



Mekong River Commission

MRC Strategy on Flood Management and Mitigation

Phnom Penh, 17.12.2001

The Mekong River Commission Secretariat

P.O. Box 1112 • Phnom Penh, Cambodia • Telephone: (855-23) 720 979 • Facsimile: (855-23) 720 972

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Key MRC Task force members, members of the consulting team and national coordinators who helped in the formulation of the Strategy included:

MRC Staff

Mr. Lieven Geerinck, Task Force Chairman and Manager of Navigation Programme
Mr. Bun Veasna, Programme Officer, Officer-in-Charge of WRMP
Mr. Thanongdeth Insiengmay, Programme Officer and Head of Flood Forecasting Team
Mr. Thomas Kimmel, Capacity Building Programme Manager
Other members of the FMM Task Force (Messrs. Hao,
Ms. Sucheata Ros, Water Resources Management Programme secretary
Mr. SophearkMith Chea, Navigation Programme secretary

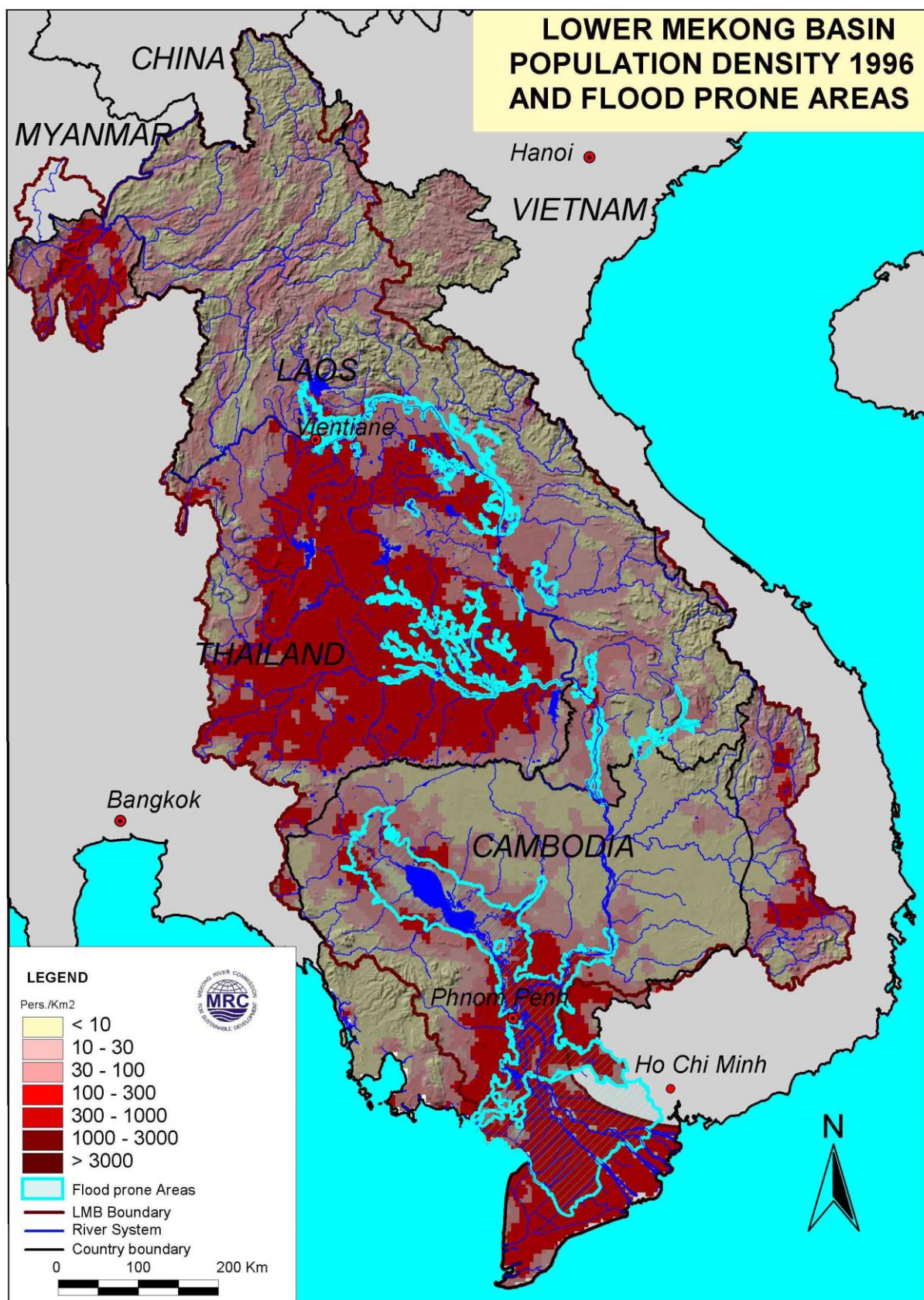
Consulting Team

Mr. Richard Paulson, Consulting Team Leader, and Flood Forecasting Specialist
Ms. Frauke Neumann-Silkow, FMM Team Coordinator and Land Use Planning Specialist
Ms. Martha Teas, Public Participation and Emergency Management Specialist

National Coordinators

Cambodia: Mr. So Sophort
Lao PDR: Mr. Lattanasay Khamsida
Thailand Mr. Karoon Premvuti
Vietnam: Mr Do Manh Hung

**Map 1: Lower Mekong Basin:
Population density (1996) and Flood Prone Areas**



EXECUTIVE SUMMARY: The MRC Strategy in Brief

1. The Council of the Mekong River Commission responded to the extreme floods of 2000 by charging its Secretariat (MRCS) with preparing a **Flood Management and Mitigation (FMM) Strategy**. Although this flood event was an extraordinary event in large parts of the Lower Mekong Basin, the high concentration of people living in flood prone areas in all four member countries of MRC (see Map 1) shows that the people living here, as well as the agencies concerned, have to be better prepared for future floods. This report is one result of the process by an MRC FMM team to prepare such a strategy for this regional organisation. **It is not a flood management strategy for the Basin, or for the member countries, but it is the strategy for this regional organisation**, i.e. what the organisation shall do to respond to flood hazards and to effectively contribute to national or basin-wide strategies. This MRC FMM Strategy has been endorsed by the Council at its 2001 annual meeting for consideration and endorsement.
2. The **strategy formulation process** was highly participatory. The National Mekong Committees (NMCs) and representatives of line agencies, civil society organisations and international organisations in each riparian country hosted the MRCS team during fact-finding and consultation visits to each country. The NMCs and the related line agencies met with the team at a national FMM workshop. Subsequently, all four NMCs and representatives from selected line agencies and civil society and international organisations joined the final discussions at a regional workshop to review the strategy before submitting it to the Council.
