Third National Strategic Development Plan
PPWSA	: Phnom Penh Water Supply Authority
PRASAC	: Programme de Rehabilitation et d'Appui au Secteur Agricole du Cambodge
RBO / RBC	: river basin organization / committee
RGC	: Royal Government of Cambodia
SDP-WS	: Strategic Development Plan for the Water Sector
UNDP	: United Nations Development Program
WSP	: Water and Sanitation Program
WSSD	: World Summit on Sustainable Development, Johannesburg,
WUP	: Water Utilisation Program (under MRC)
WWF	: Worldwide Fund for Nature

1. Introduction

1.1 Purpose

Development and management of water resources in the Kingdom of Cambodia have long been recognized as one of the main thrusts in the economic and social development of the country. In the development process, the country continues its efforts to ensure harmonious development of water and related resources and smooth coordination of water resources management. In this context, the Ministry of Water Resources and Meteorology (MOWRAM) was established to “foster the effective management of the water resources in the Kingdom of Cambodia to attain socio-economic development and the welfare of the people.”

This document sets out strategic directions for development of water resources in Cambodia for the next 20 years. It is intended to lend guidance to sustainable water resource development and management in Cambodia, and is relevant to all stakeholders. It aims to synthesize directions identified in national plans and strategies and add a basin dimension, and to promote the approach of Integrated Water Resources Management (IWRM) within the Basin.

Implementation of IWRM is the responsibility of all stakeholders in the Basin, from local communities to national governments and regional organizations. This document provides a context and broad framework for a coordinated approach. It will be translated into action through a range of national and regional instruments, including the Royal Government’s *Strategic Framework for Decentralization and De-concentration Reforms*, *The Rectangular Strategy of the Royal Government for Growth, Employment, Equity and Efficiency*, *National Strategic Development Plan 2006-2010*, *Strategic Development Plan for the Water Sector 2006-2010*, *National poverty reduction strategies of Cambodia*

1.2 Strategy Development Process

The process of formulation of the strategy document contained in this report was based on the following approach:

- a task force of officials of the Line Agencies was set up to formulate the strategy and roadmap document, thereby establishing Government ownership of the output;
- a brief description was provided of the water sector, including the status of water resources, water uses and existing demands, as well as the existing policy, legal and institutional framework;
- water resources management issues were considered and categorized;
- possible solutions were identified;
- The respective responsibilities of the institutions involved in the water sector were identified.

The document was distributed to representatives of various ministries and institutions, to be discussed within the framework of a National Workshop on IWRM Strategy and Roadmap in Cambodia, which was held in Phnom Penh (Sunway Hotel), 23-24 May 2006. Participants in this Workshop provided useful comments and suggestions that were incorporated in the document. Further elaboration and discussions led to the preparation of the present document, which shows IWRM Strategy and

roadmap needed for their implementation, as well as the role of the MOWRAM and of the other institutions.

2. Vision and goals

2.1 Vision

Our *Vision for Water* in Cambodia is:

- *Access for all to safe, adequate, and affordable drinking water, hygiene, and sanitation*
- *Freedom for all from the threat of loss of life and livelihood as a result of floods and droughts*
- *Sufficient water where it is needed, to provide for food security and industrial activity*
- *A water environment that is unpolluted, and supports healthy fisheries and aquatic ecosystems*

This vision is reinforced by a shared commitment to

- The Rectangular Strategy of the Royal Government for Growth, Employment, Equity and Efficiency.
- Millennium Development Goals
- Regional political and economic cooperation, as embodied in ASEAN (Association of South East Asian Nations) and the Asian Development Bank Greater Mekong Sub-region program (ADB-GMS)
- Sustainable development (as defined under Agenda 21)
- Poverty alleviation (as set out in national policies)¹
- Ministerial conference declaration at the 4th world water forum Mexico 23-24 March 2006

Millennium Development Goals	
1	Eradicate extreme poverty and hunger
2.	Achieve universal primary education
3	Promote gender equality and empower women
4	Reduce child mortality
5	Improve maternal health
6	Combat HIV/AIDS, malaria and other diseases
7	Ensure environmental sustainability
-	Integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources
-	By 2015, reduce by half the proportion of people without access to safe drinking water.
8	Develop a global partnership for development
9	De-mining, Unexploded Ordnance and Victim assistance ²

¹ National poverty reduction strategies of Cambodia

² set out by the Royal Government of Cambodia

2.2 Goals

Based on The Rectangular Strategy of the Royal Government for Growth, Employment, Equity and Efficiency, the Cambodian Millennium Development Goals, and on national policies and plans, a set of goals can be identified which will guide the way in which the river and its resources are used to achieve the vision.

Table 1. Principle areas of work and Goals

Principle area of work	Goals
1. Economic growth and development	To promote economic growth through use and development of water resources in a manner that significantly alleviates poverty.
2. Environmental protection	Projection of environment, natural resources, aquatic life and conditions and the ecological balance of the country from harmful effects of development.
3. Social development and equity	To ensure equity in the allocation of water resources and services across different economic and social groups to reduce conflict and promote socially sustainable development.
4. Flood and drought management	The impacts of water related hazards, particularly floods and droughts, on the lives, property and livelihoods of Cambodian People and on public property, are minimized
5. Integration through basin planning	Implementation of a participatory, multi-sectoral basin planning process which integrates economic, social and environmental concerns across the LMB
6. Water Resources Information Management	Cambodia's Water Resources are developed and managed confidently and wisely, on the basis of adequate information.
7. Regional cooperation	Integrated and coordinated water resources development and management between countries to optimize benefits from the joint resource and minimize the risk of water-related conflicts.
8. Governance	Open, transparent and accountable institutions and regulatory frameworks that will promote IWRM at all levels.

2.3 Principles of Integrated Water Resource Management

“Integrated Water Resources Management is a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the

resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.”

Global Water Partnership

Cambodia is committed to implement IWRM principles in managing the water resources of country. IWRM is not an end in itself but a means of achieving three key strategic objectives (Global Water Partnership, 2003):

Efficiency in water resource development and use: Maximising the economic and social welfare derived both from the water resources base and from investments in water services;

Equity in the allocation of water resources and services across different economic and social groups, to reduce conflict and promote socially sustainable development;

Environmental protection, as ultimately all attempts at water management reform will fail if the water resources base and associated ecosystems are compromised.

The following benchmarks of “good IWRM” can be defined

- Institutional and regulatory frameworks with clear pathways of accountability – establishing the ethic and performance of good governance
- Knowledge-driven planning and management, with open sharing of information
- Community and stakeholder participation – partnerships between government and community for demand-responsive approaches to development
- Integration and coordination of policies and programs across sectors, countries, competing stakeholder interests and levels of government.

All activities, programs and projects relating to water resources should be guided by IWRM concepts and contribute to sustainable development.

The World Summit on Sustainable Development (WSSD) in Johannesburg, 2002, set at target of developing “IWRM and water efficiency plans by 2005” (WSSD Plan of Implementation, Article 26). All countries in the LMB are engaged in formulating water resource strategies at the national level, but these are at varying stages of completeness. This paper aims to give a national view, as an overarching framework of principles and guidelines within which the national strategies will provide more detailed plans for action.

3. SITUATION ANALYSIS

3.1 Current conditions

Cambodia is a predominantly rural and forested tropical country, bordering the Gulf of Thailand. About 14% of the country drains directly to the Gulf; the remainder is in the catchment of the Tonle Mekong, which Cambodia shares with Vietnam, Laos, Thailand, Myanmar, and China. The cultivable area is approximately 26% of the total land area; more than 60% is forested, but the average rate of loss of forest cover is estimated at 0.5%/annum.

With a population of nearly 12 million and a total land area of 181,035 km², Cambodia has a relatively low average population density, by Southeast Asian standards. Nearly 80% of the population still resides in rural areas, and is engaged in agriculture. The Socio-economic Survey of 1997 estimated that 36% of all households are under the poverty line, with 90% of these in rural areas. In terms of the UN Human Development Index, Cambodia ranks 137 out of 174 countries. Poverty is the result of many causes, such as lack of access to credit, or geographical remoteness from social services or markets for agricultural products. A significant aspect of poverty is access to safe water and sanitation, and consequent implications for health. Rural dwellers in particular have very limited access to these facilities. There is a strong drift to the cities, which is putting increasing pressure on urban infrastructure. Cambodia's health indicators, such as life expectancy (53.4 years at birth) or under-5 child mortality (147 per 1,000 live births), indicate a need for a sustained effort in the area of public health provision, and this is recognised in the Royal Government of Cambodia's (RGC's) Socio-Economic Development Requirements and Proposals (Ref. 30).

The country is hilly to mountainous around its periphery, but the dominant feature of its landscape is the extensive flood plains of Tonle Mekong, Tonle Sap, and the Tonle Sap Lake (the Great Lake). These water bodies are a unique hydrological system. From May to October, when the Mekong level is high, water flows upstream along the Tonle Sap into the Lake, which increases in size from 2,600 km² to 13,000 km². In November, the flow reverses, and water drains from the Lake to the Mekong and thence to the South China Sea - around 500 billion m³/annum. The Mekong system represents a valuable resource for Cambodia, particularly in terms of fish production, and a future potential for hydropower.

Mean annual rainfall in Cambodia is 1200-1300 mm/y in coastal areas, 1200-1400 mm/y in the Central Plains, and 2000-3500 m/y in the mountains.

Hydraulic engineering for irrigation and water supply was developed to a very high level in Angkorian times, but today many facilities built under the French and Khmer Rouge require rehabilitation. Only about 16.6% (473,000 ha in 1998) of the total rice-growing area (1.93 million ha) presently receives supplementary irrigation. Production on 85% of the rice-growing area is rain-fed; a "flood-recession" system of production is used on 7% of the area, and deep-water floating rice on 6%. Hence, almost all the rice area is single-cropped, resulting in low production – although Cambodia now is achieving self-sufficiency in average to good years. There are many other constraints to raising agricultural production and rural incomes, such as property rights, transport systems, availability of rural finance, agricultural extension, and levels of education.

As a result of over three decades of strife and political instability, Cambodia's economy has been weak, and the country is very dependent on international development assistance and foreign direct investment. The over-arching national "Triangle Strategy" for recovery includes achieving peace and stability, integration into the international community, and comprehensive governmental and fiscal reform. Rates of growth in GDP have varied widely in recent years in response to internal political events and the performance of the Asian economy; rates of economic growth on the order of 6-7% are regarded as sustainable, and planned for. However, indications are that the great majority of the population has not experienced a rise in living standards during the 1990s. The water sector is expected, in the RGC's Socio-Economic Development Requirements and Proposals (Ref. 30), to make its greatest contribution to economic growth and poverty alleviation in terms of irrigated agriculture and domestic water supply.

For the percentages below, indicate whether they are stable, increasing, or decreasing.

Population (estimated 1999)	11.7 million, increasing	Population (projected for 2020)	20 million
Population growth rate (estimated 1998)	2.5%, decreasing	Urban population growth rate	8%/annum
Urban population (1992-98)	16%, increasing	Urban population (projected for 2020)	8 million, assuming current growth rates
Land area	181,035 km ²	Average population density	63 persons/ km ²
Total water available	~500 billion m ³ /yr	Total water developed (estimated withdrawal, 1987)	520 million m ³ /yr

Water use, share of total		Population access to:		
Agriculture ³	56%	Safe water		Sanitation
Industrial ⁴	4%	Rural	23.7%	8.6%
Domestic Purpose ⁵	17%	All urban	60.3%	40.9%
Livestock	13%			
Other	10%			

3.2 Scenarios for the future

Over next 20 years, Cambodia will undergo great social and environmental change. The rate of change is already very rapid, driven by a complex mix of demographic, economic, technological and social factors, as well as external factors such as globalization and climate change. It is not possible to predict the exact path of change, but existing trends can be used to outline likely directions. By 2020, population in Cambodia could reach between 18.5 and 20.3 million. Demands for food, water supply and energy will increase even more quickly, as a result of economic growth, industrialization and urbanisation. To meet these needs, production in both agriculture and fisheries will need to increase significantly. Irrigated area could increase by over 30%, and intensification of cropping will further increase demand for water. Increased demand for energy, for internal use and export, could result in development of large scale of new storage.

- Construction of storages (whether in the Country) will result in transfer of flows from the wet to the dry season, with corresponding opportunities for increased dry season irrigation and improved conditions for dry season navigation. Storages may impact on fishery productivity by obstructing migration routes; by reducing the overall extent and duration of inundation of floodplain and wetland ecosystems (particularly in low flow years); by increasing dry season flows; and by increasing short-term flow variability. The impacts of increased dry season flows on fish ecology are not yet well understood.

³ MOWRAM & CNMC (2003)

⁴ MOWRAM & CNMC (2003)

⁵ 28 litres per one person

- Without offsetting storage, extraction and diversion of water for irrigation development may result in decreased dry season flows and a concomitant increase in the area affected by salinity intrusion. However, additional water storage and increased dry season flows associated with planned hydropower development are more than sufficient to offset likely increases in irrigation withdrawals.
- Developments on the floodplain (such as embankments and dykes) can potentially change flood patterns and duration in the floodplain significantly. Changes on the floodplain itself are likely to have larger impacts on the floodplain than flow changes in the river due to upstream regulation.
- The impact of development on Mekong flows is likely to be significant and observable, but that currently proposed levels of development are not likely to dramatically change the nature of the Mekong's seasonal flow patterns or the functioning of the Tonle Sap Lake. The ecological significance of local changes, particularly to the floodplain, needs to be carefully assessed. The analysis reinforces the importance of a balanced and coordinated approach to water resources development and management.

