

Strategic Directions for
Integrated Water Resources
Management
in the Lower Mekong Basin

**Prepared by the Mekong River Commission
under the Basin Development Plan**

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Contributing Agencies

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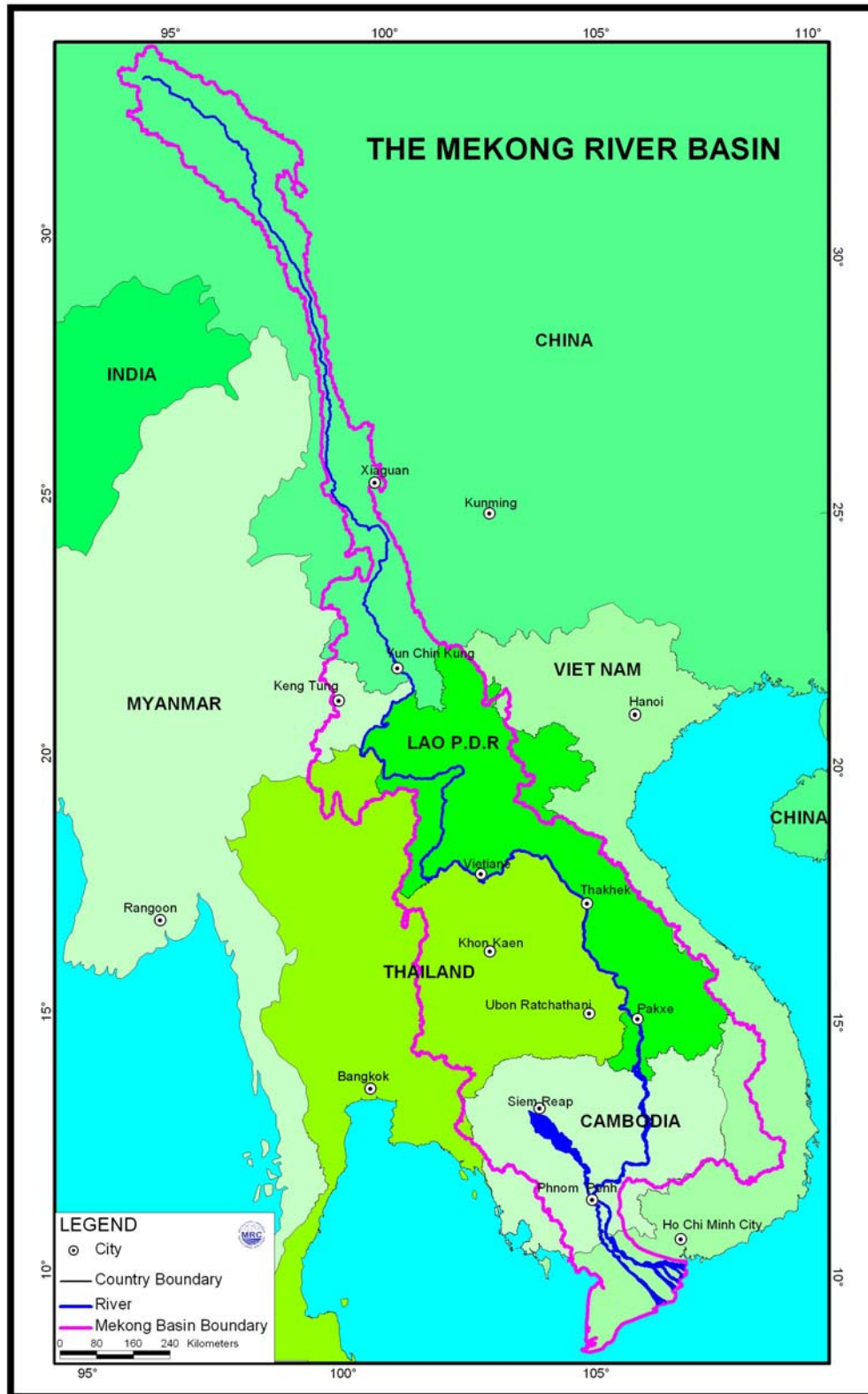
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Acronyms and Abbreviations

ADB	Asian Development Bank
ASEAN	Association of South East Asian Nations
BDP	Basin Development Plan (under MRC)
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
LMB	Lower Mekong Basin
M&E	Monitoring and evaluation
MDG	Millenium Development Goals (under the UNDP)
MRC	Mekong River Commission
MRCS	Mekong River Commission Secretariat
NGO	Non-government organisation
RBO / RBC	River basin organization / committee
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

Map of the Mekong River Basin



1. Introduction

1.1 Purpose

This document sets out strategic directions for development of water resources in the Lower Mekong Basin for the next 20 years. It is intended to lend guidance to sustainable water resource development and management in the LMB, 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 MRC Strategic Plan (2006-2010), national IWRM strategies, and regional initiatives such as the World Bank Mekong Water Resource Assistance Strategy (MWRAS), ASEAN Strategic Plan of Action on Water Resources Management, ADB's Greater Mekong Subregion program.

From the strategic directions identified in this document, the MRC Strategic Plan (2006-2010) will draw out goals and actions relevant to regional and trans-boundary issues that are under the mandate of MRC, to establish MRC's areas of action for the next 5 years. Within this, the MRC Basin Development Plan will provide a specific framework for identification and promotion of high priority projects; and support to national IWRM to ensure consistency between national and regional strategies.

1.2 Rationale and Approach

Due to the complexity of water resource development and management in the Lower Mekong Basin a joint approach to water resource planning is essential. The complexity of the system and its stakeholders means that it is not realistic to frame a single, all-encompassing plan for water resources in the LMB. However, based on national water policies and plans and on international agreements, the countries of the LMB share a set of goals, issues and concerns regarding water resources and from these it is possible to identify agreed priority areas for action in water-related sectors.

This paper has been prepared as a part of the Mekong River Commission's Basin Development Plan (BDP) program (Appendix 1). It draws together information from a wide range of sources, including

- the extensive process of national consultation under BDP regarding regional, national and sub-area development plans, policies, strategies and options (coordinated by the National Mekong Committees)
- information and analyses from the BDP's planning process (for example, sub-area analyses and development scenarios)
- consultation, information and strategic directions identified under MRC programs
- enhanced understanding of LMB hydrology resulting from the Basin Models and DSF developed under MRC's Water Utilization Program
- consultation with donors and investment banks (including World Bank, ADB, Danida, SIDA, AusAID).

It spells out the concepts, principles, practices and guidelines that constitute ‘good’ IWRM, and why it is important such concepts and guidelines drive the next phase of Mekong basin water resources development. It identifies eight major areas of IWRM that are seen as of most relevance to the Mekong basin at this stage, and specifies a broad reaching objective for each category with a general description as to how the various ‘players’ in the basin might address issues as a means of moving toward the objectives.

2 Shared Vision, Goals and Values

2.1 Vision

The countries of the Lower Mekong Basin, through the MRC, have enunciated a shared vision of

“an economically prosperous, socially just and environmentally sound Mekong River Basin” (MRC Mar 2001).

This vision is reinforced by a shared commitment to

- 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)
- Millennium Development Goals (set out by the United Nations – see below);
- Sustainable development (as defined under Agenda 21)¹
- Integrated Water Resource Management (see Section 2.3); and
- Poverty alleviation (as set out in national policies)².

1 <http://www.un.org/esa/sustdev/documents/agenda21/index.htm>

2 National poverty reduction strategies of Cambodia, Lao PDR and Viet Nam; and the 9th National Economic and Social Development Plan of Thailand

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

<http://www.undp.org/mdg/abcs.html>

2.2 Shared Goals and Values

Based on the 1995 Mekong Agreement, the Millennium Development Goals, and on national policies and plans, a set of shared goals and values can be identified which will guide the way in which the river and its resources are used to achieve the shared vision.

Economic growth and development

Realising the economic value of the Mekong for development: to achieve equitable and sustainable use of the Mekong River and its resources to contribute to social and economic development.

Poverty alleviation³: to give high priority to water resources developments which contribute to poverty alleviation.

Maximising water productivity: to make efficient use of Mekong Waters and prevent wasteful use by treating water as an economic good.

Freedom of navigation: to ensure freedom of navigation throughout the mainstream of the Mekong, without regard to territorial boundaries to promote regional cooperation, trade and economic exchange.

Regional integration: to promote economic and social integration in the Mekong region through coherent water resource development and environment protection

³ Poverty alleviation is equally an economic and a social goal

Protection of Mekong resources: to protect the productive capacity of the Mekong (including the fishery and aquatic resources). The Mekong is an important resource base for many industries. In particular, the freshwater capture fisheries is an important economic resource and forms the basis of semi-subsistence livelihoods for many people in the LMB.

Dealing with climate variability: to prevent, minimize or mitigate people's suffering and economic loss due to climate variability (floods and drought).