3. According to the **concept of modern floodplain management**, four major groups of management measures to reduce flood risk and flood hazard across the floodplain are to be distinguished:
 - **Land-use Planning Measures** are aimed at '*keeping people away from the floodwaters*'. Land-use measures on the floodplain aim to ensure that the vulnerability of a particular land-use activity is consistent with the flood hazard on that area of land, ie the objective is to keep people and vulnerable activities out of the most hazardous areas of the floodplain.
 - **Structural Measures** are aimed at '*keeping floodwaters away from the people*'. Typical structural measures include flood mitigation dams, embankments and flood detention basins. Development and Building Controls can be seen as a particular kind of structural measures for urban and settlement areas, aimed at reducing flood damage to buildings. Typical building controls include minimum floor levels to eliminate nuisance flooding, and the use of building materials and building designs that enable rapid and effective cleanup after a flood.
 - **Flood Preparedness Measures** recognise that - no matter how effective the above types of management measures are - an overwhelming flood will always occur. They aim at '*getting people ready for floods before they come*'. In a number of cases, Flood Preparedness and Emergency Measures may be the only type of management that is feasible or

economically justified. Flood preparedness measures embody flood forecasting, flood warning, and raising the general flood awareness of the potentially affected population groups.

- **Flood Emergency Measures** deal with the aftermath of such an event by *'helping affected people to cope with floods'*. Flood Emergency Management, like Floodplain Management, is a process that typically encompasses preparation, response, and recovery. In addition to flood preparedness, the flood emergency management process embodies evacuation planning and training, emergency accommodation planning, flood cleanup planning and the restitution of essential services, and social and financial recovery measures.

Integrated Floodplain Management involves an **integrated and coordinated mix of these types of management measures** that reflects the flooding, flood risk and flood hazard characteristics of the particular floodplain, the specific social and economic needs of the flood-prone communities, as well as environmental and resource management policies for the floodplain.