3.3 Issues and Constraints

Legislation and policy

There is not a coherent body of water-related law, regulatory instruments, or policy. A draft Law on Water Resources Management (WRM) is before the National Assembly. Several sub-sectoral policies are at various stages of development or approval, and a framework and law on regulation of water supply is in draft. The legal and regulatory environment needs further strengthening to provide a secure basis for private sector participation in the water sector, and to avoid the difficulties experienced elsewhere (e.g. forests, fisheries) with property rights, licensing, revenue collection, etc. Implementation of laws is generally weak, although advances are being made, e.g. in administering provisions of the Law on Environmental Protection and Natural Resources Management related to wastewater discharges. MOWRAM will need to develop institutional capacity to administer the Law on WRM when it is passed.

Institutional arrangements

Several RGC line ministries have responsibilities for aspects of water resources exploitation, while the CNMC deals with Cambodia's responsibilities under the Mekong Agreement. The MOWRAM was established in 1999 with a mandate to manage the Nation's water resources, but attends primarily to irrigation and drainage (I&D), river bank erosion and flood control. Inter-agency relationships tend to be uncooperative, although MOWRAM has reached formal agreements with several other ministries to delineate responsibilities. Water quality management (as well as other matters) is within the mandate of several ministries as well as MOWRAM, and clearer responsibilities are needed. The RGC is devolving responsibilities to provincial and more local levels, which will require allocation of increased financial and trained human resources, to lessen reliance on non-governmental support.

(It is clearly defined by Royal Government of Cambodia sub-decree on Organization and Function No. 58 dated 30th June 1999, confirmation letter of Council Minister No. 1699 dated 26th November 1999 and Royal Government of Cambodia Sub-decree on Organization and Function of MAFF No. 17 Dated 7th April 2000) . Water management systems cannot be sustained because of limited government resources. MOWRAM is implementing a policy of irrigation management transfer and participatory irrigation management and development. These are applied to new and rehabilitated schemes and progressively introduced to existing systems, with establishment of Farmer Water User

Communities. The process requires ODA for capacity building of FWUCs and sub-national government offices, and farmers are not always keen or able to accept responsibility. Functional I&D systems and infrastructure are few, and supply water on a supplementary basis using simple (and often decrepit) structures. The RGC goal of increasing irrigated area requires that institutional arrangements for assuring beneficiary participation and scheme sustainability must be established before schemes are completed.

Institutional/community capacity

RGC capacity (especially at sub-national levels) is limited, because of the loss of an entire cohort of people during the civil war, low public sector salaries, run-down infrastructure, etc. The RGC is implementing a variety of measures in civil service and governance reform. Capacity building, of physical facilities, operational funding, and human resources development will continue to be required in MOWRAM, other water-related institutions, and the public service as a whole. Sustainable results of capacity building will be unlikely until the RGC sets public service salaries at realistic levels. The successful development of PPWSA as a public corporation exemplifies what is possible, and the RGC seeks greater private sector and/or beneficiary involvement in water services provision (water supply, sanitation, hydropower, I&D). For MOWRAM, a major re-training and/or recruitment programme will be required, at both central and provincial/district levels, for water resources management, law enforcement, support for community groups, etc. This will assist it fully to carry out its mandate in water resources planning, management and regulation.

Providing data and information

Capacity to provide the data and information required for design of water-related infrastructure, IWRM&D, and management of droughts and floods is limited, leading to inefficient design. International programmes in the Mekong River basin (flood forecasting, water quality investigations, fisheries management, etc.) provides valuable support. Exchange of existing information among RGC institutions is inefficient, because of a lack of awareness of what is available, a lack of formal mechanisms for obtaining access, and possessiveness of information. Hence, the heavy investment by international funding agencies in natural resources information has not been fully effective. The draft National Water Resources Policy includes policies on exchange of data and information. Mechanisms and willingness to implement these policies will be required. A large investment in the collection, archiving, and dissemination of data and information about water resources and use (quantity and quality; surface water and groundwater), river basin characteristics, weather and climate still is needed, via a coordinated water and climate information strategy. The possible impacts of climate variability and change also will need to be considered.

Managing irrigation and drainage (I&D) systems and related infrastructure

Poverty is concentrated in rural areas, but agricultural production is low, cultivable land is under-utilised, and rural incomes and food security are not assured. Limited progress has been made in the last ten years to deal with this situation. Improved water control is regarded as essential; only ~19.5% of agricultural land is irrigated in year 2001 mostly by supplementary irrigation, and multiple cropping is uncommon. Much of Cambodia's water-related infrastructure, especially for I&D, fell into disrepair during the 1980s and 1990s, becoming unusable or able to provide only poor standards of service. A 1994 survey showing that 20% only of I&D systems were fully operable, and 14% completely inoperable. Irrigation management is undeveloped, with little effort to promote water use efficiency and sharing, even in new schemes. Rehabilitation is proceeding as rapidly as the RGC, donors, and farmers can provide resources, but has not always produced sustainable results.

Infrastructure deteriorates rapidly, and sustainability requires resources for on-going O&M. The RGC cannot afford to carry the whole burden of rehabilitation, operation and maintenance of all water-related infrastructure.

For newly rehabilitated I&D systems, MOWRAM and funding agencies generally require the formation of FWUCs to participate in design and take responsibility for O&M. This as yet applies to 10-15% of systems, and only to secondary and lower-level canals, and is not always successful because of un-completed system. Considerable ability is required for farmers to manage a FWUC, which takes time to develop, and good training by RGC staff, who also need training. Persistence will be needed to fully implement PIMD. MOWRAM emphasizes the need to rehabilitate medium and large-scale public I&D schemes, while MAFF tends to promote smallholder-scale developments, e.g. using groundwater. The latter are regarded as avoiding the organisational problems of public schemes, while requiring more manageable investment. Perhaps 70% of cropland is not readily irrigable by public schemes, and small-scale investments e.g. in water harvesting will be needed also. A national strategy for I&D is needed to achieve an appropriate mix of approaches, combined with workable arrangements to ensure sustainability. It must take account of the many other factors that can increase agricultural production and productivity, e.g. improved varieties, diversification, product quality, access to urban/international markets.

rry the whole burden of rehabilitation, operation and maintenance of all water-related infrastructure.

Managing water supply and sanitation facilities

There is a high incidence of water-related diseases in Cambodia, including diarrhoea, dysentery, and typhoid. A significant contributor is that domestic water supply and sanitation is at a low level in Cambodia, except in the capital city. Rural water supply is in many villages dependent on streams, open ponds and shallow wells, which constitute a health hazard. Water supply systems in the <20 towns that had them have deteriorated to a very poor state, with low coverage (maybe 10% of households in a town), short periods of supply (a few hours a day), and water that is not potable without boiling. Urban wastewater treatment is largely absent in Cambodia, except for primary (lagoon) treatment of some sewerage in Phnom Penh, a small plant at Battambang, and planned investment in Siem Reap and Kampong Som. An expected doubling of urban population by 2030 will greatly increase pollutant loadings on rivers, unless there is large scale investment (e.g. \$300 m to rehabilitate Phnom Penh's sewerage system). Private sector involvement in urban water supply and sanitation requires that companies can be sure of profitability, within a regulatory environment that protects both public and private interests.

NGOs and IOs (especially UNICEF) are largely active in installing tube wells and latrines to provide safe water and improved sanitation in rural areas. For small-scale facilities such as handpumps, Donors normally introduce arrangements for beneficiary O&M, but these are not consistently successful. Motivation, training and education, spare parts, etc, are needed to enable beneficiaries to take responsibility for facilities. Key constraints are lack of funds for O&M, lack of management skills from financial management to the ability to replace parts in a pump, and lack of information on the distribution of high quality water, which has led to the drilling of many wells that have proved to be unusable.

Mitigating the impacts of water-related hazards

Floods and droughts are a severe constraint on development and poverty alleviation and in a bad year like 2000 can cause huge economic losses, disruption, and loss of life. Measures such as construction of secure flood embankments around Phnom Penh city, Pdau Chhum Flood Control Dike in Kampong Cham and Pich Sar Flood Control Dike in Takeo Province, participation in the MRC's

flood forecasting system for the Mekong, and establishment of the NDMC are significant advances. Much remains to be done, especially in rural areas where farmers are exposed to the risk of impoverishment by natural disasters. A structural approach to flood mitigation is unaffordable, probably would be disastrous for the Mekong-Tonle Sap fishery and ecosystem, but is favoured by some officials. I&D infrastructure can mitigate the effects of dry spells and drought in localities that are already well-watered, but the ~77% of the cultivable area that will continue to be rain-fed needs alternative approaches to water management. A strategic approach is needed that efficiently combines structural and non-structural means of mitigating the impacts of floods, dry spells and droughts, and assists the rural community – particularly in the non-irrigable, rain-fed areas – to respond to extreme conditions without being plunged into indebtedness.

Managing competition for water and deteriorating water quality

Cambodia is “water wealthy” during the wet season, but during the dry season ponds, streams, and rivers other than the major ones dry up. All but the Mekong are showing increasing signs of contamination by human and animal waste, fertilisers, etc. With agricultural development and intensification, and a growing urban population, continued degradation of water quality is likely. During the dry season, arable farming is impracticable over much of the country without irrigation. Abstractive and instream water uses are uncontrolled, and the Law on WRM is still only in draft. Enforcement will need capacity building in MOWRAM, but will not easily address non-point source pollution, abstraction by smallholders, etc. Rivers like the Battambang are lined with hundreds of motor pumps that collectively have greater impact than a single large irrigation offtake; toileting, animal watering, etc. degrade chemical and bacteriological water quality. The consequences include depleted streamflows, widespread water-related illness, algal blooms, and potential degradation of the freshwater fishery. The Law on Environmental Protection and Resource Management cannot deal easily with non-point and informal/community sources of contamination. The public are ill-disposed to governmental regulation, or even to community-level cooperation, and are poorly informed about water resources issues like pollution. Community education and participation are required to engage the public – especially children – in safeguarding water resources from competition and mis-use. Reliance on regulatory measures is unlikely to be successful. Competition for water is managed most effectively at river basin level and the impacts of developments such as impoundments and of processes such as deforestation can only be managed there. Cambodia has little capacity or experience in river basin management. The RGC recently has been promoting IWRM principles in the river basin framework through conferences etc. They will need to be made operational, by funding of river basin planning and management exercises.

Conservation of aquatic ecosystems, biodiversity and fisheries

Environmental degradation of seasonally flooded areas, conversion of floodplain forests to agriculture and growing fishing pressure threaten the internationally important biodiversity “resource”, aquatic ecosystems and capture fisheries. The catch of large and medium-sized fish is declining, though the catch of small, less valuable fish is increasing. The Mekong-Tonle Sap ecosystem includes many migratory species, whose life cycles may be disrupted by activity elsewhere in the basin. An estimated 1 million people depend on fishing for their livelihoods, and fish provide the principal source of protein in Cambodia, so conservation of aquatic ecosystems is essential for socio-economic as well as ecological reasons. Ecotourism provides a growth area whose development requires that natural ecosystems be protected.

Managing international water resources

Cambodia is a signatory to the Mekong Agreement, and benefits from MRC programmes, e.g. flood forecasting, and investigations/ surveys of fisheries, aquatic ecosystems, and water quality. Donors increasingly take a basin-level perspective on water and aquatic resources development and management, e.g. through MRC’s Basin Development Programme, which provides a broad context for Cambodia. However, Cambodia, as the most downstream country except for the delta area of Vietnam, feels very exposed to the impact of activities both upstream and downstream. It has experienced negative impacts from hydropower development and I&D in Vietnam, and many RGC officials believe that land use change, damming, river works etc in the upper Mekong affect the frequency and severity of floods, sedimentation, fish populations, etc. Cambodia will need reassurance that multilateral cooperation through MRC will safeguard its interests. Donors have a role in this, e.g. through appropriate conditions on investments.

Managing the coastal zone

The coastal zone of Cambodia is thinly populated, and human pressure on the coastal zone is light, except at Sihanoukville. The population is particularly dependent on marine and coastal resources, however. Aquaculture and mangrove clearance, as well as contaminated runoff, discharges from ships in ports and shipping lanes, and offshore oil/gas exploitation present considerable threats to coastal and marine waters. No legal instruments provide for management of marine and coastal waters, and at least 5 RGC ministries, as well as provincial government, have unclear and poorly coordinated responsibilities. The knowledge base also is weak, and investigations tend to be piecemeal. Coastal waters offer significant opportunities for social and economic development, but will need careful management to avoid the rapid degradation experienced in so many other countries.

3.4 Institutional analysis

The Main Stakeholder Groups

The main stakeholder groups⁶ in relation to the IWRM Strategy and their perceived core interests are identified and prioritized as follows:

Table 1: Main Stakeholder Groups

Institution	Water-related Responsibilities
Governance	
Parliament	<ul style="list-style-type: none"> • Develop Laws and Legislations Frameworks • Endorse Laws and Legal Frameworks • Adoption, Endorse and Amendment • Laws Enforcement • Monitor
Royal Government	<ul style="list-style-type: none"> • Leading and Management • Monitoring and Evaluation • Decisions making • Provide Policy Guideline • Coordination among line ministries

⁶ Some of these main groups are further differentiated in the textual analysis below.