Social Development and Equity

Access to water for basic human needs: to provide access to sufficient water of adequate quality for basic human needs to all the people of the basin.

Cultural and heritage values: to respect and preserve the important cultural and heritage values for the Mekong for the people of the LMB.

Reasonable and equitable use: to take account of equity between countries, and encourage equity of access for different ethnic and social groups (particularly women and the poor) in development of water resources; and to ensure that benefits in the future are not precluded (inter-generational equity).

Environmental protection

Protection of environment: to protect environment, natural resources, aquatic life and conditions and the ecological balance of the Mekong Basin from harmful effects of development.

Prevention of pollution: to prevent pollution and other harmful effects of development, and acceptance of responsibility for damage caused.

Protection of important habitats: to protect important habitats and wetlands, including Tonle Sap Great Lake.

Maintenance of flows: to maintain Mekong flows in both the wet and dry seasons within agreed limits (negotiated under the 1995 Agreement).

Governance

National sovereignty: to protect the entitlement of the riparian countries to use the waters of the Mekong system within their respective territories, within the limits of reasonable and equitable use, and subject to the Procedures negotiated under the 1995 Mekong Agreement.

Regional cooperation: to promote cooperation between the countries of the Mekong basin in managing the Mekong and related resources for the mutual benefit of all.

Watershed-based management : to encourage all countries to recognize the watershed as the most appropriate unit for water resources management.

Institutional and legal frameworks: to promote the establishment of open, transparent and accountable institutional and legal frameworks for water resource management that are consistent across the Basin.

Monitoring and evaluation: to ensure that monitoring and evaluation are an integral part of all water resource development programs to promote equity and efficiency.

Stakeholder participation in decision making: to base water resources development and management on a participatory approach, involving users, planners and policy makers at all levels.

Human resource development: to improve the capacity of all stakeholder groups to manage water resources through training and education programs.

Areas of cooperation

The 1995 Mekong Agreement states that the countries agree “to cooperate in all fields of sustainable development, utilization, management and conservation of the water and related resources of the Mekong River Basin including, but not limited to irrigation, hydropower, navigation, flood control, fisheries, timber floating, recreation and tourism”⁴.

⁴ 1995 Mekong Agreement, Chapter 3, Article 1

2.3 Principles of Integrated Water Resource Management ⁵

“Integrated Water Resources Management is a process which promotes the co-ordinated 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

MRC member countries are committed to implement IWRM principles in managing the water resources of the LMB. 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 (Millington 2004):

- 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 (see Section 3.3), but these are at varying stages of completeness. This paper aims to give a regional view, as an overarching framework of principles and guidelines within which the national strategies will provide more detailed plans for action.

⁵ In this context, management explicitly includes the concepts of both development and utilization.

3. Situation analysis

3.1 State of the Basin – current conditions

The water resources of the Lower Mekong Basin are described in some detail in the MRC State of the Basin Report (MRC 2003). In strategic terms, important characteristics of Mekong water resources include:

Abundance: Annual runoff averages around 475 km³ / year. Per capita resources currently stand at over 8500 m³/person/year – compared with 2200 for the Nile; 1400 for the Rhine; 2265 for the Yangtze and 1700-4000 for the Ganges (WRI, 2003).

Low level of exploitation for extractive uses: Average annual withdrawals are estimated at around 60,000 million m³, or 12% of total annual flows; the total volume of regulated storage in the basin (including the Upper Basin) for hydropower and irrigation is less than 20,000 million m³ (less than 5% of annual flows).

High dependence on in-stream uses (particularly by the poor): The Mekong fishery is the largest inland fishery in the world, estimated to be worth at least \$US 2,000 million annually, and providing the major protein source for many people in the basin. Inland navigation is an important mode of transport for many areas where road access is limited. There is an urgent need to balance in-stream uses against extractive demands as agricultural production in the LMB is expanding rapidly.

Extreme seasonality: In most parts of the Basin, flows in the driest three months constitute less than 10% of total annual flows; while flows in the wettest three months make up over 50% of total annual flows (MRC DSF).

Importance of the flood pulse for the ecology of the floodplain and the Mekong fishery: During the wet season, between 1 and 4 million hectares of floodplain are submerged, including the Tonle Sap Great Lake.

Dry season water shortages: Dry season shortages occur as a result of the rainfall seasonality, concentration of extractions in the driest period and drought events during the onset of the wet season.

Water quality: Water quality in the mainstream is generally good, and is rarely a constraint to water use. The exception is saline intrusion, acid sulphate drainage and pollution in intensively used areas of the Mekong Delta

Groundwater: Groundwater resources are very widely used as a source for domestic and industrial supply. Use for irrigation is limited, but expanding. Groundwater systems in the flood plain are closely coupled to the river.

Upper Basin: Flows from China and Myanmar constitute around 18% of total Mekong flows. The proportion is higher in the dry season, when snow melt contributes a significant component of flow.

3.2 Scenarios for the future

Over next 20 years, the Mekong Basin 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 2025, population in the LMB could reach between 75 and 90 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 up to 50,000 million m³ of new storage.

Studies have been initiated by MRC to investigate the impacts of different future development scenarios for the Mekong. Scenarios were formulated to investigate the likely “development space” within which the LMB will operate over the next 20 years, based on national policies and plans, demographic trends and market demands, as well as external factors such as the impact of development in the Upper Mekong. The results describe the possible effects that such assumed developments might have on the hydrology and selected environmental indicators in different parts of the basin and provide a preliminary assessment of broad development options. Strategic conclusions from these studies are summarized below. A summary is given in Appendix 3, and full details are available in MRC-BDP (2005a,b).

- Construction of the planned cascade of dams on the Upper Mekong in China (MRC 2005a, Plinston and Daming 2000) would change flow conditions in the *northern reaches of the Mekong (in Thailand and Lao PDR)*, mainly by increasing flow in the dry season and reducing flow in the flood season. Short-term (hourly to daily) flow variability may also increase. The impact on the floodplain, Tonle Sap and the Delta would be largely mitigated by inflows from major tributaries within the LMB. Long term development plans for LMB should be evaluated in the context of the resulting changed flow regimes.
- Construction of storages (whether in the Upper or Lower Basin) 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.
- 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 Institutional analysis

At the **national level**⁶, administration, planning and legislation for water resources in each country 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, tambon or 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).

All four countries have **provincial, district and local level** government organizations which have responsibility for the management of local water resources, such as dams, water supply, and irrigation projects. A summary of the planning processes within each country is given in Poppe (2004).

National water resource laws and strategies have been formulated, or are under consideration in all four countries⁷.

- In Lao PDR, a water sector strategy and action plan have been prepared by the National Water Resources Coordinating Committee. The strategy includes initiation of an IWRM approach in important river basins.
- In Viet Nam, a law on water resources was adopted in 1998 and a National Water Resources Council was recently established. Implementation of the law is underway, including establishing river basin organizations (RBOs) for major river basins, including the Mekong Delta. A National IWRM Strategy is currently being formulated.

⁶ Comprehensive reviews of the institutional and legal frameworks relating to water resources planning and management in the Mekong countries are given in MRC-BDP (2002); Poppe (2004); Hannam (2003); Zhang (2005); Badenoch (2002); Birch (2005) and Millington (2005).

⁷ In accordance with the WSSD target, WSSD Plan of Implementation, Article 26.

- In Thailand, a water resources law is being formulated. In line with Thailand's emphasis on decentralized planning and management, the National Water Resources Committee has begun implementation of water resources management through river basin committees (RBCs). A National Water Resources Strategy Plan is currently being formulated.
- In Cambodia, the National Water Law has been submitted to the National Assembly for approval. A national water strategy is being formulated through integration of relevant sector strategies by the Ministry of Water Resources and Meteorology (MOWRAM).

As part of the implementation of their new water laws and policies, **River Basin Organisations** (RBOs) or Committees (RBCs) have begun operation in parts of Thailand and Viet Nam, and are being formed in Cambodia. These will represent a wide stakeholder base, incorporate the principles of IWRM and provide a spatial basis for inter-sectoral integration of water resources planning.

At the **Basin level**, international and multi-lateral agreements and laws potentially play an important role in promoting sustainable use of land and water. Hannam (2003) identifies 25 international and regional conventions, treaties, protocols and declarations relevant to water and land management in the Mekong region. These have the status of guidelines or protocols – there are currently no binding regional legal frameworks. The most comprehensive regional agreement relating to water is the 1995 Mekong Agreement, which established MRC as a platform for cooperation and negotiation regarding shared water resources (see Section 3.3.1). MRC has a potential regulatory role for water through the rules and procedures envisaged in the 1995 Agreement. Regional cooperation and joint planning may be a more efficient mechanism than strict regulation.