4. Floodplain management issues - based on the extent of their impact - can be of three types - **National, Regional and Trans-Boundary Issues**. In defining possible roles for the MRC, it needs to be recognised that national flood impacts – ie impacts generated and experienced solely in a single country – remain that country's responsibility. Therefore, the lead function for dealing with most of these elements are with the responsible line agencies at national level, possibly supported by international organisations and civil society organisations. MRC is to mainly support these agencies and organisations with supplementary services that are of relevance at the regional level and with respect to trans-boundary issues.
5. The 1995 Agreement sets the mandate for the organisation's involvement in FMM. According to this mandate and the results of the strategy formulation process, the **roles for MRC** can be grouped into three categories:
 - **Providing Technical Products and Services** includes first of all the provision of flood forecasts to the member countries. This activity has already commenced: –the requested immediate improvement of the MRC Flood Forecasting System is well underway and 3 to 5-day flood forecasts are published on the web (www.mrcmekong.org) on a daily basis. The forecasting system will be further enhanced when the telemetering network of water level (and rainfall) stations will be online by the second half of 2002, including data from two stations in China. MRC will also act as a repository of flood data and information for the basin, and will provide technical products, such as flood hazard maps and other GIS services. Flood data and information can be entered into the MRC database for ready retrieval, the production of thematic maps, and further use by member countries. Provision of technically excellent analytical services to the member countries in relation to flooding and flood issues includes the setting of standards in relation to flood management, so that all member countries use a common terminology, common data recording forms, common methods of analysis, etc.
 - **Addressing Differences and Facilitation** on water and related issues is explicitly mentioned in the 1995 Agreement as one essential role of

MRC. The member countries respect MRCS for its neutrality, objectivity and technical excellence. With respect to trans-boundary issues of FMM, for example on land-use or structural measures, MRCS should serve the member countries – upon invitation - as a neutral facilitator.. The results of scientific modelling provide an excellent base for MRC to assess and facilitate such trans-boundary issues. In addition, MRC should assist with respect to coordinating floodplain management aspects of national programmes with relevant MRC programmes. For example, the three MRC Core Programmes, ie the Water Utilisation Programme, the Basin Development Plan, and the Environment Programme, are of direct relevance to floodplain management and vice versa. Finally, MRC should build confidence among the neighbouring countries by becoming the focal point for a floodplain management forum that addresses flood and floodplain management and flood preparedness.

- **Capacity Building and Technology Transfer** to the member countries is required, especially with regard to flooding issues that are of regional and trans-boundary relevance. MRC could develop standard training programmes to be delivered to relevant line agencies in the member countries, including the transfer of technology/know how and equipment.
6. These roles are to be played by MRC as an organisation made up of the Council, Joint Committee and **MRC Secretariat** as well as the **National Mekong Committees** in the four member countries. The NMCs are national public agencies that represent the relevant line agencies. With this, they also play a unique coordinating role in their respective countries between the MRC Joint Committee, MRC Secretariat and national interests. Concerning flood management measures, the NMCs promote adopted positions of the MRC Council and Joint Committee to national agencies, provide insights on national concerns for guiding MRC's involvement with respect to the above mentioned roles, and provide a forum for continued interaction with other stakeholders
 7. Looking at these roles, it becomes clear that MRC can only be one player in Integrated Floodplain Management in the Basin. The services that the organisation can provide are basically **support services for others**, such as national line agencies and emergency relief agencies, to more efficiently fulfil their own tasks in this field. Cooperation with these other national and international agencies is therefore of utmost importance for the effectiveness of an MRC Strategy. Partnerships have been formed already between MRC and organisations such as WMO, UNDP, IFRC, USGS, ESCAP, ADPC, etc. Such cooperation initiatives have been further worked out during the Regional Workshop and form part of the strategy. The benefit of any MRC involvement in FMM will have to be judged according to the usefulness of MRC products and services for the MRC clients who are the main implementers of floodplain management measures in the field, mainly at the national and local level. And the final benefit of all these concerted efforts will be seen from how much damage of properties and loss of life resulting from flood impacts was likely to have been spared.
 8. According to the three Strategic Roles of MRC, ie (1) Providing Technical Products and Services, (2) Addressing Differences and Facilitation, and (3)

Capacity Building and Technology Transfer, and the four elements of integrated floodplain management, ie (a) Land-use planning, (b) Structural measures, (c) Flood preparedness, and (d) Emergency management, the **fields of intervention for a future MRC Programme on FMM** are outlined and defined in this MRC Strategy document. These have been prioritised by the national and regional workshops.