	<ul style="list-style-type: none"> • Clear guidance on policy, strategy and legal/regulatory
National	<ul style="list-style-type: none"> • Develop Policy and Strategy • Provide Policy Guideline • Provide Regulation Service • Provide Technical service • Monitoring
Province	<ul style="list-style-type: none"> • Management and Coordination • Develop Provincial Plans • Monitoring and Evaluation • Seeking fund for Development • Intervention
Local authorities	<ul style="list-style-type: none"> • Community Development Plans • Security • Administration • Empower Local Communities
Users	
Communities	<ul style="list-style-type: none"> • Participation • Utilization and Management • Operation and Maintenance • Election
Private sector	<ul style="list-style-type: none"> • Participation • Provide Funding for Research and Development • Investment
Supporters	
Universities	<ul style="list-style-type: none"> • Human Resource Development • Academic Study • Provide Guideline document, • Technical Support and Extensions • Training
Research institutes	<ul style="list-style-type: none"> • Provide Guideline document, • Research and Development • Academic Study • Technical Support and Extensions • Training
PS's	<ul style="list-style-type: none"> • Participation • Training and Extension
NGO's	<ul style="list-style-type: none"> • Help to seek funding • Clear priorities and good participation

Stakeholder Analysis

The identified main stakeholder groups are further described and analyzed in relation to the strategy development. The principal aim is to clarify their partnership roles in this context.

Parliament

The National Assembly shall be the only organ to hold legislative power. This power shall not be transferable to any other organ or any individual.

- The National Assembly shall approve the national budget, State Planning, loans, lending and the creation, changes or annulment of tax.
- The National Assembly shall approve Administrative Accounts.
- The National Assembly shall approve or annul treaties or international convention.

The adoption of the above-mentioned clauses shall be decided by a simple majority of the entire assembly membership.

Royal Government

The Member of Royal Government's role is their decision –making capacity, and in explaining the strategy to the people, and influence them to support it in order to gain popularity by association with successful strategy. This would require development of a credible strategy with such qualities made visible.

National

At the National level, administration, planning and legislation for water resources in each ministry is generally distributed between several ministries. National planning is often sector driven, with limited consideration given to cross-sectoral interactions. In addition, each country has national, provincial, district and local (village, commune) levels of administration, all of which may have responsibility for aspects of water resources management. In all countries there is a move to decentralization and devolution of planning, moving responsibility to the lowest appropriate level (following the subsidiarity principle).

Province

Provincial governments have an oversight and coordinating role with regard to the provincial departments of ministries with water-related responsibilities. They provide the framework for provincial and sub-provincial development committees, some of which are engaged in water-related development (mostly water supply, sanitation, small scale irrigation).

Local authorities

Local authorities has opportunities for improving local planning and investments, but otherwise perhaps limited influence on sector strategy. The strategy can never the less benefit local authorities mainly by achieving the common targets and objective of national policies, the Rectangular Strategy and MDG, as they related to development of their areas.

Communities

Development committees at provincial, district, commune and village levels have responsibility for socio-economic development initiatives. In some, water-related initiatives may be included, particularly with regard to water supply and sanitation.

Private sector

The private sector has had limited or involvement in national sector strategy formulation. The rationale for their participation is in the potential for provision of investment resources and for definition of

clear investment areas. It is therefore relevant to consider how to better utilize and mobilize their interest in Integrated Water Resources Strategy developments.

The strategy can benefit the private sector's mainly by increasing business, income and profit (if it is implemented), and through consultation with the private sector. It follows that the strategy interest by: (i) giving an enabling environment and good legislative framework for guiding investments, (ii) and by giving clear steps and a process orientation for the private sectors participation in the process.

Universities/Research institutes

Universities, Academics, researchers and their institutions may play an important role in particular as resource persons for the development of the Integrated Water Resources Management Strategy. Their active interest in the strategy is perceived to be in assisting in developing strategy and in gaining clear directions for development of the sector

The strategy can further benefit universities, Academics and researcher by providing research priorities and plans, and by achieving common goals. The strategy can target these interests by: (i) sharing information and getting process inputs from them, and (ii) by delegating development and testing of technologies to them.

NGO's

The Non-Government Organisations may be enabled to play an important role in facilitating the implementation of the Integrated Water Resources Management Strategy.

The active interest of the NGO's in the strategy is perceived to depend on the strategy's participation and process for involvement / empowerment to do the rights things in local social and economic development, food security, poverty reduction, and community participation.

3.5 Legal Framework

A legal document covering all aspects of water resources management all together does not yet exist in Cambodia. Some isolated provisions relating to water are to be found in the 1993 Constitution, in the Law on Environment Protection and Natural Resources Management (1996) and in the Law on Land (1992). The Constitution vests water ownership in the State (Art. 58) and assigns to the state the task of planning the management of water resources (Art. 59). By stating that "The control, use and management of State properties shall be determined by law", the Constitution lays down the foundations of the water law.

Under Article 8 of the Law on Environment Protection, natural resources, including water, "shall be preserved, developed and managed to use in a rational and sustainable manner". At Article 10, the Law calls for consultation between the line agencies and the Ministry of Environment on decisions and activities of relevance to natural resources. Measures for the prevention, reduction and control of water pollution are left to be determined by sub-decree (Article 13). Finally, the Law envisages a duty of the Ministry of Environment to cooperate with the other ministries in requiring industries and those engaging in polluting activities to install and use monitoring equipment, to take samples and to keep records ready for inspection (Art. 14). Articles 16 to 18 are devoted to public participation in environment protection and access to information. The Investment Law of 1994 provides for financial incentives in the form of exemptions from taxes and duties, to encourage investments in environment protection, rural development and energy, amongst other things (Articles 12-13).

A sub-decree on water pollution control was adopted on 16 April 1999. This sub-decree assigns water quality control responsibilities to the Ministry of Environment. Article 27 states that all data on water quality and water pollution are to be administered by this Ministry. Article 10 subjects the discharge and transport of wastewater to a licence to be granted by the Ministry. The application for this licence is to be copied to the line agencies concerned (Article 10). In addition, the sub-decree lists dangerous substances (Annex 1), sets general effluent standards (Annex 2), lists the potentially polluting activities subject to licencing (Annex 3), sets ambient quality standards for rivers, lakes, reservoirs and the sea (Annex 4), and for public water supply sources (Annex 5). It is to be noted that the MOWRAM is now vested with overall water resources management responsibilities, although the Ministry of Environment existed prior to its establishment in June 1999.

The Law of 1992, on land, reiterates the principle by which rivers and lakes may not be privately owned (Art. 5). Articles 113-140 deal with easements (or servitudes). They regulate the relations between upstream and downstream land with regard to the natural water flow (Articles 113-115), and the establishment of easements by law for the purpose of irrigating or draining land against the payment of compensation to the occupant of the land on which the easement is established (Articles 125-129).

The Law of 9 March 1987, on Fisheries Management and Administration, regulates fishing and aquaculture in inland waters. The Law is currently being reviewed and revised with a view to stimulating investment in the fisheries sector and providing a better protection of fish resources.

Finally, Prime Minister's Circular No. 01 SR of 11 January 1999, on the Implementation Policy for Sustainable Irrigation Systems, contains model statutes of Farmers Water User Communities (FWUCs) and provisions on the assessment and collection of irrigation fees. Apart from this Circular, there is no legislation on the actual formalities for the establishment and registration of FWUCs. In particular, no legislation vests FWUCs with juridical personality and the capacity to assume rights and obligations with a view to a sustainable management of irrigation schemes. The legal provisions in force are also silent with regard to the manner in which irrigation management responsibilities will be transferred to FWUCs.

A draft law on water resources management was elaborated and discussed within the MOWRAM in 2000. Once adopted, this draft law will regulate in a comprehensive manner the planning, allocation and protection of water resources in Cambodia, through provisions on planning and on the licensing of water uses and wastewater discharges, amongst other things.

With MOWRAM's wide mandate under Sub-Decree No. 58, it will continue its efforts to establish IWRM&D in Cambodia. A basic step will be to develop an implementation strategy for IWRM&D. MOWRAM will inform officials, the public, students, and other stakeholders of the national benefits of IWRM&D, and build its own capacity to lead IWRM&D.

Table 1. The legal basis for water resources management

Laws and Sub-Decrees related to water resources etc.	Date	Responsible Agency
A. Existing Legislation		
• Sub-decree on the Management/Administration of the Use of Agricultural Lands	1985	MLMUPC
• Royal Decree on the Protection of Natural Areas	1993	MOE
• Law on Environmental Protection and Natural	1996	MOE

<ul style="list-style-type: none"> Resource Management • Royal Decree on the Determination and Management of Forest in Sloping Areas • Sub decree on Forest Concession Management • Law on Mineral Resource Management and Exploitation • Land Law • Forestry Law • Sub-decree on Water Pollution Control 	<ul style="list-style-type: none"> 1999 2000 2001 2001 2002 1996 	<ul style="list-style-type: none"> MAFF MAF MIME MLMUPC MAFF MOE
<p>B. Pending Legislation</p> <ul style="list-style-type: none"> • Law on Water Resources Management in Cambodia • Law on Inland Waterway Transportation 	<ul style="list-style-type: none"> In Parliament Draft 	<ul style="list-style-type: none"> MOWRAM MPWT

4. IWRM IN THE CAMBODIA – STRATEGIC PRIORITIES

Eight key result areas in IWRM of most relevance to Cambodia at this time have been identified, recognizing that later, other areas or categories might become dominant:

- Economic development and poverty alleviation
- Environment protection
- Social development and equity
- Flood and drought management
- Integration through basin planning
- Water resources information management
- Regional cooperation
- Governance

4.1 Economic development and poverty alleviation

***Goal:** To promote economic growth through use and development of joint water resources in a manner that significantly alleviates poverty.*

The most pressing requirement for all Cambodia is to realise economic and social development through use of water and related resources. This drive must be balanced by two considerations: protection of the water resource base to ensure environmental sustainability; and equitable distribution of the benefits from development, to ensure social sustainability and prevent conflict.

In addition to the macroeconomic benefits of accelerated growth, properly managed economic development can also have a significant and positive impact on poverty alleviation. The water and related resources of the Mekong Basin and Tonle Sap Basin serve as inputs into productive activities.

The abundance of surface water, low level of development and generally good water quality in Cambodia indicate that very significant opportunities exist for exploitation and development of water and water-related resources.

Key issues for water resource development and utilization are:

- Providing a predictable and fair resource management framework, as a basis for a favorable investment climate
- Identifying and promoting investment opportunities that are responsive to real development demands and have a favorable poverty impact
- Linking with appropriate regional initiatives to exploit comparative advantages in pursuing basin development
- Ensuring balanced and equitable development, between different areas and different sectors

Priority areas for action

Priority areas for action have been identified from national policies and plans, national and regional sector overviews and from sub-area and national consultation processes under the Basin Development Plan program. Development opportunities have been identified from each of the major sectors; summaries for each sector are provided in Appendix 2.

Common priorities emerging from all sectors include:

- Formulation of consistent or non-conflicting National development strategies for key sectors, in particular irrigated agriculture and hydropower.
- Identification of synergies between proposed national projects, and combining projects into joint and/or cross-sectoral programs
- Improved cross-sectoral planning through a coordinated programme of land use planning (land suitability / capability assessment)
- Identification of an agreed set of indicators to assess trade-offs between sectors (through economic valuation methods)
- Value-adding through processing, market development and improved access to markets
- Mechanisms for developing joint and basin-wide projects from the agreed IWRM framework (for example, through MRC's Basin Development Plan program).

Agriculture and irrigation:

- Increased irrigation water use efficiency
- Land suitability / capability studies to identify the most promising areas for irrigation expansion
- Expansion and development of irrigation in priority areas
- Restoration and modernization of existing irrigation schemes
- Assessment of the feasibility of inter- and intra-basin transfer of water to priority areas
- Higher returns from irrigated and rain-fed agriculture, through improved farming practices, promotion of high quality production (rather than mass production), intensification and diversification of crop types and livestock, and support to processing, distribution and marketing.

It is important to note that improvements to irrigation will not be effective unless the underlying institutional structures for agriculture, such as land reform and land titling, are in place

Hydropower

- Ranking of proposed projects in terms of efficiency, financial viability and social and environmental outcomes
- Optimising operation rules to minimize downstream environmental impacts
- Assistance with preparation of detailed proposals for high priority projects
- Identification of joint projects to take advantage of synergies between hydropower generation and irrigation development (in terms of additional dry season flows from storages)
- Cooperation with upstream countries in planning and managing hydropower projects.

Navigation:

- Development and implementation of ports, river works and regional waterways
- Regional standardisation schemes (border regulation, navigation aids, navigation rules, pollution control, certification, pilotage, monitoring, statistics)
- Morphological management, including bank protection and dredging
- Promotion of international navigation both within the LMB and with upstream countries.