Economic co-operation in the region is promoted through both the Asian Development Bank Greater Mekong Sub-region Program (ADB-GMS) and various mechanisms of the Association of South East Asian Nations (ASEAN)⁸. Both organisations have programs in sectors relevant to water resources, including energy, transport and agriculture. Neither ASEAN nor ADB-GMS have associated regulatory or legal frameworks, although the GMS Strategic Environmental Framework (GMS-SEF) provides guidelines for promoting sustainable development and use of natural resources.

3.3.1 Mekong River Commission

The Mekong River Commission was established by the 1995 Mekong Agreement, specifically to promote cooperation for sustainable water resource development in the Lower Mekong Basin. MRC is the lead agency for coordination of water related issues in the LMB. The member countries are Cambodia, Lao PDR, Thailand and Viet Nam; China and Myanmar are dialogue partners, and cooperate increasingly in MRC programs.

⁸ GMS includes all six countries of the Mekong Basin - Cambodia, Lao PDR, Thailand, Viet Nam, Myanmar and China. All except China are members of ASEAN.

Under the 1995 Agreement, the countries established a clear management framework for the Mekong River Basin, of which the key elements are:

- An **institutional framework** (the MRC) to act as a focal point for cooperation, and to provide technical guidance and mediation
- A **policy framework** of agreed goals and objectives for development
- **Procedures, rules and guidelines** that facilitate interaction between the member states, provide a mutually agreed basis for utilizing the waters of the Mekong in a reasonable and equitable manner (see Box)
- A **monitoring system and procedures** to ensure that sustainable limits are not exceeded and to provide information to guide future development
- A **basin-wide planning process** (the BDP) by which the member states can identify and promote projects and programs to fulfill the aims of the Agreement.

Procedures negotiated through the Mekong River Commission

- Procedures for Data Information Exchange and Sharing (PDIES) – 2003
- Procedures for Water Use Monitoring (PWUM) – 2004
- Procedures for Notification, Prior Consultation and Agreement (PNPCA) – 2004
- Procedures for Maintenance of Flows in the Mainstream (PMFM) – under negotiation
- Procedures for maintenance of water quality - under negotiation

MRC Water Utilisation Programme

4 IWRM in the LMB – Strategic Priorities

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

- Economic development and poverty alleviation
- Environment protection
- Social development and equity
- Dealing with climate variability
- Integration through basin planning
- Information based management
- Regional cooperation
- Governance

4.1 Economic Development and Poverty Alleviation

Objective: 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 the countries 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 serve as inputs into productive activities. As a resource management organization, the MRC's role is to lend guidance to the development of the resources to build a favorable investment climate that is attractive to donors and private sector investors alike. Through their work, the MRC can further ensure that economic development patterns have a poverty alleviation impact while protecting the environment.

The abundance of surface water, low level of development and generally good water quality in the LMB indicate that very significant opportunities exist for exploitation and development of water and water-related resources. Except in the Delta and more mountainous parts of Lao PDR, land suitable for irrigation is not limiting; abundant sites suitable for hydropower development exist; and the potential for expansion of navigation and tourism is high. In most cases, access to markets will be as significant a constraint as access to natural resources and it will be necessary to partner with other regional initiatives to simultaneously improve access to markets and 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 regional 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

Objective: Protection of environment, natural resources, aquatic life and conditions and the ecological balance of the Mekong River Basin from... harmful effects of development (1995 Agreement)

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 LMB is a lack of coordinated environmental planning, and coherent regulatory and planning structures and institutions are essential for effective environment protection (see Sections 4.5 and 4.8).

Protection of the water resource base falls into four broad areas (MRC 2005c), all of which are covered by the 1995 Agreement:

- Maintenance of flows
- 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 flows

Procedures for maintenance of flow in the mainstream (PMFM) are being negotiated under the Water Utilisation Programme (WUP), in accordance with the 1995 Agreement. Determining acceptable limits for change from the natural regime that allow utilization of the river without causing unacceptable change to the ecosystems requires a clear understanding of the links between river flows or quality and the health of particular ecosystem components. MRC has instituted the Integrated Basin Flow Management Program (IBFMP) to provide a technical assessment of impacts of changes in flow on the ecology of the river.

Maintenance of water quality

Procedures⁹ for water quality are to be drafted by MRC under the Water Utilisation Program, by the end of 2005. Since 1995, MRC has provided technical advice on defining acceptable water quality parameters. The main area of concern for water quality in the LMB 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 (RBOs – see Section 3.3) 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 (see Appendix 2.8).

Priority areas for action

- Early identification of environmental consequences of development options using SEA / CEA approaches, so that protection or mitigation measures can be included in planning
- Valuation of environmental and livelihood benefits from in-stream uses of water
- 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
- Finalisation of procedures for maintenance of flow in the mainstream and water quality (under the 1995 Agreement).

⁹ termed "Rules" under the 1995 Mekong Agreement

- Enhanced collaboration with upstream countries in environmental planning and management programs.

4.3 Social development and equity

Objective: 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.

MRC initiatives in this regard include

- a Public Participation Strategy (MRC 2002) to guide integration of stakeholder consultation into its work plans and practices
- MRC Gender policy, which calls for mainstreaming of gender perspectives in all MRC development efforts, ensuring that all MRC development programs benefit men and women equally.

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

- 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 Dealing with climate variability

Objective: people's suffering and economic loss due to climate variability prevented, minimized or mitigated

Water resource development and management takes place within the context of inherently variable climate conditions. Although the hydrology of the Mekong is one of the most regular and predictable of any river of its size, there is still significant annual variability. In addition, the possibility exists of long term changes in flow due to climate change. Dealing with variability due to floods, droughts and climate change is an integral part of water resource management and development, which impacts on all sectors. Responses must make a balance between adapting the hydrological systems (for example with storage dams and flood protection works) and adapting human systems (agricultural systems and patterns of settlement) to fit better with the existing conditions.

Flood management and mitigation

Floods are part of the natural cycle of the Mekong, and are vital to the functioning of Mekong ecosystems. The flood pulse is the engine which drives the enormous productivity of Mekong fisheries (MRC 2002). The urgent need for improved flood management and mitigation is reflected by the recurrent damage in the Lower Mekong Basin. The poor are often the most adversely affected by floods. The extent of damage will increase as the population and economy develop.

Drought

As with flooding, drought is a natural part of the climate cycle of the region. In addition to the on-going problem of access to water during the months of the dry season, drought may occur due to low overall rainfall for the year, or to delay or breaks in the on-set of the wet season causing short-term water shortages at crucial points in the cropping calendar. It is not uncommon for the Mekong floodplain to experience flooding and drought simultaneously, with high river levels fed by rain in the upper parts of the basin, but drought conditions away from the river. Provision of irrigation storage is an important "drought-proofing" measure. Increasingly, groundwater is used to provide secure water supply for domestic use and in some cases, irrigation; but groundwater systems in the floodplain are very closely linked to the river and may also experience shortages in periods of drought.

Climate change

The overall conclusion from international climate change studies for the Mekong region, is that the total level of rainfall is not likely to change dramatically over the next 20-50 years, but that variability may increase, with longer, drier dry seasons and wetter, more intense monsoons (Hoanh *et al* 2002). Predictions for the Himalayas (WWF 2005) suggest that global warming could result in increased snow melt over the next 20-50 years, with resulting higher flows in rivers; but a long term decrease as the area of snow

pack declines. In the long term, more specific strategies must be developed based on an improved understanding of the likely direction and magnitude of change.

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

Objective: 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 (Section 4.1)
- Integration of the concerns of different stakeholders to ensure equity (Section 4.3)
- Integration of environmental and social concerns into development planning to ensure sustainability (Section 4.2, 4.3)
- Integration and cooperation between geographic areas (countries, upstream – downstream areas) to prevent water use conflicts (Section 4.7)
- Integration of policy, institutional and regulatory frameworks at different levels to ensure consistency (Section 4.8)

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 (see Appendix 1 and Section 3.2). 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)¹⁰. 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 is 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

¹⁰ The Water Utilisation Program Decision Support Framework (WUP-DSF)

- 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 Information-based management

Objective: to ensure that water resource management decisions are based on best available information.

The importance of shared information for regional decision making was recognized in the 1995 Agreement, and in accordance with its provisions, the countries have signed

- Procedures for Data Information Exchange and Sharing (PDIES)
- Procedures for Water Use Monitoring (PWUM)
- Procedures for Notification, Prior Consultation and Agreement (PNPCA).

MRC has built a shared MRC Information System (MRC-IS), available to all countries, which allows MRC to provide reliable information in three key roles.

- independent monitoring of changes in flow and water quality in the river
- prediction and assessment of potential impacts of different development options, through the use of scenario analysis
- notification and prior consultation of proposed developments which may have transboundary impacts.

Given the cost of creating and managing information, links to policy and the adoption of demand-driven data management are important considerations.