9. Within each of these elements, the Strategy discusses the **needs and justifications**, defines possible **MRC involvement**, identifies possible **cooperating organisations**, and lists the **clients** to be served. The strategy formulation process revealed a large number of flood-related needs of MRC member countries, both domestically and from regional and trans-boundary points of view. These were then screened as to whether it is appropriate for MRC to assume a role to meet the need. Each country indicated its priority for MRC to undertake the range of roles identified by the strategy. The Strategy and its elements, ie the fields of intervention for the MRC FMM Programme, have then been formulated based on a summary of the countries' common needs and priorities, as well as the MRC mandate, policies, and working principles.
10. This Strategy document provides now the **basis for the preparation of an MRC FMM Programme**, including a detailed action plan and bankable programme components. During the remainder of 2001, the MRCS team with active involvement of and consultation with the NMCs, relevant line agencies, and other stakeholders, will define the programme components to implement the strategy. These components will be discussed with — and reviewed by - the above mentioned co-operators and stakeholders. Thereafter, the MRC Strategy for FMM will be updated in about three years from now, as lessons are learnt about how MRC is coping with its challenge to support management and mitigation of the periodic floods in the Mekong River Basin.

Figure 1: Hierarchy of Objectives of the MRC Strategy on FMM

Recognising MRC's role as a river basin organisation for regional co-operation on sustainable development, utilisation, management, and conservation of water and its related resources in the Mekong River Basin, the MRC Strategy on Flood Management and Mitigation fully reflects the concept of integrated floodplain management and highlights those aspects of this concept that could be addressed under the present mandate of MRC. With reference to the logic and terminology of Logical Framework, the MRC Strategy can be summarised as follows (with the arrows representing the means-impact relationships that are expected from implementing the strategy):