Fisheries

- Management and protection of the capture fisheries, particularly co-management of fisheries involving local communities
- Development of reservoir fisheries and aquaculture; in particular, small scale aquaculture for rural households and aquaculture of indigenous Mekong species
- Value-adding through marketing and processing

Watershed management:

- Development and promotion of watershed-related knowledge, awareness and attitudes among stakeholders and decision-makers in the public and private sectors
- Integrated spatial planning for water related natural resources at local, national and basin levels
- Improved agricultural practices in upland areas (particularly with regard to shifting cultivation)
- Support to sustainable commercial forestry, agro-forestry and traditional forest-related livelihoods, including reforestation and greening schemes
- Appropriate management (including management plans and monitoring) of important habitats, including restoration and protection.

Tourism

- Promotion of water-based tourism, particularly community-based eco-tourism and agro-tourism.

Domestic and industrial water supply and sanitation

- Maintenance, rehabilitation and expansion of urban and rural water supply and sanitation infrastructure (particularly for the poor)
- Provision of rural water supply (in line with MDG 7)
- Prevention and mitigation of pollution (both urban and rural)

4.2 Environment protection

Goal: *Projection of environment, natural resources, aquatic life and conditions and the ecological balance of the country from harmful effects of development.*

Protection of the water resource base is crucial both to secure human uses, and to protect the natural and cultural values of the river. Potential threats include loss of wetland habitats and active flood plains, unsustainable water consumption, river regulation, loss or degradation of habitats, pollution (both from industry and agricultural runoff), and over-harvesting of significant species. Several threats have a trans-boundary and/or a distinctive cumulative character. One of the key issues in environment protection in the country is a lack of coordinated environmental planning, and coherent regulatory and planning structures and institutions are essential for effective environment protection

- Maintenance of water quality
- Protection of aquatic ecosystems and biodiversity (habitat management)
- Protection of watershed functions (catchment land use management)

Changes to the river associated with development will inevitably change the river's ecosystems. A balance between development and protection will often mean trading off some degree of environmental value to gain a development benefit. Determining where the balance should lie requires understanding of the potential impacts of change, and of the value of ecosystems in terms of the total range of goods and services they provide.

Maintenance of water quality

The main area of concern for water quality in the Cambodia are diffuse pollution from agricultural inputs (fertilizers, pesticides, herbicides) due to intensification of agriculture with irrigation development (particularly in the Delta); and pollution from sewage and industry downstream from major population centres (point source pollution). Integrated watershed management is key to addressing these concerns, and River Basin Organisations potentially have an important role in this process.

Protection of aquatic ecosystems and biodiversity

To maintain biodiversity, it is necessary to preserve a diverse range of habitats, and also to preserve the linkages between them – for example, migration paths and connections between river and floodplain. Particular attention should be given to identifying and preserving important or unique ecosystems, such as the Great Lake of Tonle Sap and its surrounding inundated forest areas.

Maintenance of watershed functions

Deforestation and poor agricultural practices can significantly degrade both the quantity and quality of run-off and alter groundwater recharge. Management of catchments must take account of the links between land use, surface water and groundwater. The ecological, economic and social functions are closely linked, and there is a need for better understanding of the links

Priority areas for action

- Valuation of environmental and livelihood benefits from in-stream uses of water
- Setting out mechanism for pollution management in harmony with the environmental laws and regulations, e.g. classification of water bodies, discharge standards and monitoring standards.
- Improved knowledge about cause-effect relationships and management options for ecosystems
- Identification of key habitats for protection
- Assessment of influence of flow regimes on the riverine systems, particularly for key locations such as Tonle Sap Lake and high value wetlands
- Integrated land use planning and management, based on land suitability / land capability assessment, and consideration of land access / land tenure issues and their impacts on water resources
- Protection of water quality through provision of sanitation for all communities, control of industrial effluents and sewage disposal
- Enhanced collaboration with upstream countries in environmental planning and management programs.

4.3 Social development and equity

Goal: *To ensure equity in the allocation of water resources and services across different economic and social groups to reduce conflict and promote socially sustainable development.*

Social development is, along with economic development, a cornerstone of the development strategies of all MRC member countries. The quality of life of the poorest people in the basin area has improved only slowly, if at all, as a result of recent economic growth, and a significant share of the rural population continues to live in poverty.

Key issues of concern regarding social development include:

- Access to water for basic human needs
- Access to water-related resources (fish, wetland products)
- Equity of access for different ethnic and social groups, particularly women and the poor
- Protection of access for traditional lifestyles, cultural and heritage values
- Protection from the impacts of floods and droughts

Issues of equity and social development can be best addressed by ensuring that all stakeholders participate in planning and management decisions. As a general precept, local communities and civil

society organization should always be consulted, although identification of stakeholders and the level at which they participate in decision will differ for different issues and areas.

Planning processes, in which the maintenance of water shed functions are addressed, like land use plans, village development plans, district development plans, watershed management plans are the ideal platform for community consultation and participation.

Priority areas for action

- Provide safe water and sanitation for all communities (in line with MDG 7), coupled with moves towards cost recovery where appropriate
- Establish clear mechanisms for community and stakeholder consultation and participation in water resource development.
- Establish a water allocation mechanism, a surface water, groundwater abstraction and wastewater discharge permit system and associated databases.
- Support River Basin Organisations to act as focal point for community consultation and participation
- Improve public awareness of regional water-related development and management concerns, options and constraints. This will be facilitated by producing documents in national languages
- Identification of social impacts of development policies and programs at an early stage (using Social Impact Analysis), so that adequate distribution and/or protection measures can be included.

4.4 Flood and drought management

Goal: *The impacts of water related hazards, particularly floods and droughts, on the lives, property and livelihoods of Cambodian People and on public property, are minimized*

Because of its geographical location in the lower Mekong River basin and its monsoon climate, Cambodia is exposed to water related hazards, particularly floods, droughts and severe pollution events. Such hazards place a severe constraint on socio-economic development because of the periodic losses that are suffered, particularly by the rural poor. These hazards will continue to grow, as the population increases and people occupy areas that are exposed to greater levels of risk.

Even the wealthiest country cannot eliminate all the impacts of water related hazards. MOWRAM's aim is to reduce them to the greatest extent that is affordable, and for the benefit of the greatest number of people. MOWRAM will cooperate closely with other organizations with related mandates, particularly the National Disaster Management Committee and the Mekong River Commission

To work towards the goal, the Strategies are:

- MOWRAM has a nationwide capability for short, medium and long term monitoring and forecasting of droughts and floods, and for issuing timely warnings, forecasts and situation reports to public.
- A properly maintained network of flood management embankment and drainage channels is in operation, the cost of which is appropriate for the value of the assets protected.

- The capacity is available in high risk provinces to provide emergency response to extreme events, particularly emergency pumping equipment to mitigate drought impacts and heavy construction machinery to carry out emergency repairs to channels and embankments.
- MOWRAM is implementing, in cooperation with the Cambodia Natural Disaster Management Committee, a comprehensive non-structural strategy for mitigation of floods and drought that integrates measures such as public education, flood plain zoning, and mobilization on community self-help.

Priority areas for action

- Improve flood preparedness (flood forecasting and regional flood warning system, community based preparedness) and flood emergency management
- Improved land-use planning for flood hazard areas
- Irrigation development, including storage of water for use in the dry season
- Development of drought management approaches for vulnerable communities and sectors
- Undertake studies to improve understanding of the groundwater resource and its sustainable limits
- Promote conjunctive use of ground and surface water during dry periods
- Research programs to refine long-term climate predictions for SE Asia, particularly impacts on snow melt
- Participation in relevant international conventions regarding climate change.

4.5 Integration through basin planning

Goal: *Implementation of a participatory, multi-sectoral basin planning process which integrates economic, social and environmental concerns across the LMB*

Integration and coordination of water resources development in the LMB has many dimensions:

- Integration between and within water use sectors to ensure maximum efficiency of resource use and economic growth
- Integration of the concerns of different stakeholders to ensure equity
- Integration of environmental and social concerns into development planning to ensure sustainability
- Integration and cooperation between geographic areas (countries, upstream – downstream areas) to prevent water use conflicts
- Integration of policy, institutional and regulatory frameworks at different levels to ensure consistency

Basin planning provides a framework to promote integration at all levels. MRC has initiated a scenario-based assessment of broad development options for the basin. This approach integrates both across sectors (by considering multi-sector development scenarios), and spatially (through the

delineation of watershed-based planning units, termed “sub-areas”). Potential impacts of different development paths are assessed in terms of the effects that planned interventions in one part of the basin will have on the natural resource systems in another part or country (using hydrological models)⁷. Impacts on the water resource are linked to environmental, social and economic values by considering the effect of hydrological change on ecology and livelihoods. An understanding of these values are fundamental to assessment of trade-offs between benefits and cost associated with particular development paths.

Scenarios provide a new and important perspective on the cumulative effects of development in the LMB. Analysis of scenarios indicates that proposed levels of development of water resources are hydrologically feasible, but reinforces the need to find an acceptable balance between water use and resource condition.

Key issues emerging from the basin planning process include:

- Links between regional and national planning agencies need to be clarified and strengthened, and mechanisms developed to ensure that regional planning concerns are taken up in national plans.
- Because basin planning must take into consideration all water-related developments, not only those that are implemented at the basin level, a regional inventory of all water resource developments is needed, in order to assess cumulative impacts and sustainability
- The importance of a basin-wide approach to balancing withdrawals and storage of water, through negotiation between countries and integration between sectors (specifically, irrigation and hydropower)
- Providing a strategic and rational approach to assessing trade-offs by understanding the impacts (direct, indirect and cumulative) of interventions within the context of the basin as a whole.

Priority areas for action

- Improved mechanism to integrate regional and national strategies and plans
- Regional inventory of all existing and planned water related developments
- Improved methods for describing and quantifying trade-offs inherent in different development options.

4.6 Water Resources Information Management

Goal: *Cambodia’s Water Resources are developed and managed confidently and wisely, on the basis of adequate information.*

The safe, economical design and operation of water related infrastructure requires accurate hydrological, meteorological, topographic, and other types of data. Management of water related hazards, particularly floods, droughts and pollution events, also requires accurate real-time data and

⁷

The Water Utilisation Program Decision Support Framework (WUP-DSF)

reliable forecasts. Long term climatic change and variability, as well as human activities in the upper Mekong River basin, may be influencing water flows down the Mekong and into the Tonle Sap Lake, but more information about trends is needed to develop appropriate responses. However, Cambodia has limited archives of data that describe long term conditions. It also has limited present day capacity to collect the data needed to design and operate projects, forecast hazards in real time, or appraise long term trends that may affect future water resources availability.

To work towards the goal, the Strategies are:

- A nationwide hydrological observing system collects archives and disseminates hydrological and related water quality data and information. It place particular emphasis on priority river basins in which water resources development is proposed.
- A nationwide meteorological observing system provides real time weather information for public forecasting purposes, and archives of historical data for agrometeorological research, design of infrastructure, etc.
- The basic information is available; in readily accessible, usable and consistently maintained form that describes the nation's water resources and hydrological systems. This includes a National River Basin Database, a National Surface Water Resource Database, and a National Groundwater Database.
- An authoritative National Flood and Drought Hazard Map is available that can be used for planning, design and regulatory purpose.

4.7 Regional cooperation

Goal: *Integrated and coordinated water resources development and management between countries to optimize benefits from the joint resource and minimize the risk of water-related conflicts.*

The 1995 Mekong Agreement provides a clear statement of intent of the four riparian countries to cooperate in sustainable development of Mekong water and related resources to mutual advantage. It also provides a management framework for regional cooperation in the four countries of the Lower Basin (see Section 3.3). Within the LMB, MRC has a clear mandate to coordinate water resource development issues.

China and Myanmar are not members of MRC, although both are cooperating in the areas of hydropower, navigation, flood and drought management and tourism. Liaison and coordination with the Upper Basin is a high priority.

The countries of the Mekong are increasingly inter-dependent in terms of trade, economic development and political cooperation. Regional initiatives for cooperation in economic development complement MRC's role in water resources. Of these, the most important are the ADB sponsored Greater Mekong Sub-region (GMS) initiative (which includes Myanmar and China); and programs under ASEAN (Association of South-East Asian Nations) (which includes Myanmar, but not China). Bilaterally, China is an important economic partner for all the Lower Mekong countries, as a developing market for energy, raw materials and food; and as an exporter of manufactured goods.

In addition, there are a number of regional programs which focus specifically on water resources, including

- Global Water Partnership – South East Asia (GWP-SEA)/ UCC-Water which promotes and facilitates the concept of IWRM, including Network of Asian River Basin Organisations (NARBO)
- Water and Sanitation Program (WSP), which coordinates efforts to improve access to water and sanitation in Cambodia
- Under ASEAN, a Long-Term Strategic Plan of Action on Water Resources Management (ASEAN 2003) was endorsed by the ASEAN ministers responsible for environment in 2003. The ASEAN Working Group on Water Resources Management (AWGWRM) has developed the ASEAN Strategic Plan of Action on Water Resources Management which is currently being considered by the ASEAN Senior Officials on the Environment.

Priority areas for action:

- Strengthening the regional negotiation process between the MRC member countries and establishing a water use agreement for the LMB
- Enhanced technical cooperation with China, particularly as regards development of hydropower and navigation in the Upper Mekong
- Closer coordination with GMS regional programs, particularly in transport and energy generation and transmission
- Cooperation and collaboration with ASEAN on common strategic priorities for water resources, as identified under respective strategic plans
- Coordination of strategies for water resources development with those of the major regional programs (particularly ADB and World Bank).