Priority areas for action

- Consolidation of monitoring programs (flows, water quality and ecological parameters)
- Improve return of information to the countries by provision of information in accessible formats
- Strengthening information capacity in national and provincial agencies through support for hardware / software, and training of key staff
- Strengthen predictive and analytical capability
- Collate information on all water related projects and programs in the LMB to allow coordinated planning and analysis of cumulative impacts
- Develop an information base for the Upper Mekong Basin (UMB) for issues relevant to LMB (e.g. land use information, proposed water resource developments, hydrological and climate models for UMB particularly for snow melt and climate change issues).

4.7 Regional cooperation

Objective: integrated and coordinated water resource 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) 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, Lao PDR and Viet Nam
- World Bank's Mekong Water Resource Assistance Strategy.
- 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

Objective: 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 LMB. 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 countries are working towards more integrated and responsive approaches to water management and planning (see Section 3.3).

At the regional level, MRC has a clear mandate to coordinate water resource issues and a number of other regional and international agreements also relate to water resources development (see Section 3.3). These regional agreements are cooperative, rather than regulatory. Links between national and regional 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 countries, through structures such as coordinating councils, 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 countries, through effective involvement in MRC
- Harmonisation between national water laws and procedures governing cross-border issues through MRC.

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 coordinating 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 (see Section 2). 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.

A substantial proportion of water resource development at the national to local level will be financed through **international financial institutions and donor organisations**. Country investment and assistance strategies should take account of regional as well as national concerns and priorities, and be formulated in the context of the overall regional strategy. IFIs and donors have a responsibility to ensure coordination of programs at the regional level, and to incorporate IWRM principles into their water-related programs.

Under the 1995 Mekong Agreement, the **Mekong River Commission** has clear responsibility for regional coordination within the water sector in the LMB. This includes all aspects of negotiation between the countries relating to water resources, including the formulation of procedures and guidelines for the countries' use of the shared resource. It has a mandate to monitor water use to ensure compliance with agreed procedures, and provides shared technical information for monitoring and as the basis for planning and research. Through the Basin Development Plan, MRC has a role to

promote joint planning for water resources in the LMB, and to facilitate and coordinate project implementation.

The **National Mekong Committees** are the link between MRC and the countries, and maintain liaison with the various national bodies and agencies that are involved in water-related development. They play an important role in collating national information and policies, and coordinate public participation at the national level. They are also key agents for facilitation of implementation of joint development initiatives.

Regional development programs, whether coordinated multilaterally (such as the development triangle initiatives) or by international organizations (such as those under ADB-GMS and ASEAN) have the responsibility to ensure that their programs fit within the overall sustainability of the basin, as well as meeting national priorities. Because of their involvement in regional sectoral development, an evolving role of regional programs is promoting and mediating the integration of, and balance between, water-related development and the sectors more broadly.

River basin organizations are being organized within key catchments in the LMB, though most are still in the formative stages. They will increasingly become focus for community involvement in water management, and for on-ground integration of sectoral requirements.

International organizations (such as IUCN, WWF and Oxfam) play an important role in regional research programs and implementation of projects in environmental and social issues relevant to water resources; and in awareness building, both locally and in the international sphere. **Local NGOs and civil society organizations** provide links into communities to promote stakeholder participation in planning and for implementation of projects at the local level.

Research priorities and directions for **research and development institutions**, (including regional and national universities and the CGIAR system) should take account of the information requirements for IWRM. Research organizations have a potential role in monitoring and evaluation of progress towards IWRM, and recommendations for improvements in implementation.

Since all four MRC member countries are promoting market-based economies, the **private sector** will play an increasing role both as users and providers of water-related services. Governments have a responsibility both to provide an enabling environment for private sector investment in water-related sectors, and to ensure that private companies understand and conform to IWRM principles.

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 (see Section 5.1).

As a follow-up to the World Panel on Financing Water for All (Camdessus Panel), the World Water Council, Global Water Partnership and the World Bank have established a working group of major international bodies on financing water infrastructure for agricultural water management. It is critical that MRC and other regional implementation agencies consider how to coordinate and share implementation financing in the most appropriate and effective manner.

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 countries 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 LMB. At the national level, each country 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 MRC's regional cooperation program for sustainable water resource development in the LMB.

References

National plans

- Cambodia (Mar 2001): Second five year socio-economic development plan, 2001-2005. Compiled by Ministry of Planning, Kingdom of Cambodia. Second draft
- Cambodia (Dec 2002): National Poverty Reduction Strategy
- Lao PDR (2001): 5th Socio-Economic Development Plan 2001-2005
- Lao PDR (Apr 2001): Interim Poverty Reduction Strategy Paper
- Lao PDR (September 2003): National Poverty Eradication Program, 8th Round Table Meeting, Vientiane
- OEPP (Dec 1997): Policy and prospective plan for enhancement and conservation of national environmental quality 1997-2016. Office of Environmental Policy and Planning, Ministry of Science, Technology and Environment, Thailand
- Thailand (Oct 2001): 9th national economic and social development plan 2002-06, compiled by National Economic and Social Development Board, Office of the Prime Minister
- Viet Nam (May 2002): The Comprehensive Poverty Reduction and Growth Strategy (CPRGS)
- Viet Nam (2001): Socio-economic Development Plan for the period 2001-05, compiled by Ministry of Planning and Investment

National sector reviews

- CNMC (June 2003 a): Fisheries management. National sector review prepared by Ministry of Agriculture, Forestry and Fisheries in association with CNMC
- CNMC (June 2003 b): Flood mitigation and management. National sector review prepared by Ministry of Water Resources and Meteorology in association with CNMC
- CNMC (June 2003 c): Hydropower. National sector review prepared by Ministry of Industry, Mines and Energy in association with CNMC
- CNMC (June 2003 d): Irrigated agriculture. National sector review prepared by Ministry of Water Resources and Meteorology in association with CNMC
- CNMC (June 2003 e): Navigation, transport and river works National sector review prepared by Ministry of Public Works and Transport in association with CNMC
- CNMC (June 2003 f): Tourism development. National sector review prepared by Ministry of Tourism in association with CNMC
- CNMC (June 2003 g): Watershed management. National sector review prepared by Ministry of Agriculture, Forestry and Fisheries in association with CNMC
- CNMC (June 2003 h): Water supply: Domestic water and sanitation, and industrial water use. National sector review prepared by Ministry of Water Resources and Meteorology in association with CNMC
- CNMC (August 2003): Integrated water resources management in Cambodia, National Sector Review
- LNMC (February 2004): National sector overviews
- TNMC (April 2004): National sector review, integrated report. Executive summary
- VNMC (May 2003): National sector overviews

Sub-area studies

- CNMC (Dec 2003): Basin Development Plan Program, sub-area analysis. The Tonle Sap Sub-area. Prepared for CNMC by Dr Pichara Leang, National Consultant, Phnom-Penh
- LNMC (March 2004): Past and future analysis for the Mekong BDP, Sub-Area 1L, Lao PDR. Prepared by Michael Tuckson, Vientiane, 4 March 2004. Draft
- LNMC (April 2004a): Key outcomes of all sub-area studies and analysis carried out in Lao PDR

LNMC (April 2004b): Report on the outcomes of studies and analysis carried out in Sub-area 4L

LNMC (April 2004c): Report on the outcomes of studies and analysis carried out in Sub-area 6L

LNMC (April 2004d): Report on the outcomes of studies and analysis carried out in Sub-area 7L

OEPP (Oct 2000): Kok River Basin, pilot study for water resources and environment management (basinwide). Final report, prepared by Office of Environmental Policy and Planning, Thailand, and MRC

VNMC (Oct 2002): Nam Rom River Basin - case study & project ideas. Prepared by Pham Tuyet Mai for MRC and VNMC in association with Lai Chau Province

VNMC and IWRP (July 2003): Basin Development Plan, analysis of sub-area 7V. Report prepared by VNMC and Institute of Water Resources Planning, Hanoi

VNMC and SIWRP (Nov 2003): Basin Development Plan, analysis of sub-area 10V. Report prepared by VNMC and Sub-Institute of Water Resources Planning, Ho Chi Minh City

MRC publications and documents

Mekong Agreement (Apr 1995): Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin, entered on 5 April 1995 between Cambodia, Laos, Thailand and Viet Nam

MRC (Aug 1998): Guidelines on mainstreaming gender in water resources development in the Lower Mekong Basin. Prepared for MRC by Alexandra Stephens (MKG/R.98023)

MRC (Apr 1999): Public participation in the context of the MRC. Prepared by MRCS

MRC (Jan 2000): Strategy study on the development of the watershed management / forestry sector in the Lower Mekong Basin. Strategy and action plan. Prepared by Arcadis for MRCS, January 2000

MRC (Dec 2000): Agriculture, Irrigation and Forestry Program for 2001 – 2005

MRC (Mar 2001): MRC Strategic Plan 2001 to 2005

MRC (Oct 2001a): MRC hydropower development strategy

MRC (Oct 2001b): MRC flood management and mitigation strategy

MRC (Feb 2002a): Proceedings of the Regional Consultation Workshop on Public Participation in MRC, MRCS, Phnom Penh, Cambodia, 30-31 January-1 February 2002