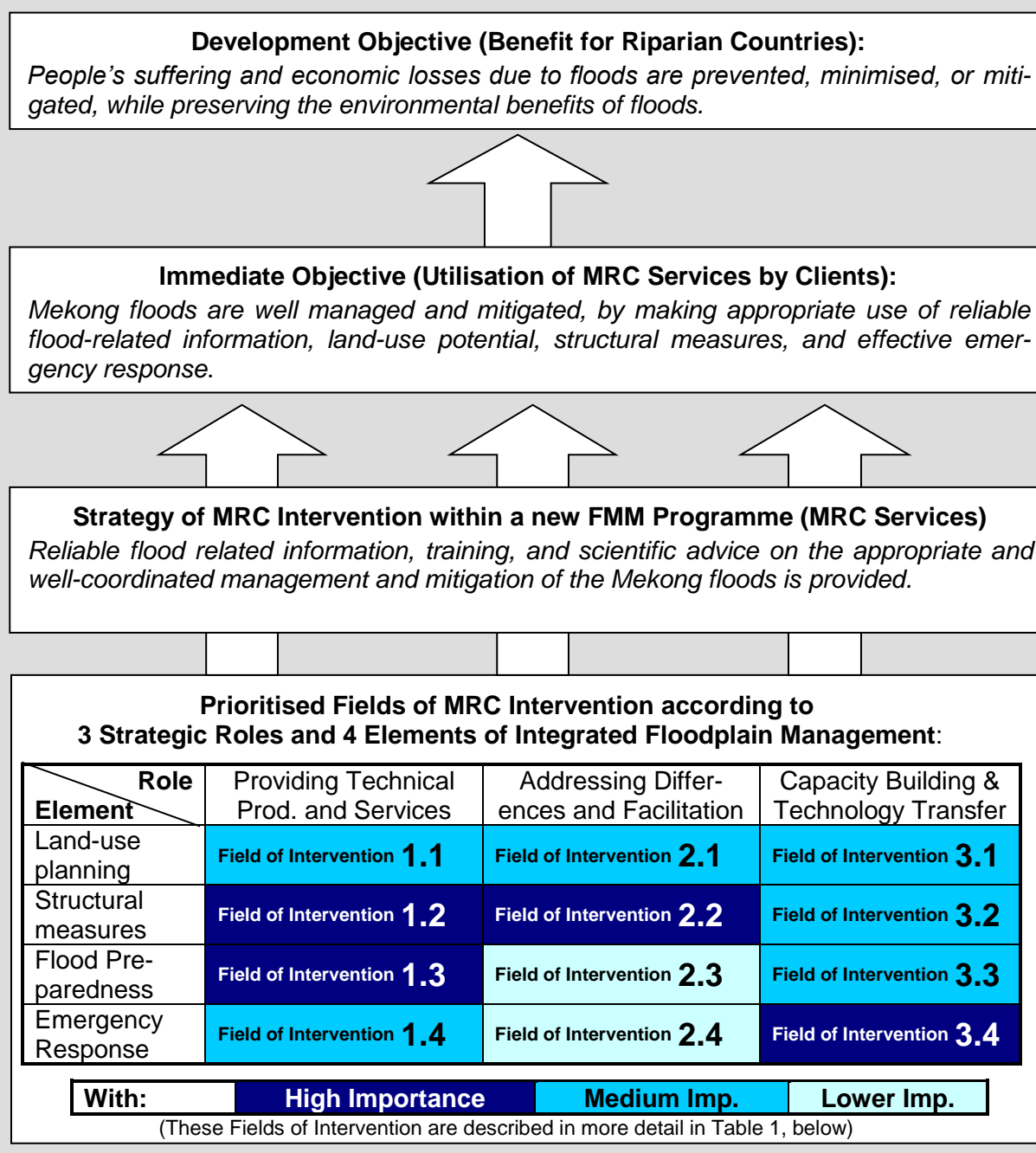


Table 1: Overview on Possible MRC Intervention by Strategic Role and Elements of Floodplain Management in descending order of importance. These possible fields of intervention will be taken into consideration for the detailed MRC programme for Flood Management and Mitigation.