4.8 Governance

Goal: *Open, transparent and accountable institutions and regulatory frameworks that will promote IWRM at all levels.*

Improved integration of planning and management across the various management levels is key to achieving IWRM in the Cambodia. In general, national water administration is fragmented, with responsibility for water spread between different agencies and between national, provincial and district levels of administration. In the past, national planning has often been sector-driven, with little consideration given to cross-sectoral interactions, accountability and stakeholder participation. All stakeholders are working towards more integrated and responsive approaches to water management and planning

At the national level, all ministries has a clear mandate to coordinate water resource issues and a number of other national and international agreements also relate to water resources development. These national agreements are cooperative, rather than regulatory. Links between national and national planning need to be clarified and strengthened.

Key issues for effective water governance include

- Accountability and transparency at all levels of government. Roles in the legislative and executive processes need to be clear. Each institution must explain and take responsibility for what it does.

- Monitoring and evaluation of programs and projects against IWRM goals and principles, to ensure equity and efficiency.
- Coordination of water policy within ministries, through structures such as coordinating relevance agencies, or a designated ministry with responsibility for water resources.
- Some issues impacting on water governance may fall outside the water domain – for example, land tenure. Water managers will need to engage in dialogue with other branches of government to seek solutions.
- Coordination of water policy between relevance agencies, through effective involvement in country.
- To promote cooperation between the all stakeholders in managing the Mekong and Tonle Sap and related resources for the mutual benefit of all.
- To promote the establishment of open, transparent and accountable institutional and legal frameworks for water resource management.
- To ensure that monitoring and evaluation are an integral part of all water resource development programs to promote equity and efficiency.
- To base water resources development and management on a participatory approach, involving users, planners and policy makers at all levels.
- To improve the capacity of all stakeholder groups to manage water resources through training and education programs.

Priority areas for action

Establish mechanisms to

- Increase transparency and accountability at all levels of administration (in particular, monitoring and evaluation systems)
- Strengthen capacity of national agencies for water resources
- Improve the capacity of stakeholder groups to manage water resources sustainably, through training and education programs.
- Encourage establishment of RBOs, and provide support (particularly information and capacity building)

5. IMPLEMENTATION

To meet their development needs, the countries will need to implement a wide variety of water resource projects and programs. The principles and priorities identified here should guide implementation of actions at national and local level, as well as basin-wide and regional programs. Water-related programs and projects should be consistent with IWRM principles and contribute to the economic, social and environmental goals agreed by the countries. However, criteria for selection of projects must go beyond assessment of projects individually. Sustainability and equity of water resource use can be assessed only in the context of all development in the basin, because of the cumulative and trans-boundary nature of potential impacts.

5.1 Roles and responsibilities

Implementation of the strategic priorities identified in this document will rely on a broad coalition of governments at all levels, private sector, communities, UN and other international organizations, research institutions, international financial institutions and donor agencies. The roles and responsibilities of different actors should be negotiated with reference to the IWRM principles of integration and coordination. An important consideration for effective implementation is the need to upgrade the institutional capacities of the relevant agencies, building intellectual capital by strengthening capability and capacity of key officials.

The primary role in water resource management will always rest with **national governments**, which have responsibility for all aspects of policy and planning. Implementation of programs will usually be carried on in partnerships with other actors. Some of the national responsibility may be devolved to provincial or local levels, in line with policies on decentralization and subsidiarity principles. National governments are responsible for ensuring integration of water across different economic sectors, through the formulation of coherent water resource laws and policies; and by providing coordinating institutions and mechanisms. They are also responsible for monitoring and coordinating private sector involvement in water management.

Table 2. Institutional basis for water resources management

Institution	Water-related Responsibilities
Cambodia National Mekong Committee	<ul style="list-style-type: none"> • Advise the Cambodian representative to the MRC Council on all matters relating to activities within the Mekong River basin that could affect Cambodian interests. • Review proposals prepared by RGC agencies in the light of the Mekong Agreement. • Provide coordination between MRC and concerned ministries of RGC.
Ministry of Water Resources and Meteorology (MOWRAM)	Responsibilities defined by RGC Sub-Decree on 30 June 1999 include (abbreviated): <ul style="list-style-type: none"> • Define policies and develop strategies for water resources • Research and investigations of water resources • Prepare plans for water resources development and conservation • Manage direct and indirect water resource use, and mitigate water-related disasters • Draft water law and monitor its implementation • Gather and manage data and information about surface water, groundwater, and meteorology • Provide technical advice • Administer international collaboration, including that within the Mekong River basin
Ministry of Industry, Mines and Energy (MIME)	Water-related responsibilities include: <ul style="list-style-type: none"> • Planning industrial water uses and hydropower • Provision of water supply to provincial towns • Preparation of policy on water supply and sanitation • Administration of single-purpose schemes involving hydro-power
Ministry of Rural Development (MRD)	Water-related responsibilities include: <ul style="list-style-type: none"> • Hydrogeological research, data collection and archiving • Water supply, sanitation, land drainage in rural areas • Preparation of policy on water supply and sanitation
Ministry of Public Works and Transport (MPWT)	Water-related responsibilities include: <ul style="list-style-type: none"> • Land drainage and sewerage in Phnom Penh and provincial towns • Study, survey and construction of river works for navigation and water transport
Phnom Penh Water Supply Authority (PPWSA)	<ul style="list-style-type: none"> • Water supply and sanitation in Phnom Penh
Ministry of Environment (MoE)	Water-related responsibilities include: <ul style="list-style-type: none"> • Protection of natural resources and environmental quality from degradation. Its legal mandate includes water in the list of media for which it is responsible • Disseminate water-related information

	<ul style="list-style-type: none"> Water quality monitoring and pollution control, including monitoring wastewater discharges and issuing permits
Ministry of Agriculture, Fisheries and Forests (MAFF)	<p>Water-related responsibilities include:</p> <ul style="list-style-type: none"> Develop policies and strategies for agriculture, forestry and fisheries related to the management of water resources Manage forests (which has relevance to watershed condition, hydrological regime and water quality).
Ministry of Economics and Finance (MEF)	<ul style="list-style-type: none"> MEF is responsible for compiling the RGC's <i>Socio-Economic Development Programme</i> and <i>Public Investment Programme</i>. To the extent that water-related investments are proposed in a number of different components of the programmes, MEF has the role of harmonising proposals, and matching them against RGC investment priorities.
Ministry of Health	<ul style="list-style-type: none"> MoH is responsible for controlling the quality of surface and ground water used for public water supply, as well as for health education and other matters related to public health.
Provincial governments	<ul style="list-style-type: none"> Provincial governments have an oversight and coordinating role with regard to the provincial departments of ministries with water-related responsibilities. They provide the framework for provincial and sub-provincial development committees, some of which are engaged in water-related development (mostly water supply, sanitation, small scale irrigation).
Municipalities	<ul style="list-style-type: none"> Some municipalities operate public water supply systems. Municipalities are responsible for drainage and sewerage within their area.
Development committees	<ul style="list-style-type: none"> Development committees at provincial, district, commune and village levels have responsibility for socio-economic development initiatives. In some, water-related initiatives may be included, particularly with regard to water supply and sanitation.

5.2 Partnerships

Partnerships are essential to IWRM. The breadth and complexity of issues to be addressed means that no single agency can possibly fulfill all the roles needed to ensure appropriate coordination and integration. IWRM assigns to all actors in water resource management the responsibility and mandate to coordinate with other actors.

Basin-level IWRM takes place within a network of partnerships that is maintained between the national governments and a wide variety of other actors and stakeholders in water resources (see above). Partnerships are important at both the strategic level and at the level of implementation of programs and projects, to ensure cooperation, prevent duplication of effort, and assign responsibilities and actions to the most appropriate groups.

5.3 Financial mechanisms

An important aim of regional collaboration on IWRM is to facilitate investment in IWRM by enhancing the certainty of the investment environment; promoting efficiency; and increasing accountability.

Investment in water resources in the Basin will come from two main sources: public (government and ODA) and private. The role of each funding source is different, but complementary. The majority of investment for water resource development will be financed and administered nationally or in the private sector. Donor funding can assure targeted intervention for timely achievement of priority developments that would otherwise not be possible. Private – public partnerships and innovative financial mechanisms can enhance involvement of user groups in water management. Monitoring and evaluation of investment at all levels is essential to ensure accountability, and M&E programs should be an integral part of all investment plans.

Certainty in the investment environment for both public and private sectors can be improved by clear delineation of an acceptable “development space”, within which investment can proceed without controversy. This is assisted by setting out agreed priorities and directions (see Section 2), and identification of priority joint projects under BDP. It would be greatly strengthened by establishing a regional “clearing house” mechanism to certify that projects conform with regional agreements, and do not have unacceptable impacts.

5.4 Monitoring and evaluation

Monitoring and evaluation of outcomes against agreed objectives and criteria are an essential component of IWRM. The aims of M&E are to check that programs have the desired impacts, to avoid unintended impacts, and to ensure equity, efficiency and accountability. In many cases, the underlying aims of IWRM projects (such as poverty alleviation and economic development) will be influenced by factors well beyond the water resource sphere, so M&E must take account of the broader economic and social context within which water resource development occurs.

M&E should take place at two levels: monitoring of individual programs and projects; and regional monitoring and evaluation of the cumulative impacts of programs.

The responsibility for M&E in individual programs lies primarily within the program – every program should have an M&E component, and major donors and banks have developed guidelines in this regard. External monitoring and reporting is also needed at a level appropriate to the program – usually local, provincial or national government as part of their accountability processes. River Basin Organisations, with both government and non-government stakeholders, can provide an effective mechanism for M&E.

At a regional level, the 1995 Mekong Agreement and later procedures assigns responsibility for monitoring of the impacts and equity of water resource use and development to the MRC. The mandate could be broadened to include monitoring of overall progress towards IWRM.

6. CONCLUSION

The shared goals and priorities which the line agencies have identified and which are presented in this document provide a solid basis for cooperation and a platform for coordinated action to facilitate integrated water resource management in the Cambodia. At the national level, each agency has outlined a commitment to sustainable water resources management and development, through their national policies and strategies. At the regional level, the involvement of all countries in regional and international agreements, conventions and programs demonstrates a willingness to work together towards mutually beneficial development.

It is hoped that the strategic directions and IWRM approach encapsulated here will provide a sound basis for Ministries’ cooperation program for sustainable water resource development in the Cambodia.

APPENDIX1: SECTOR ANALYSES

1.1 Agriculture and irrigation

Current status

Water in Cambodia is used for agriculture, industry, hydropower, navigation, and tourism. The estimated total quantity used each year 750 MCM/year, of which 95% (about 710 MCM/year) is used for irrigated agriculture. There is very little reliable information on the quantities used for other purposes. Groundwater potential for irrigation is an integral aspect of Cambodia's water balance, and provides a substantial natural storage of water that may be available to provide a year-round source of water.

Currently, approximately 2.7 million hectares is effectively utilized for crop production. In 2001, 2.6 million hectares was under wet and dry season rice production. Other significant crops are maize (71,500 ha), rubber (40,000 ha), soybean (33,300 ha), vegetables (33,800 ha), and mung bean (25,000 ha). In 1999, the agriculture sector contributed to approximately 26% of the total GDP, which was about 2,014 billion Riels. Of this figure, rice accounted for 859 billion Riels, other crops for 591 billion Riels, and livestock for 564 billion Riels.

Different irrigation systems have been found in lowland irrigated areas along the Mekong River, around the Great Lake of Tonle Sap, and in the associated wetland and seasonally flooded areas. Lowland irrigated agriculture is generally practiced around swamps and lakes, using a combination of canals, dikes, reservoirs, small pumps and traditional lifting devices to manage and exploit waters arriving during the annual monsoon flood.

The use of surface water ponds as a source of water for farm-scale irrigation is also widespread, and newly excavated ponds can be seen in many places (no data are available on the number or rate of increase in number of ponds, however). Ponds with a surface area on the order of 400 m² and a depth of 2-3 meters typically can provide water for irrigation through much of the dry season, particularly for application at critical times in the growth cycle.

- Much of the irrigation infrastructure in the country is old, poorly maintained and inefficient.

Development opportunities and constraints

- Access to markets is limiting for development in many areas, as well as access to land and water.
- Without offsetting storage, extraction and diversion of water for irrigation development results in a significant decrease in dry season flows and a concomitant increase in the area affected by salinity intrusion
- Major development of irrigation will thus require construction of regulatory storages; but due to very seasonal nature of rainfall, even construction of very large storages will not completely remove risk of water shortages
- Use of groundwater for irrigation is not highly developed.