MRC (Feb 2002b): Development of an EIA/SEA system for the Lower Mekong Basin. Volume I: Review report and volume II: Policy and guidelines. Final Draft Report prepared for MRCS by Environmental Resources Management, London. February 2002

MRC (Feb 2002c): Tools for impact analysis. Water Utilization Project Component A: Development of Basin Modelling Package and Knowledge Base, Working Paper No 6, prepared for MRC by Halcrow Group Limited

MRC (May 2002): Fisheries in the Lower Mekong Basin: Status and perspectives

MRC (June 2002): MRC Programming Manual

MRC (Oct 2002): Fish migrations in the Lower Mekong Basin: Implications for development, planning and environmental management

MRC (Nov 2002b): Strategy for navigation development and coordination in the Lower Mekong Basin. Draft report submitted by Royal Haskoning to MRCS, 29 November 2002

MRC (Nov 2002c): MRC Work Program 2003

MRC (June 2003): Biodiversity and fisheries in the Mekong River Basin

MRC (2003a): State of the Basin Report 2003

MRC (2003b): Social Atlas of the Lower Mekong Basin

MRC (August 2003): MRC Navigation Strategy

MRC 2004 Overview of the hydrology of the Mekong Basin, Water Utilisation Program Start-up Project, Mekong River Commission, Vientiane, Lao PDR. 55pp

MRC-BDP (Jul 2002): Basin Development Plan. Inception Report

- MRC-BDP (Nov 2002a-g): BDP regional sector overviews. (a) Executive summary and sectors, including fisheries and tourism development; (b) Agriculture and irrigation; (c) Watershed management; (d) Hydropower; (e) Navigation; (f) Water supply - domestic water and sanitation, and industrial water use; (g) Flood management and mitigation
- MRC-BDP (Oct 2002): Economics in the BDP: Macroeconomic overview of the Lower Mekong Basin
- MRC-BDP (Apr 2003a): BDP stakeholder participation working paper # 1: Stakeholder participation in the formulation of the Basin Development Plan. Final draft
- MRC-BDP (Apr 2003b): BDP stakeholder participation working paper # 3: Sub-area forums, approach and process for stakeholder participation in BDP sub-area analysis. Final draft, April 2003
- MRC-BDP (March 2003): Social Atlas of the Lower Mekong Basin
- MRC-BDP (March 2004): Strategic Framework for BDP
- MRC-BDP (Sept 2004): The BDP Planning Cycle (final draft)
- MRC-BDP (2005a) "Modelled Impacts of Scoping Development Scenarios in the Lower Mekong Basin" . Draft BDP Report. MRC, Vientiane.
- MRC-BDP (2005b) A report on likely infrastructure developments in the Mekong floodplain in Cambodia and their significance in changing flow patterns" . Draft BDP Report. MRC, Vientiane
- MRC-WUP-WG2 (Sep 2001): On preliminary trans-boundary analysis. Working Paper 1, prepared by WUP Working Group 2, February 2001, revised September 2001
- MRC-WUP-WG2 (Feb 2002):Steps towards a public participation strategy. Working Paper 5, prepared for WUP Working Group 2 by Helen Rosenbaum
- Poppe, M (2004) Integrated watershed management planning in the Lower Mekong Basin. MRC-GTZ Cooperation Program, MRC, Vientiane, Laos PDR.
- Rowcroft, P and Ward, K (in press) Economic Development and Water Resource Demands in the LMB. MRC Development Series. MRC, Vientiane.

Other publications and documents

- ASEAN (2003) ASEAN Long Term Strategic Plan for Water Resources Management. Initiative for ASEAN Integration Unit, Indonesia.
- Badenoch, N (2002) Transboundary Environmental Governance – Principles and Practice in Mainland Southeast Asia. World Resources Institute. Washington, USA. 37pp.
- Birch, A (2005) Benchmarking National Water Sector Capacity in the Lower Mekong Basin Countries. Unpublished paper prepared for an World Bank-ADB Mekong Water Resources Review.
- Chu Thai Hoanh, H. Guttman, P. Droogers and J. Aerts (2003) Water, Climate, Food, and Environment in the Mekong basin in southeast Asia. Final Report, ADAPT Project. International Water Management Institute, Colombo, Sri Lanka. sheba.geo.vu.nl/~ivmadapt/downloads/Mekong_FinalReport.pdf.
- Hannam, I (2003) A method to identify and evaluate the legal and institutional framework for the management of water and land in Asia. IWMI Research Report 73. IWMI, Colombo, Sri Lanka.
- Jønrh-Clausen, T (January 2004): Integrated Water Resources Management (IWRM) and Water Efficiency Plans by 2005 - Why, What and How? Global Water Partnership
- GWP-TAC-4 (March 2000): Integrated Water Resources Management. Global Water Partnership, Technical Advisory Committee (TAC) Background Papers no. 4, edited by Henrik Larsen (Available on the Internet)
- Millington, P (2004) Integrated water resources management – what need the countries do? Contribution to “Towards a Mekong Water Resources Assistance Strategy for the World Bank”. Unpublished paper commissioned by World Bank.
- Nesbitt, H (2003) Water used for agriculture in the Lower Mekong Basin. BDP Report 017. Basin Development Plan Program, Mekong River Commission, Phnom Penh, Cambodia
- Öjendal, J (2000): Sharing the Good - modes of managing water resources in the Lower Mekong Basin. Department of Peace and Development Research, Göteborg University, Sweden, ISBN 91-87380-46-3, 325 pp

- Ringler, C (May 2001): Optimal water allocation in the Mekong Basin. ZEF Discussion Papers on Development Policy no. 38. Centre for Development Research, Bonn University, Bonn. (Available on the Internet)
- UNESCO (1983) Preliminary Appraisal of the Hydrogeology of the Lower Mekong Basin, UNESCO-IMC
- WCD (Nov 2000): Dams and development, by World Commission on Dams. (Available on the Internet)
- World Bank (2004): Modelled observations on development scenarios in the Lower Mekong Basin
- World Resources Institute (2003): Watersheds of the World CD, <http://www.waterandnature.org/eatlas/>
- WWF (2005) An Overview of Glaciers, Glacier Retreat, and Subsequent Impacts in Nepal, India and China. WWF Nepal Program, Kathmandu, Nepal. 79pp.
- Zhang, J (2005) Scoping Study of Existing Frameworks Relating to the World Commission on Dams Strategic Priorities. IUCN unpublished report. IUCN, Bangkok. 48pp.

Appendix 1: MRC Basin Development Plan

In Article 2 of the 1995 Mekong Agreement, the parties agreed

'to promote, support, cooperate and coordinate in the development of the full potential of sustainable benefits to all riparian States and the prevention of wasteful use of Mekong River Basin waters, with emphasis and preference on joint and/or basin-wide development projects and basin programs through the formulation of a basin development plan, that would be used to identify, categorize and prioritize the projects and programs to seek assistance for and to implement at the basin level.'

Preparation of the Basin Development Plan was initiated in October 2001, and the work was divided into 2 phases. Phase 1 is scheduled to finish in January 2006; and a second phase will be initiated during 2006. Formulation of the BDP is guided by the BDP teams at MRC Secretariat and in each NMC. The work has involved a broad network of national planning and line agencies, private sector and civil society actors. The work is supervised by the MRC Joint Committee and by national Sub-Committees.

BDP Phase 1

The objectives of Phase 1 of the BDP formulation are to establish:

- A participatory basin-wide planning process (based around hydrological divisions of the LMB known as sub-areas – see Figure 1)
- An IWRM Plan, including:
 - an IWRM Strategy for water-related development in the LMB
 - a portfolio of priority projects and programs that will support the Strategy
- IWRM tools and a knowledge base.

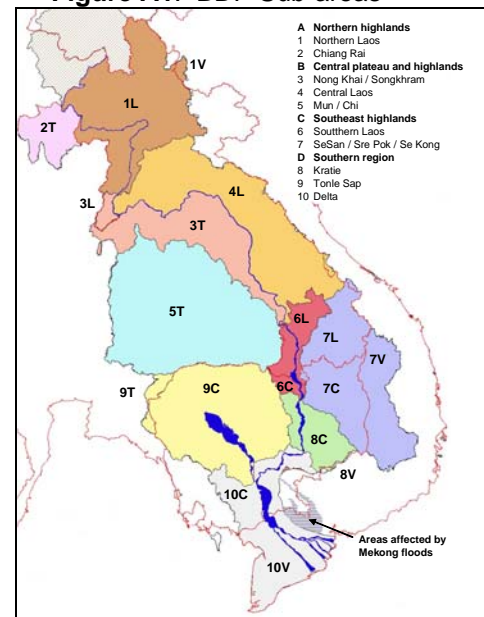
All outputs are produced in a close collaboration with the other MRC programs. Notably, the tools and knowledge base (shared by all MRC programs) have been produced in a close and active collaboration with the Water Utilisation Program, the Environment Program and the Technical Support Division.

BDP Phase 2

BDP Phase 2 is scheduled to begin in 2006. A draft program document for BDP Phase 2 is currently being prepared, which proposes 5 components, covering:

- A rolling IWRM based Basin Development Plan produced in support of sustainable development in the Mekong River Basin
- Knowledge base and assessment tools further developed and utilized effectively in MRC and NMCs
- Capacity built at MRC and NMC levels for IWRM planning and for facilitation/mediation in areas where trade-off management is required

Figure A1: BDP Sub-areas



Appendix 2: Sector Analyses

A2.1 Agriculture and Irrigation

Sector objectives: safe food production, high value and high employment generated by agricultural water use

Current Status

- Irrigated area in the LMB in 2002 was around 2.1 million ha in the dry season, and 5.34 million ha in the wet season.
- Irrigated agriculture is by far the largest water user – total annual withdrawals for agriculture are estimated at around 57,000 MCM, of which over 60% is extracted in the Vietnamese delta (MRC DSF).
- Irrigated agriculture in the LMB is estimated to be worth about \$650 - \$700 million annually (difficult to define irrigated – whole spectrum from recession rice to wet season supplementary to dry season fully irrigated).
- Differences in value extracted, depending on crop grown, market prices and access, labour inputs etc. Estimates vary from around \$6,200 /MCM in Mun Chi, to \$14,600/MCM in Vietnamese delta.
- Dry season withdrawals are at critical levels in NE Thailand, where water shortages occurs in some years; and in the Vietnamese Delta where large irrigation withdrawals in the dry season have resulted in intrusion of sea-water, threatening crops.
- Much of the irrigation infrastructure in the region is old, poorly maintained and inefficient.

Development opportunities and constraints

- Except in the Vietnamese Delta and more mountainous parts of Lao PDR, land suitable for irrigation is not limiting
- Access to markets is limiting for development in many areas, as well as access to land and water.
- Construction of both Chinese and LMB dams will result in significantly increased dry season flow, presenting opportunities of increased irrigation (see Section 3.2).
- 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 except in Central Highlands of Viet Nam. The groundwater resource is not well studied – there may be significant opportunities for conjunctive use to relieve pressure on surface water supplies in critical periods in some areas. However, groundwater irrigation potential in the Korat Plateau is limited due to salinity and low supplies.

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, particularly due to hydropower development in Yunnan, for example
 - Savannakhet and Vientiane plains
 - Bolovens Plateau and Southern Laos
 - Battambang region in NW Cambodia
 - Eastern Cambodia
 - NE Thailand (eg Kong – Chi - Mun)
- Upgrade and improvement of existing infrastructure
 - for example, colmatage systems south of Phnom Penh in Cambodia
- Support for farmer water user groups

References

- BDP 012-2: Regional sector overview: Agriculture. Basin Development Plan Program, Mekong River Commission, Phnom Penh, Cambodia. November 2002. (46 pages)*
- State of Basin Report 2003: Chapter 8*
- Nesbitt, H (2003) Water used for agriculture in the Lower Mekong Basin. BDP Report 017. Basin Development Plan Program, Mekong River Commission, Phnom Penh, Cambodia.*

A2.2 Hydropower

Sector objectives: The increasing demand for affordable electric energy in the MRC member countries is met with minimal negative impacts on the environment and local people, thereby promoting economic growth for the countries' mutual benefit

Current Status

- Total energy demand in the four countries in 2000 was estimated at 125,000 GWh. Of this, around 22% is supplied from hydropower, with the balance mainly from fossil fuels.
- Current installed capacity in the LMB is 1600 MW in 11 schemes, xx% in Lao PDR
- Electrification rates are very low in Cambodia, Lao PDR and parts of Viet Nam. Demand is growing very rapidly, particularly in Thailand and Viet Nam.
- Hydropower is a significant component of the power sector in all four countries, but particularly for Lao PDR where potential substantially exceeds projected demands and export of power is an important component of GDP
- Export trade in power is well established between Thailand, Lao PDR and Viet Nam; China is becoming a player in LMB power sector with the construction of the joint Thai-Chinese Jinhong power station on the upper Mekong.
- Viability of hydropower will be enhanced by extension and upgrading of regional transmission systems under ADB and ASEAN programs

Development opportunities

- LMB has very abundant sites suitable for hydropower development – over 60 have been identified, with total potential estimated at 30,000 MW – 13,000 on the mainstream, 13,000 MW on Lao tributaries, 2,200 MW on Cambodian tributaries and 2,000 in Viet Nam. No further dams have been proposed for Thailand.
- 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 by 7% a year over the next 20 years – requiring generating capacity four times greater than at present. ABD (2001) estimates that MRC member countries will need to develop about 20,000 MW of new generating capacity in the next 10 years, and that after that demand will increase even more quickly.
- Export demand is growing from within the MRC member states, but also possibly from China, Malaysia and Singapore
- China's planned development of large scale hydropower on the Upper Mekong will be an important factor in regional energy policy and directions. Depending on the extent to which the planned cascade is implemented, China may become either a net importer or an exporter of power in the region.

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
- Optimising operation rules to minimize downstream environmental impacts
- Predicting and responding to changes in flow conditions due to hydropower development in the Upper Mekong (Yunnan)
- Assistance with Environmental Impact Assessments for proposed developments – in particular, incorporating processes proposed by the World Commission on Dams
- Consideration of environmental and socio-economic factors in hydropower development – in particular:
 - cumulative impacts of hydropower development
 - impacts on fisheries
 - possible mitigation measures

References

MRC Hydropower Development Strategy (October 2001)

State of Basin Report 2003: Chapter 10

BDP 012-4: Regional sector overview: Hydropower. Basin Development Plan Program, Mekong River Commission, Phnom Penh, Cambodia. November 2002. (33 pages)

A2.3 Navigation

Sector objective: To increase the international trade opportunities for the MRC member countries' mutual benefit, and to assist in co-ordination and co-operation in developing effective and safe waterborne transport in a sustainable and protective manner for the waterway environment (Article 9, 1995 Mekong Agreement).

Current Status

During the last decade, the Governments of most Mekong-riparian countries have initiated series of market-oriented policy reforms. The growth in intra-regional trade and investment has surpassed the prospected average. One way of keeping this momentum in shape is by improving navigation on the Mekong River; shipping is a necessary means to facilitate regional trade. Establishing strategic links with the road and rail in the Basin will form a comprehensive multimodal transport network.

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 \$4.7 billion was distributed by inland waterway transport (\$88m between Thailand and China; \$350m between Lao PDR and Thailand; \$235 million in Cambodia; and \$4 billion in the Mekong Delta).

Waterway transport has traditionally been the principal means of travel for much of the population, both locally and for international trade. Around a third of the population in rural areas of Cambodia and Lao PDR live further than 10 km from a road that can be used year round. Waterborne transport represents 85 % of all means of transportation in the Mekong Delta of Viet Nam.

Navigation modes on the Mekong river can be divided into two major portions:

- Upper portion suitable for inland navigation only (from the port of Simao down to Kampong Cham in Cambodia, and from Kampong Chnnang to the Great Lake in Cambodia. There is no traffic between Cambodia and Lao PDR because fo the impassable Khone Falls.
- The lower portion suitable for inland and maritime navigation (from Kampong Cham to the sea and from Kampong Chnnang to the sea on the Mekong, Bassac and Tonle Sap rivers)

Conditions in the river are very dynamic. Water levels can vary as much as 10-13 m between wet and dry seasons: low flows constrain the size and capacity of vessels during the dry. The location of banks and channels may change after the flood.

A **Navigation Strategy** has been prepared by MRC, which sets out principles and objectives for involvement of MRC in development of navigation; and forms the basis for a comprehensive **Navigation Programme**, with five components:

1. Socio-economic analysis and regional transport planning
2. Legal framework for cross-border navigation
3. Traffic safety and environmental sustainability
4. Information, promotion and coordination
5. Institutional development.

Development opportunities and constraints

- Programs under ADB and ASEAN are upgrading transport links in the region, including construction of roads and bridges. IWT has greater operating efficiency and lower costs than other forms of transport, particularly for long-haul and large volumes. Better integration of IWT into the regional transportation systems could improve overall efficiencies
- 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
- Regional standardisation schemes (navigation aids, navigation rules, certification, pilotage, monitoring, statistics)
- Streamlining of border regulation in general and transit regulation in particular
- Promotion of “clean” river transport; prevention of environmental damage

References

MRC Navigation Strategy (August 2003)

MRC Navigation Programme (Dec 2003)

BDP 012-5: Regional sector overview: Navigation. Basin Development Plan Program, Mekong River Commission, Phnom Penh, Cambodia. November 2002. (21 pages).