Cross-sectoral opportunities

- Possibilities for multi-purpose storages (irrigation – hydropower – fisheries)
- Importance of rice-field fisheries and shrimp-rice agriculture
- Land capability / suitability assessment and land use planning

Trade-offs

- Impact of irrigation extractions on dry season low flows and salinity intrusion
- Impact of intensification of agriculture (both irrigated and non-irrigated) on water quality due to agricultural chemicals
- Alienation of flood-plain and clearing of wetlands for irrigation development
- Impacts of storages on water flow patterns and water quality (sediment loads)
- Upstream – downstream demand competition
- Transfer to areas in other basins to mitigate water shortage

Priority areas for investment and cooperation

- Higher returns from irrigated agriculture, through improved farming practices, increased efficiency of water use, diversification of crop types and support to distribution and marketing
- Changes to farming systems in the Delta to reduce withdrawals in the critical dry season period
- Conjunctive use of groundwater to reduce pressure on surface water in critical periods
- Expansion of irrigation to utilize potentially higher dry season flows resulting from increased regulation and storage which will result from hydropower development
- Expansion of irrigation to utilize potentially higher dry season flows resulting from increased regulation and storage. for example
 - Battambang region in NW Cambodia
 - Eastern Cambodia
- Upgrade and improvement of existing infrastructure
 - For example, colmatage systems south of Phnom Penh in Cambodia
- Support for farmer water user groups

1.2 Hydropower

Current status

Cambodia is one of the south-east Asian countries that are rich in water resources. According to the latest preliminary study, the total hydropower potential of the country is estimated at 15,000 MW-10,800MW on the mainstream, 2,727 MW on tributaries of the Mekong, 313 MW on Tonle Sap

Basin and 1,136 MW outside Mekong Basin. It is estimated that there are about 60 possible sites of small to large hydropower projects in the whole country.

The power demand is increasing yearly due to the increase of population. It is estimated that the demand will increase up to 991 MW and the generated power will be 3488.4 GWh in 2020, with average annual growth rates of 12% and 9.4% respectively.

The major socio-economic effects of hydropower development in Cambodia include the displacement of population living within the reservoir area of the projects and their resettlements in new areas. The flooding resulting from the impoundment of water in front of a dam will remove land that is used for other purposes such as farming and forests, and which provide various ecological as well as economic benefits. On the other hand, all economic sectors (agriculture, industry, services and trade) and private households will benefit from sufficient and reliable energy production.

The construction of dams causes ecological consequences including climatic change, influences on the water and soil quality, flora and fauna, land use, etc. social impacts and health

Development opportunities

- Cambodia has very abundant sites suitable for hydropower development – over 50 have been identified, with total potential estimated at 15,000 MW – 10,800 on the mainstream, 2,727 MW on tributaries of the Mekong, 313 MW on Tonle Sap Basin and 1,136 MW outside Mekong Basin.
- The viability of hydropower development is determined by the relative cost of power from other sources, and effective hydropower planning requires very close integration with the rest of the sector
- Demand for power is expected to increase up to 991 MW and the generated power will be 3488.4 GWh in 2020, with average annual growth rates of 12% and 9.4% respectively. And that after that demand will increase even more quickly.

Cross-sectoral opportunities

- Possibilities for multi-purpose storages (irrigation – hydropower – fisheries)
- Enhanced dry season flows from hydropower development may provide opportunities for additional dry season irrigation
- Enhanced dry season flows may improve navigation reliability.
- Recreational and tourist potential of reservoirs
- Some potential for flood mitigation (but probably limited - see Section 3.2)

Trade-offs

- Impacts of dam construction, including environmental (loss of habitat) and social (resettlement)
- Impact of changed flows (quantity and quality) on downstream environments, particularly wetlands
- Impact on fisheries of dam construction, due to blocking of migration route, and changed flow patterns

Priority areas for investment and cooperation

- Sector planning and efficient integration of hydropower
- Ranking of regional projects in terms of efficiency, financial viability and social and environmental outcomes
- Efficient hydropower generation and distribution mechanisms
- Optimizing operation rules to minimize downstream environmental impacts
- Predicting and responding to changes in flow conditions due to hydropower development.
- Consideration of environmental and socio-economic factors in hydropower development – in particular:
 - Cumulative impacts of hydropower development
 - Impacts on fisheries
 - Possible mitigation measures

1.3 Navigation

Current status

Most of the waterway traffic is on the Mekong River between Phnom Penh and Ho Chi Minh City, and from Phnom Penh upstream to Kratie. Vessels of up to 5,000 tones can navigate along the Mekong up to Phnom Penh for most of the year. Traffic on waterways other than the Mekong is by means of small crafts, which constitute a very small volume. There is no reliable dredging needed to maintain adequate water depths in the dry season. Further reliable statistics related to the water traffic are not available.

The Inland waterway system traditionally plays a vital role in the Cambodian economy. The system consists of the Tonle Sap Lake, the Mekong River and the Bassac River for a total navigable length of 1,750 km, with 580 km navigable all year round. In the dry season, the draft of Mekong upstream of Phnom Penh is some 3.8 m to Kampong Cham (105 km) and 1.5 m to Kratie (116 km from Kampong Cham). With dredging a draft of 2.5 m could be kept the whole year as far as Kratie with annual dredging. Between Kratie and Stung Treng, 50 ton-boat can pass easily during the rainy season, but at low water only 20 ton-boats can pass. On Tonle Sap River the draft is about 3.5 m up to Kampong Chhnang in dry season but from Kampong Chhnang to Chong Kneas (near Siem Reap) on the Lake, dry season draft is 0.8 m and reaches between 5 and 11 m in the rainy season. The Bassac River links Phnom Penh to Chau Doc, the capital of Vietnam's An Giang province. In the rainy season 100 ton-boat can be used.

The most important domestic ports are in Phnom Penh, Kampong Cham, Kratie and Stung Treng on the Mekong, Kampong Chhang, Chnok Trou and Siem Reap on the Tonle Sap River and lake. Chnok Trou and Kampong Chhang are also road-river transshipment ports. All the domestic ports suffer from insufficient or the total absence of supporting landing infrastructure. There is presently no any reliable data on domestic cargo movements on the river system. In 1994, it was estimated (in depth survey of boat operators) that about 40 to 50,000 tones could constitute the domestic cargo. Figures between 15 and 50,000 tons are usually quoted. The absence of reliable figures makes the task of designing and promoting river ports extremely difficult.

The shallower Mekong, rather than the Bassac River is the declared international channel for navigation to Phnom Penh, Kompong Cham and Kratie, restricting vessel size. Small seagoing vessels (up to 4,500 DWT) are able to serve Phnom Penh in Cambodia.

The use of the river for transportation does not only depend on the physical potential of the waterway but also on the demand for trade. In 2002, trade estimated at \$235 million was distributed by inland waterway transport in whole country.

Development opportunities and constraints

- Access to international and maritime routes through the Delta
- Water –based tourism, including long distance cruise routes from Ho Chi Minh City to Phnom Penh and Siem Reap; and on the upper stretch of the river, between Thailand, China, Myanmar and Lao PDR
- Constraints:
 - Non-physical barriers to international navigation;
 - Competition from other transport choices (notably road);
 - Physical restrictions due to low water in dry season or (in the Delta) at low tide

Cross-sectoral opportunities

- IWT plays a crucial role in providing access to markets for agricultural produce
- Environmentally sound mode of transportation
- Opportunities for development of water-based tourism

Trade-offs

- Disruption of riverine ecosystems
- Risks for pollution if no rules are established and enforced

Priority areas for investment and cooperation

- Design, feasibility and impact studies related to ports, river works and regional waterways development
- Implementation of ports, river works and regional waterways development
- Morphological studies and bank protection schemes
- Basin-wide institutional capacity-building; development and implementation of education programs for pilots, skippers, and administrative officers
- Promotion of “clean” river transport; prevention of environmental damage

1.4 Fisheries

Current status

The Tonle Sap River is an important inland wetland in Cambodia. It is endowed by a rich natural resources base. Its area ranges from 250,000 to 300,000 ha in the dry season and 1 to 1.6 million ha in the wet season (ADB, 2002). During the dry season, the water flows out of the Great Lake into the Mekong River at Phnom Penh and is forced to flow backwards due to the greater height of water in the Mekong during the wet season. The water levels in the Great Lake consequently rise by 6–9 meters and thousands of square kilometres of land around the lake are temporarily submerged. It has been recorded that the Tonle Sap contains at least 200 species of fish, 42 species of reptiles, 225 species of birds, and 46 species of mammals. It is estimated that approximately 1.2 million people live in the area bordered by Highways No.5 and No.6.

Fisheries and aquaculture are significant economic activities in Cambodia, particularly those who live around the Tonle Sap areas. It is indicated that 88% of people in 170 villages around the flooded forest rely on fishing or related activities (Thouk & Sina, 1997). Inland Fisheries produce approximately 290,000 to 430,000 tones annually, with a value at landing of between US\$ 150 million and US\$ 250 million and retail value of up to US\$ 500 million. The sector contributes as much as 8-10% of Cambodia's GDP.

Development opportunities and constraints

- In the Tonle Sap River capture fishery, catches have not decreased but size and species diversity of fish caught has declined over the last 20 years. Internationally, this is often an indicator that the fishery is at risk. It is likely that the capture fishery is at or close to its sustainable limits. Thus, the emphasis is on management and conservation of the existing resource.
- Improvements in licencing and management of commercial fishing lots
- Expansion of aquaculture, in particular small scale operations using native species
- Processing to reduce loss through spoiling, and to improve value adding
- Development of export markets, both within the basin and to nearby urban areas.

Cross-sectoral opportunities

- Possibilities for multi-purpose storages (irrigation – hydropower – fisheries)
- Importance of paddy-field fish cultivation
- Opportunities for shrimp-rice cultivation systems in the Delta

Trade-offs

- The capture fishery is the most vulnerable sector in the basin. In particular, fisheries are threatened by loss of habitat due to clearing of wetlands, alienation of the floodplain and changed flow regimes; disruption of migration paths by dams; fishing pressure; and pollution of waterways. Loss of fish productivity often impacts most severely on the poor, who depend on fish as a vital part of subsistence livelihoods

- Alienation of the flood-plain to protect land for agriculture and urban development, preventing access for spawning and feeding
- Intensive aquaculture is highly polluting, releasing nutrients and chemicals into natural water sources
- Conflicts between brackish and freshwater production systems in the Delta
- Clearing of mangrove and wetland areas for large-scale aquaculture.

Priority areas for investment and cooperation

- Management and protection of the capture fisheries:
 - Protection of vulnerable habitat important for fisheries, such as floodplain, flooded forests, deep pools
 - Maintenance of major migratory paths (including Tonle Sap system and deep pools in mainstream)
 - Co-management of fisheries involving local communities, as well as provincial and national authorities
- Improved management and development of reservoir fisheries and aquaculture; in particular, small scale aquaculture for rural households and aquaculture of indigenous Mekong species.
- Opportunities for value-adding through marketing and processing
- Improving the information base for fisheries, in particular
- Economic value and nutritional importance of Tonle Sap and Mekong fishery
- Ecological studies of Tonle Sap and Mekong fisheries and basis for productivity
- Improved integration of fisheries into catchment planning

1.5 Tourism

Current status

Tourism in Cambodia has developed rapidly since the early 1990's, and is targeted in the economic development policies of all as an area for increasing contribution to GDP. GMS has identified tourism as a key sector for cooperation. Tourism is a major source of foreign exchange earnings and foreign direct investment for Cambodia.

Within the Cambodia, major tourist destinations are Siem Reap (Angkor Wat), Prek toul, all with important connections to the river system. The Mekong system is itself a major tourist attraction, both for the water bodies (rivers, lakes, waterfalls) and for associated ecosystems and wildlife. Ecotourism is an increasingly important sub-sector – natural environment.

Development opportunities and constraints

- Water-based and eco-tourism development focusing on the river and its environment
- Cross-sectoral opportunities
- Recreational and tourist values of irrigation and hydropower reservoirs

- Development of IWT as a major tourist transport mode (including long distance cruise routes from Ho Chi Minh City to Phnom Penh and Siem Reap);
- Village based eco-tourism and agro-tourism
- Promotion of national parks and protected areas as tourist destinations

Trade-offs

- Social and cultural pressures
- Pressure on local water supply and sanitation systems, particularly in smaller destinations
- Disruption of riverine ecosystems and increased bank erosion, particularly from high-speed IWT traffic used by some tourist operators

Priority areas for investment and cooperation

- Promotion of water-based tourism, particularly in the context of promoting the Mekong countries as a joint destination
- Promotion of community-based eco-tourism and cultural tourism
- Monitoring and prevention of environmental degradation related to increased human activity in ecologically sensitive areas
- Raising awareness and capacity to deal with social issues arising from increased tourism
- Provision of adequate water supply and sanitation infrastructure

1.6 Domestic and industrial water supply

Current status

Water supply is a crucial component for human being. Without water, life can not be sustained. Surface and ground water are the main sources for domestic water supply in urban and rural areas in Cambodia. It has been shown that groundwater is used as the major source for industrial sector.

63% of the total population living in urban areas can access to safe water supply while only 24% of the total population in rural areas can. Unprotected water sources are used by people in rural areas.

Industrial sector development has been significantly increased and improved since 1999. The garment industry is the most important sector among others. There were 25,791 companies in manufacturing. Of these, 6,257 were enterprises, 19,277 were small and medium business enterprises (SMEs) and 257 were big business enterprises (Siphana, 2003). Rapid expansion of the textile industry, based primarily on exports to the United States, contributed to double-digit growth for industrial value added in 2000. Manufacturing increasingly dominates the industrial sector, accounting for 75.0 percent of industrial value added and nearly 15.0 percent of GDP in 1999 (ADB, 2003).

In terms of water demand for the industrial sector, the demand varies depending on the size of the industry, the kind of processing, etc. It is estimated that the demand by industry ranges from 50 m³/day to 20,000 m³/day per industrial unit.

The water supply for domestic use must be clean and safe compared with the supply for other uses. The sources of water pollution include municipal, industrial, and agricultural. It has been indicated that the causes of major environmental issues related to the water supply include sewage, pesticides, and fertilizers. Sewage, both from municipal and industrial sources, is the most important environmental issue in water supply in most cities and provincial towns throughout Cambodia. Groundwater quality is good for most provinces. It has been reported that the groundwater for five provinces contains Arsenic, with high concentration that exceeds the WHO's standard, and this is a growing concern.

Water extraction for domestic supply does not result in trans-boundary impacts due to the small volume of water extracted. Water contamination, both surface and ground water, by sewage discharge is also not a major trans-boundary environmental effect at present. It has been demonstrated that wastewater discharge by the industrial sector is likely to have negative impacts on both surface and ground water.

Development opportunities and constraints

- Dry season water availability is limited in many areas away from the main rivers; supplies often rely on groundwater. Understanding of the groundwater resource is limited and studies are needed to determine the sustainability of groundwater use and its potential for large scale extraction for municipal and industrial use.
- Water quality issues (and particularly contamination of both surface and groundwater supplies by effluent disposal) may threaten supply more than availability.

Cross-sectoral opportunities and issues

- Multipurpose reservoirs – provision of water supply from irrigation and hydropower reservoirs
- Localised pollution problems downstream from major urban areas

Trade-offs

- Provision of safe water and sanitation has very few negative consequences, and can generally be accounted as low to no impact. In some cases there may be local loss of wetland amenity, where natural wetlands are used for primary treatment of effluent.
- It is important to establish that access to water for basic needs as highest priority, and provide adequate protection of domestic water supplies from overuse by other sectors
-

Priority areas for investment and cooperation

- Urban water supply (particularly for the poor) – maintenance, rehabilitation and expansion of existing water supply and sanitation infrastructure
- Rural water supply
- Efficiency of water use and distribution systems

- Prevention and mitigation of pollution (both urban and rural)
- Monitoring access for equity, sustainability and impact
- Innovative mechanisms for financing water supply (eg through public – private partnerships)

1.7 Flood management and mitigation

Current status

Flooding is a major problem severely affecting all the Mekong River riparian countries. Within the Mekong Delta in Cambodia and Vietnam flooding is more frequent – and the areas flooded are larger.

The Tonle Sap is filled with water from the beginning of the flood season until the main flood peak reaches Chaktomuk at Phnom Penh. For a short time at the peak, the water levels at Chaktomuk and Prek Kdam become almost the same and the flow in the TonleSap River is stagnant, thereafter throughout the dry season the Lake continues discharging. It has been estimated that the Tonle Sap Lake stores approximately 20 to 30 per cent of the total discharge from Kratie during the flood season.

Flooding is one of the critical issues in Cambodia. Flooding has dual effects on the country – negative and positive. Seasonal flooding is very important for increased fishery production, maintenance of wetland ecology, and replenishment of soil fertility with silt and sediment, and supply of water for irrigation. Freshwater fish production remains the most important source of livelihoods in the rural area and fish constitutes some 60% of protein intake in the Cambodia diet.

But excessive flooding can inflict damage on the social infrastructure, disruption of economic activities, loss of human lives and livestock, and destruction of cultivated crops. The 2000 floods resulted in damage to some 370,000 ha of paddy rice, destruction of 6,081 houses, loss of 2,444 livestock, and affected 3.44 million people in 132 districts. Subsequent flood in following years, though on a smaller scale, continue to disrupt the normalcy of economic activities, especially agricultural production. As a result, the rural population is exposed to unstable food security and further impoverished. Damage by the year 1996 and 2000 floods was estimated to have totaled US\$ 86 million and US\$ 164 million respectively.

As flooding becomes a frequent phenomenon and causes substantial social and economic damage to the country, country coordination for flood emergency relief and rehabilitation became critical. In 1995 a National Committee for Disaster Management was formed by a Sub-Decree, which was amended in 1999 to include all representation of all ministries to the committee. The committee is given a broad mandate to deal with country disaster preparedness and emergency response, information systems, public awareness and community based disaster preparedness.

A comprehensive flood management and mitigation strategy is urgently required for Cambodia, as a framework amongst others for investments in response to the major flood of 2000-2002. This must be based on an accurate assessment of the communities and assets at risk and the realistic costs (financial and social) of flood damage in the future.

Development opportunities and constraints

Floods are natural events, and it is usually not possible to achieve complete protection – particularly in the context of the very large natural floodplain of the Mekong. In addition, large structural flood protection works induce major changes in ecosystems. However, the flood risk can be greatly reduced if communities are appropriately prepared. In many cases, a mixture of structural and flood preparedness measures will be most effective in reducing vulnerability.

Cross-sectoral opportunities

Land use planning is a crucial part of flood preparedness and reducing flood damage. There is some potential for mitigation of floods by dams, particularly at a local level. Model results (see Section 3.3) indicate that construction of proposed storages will reduce average wet season flows by up to 0.3 m, but this may not provide a significant benefit in terms of flood protection on the floodplain and Delta. In many cases the worst floods occur in the late wet season, when storages operated for hydropower or irrigation are full and have no capacity to absorb extra flows.

Trade-offs

The major trade-off with flood protection is alienation of the floodplain and adverse impacts on environment and fisheries. There is also evidence that loss of the annual deposit of river silt in areas protected from floods may lead to decline in soil fertility.

Priority areas for investment and cooperation

- Flood preparedness (flood forecasting and regional flood warning system, community based preparedness)
- Strengthening flood emergency management
- Improved delineation and land-use planning for flood hazard areas
- Development and operation of hydraulic structures to reduce flood risk from inappropriate structural intervention
- “Flood-proofing” to reduce vulnerability (rather than aiming at full structural flood protection)

1.8 Watershed management

Current status

Watershed Management is the process of people guiding and organizing water, land and forest resource use on a watershed in order to provide desired goods and services without adversely affecting water, soil and vegetation resources. Embedded in this concept is the recognition of the ecological interrelationships among land use, soil and water, and the ecological, social and economical linkage between upstream and downstream areas.

Therefore the following areas need to be addressed:

- Consistent sector policies and planning processes
- Effective stakeholders negotiating processes
- Appropriate implementation technologies
- Adequate monitoring system
- Sustainable information- and data management including target oriented preparation of lessons learned

These include

- Conserving or rehabilitating resources and environment
- Promoting social and economic development
- Achieving specified and agreed land and water management targets
- Ensuring agreed upon level of biodiversity
- Minimizing land degradation.

Effective watershed management needs to be holistic in coverage and inter-disciplinary in scope. WSM has to consider the natural resources (land, water, forest) as well as the human resources and coordinate their management needs and development potentials. Watershed interventions should consider the different stakeholders' interest and include mechanisms for conflict resolution.

Large and unique areas of forest, wetlands and floodplain areas remain in the LMB (including the Tonle Sap Great Lake and its environments). These represent assets with a high economic, social, cultural and environmental value. In general, the forest and wetlands are under pressure. Headwater areas are exposed to deforestation from forestry activities intensified shifting cultivation and unsustainable agriculture systems. Wetlands are under pressure from cultivation and changed flow regimes from regulation, and floodplains are from land development and infrastructural intervention.

Deforestation and poor agricultural practices can significantly degrade both the quantity and quality of run-off and alter groundwater recharge, as well as threatening habitats and biodiversity. Mining in headwater areas (and elsewhere) requires a particular caution to minimise the environmental impacts such as soil erosion, habitat degradation, and release of toxic substances.

Watershed degradation threatens both rural and semi-subsistence livelihoods. Control of impacts is subject to complex socio-economic cause-effect relationships, and involvement of local communities is critical to effective management.

Issues of governance and subsidiarity are crucial for appropriate watershed management. Participatory land use planning and land allocation is the foundation for an IWRM approach. Integrated spatial planning should include institutional analysis and design, and transparent methods for participation and delegation of authority and responsibility. Special consideration must be given to underprivileged groups (such as ethnic minorities), comprising empowerment and targeted support.

Cross-sectoral opportunities and trade-offs

Watershed management is intrinsically cross-sectoral. IWRM views the watershed as a coherent unit, within which the social, environmental and economic outcomes are inextricably linked. IWRM thus explicitly incorporates the concepts of watershed management with a special focus on the importance of maintenance of watershed functions.

Watershed management efforts interact positively with rules regarding flow regimes, environmental impact assessment, development of tourism and the recreation sector, with fisheries development, and with flood management efforts

Priority areas for investment and cooperation

- Development and promotion of watershed-related knowledge, awareness and attitudes among stakeholders and decision-makers in the public and private sectors
- Creation of relevant and effective watershed management related institutional framework
- Integrated spatial planning at local, national and basin levels
- Improved farming systems and agricultural practises in upland areas (particularly with regard to shifting cultivation)
- Support to sustainable commercial forestry, agro-forestry and traditional forest-related livelihoods, including reforestation and greening schemes
- Support to appropriate management (including land management plans and monitoring) of important habitats, including restoration and partial protection where necessary. Such habitats could be forests, wetlands, and floodplains, including inundated forests and other unique LMB ecosystems
- Measures to improve traditional forest-related livelihoods, such as mountain agriculture and non-timber forest production; including awareness and education programs, and scientific research
- Related education, capacity-building and awareness-building

APPENDIX2: WATER SECTOR ROADMAP

Sector Outcomes	Current status	2010
National Water Reforms		
1. Effective national water policy	Draft Law on Water Resources Management with National Assembly, National Water and Resources Policy approved by Council of Ministers.	Law and associated regulations fully disseminated and implemented. Policy reviewed and revised as necessary.
2. Effective water sector apex body	CNMC implements the Mekong Agreement with NMCs of other MRC members, but is under-resourced. MOWRAM focuses on I&D, but is developing capacity in water resources policy and management.	CNMC contributes to successful achievement of the Mekong River Basin Vision, in cooperation with the other NMCs. MOWRAM continues to lead development and management of water resources, particularly at the basin level.
3. Effective water action agenda	A National Water Resources Strategy prepared; and a draft Strategic Plan 2001-5 for MOWRAM.	National Water Resources Strategy reviewed and revised to incorporate IWRM at all levels of government.
Water Resources Management		
4. Total annual withdrawals as share of annual water resources	An estimated 0.75 km ³ /y), still << 1%	Increasing, but still <1%
5. Existing policy and capacity to collect and manage water data among agencies	Hydrometeorological data collection capacity less than needed, except for flood warning on the Mekong. Inter-agency cooperation is weak but included in the draft Policy.	MOWRAM's hydro-meteorological capacity meets national information needs. Line agencies implement the provisions of the National Water Policy with regard to data exchange.
6. River basin perspective for management and development	River basin approach being considered. CNMC implements the Mekong Agreement within resource constraints. Flood forecasting within MRC system.	River Basin Committees established for the 2-3 priority (sub) river basins, and river basin-based approach to IWRM being applied effectively.
7. Devolution of integrated water resources management	Growing stakeholder participation. PIMD and IMT promoted in I&D, with >100 FWUCs. IWRM principles disseminated but not yet adopted.	High awareness of IWRM with MOWRAM support in at sub-national and river basin levels and IWRD adopted at local level (Village Development Committees, FWUCs, etc.). Rural water supply/sanitation managed by beneficiaries..
8. Water quality impacts	Moderate impacts Surface water quality (except turbidity) during the wet season is good. Dry season water quality is high in the Mekong, but degraded in Tonle Sap and many other waters. Bacteriological quality of river water is severely degraded downstream from Phnom Penh. National standard for drinking water under preparation.	No targets for quality of natural waters appear to have been set. National standard for drinking water established.
9. Water quality management in	Partially effective. MoE	Data available on water quality at

place	enforcement program partly effective for point source discharges. No management of rural water quality or non-point source contamination. Draft Law on WRM enables MOWRAM to manage water quality.	public areas, effluents, surface and groundwater, as a basis for measures to eliminate sources of contaminants. Necessary human resources and information available to establish such measures.
10. Adversely affected coastal zone.	Slight impacts. Situation little changed. Growing pressure at Kampong Som offset by installation of wastewater treatment facilities.	Goals for 2010 to be developed during development of MoE strategic plan and SEDP-III.
11. Economic losses from floods and droughts (annual average from 1990 to 2000)	>2 million people affected by 2001 flooding, and 920,000 evacuated. Losses were \$36 m in 2001 (2,250 houses, 165,000 ha of crops, 7,940 km of rural roads damaged). Losses much less in 2002.	Goals for 2010 to be developed during planning for SEDP-III
12. Annual Loss of life from floods and droughts.	62 people in 2001 flooding, 70% children. Less than 10 died in 2002.	Goals for 2010 to be developed during planning for SEDP-III
13. Incidence of children under 5 with diarrhea	10,850 out-patient cases and 1,840 in-patient cases; 54 deaths in 2001. Unknown number of untreated cases.	MoH Program to reduce morbidity and mortality due to diarrhea and acute respiratory diseases among children <5
14. Urban population with access to safe water	Situation improving in Phnom Penh, Sihanoukville and provincial towns receiving investment. 5 provincial centres have no piped supply. 15 public water-works are in operation; house connections range 3%-28%.	Goals for 2010 to be developed during planning for SEDP-III
15. Urban population with access to adequate sanitation	Current situation is not changed significantly.	Goals for 2010 to be developed during planning for SEDP-III
16. Performance of urban water supply/sanitation – non-revenue/unaccounted-for water	Improving: 22% UFW in Phnom Penh, 16-55% UFW in provincial water supply systems (private sector management).	Goals for 2010 to be developed during planning for SEDP-III
17. Amount (%) of urban effluent that is treated	Current situation for urban wastewater is unchanged. 70% of factories have their own wastewater treatment plant.	Goals for 2010 to be developed during planning for SEDP-III
18. Cost recovery for urban water supply	99% for Phnom Penh. Unchanged for provincial towns.	Goals for 2010 to be developed during planning for SEDP-III
19. Private sector participation in urban water supply	Private sector management of urban water supply is promoted. PPWSA is a self-sustaining public corporation. There is private sector owner-ship or management in 3 provincial and 8 district towns.	Goals for 2010 to be developed during planning for SEDP-III
20. Effective regulatory system for urban water supply	National Policy on Water Supply and Sanitation adopted in	Water Supply and Sanitation Regulatory Body prepares sub-