Geerinck, L. (Jan 2005) Incorporation of Navigation into the Integrated Water Resource Development and Management Strategy. BDP unpublished document. MRC, Vientiane, Lao PDR.

A2.4 Fisheries

Sector objectives: Coordinated and sustainable development, utilisation, management and conservation of the fisheries

Current Status

The Mekong has one of the largest, most diverse and abundant fisheries in the world. Around 2 million tonnes of fish and aquatic product are caught and cultured each year, with a total value of over \$1,400 million. Fish is a vital food source in the Mekong, particularly for the poor. On average, people consume 36kg per person per year.

The natural capture fishery accounts for over 75% of total production. In addition, it underpins much of the aquaculture production, providing both fingerlings and a food source. Commercial aquaculture have developed rapidly in NE Thailand and the Vietnamese delta. Both capture and culture fisheries operate at commercial, semi-commercial and subsistence levels.

The fisheries sector is particularly significant for Cambodia, where it contributes around 12-16% to GDP due to the highly productive natural fishery of the Great Lake and floodplain. Fish catches are highly correlated with the size of the flood, and fish productivity is dependent on maintaining natural floodplain and wetland ecosystems.

Development opportunities and constraints

- In the Mekong 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 (Bangkok, Ho Chi Minh City)

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 Mekong fishery
- Ecological studies of Mekong fisheries and basis for productivity
- Improved integration of fisheries into catchment planning

References

- Fisheries in the Lower Mekong Basin: Status and Perspectives; MRC Technical Paper No. 6 (May 2002). MRC, Phnom penh, Cambodia.*
- MRC Programme for Fisheries Management and Development Cooperation. Annual Report April 2003 – March 2004. MRC Phnom Penh, Cambodia.*
- State of Basin Report 2003 – Chapter 7: Fisheries. MRC, Phnom Penh, Cambodia.*
- BDP 012-1: Regional sector overview: Fisheries. Basin Development Plan Program, Mekong River Commission, Phnom Penh, Cambodia. November 2002. (10 pages).*

A2.5 Tourism

Sector objectives: Regional water-related tourism further developed, with due regard to social and environmental impacts

Current Status

Tourism in the LMB countries 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 all four LMB countries.

Within the LMB, major tourist destinations are Siem Reap (Angkor Wat), Luang Prabang and the Mekong Delta, all with important connections to the river system. The Mekong system is itself a major tourist attraction, both for the waterbodies (rivers, lakes, waterfalls) and for associated ecosystems and wildlife. Ecotourism is an increasingly important sub-sector – for example, about half of tourist arrivals to Lao PDR express an interest in the natural environment.

Development opportunities and constraints

- The GMS Mekong Lancang River Tourism Development Programme is promoting regional tourism
- 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; and on the upper stretch of the river, between Thailand, China, Myanmar and Lao PDR)
- 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

References

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)

A2.6 Domestic and Industrial water supply

Sector objectives: Water available to people and industries in sufficient quality and quality

Current Status

Provision of safe water supply and sanitation is one of the most urgent tasks facing the countries of the LMB. In rural areas of Cambodia and Lao PDR less than 40% of households have access to safe water, and access to sanitation is even lower. Health outcomes are correspondingly poor, with infant mortality rates as high as 130 deaths per 1000 live births. Population is growing very rapidly, projected to increase from 55 million in 2000 to between 80 and 100 million by 2020 (depending on assumed growth rates, which vary widely).

Current requirements for domestic and municipal supply are estimated to be less than 0.5% of total Basin flows. Even so, dry season shortages sometimes occur, particularly in NE Thailand and in the Delta, where reliance on groundwater and stored rainwater is common. Demands for municipal use are increasing as populations grow, living standards rise and industries develop. It is estimated that domestic and industrial requirements will increase by over 250% by 2020. Water quality, rather than quantity, is likely to provide the most serious challenges for domestic supply, emphasizing the need for adequate waste disposal and sanitation systems in both urban and rural areas.

Rapid growth of urban areas has resulted in local pollution problems from effluent disposal, as well as straining supply systems. Provision of adequate water and sanitation in urban areas is an urgent priority. ADB-GMS programs addressing water supply in urban areas are under way in Phnom Penh, Vientiane, Luang Prabang and a number of other developing urban areas.

Under MDG7 the countries of the LMB aim to reduce by half the proportion of the population without access to safe water by 2015. Much of this effort is being carried out under small rural development projects and NGOs. In Cambodia, Lao PDR and Viet Nam, these efforts are coordinated by the Water and Sanitation Program of the World Bank (WSP) http://www.wsp.org/07_EastAsia.asp

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)

References

State of Basin Report 2003: Chapter 12

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)

A2.7 Flood management and mitigation

Sector objectives: People's suffering and economic losses due to floods are prevented, minimised, or mitigated, while preserving the environmental benefits of floods.

Current Status

Floods are part of the natural cycle of the Mekong, and vital to the functioning of Mekong ecosystems. Lifestyles and agricultural practices have evolved around the flood pulse - for example, cultivation of deep water and recession rice. The flood pulse is the engine which drives the enormous productivity of Mekong fisheries.

The urgent need for improved flood management and mitigation is reflected by the recurrent damage in the Lower Mekong Basin. In 2000, more than 800 people died, and the economic damage was assessed at more than US\$400 million; significant damage also occurred in 2001 and 2002. The poor are often the most adversely affected by floods.

The extent of damage is increasing as populations rise, with more people living in flood-prone areas. Developments on the floodplain, such as levees to protect crops and infrastructure and construction of elevated roads, result in changes to patterns of flooding and may exacerbate flooding elsewhere. They can also block access of fish to feeding area on the floodplain.

Development opportunities and constraints

A **Flood Management and Mitigation Strategy** has been prepared by MRC (MRC 2001) . This forms the basis for the new **Flood Management and Mitigation Programme** (FMMP) (MRC 2002), with five components:

1. Regional FMM Centre,
2. Structural measures and flood proofing
3. Mediation of trans-boundary flood-related issues
4. Flood emergency management
5. Land use management.

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 3.2) 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)

References

MRC Strategy on Flood Management and Mitigation. MRC, Phnom Penh, Cambodia. October 2001.

Flood Management Programme (November 2002)

State of Basin Report 2003: Chapter 13

A2.8 Watershed management¹¹

Overall objective: Effective management of watersheds by relevant institutions in accordance with the maintenance of relevant ecological, economic and social watershed functions.

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.

¹¹ Watershed management is intrinsically cross-sectoral, and so is not regarded as a "sector", but as an integrative process.

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.

Watershed management goal in the LMB

The overarching goal of watershed management in the LMB is that watersheds (including flood plains, wetlands and forest areas) are sustainably managed (preserved and/or utilised) in accordance with clear preferences and safeguards, described in transparent policies and land management plans and monitored continuously.

Important elements of this sustainable watershed management are:

- Community-based natural resource management
- Natural resource utilisation with a suitable, diversified balance between economic, social, cultural and environmental benefits
- Maintenance of hydraulic regimes (including upstream and downstream flow resistance, natural storage capacity, and runoff rates), to assure appropriate flow regimes in the rivers for maintenance of livelihoods and ecological health;
- Habitat conservation (especially in forests, wetlands, and floodplains);
- Management of flood risk (to reduce human and economic costs while maintaining ecologic values);
- Control of erosion and siltation (particularly in large lakes and reservoirs)

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

References

State of Basin Report 2003: Chapters 8 and 9

Poppe, M (2004) Integrated watershed management planning in the Lower Mekong Basin. MRC-GTZ Cooperation Program, MRC, Vientiane, Laos PDR.

MRC (Jan 2000): Strategy study on the development of the watershed management / forestry sector in the Lower Mekong Basin. Strategy and action plan. Prepared by Arcadis for MRCS, January 2000

BDP 012-3: Regional sector overview: Watershed manageent. Basin Development Plan Program, Mekong River Commission, Phnom Penh, Cambodia. November 2002. (22 pages)

Appendix 3: Scenarios for Development in the LMB

What are scenarios?

Scenarios are used internationally in many areas of planning as a way of analysing possible outcomes of different options. Scenarios are a structured way of asking (and answering) the question “What if?”. They describe possible futures, but are options, not predictions.

Scenarios for Basin Planning

Scenarios are used in basin planning to illustrate the potential impact of different development options on the hydrology of the Mekong, and hence on environmental, social and economic outcomes. The analysis provides important insights into the way the Mekong Basin functions as a system, and underpins the formulation of strategies for sustainable development of Mekong water resources.

Scenarios can be used to

- compare development options at a strategic level;
- identify benefits and trade-offs; and
- provide an understanding of the sensitivity of the water resources system to change.

Formulating scenarios

Within the MRC Basin Development Plan (BDP), scenarios have been formulated to capture the impacts of different combinations of developments for the LMB. National plans for development and external trends (such as population growth) affecting water resources were identified with the help of the National Mekong Committee (NMC) BDP teams, based on sub-area reports and analysis, and on national and regional reviews of major sectors.