	February 2003. A regulatory framework about to be submitted to the Council.	decrees etc. to enable implementation of the Framework.
21. Rural population with access to safe water	~30%	48% have access to safe water by 2011. (MDG is 80% by 2015)
22. Rural population with access to adequate sanitation	<10%	32% by 2011
23. Self-sustaining rural water supply systems	No systems exist. Current situation is unchanged.	Community institutions formed for all new and many existing RWS systems, with performance standards, training, and private sector incentives.
24. Irrigation efficiency	Current situation unchanged.	No national target. Systems designed appropriately for local soil and construction material.
25. Average yield per ha or yield per volume of water for rice	Yield averages 2 t/ha, is increasing, but is well below the achievable level of >5 t/ha	Sustained 2.2-2.5 t/ha, with a cultivated area of 2.5 m ha.
26. Cropping intensity	The current situation is unchanged.	No target for cropping intensity. The strategy is for crop diversification and increased cultivated area.
27. Cost-recovery for irrigation system O&M	Policies implemented in 72 existing schemes, in all new/rehabilitated schemes and in 11 new "model" schemes. Training is ongoing for MOWRAM staff.	An Irrigation Improvement Fund established. The general goal is improved farming systems, agricultural productivity, food and income security. No quantitative targets set yet.
28. User participation in irrigation	>100 FWUCs exist, with O&M and governance functions. A PIMD Training Manual produced. Draft Decree on PIMD and Sub-decrees on FWUC and Irrigation Management Transfer prepared.	General goal is sustainable management/development of irrigation systems, and increased funds mobilisation for I&D sector. No quantitative targets set yet.
B. Indicative Sector Outputs		
Appropriate national policy, legislation and strategy for IWRM	Draft National Water Resources Policy and WRM Law under consideration by Gvt. Various sub-sectoral policies and strategies in draft or adopted.	Sub-decrees adopted and effectively implemented. Sectoral and sub-sectoral policies and strategies effectively implemented.
Effective institutional arrangements for IWRM	MOWRAM (IWRM and I&D), CNMC (administering Mekong Agreement) and MoE (pollution control) have principal responsibility for IWRM; other agencies have responsibility for service delivery. Effectiveness is limited by lack of resources and inter-agency coordination.	MOWRAM fully able to implement and promote IWRM, and other agencies carry out their responsibilities consistently. River basin committees established in 2-3 priority river basins for which basin management plans have been developed.
Sound basis for private sector participation in the water sector	Legal/regulatory basis for private sector participation in water service delivery is weak, and provides limited security. No arrangements to license/allocate rights to take/use water, but draft	Secure environment well established for private sector investment in the economy. Procedures established for administration of water rights, regulations, and licenses for water service providers, and applied

	Law on WRM has provisions. A law on regulation of water supply in draft. Wastewater discharges are licenced by MoE.	efficiently, fairly, and transparently.
Adequate water and climate-related data and information	Water and climate-related data and information inadequate to support IWRM, water project design, and I&D management. Flood forecasting for Mekong River fully functional.	Basic monitoring and archiving capacity operational, and water and climate archives extended. Information and systems required for I&D design, management, monitoring and evaluation, available on an operational basis.
Effective community response to water-related natural hazards (especially floods and droughts)	Severe impacts on the whole population and mitigation limited largely to flood forecasting along the Mekong, structural flood protection for Phnom Penh city, and after-the-fact flood/drought relief. NDMC responsible to coordinate disaster mitigation and MOWRAM to implement flood and drought mitigation. Effectiveness growing but resource-limited.	Loss of property, livelihood and life as a result of 1:10 year events minimal. In more severe (less frequent) events, losses significantly reduced below the present, and promptly mitigated by effective relief efforts.
Sustainable arrangements to manage and control water for agricultural production.	About 18% of cropland receives irrigation (largely supplementary) and about 20% of public I&D systems are fully operable. Sustainability low because of limited funds and organizational/community capacity. Uncontrolled and often unsustainable use of by many farmers to exploit groundwater and surface water for small-scale irrigation. Most cropland is rain-fed, and novel means of water control needed.	About 25% of cropland irrigated. PIMD and IMT progressively extended to existing public I&D systems. Small-scale private water management widely practiced, within sustainable limits set by local water resources.
Effective regulation of competing demands for water	No legal basis for allocation of water or regulation of water use, and no implementation.	To be developed during planning for SEDP-III.
Improving water quality	Water quality is good in the Mekong and deep aquifers, but degraded in smaller rivers, shallow aquifers and the Tonle Sap, due to non-point source contamination, especially in the dry season, and in the Tonle Sap/Bassac Rivers by Phnom Penh sewers.	To be developed during planning for SEDP-III.
Enhanced water supply, sanitation and public health in urban and rural areas	Incidence of water-related diseases very high, in part because sanitation and sewerage facilities inadequate. Concern about potential health effects of arsenic and pesticide contamination of ground waters.	Health impacts of environmental pollution, particularly by arsenic and pesticides, addressed in the health sector strategic plan for 2003-7.

Increasing contribution of hydro-electricity generation to electric power supplies	Installed capacity ~12 MW (~10,000 MW potential), contributing <1% of total supply. Investment questioned because of environmental and capital costs. Inadequate data for design of new stations.	To be defined in national Power Sector Strategy for 2006-10. Private sector investment actively promoted.
Effective management of the coastal zone	Growing human pressure on coastal waters and ecosystems. Several ministries and provincial agencies responsible for coastal and marine waters and resources, but no legal instruments provide for management, and knowledge lacking.	To be developed during planning for SEDP-III.
Increasing importance of inland water transport	~1,800 km of waterways, over a third of which can be used year-round. Phnom Penh has a major port. Navigation limited by low water during the dry season, bars (particularly at the entrance to Tonle Sap Lake), lack of navigational aids, hydrographic surveys, and skilled sailors.	A basic network of landing facilities enables inland water passenger transport. Inland waterways as a leading all-weather mode of transport, to link rural and urban centers.
Sustainable community-based fisheries	500,000 ha of fishing lots allocated to communities through 248 freshwater and 16 marine community fisheries groups. Only those supported by NGOs and IOs generally run smoothly.	Existing community fisheries strengthened, and becoming independent.

REFERENCES

1. BDP 012-6: Regional sector overview: Domestic water, sanitation and industrial water use. Basin Development Plan Program, Mekong River Commission, Phnom Penh, Cambodia. November 2002. (12+27 pages)
2. Council for the Development of Cambodia, 2000 (May). *A new development cooperation partnership paradigm for Cambodia*. Royal Government of Cambodia, Phnom Penh.
3. CTI Engineering International Co. Ltd. 1999 (August). *The study on drainage improvement and flood control in the Municipality of Phnom Penh*. Department of Public Works and Transport, Phnom Penh.
4. Danish Ministry of Foreign Affairs, 2000 (May). *Draft natural resources and environmental programme document, Cambodia*.
5. Department of Fisheries, 1999 (January). *Present status of Cambodia's freshwater capture fisheries and management implications*. Annual meeting of the Department of Fisheries, Ministry of Agriculture, Forestry and Fisheries, Phnom Penh.
6. Garn, Mike *et al.*, 2000 (June). *Should we bed on private or public water utilities in Cambodia? Evidence on incentives and performance from seven provincial towns*. World Bank.
7. Jensen, J. G., 2000 (September). *Fish, flood plains, and food security in the Lower Mekong Basin*. Proceedings of the 3rd International River Management Symposium, Brisbane.
8. Kokusai Kogyo Co. Ltd., 1999 (September). *The study on groundwater development in Southern Cambodia. Draft Final Report*. Ministry of Rural Development, Phnom Penh.
9. Mahfuzuddin Ahmed *et al.*, 1998. *Socio-economic assessment of freshwater capture fisheries of Cambodia. Report on a household survey*. Department of Fisheries and Mekong River Commission, Phnom Penh.
10. Ministry of Environment, 1998. *Cambodia: National Environmental Action Plan 1998-2002*. Ministry of Environment, Phnom Penh.
11. Ministry of Industry, Mines and Energy, 1999 (January). *Cambodia power sector strategy 1999-2016*. Royal Government of Cambodia, Phnom Penh.
12. National Institute of Statistics, 1998 (July). *General population census of Cambodia 1998, provisional population totals*. Ministry of Planning, Phnom Penh.
13. O'Brien, Noelle, 1999. *Environment: concepts and issues. A focus on Cambodia*. Ministry of Environment/UNDP/ETAP, Phnom Penh.
14. OXFAM, 1995 (April). *Report of the evaluation of OXFAM's rural drinking water programme in Cambodia, 1982-1995*. OXFAM, Phnom Penh.
15. Romeo, Leonardo, 2000 (March). *The SEILA Programme and decentralized planning in Cambodia*. Phnom Penh.
16. Royal Government of Cambodia, 1997 (January). *First five year socioeconomic development plan, 1996-2000*. Royal Government of Cambodia, Phnom Penh.
17. Sheladia Associates, 1998 (April), *Inception report, Phnom Penh water supply and drainage project, ADB Loan 1468-CAM (SF)*. Department of Public Works and Transport, Municipality of Phnom Penh.
18. Sok Siphana and Sarin Denora, undated. *Laws and regulations on environment biodiversity, and protected areas*. Cambodian Legal Resources Development Centre, Phnom Penh.
19. UNICEF, 1997 (October). *From emergency to community action. Rural water supply and sanitation programme activities, 1992-1997*. UNICEF/Kingdom of Cambodia.
20. Veng Sakhon, 2000 (January). *Preparatory study on establishment of a new monitoring system for land and water resources management in Cambodia*. MOWRAM, Phnom Penh.

21. *Cambodia power sector strategy 1999-2016*, 1999 (January). Ministry of Industry, Mines and Energy.
22. *Irrigation policy 2000*, 2000 (March). Ministry of Water Resources and Meteorology.
23. *Proposed outline of a policy for the Rural Water Supply and Sanitation Sector (RWSS)*, 2000 (July), Ministry of Rural Development.
24. *Urban sanitation policy*, 2000 (January).
25. *Water supply policy*, (undated) Department of Potable Water Supply, Ministry of Industry, Mines and Energy.
26. BDP 012b: Mekong River Commission, Basin Development Plan. Regional sector overview: Tourism development. Prepared by Mekong River Commission Secretariat, Phnom Penh, Cambodia. November 2002. (10 pages)
27. Fisheries in the Lower Mekong Basin: Status and Perspectives; MRC Technical Paper No. 6 (May 2002). MRC, Phnom penh, Cambodia.
28. MRC Programme for Fisheries Management and Development Cooperation. Annual Report April 2003 – March 2004. MRC Phnom Penh, Cambodia.
29. State of Basin Report 2003 – Chapter 7: Fisheries. MRC, Phnom Penh, Cambodia.
30. BDP 012-1: Regional sector overview: Fisheries. Basin Development Plan Program, Mekong River Commission, Phnom Penh, Cambodia. November 2002. (10 pages).
31. MRC Navigation Strategy (August 2003)
32. MRC Navigation Programme (Dec 2003)
33. BDP 012-5: Regional sector overview: Navigation. Basin Development Plan Program, Mekong River Commission, Phnom Penh, Cambodia. November 2002. (21 pages).
34. Geerinck, L. (Jan 2005) Incorporation of Navigation into the Integrated Water Resource Development and Management Strategy. BDP unpublished document. MRC, Vientiane, Lao PDR
35. MRC Hydropower Development Strategy (October 2001State of Basin Report 2003)

Relevant Ministry



Ministry of Water Resources and Meteorology
MOWRAM



Cambodia National Mekong Committee
CNMC



Ministry of Agriculture, Forestry and Fisheries
MAFF



Ministry of Environment
MOE



Ministry of Industry, Mines and Energy
MIME



Ministry of Land Management, Urban Planning and
Construction
MLMUPC



Ministry of Public Works and Transport
MOPWAT



Ministry of Rural Development
MRD



National Committee on Disaster Management
NCDM

Supported by:

UNEP Collaborating Centre on Water and Environment

UCC-Water



DANIDA