Proposed developments fall into four main categories in terms of their hydrological impacts:

- Increased extractions for irrigation, domestic, industrial and other uses
- Storages which redistribute flow between wet and dry seasons (for hydropower or irrigation)
- Diversions of water either within (intra-basin) or outside (inter-basin) the LMB
- Physical changes to the flood plains (such as embankments, dykes, roads) which may change patterns of flow in the flood plain, Great Lake and Delta.

Preliminary scenarios were formulated to capture the impacts of different combinations of these developments. The details of components to be included in each scenario (such as areas irrigated, hydropower projects) were discussed with the NMC-BDP teams.

At this stage, five preliminary scenarios have been described and analysed for BDP using the Decision Support Framework and Basin models developed under MRC's Water Utilisation Program; and two have been analysed qualitatively, using available information rather than the models (see below).

This group of scenarios is only the beginning of the analysis. They have been formulated specifically to help define the “development space” (see Figure A3.1). Many other scenarios will be needed to give a comprehensive picture of basin development possibilities. This will be the focus of on-going work in BDP Phase 2.

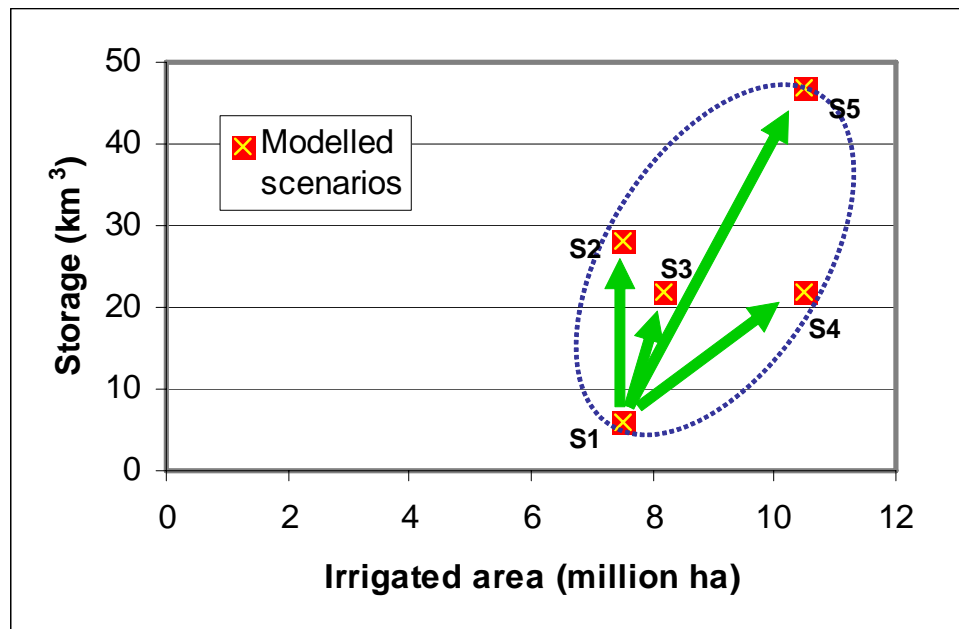


Figure A3. 1: Hydrological “development space” for the LMB, defined in terms of options for irrigation and hydropower development.

BDP Scenarios

Five preliminary model scenarios were formulated for BDP, as follows (see Figure 1)

S1 - Baseline: to describe current development conditions (for year 2000)

S2 - Upper Mekong development: to analyse impacts of planned large storage dams

S3 - in the Upper Mekong without development in the LMB. This scenario was run to help define the relative impacts of developments within the LMB, compared to those in the Upper Basin.

S4 - Low development: irrigation and hydropower development are assumed to keep pace with population growth, but without significant economic growth

S5 - Irrigation development: large irrigation demand growth, without offsetting storages (but with intra- and inter-basin diversions)

S5 - High development: irrigation and hydropower development significantly exceed requirements from population growth, to allow for export and economic growth (includes diversions)

A full description of these scenarios is available in MRC-BDP (2005a). These scenarios form the basis for work under the Integrated Basin Flow Management Program.

Two further issues were considered as non-model (qualitative) scenarios. The first described potential impacts of development on the floodplain. Because of the complexity both of possible development patterns, and of the likely impacts, a very large number of modeled scenarios would be required to describe the issues adequately. For this reason, a preliminary analysis of likely development patterns and potential impacts has been prepared based on existing information. This is described in MRC-BDP (2005b).

Climate change is an issue of some concern and interest internationally. Preliminary analyses have been made of the likely impacts on SE Asia and the Mekong region in the medium term. These have been reviewed in Hoanh et al (2003) and in WWF (2005).

Describing and analyzing scenarios – the models

The Basin models and DSF (developed under the Water Utilisation Program and now operated by TSD) provide an important tool for description and analysis of scenarios. The scenarios formulated by BDP were analysed by the TSD Modelling Group to give detailed descriptions of the expected hydrological changes resulting from different development options. The hydrological impacts were then analysed in the context of their likely impact on ecological, social and economic outcomes, with assistance from Environment Program and sector programs (notably Fisheries and Navigation).

Not all scenarios must be modeled. It is possible, and in some cases more flexible, to consider a scenario in qualitative terms, describing likely impacts on the basis of existing information rather than model outputs. This is the approach that was taken for floodplain development and climate change.

The results of scenario analysis are described in detail in MRC-BDP (2005a, 2005b).

Major conclusions from scenario analysis

While the detailed results are of considerable interest, the broad picture that emerges from the scenario analysis is more important in terms of basin planning. The strategic significance of the conclusions from these studies is summarised below.

Construction of the planned cascade of dams on the Upper Mekong will change flow conditions in the upper part of the LMB very substantially, but the impact on the floodplain, Tonle Sap and the Delta is largely mitigated by inflows from major tributaries within the LMB. Long term development plans for LMB should be evaluated in the context of the resulting changed flow regimes.

Construction of storages (whether in the Upper or Lower Basin) will result in transfer of flows from the wet to the dry season, with corresponding opportunities for increased dry season irrigation. Near-field impacts of developments may be substantial. However, even under a high development scenario (50,000 MCM of storage, or over 10% of average annual flows), the overall character of the hydrograph at Kratie is maintained. Low flows at Kratie are significantly increased (higher than the historically observed range), but high flows are reduced only marginally (within the historically observed range). Construction of storages in the upper reaches of the LMB or on the tributaries is unlikely to mitigate floods on the lower floodplain and Delta.

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); and by increasing dry season flows. The impacts of increased dry season flows on fish ecology are not well understood.

Developments on the floodplain (such as embankments and dykes) can potentially change flood patterns and duration in the floodplain very 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.

Without offsetting storage, extraction and diversion of water for irrigation development will result in a significant decrease in dry season flows and a concomitant increase in the area affected by salinity intrusion. However, planned hydropower development is more than sufficient to offset likely increases in irrigation withdrawals. Construction of storage, and intra-basin transfer of water, can greatly increase the reliability of dry season irrigation, but does not completely remove the risk of water shortages.

Existing studies of global climate change (Hoanh et al 2003, WWF 2005) indicate that climate variability in SE Asia may increase in the next 20 to 50 years, with longer, drier dry seasons and wetter, more intense monsoons. This reinforces the need for production and livelihood systems that can cope with variation in water availability.

Scenario analysis confirms that 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 completely 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.

Future work

Scenario analysis has helped to start defining the "development space" available to the Mekong, and the impacts that different options might have. The Integrated Basin Flow Management Program (IBFM) will extend the analysis, to increase the understanding of how hydrological change impacts on ecological, social and economic outcomes. Future work can build on this understanding, by considering, for example

- impacts of different crop types and cropping patterns on irrigation demands
- the impact of different operating rules for large storages
- the sensitivity of the system to different spatial patterns of development
- more detailed studies of the impacts of particular projects or groups of projects.

References

- MRC-BDP (2005a) "Modelled Impacts of Scoping Development Scenarios in the Lower Mekong Basin" . Draft BDP Report. MRC, Vientiane.
- MRC-BDP (2005b) A report on likely infrastructure developments in the Mekong floodplain in Cambodia and their significance in changing flow patterns" . Draft BDP Report. MRC, Vientiane
- WWF (2005) An Overview of Glaciers, Glacier Retreat, and Subsequent Impacts in Nepal, India and China. WWF Nepal Program, Kathmandu, Nepal. 79pp.
- Chu Thai Hoanh, H. Guttman, P. Droogers and J. Aerts (2003) Water, Climate, Food, and Environment in the Mekong basin in southeast Asia. Final Report, ADAPT Project. International Water Management Institute, Colombo, Sri Lanka. sheba.geo.vu.nl/~ivmadapt/downloads/Mekong_FinalReport.pdf.