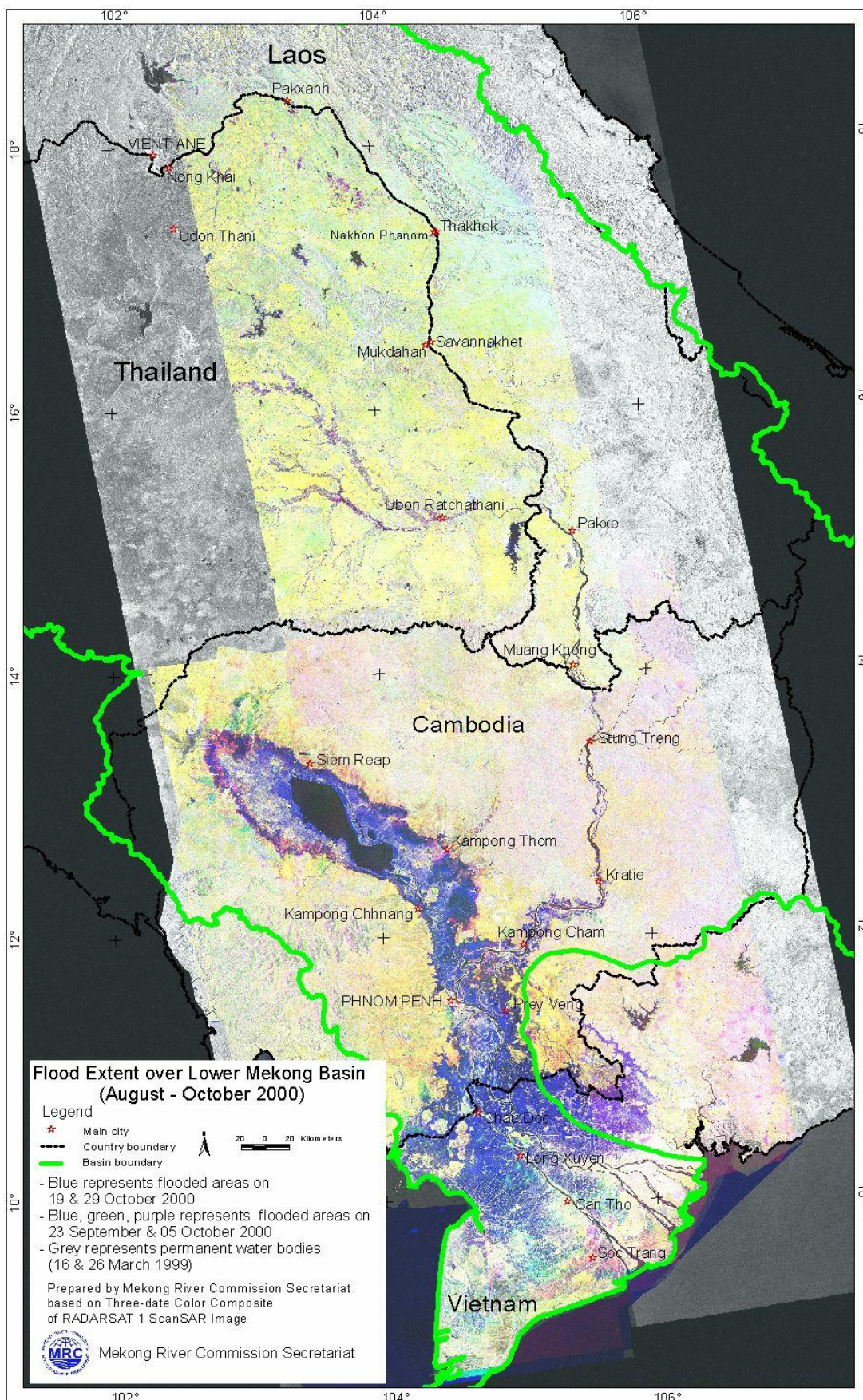
<div style="text-align: right;">Role</div> <div style="text-align: left;">Element</div>	Strategic Role 1: PROVIDING TECHNICAL PRODUCTS AND SERVICES	Strategic Role 2: ADDRESSING DIFFERENCES AND FACILITATION	Strategic Role 3: CAPACITY BUILDING AND TECHNOLOGY TRANSFER
For Land-use Planning:	<ul style="list-style-type: none"> • Develop common definition for flood risk areas and flood hazard areas • Provide regional flood maps (flood hazard maps, flood damage risk maps) • Conduct research and analytical analysis on the transboundary impact of land-use changes on flooding, • Develop guidelines on integrated land-use planning and land-use for flood hazard areas and catchment areas • Develop a (general) land-use classification system (in cooperation with other programs) 	<ul style="list-style-type: none"> • Promote data and information exchange and sharing • Provide inputs on flood-related land-use aspects to the MRC Basin Development Plan (BDP) • Organise workshops and forums to discuss best practices and regional guidelines for land-use planning in floodplains and catchment areas • Provide objective technical expertise and act as facilitator on transboundary impact of land-use (if invited) 	<ul style="list-style-type: none"> • Improve institutional capacity and facilitate technology transfer and on the job training for the preparation of flood maps • Provide on the job training to promote the better use of flood maps for land-use planning. • Provide tools, software such as GIS, Remote Sensing • Start pilot projects in selected areas to demonstrate best practices for land-use planning in flood prone areas and catchment areas. • Public education

<div style="text-align: right;">Role</div> <div style="text-align: left;">Element</div>	Strategic Role 1: PROVIDING TECHNICAL PRODUCTS AND SERVICES	Strategic Role 2: ADDRESSING DIFFERENCES AND FACILITATION	Strategic Role 3: CAPACITY BUILDING AND TECHNOLOGY TRANSFER
For Structural Measures:	<ul style="list-style-type: none"> • Provide analytical services by making use of flood patterns and frequency analysis, hydrologic and hydraulic model analyses, correlations of flood frequency with land-use, water-quality implications of floods, and flood-inundation maps (in cooperation with the WUP and other core programmes). • Test or adjust for the appropriateness of hydrologic and hydraulic models of other programmes for FMM for the Lower Mekong Basin • Compilation of existing and planned infrastructure in the LMB • Risk assessment of structures • Guidelines on flood proofing for specific areas (on building and development control) with data from line agencies 	<ul style="list-style-type: none"> • Provide impartial technical expertise and act as facilitator to address trans-boundary issues on structural measures (if invited) • Promote data and information exchange and share; • Foster regional exchange of information on gate/dam operations which may have trans-boundary impacts • Promote notification, prior consultation and agreement wrt water use in cooperation with WUP • Draft and promote guidelines for gate operating rule of dams and flood embankments / dikes 	<ul style="list-style-type: none"> • Provide training in hydrologic and hydraulic modeling in cooperation with WUP, BDP, EP and other programmes

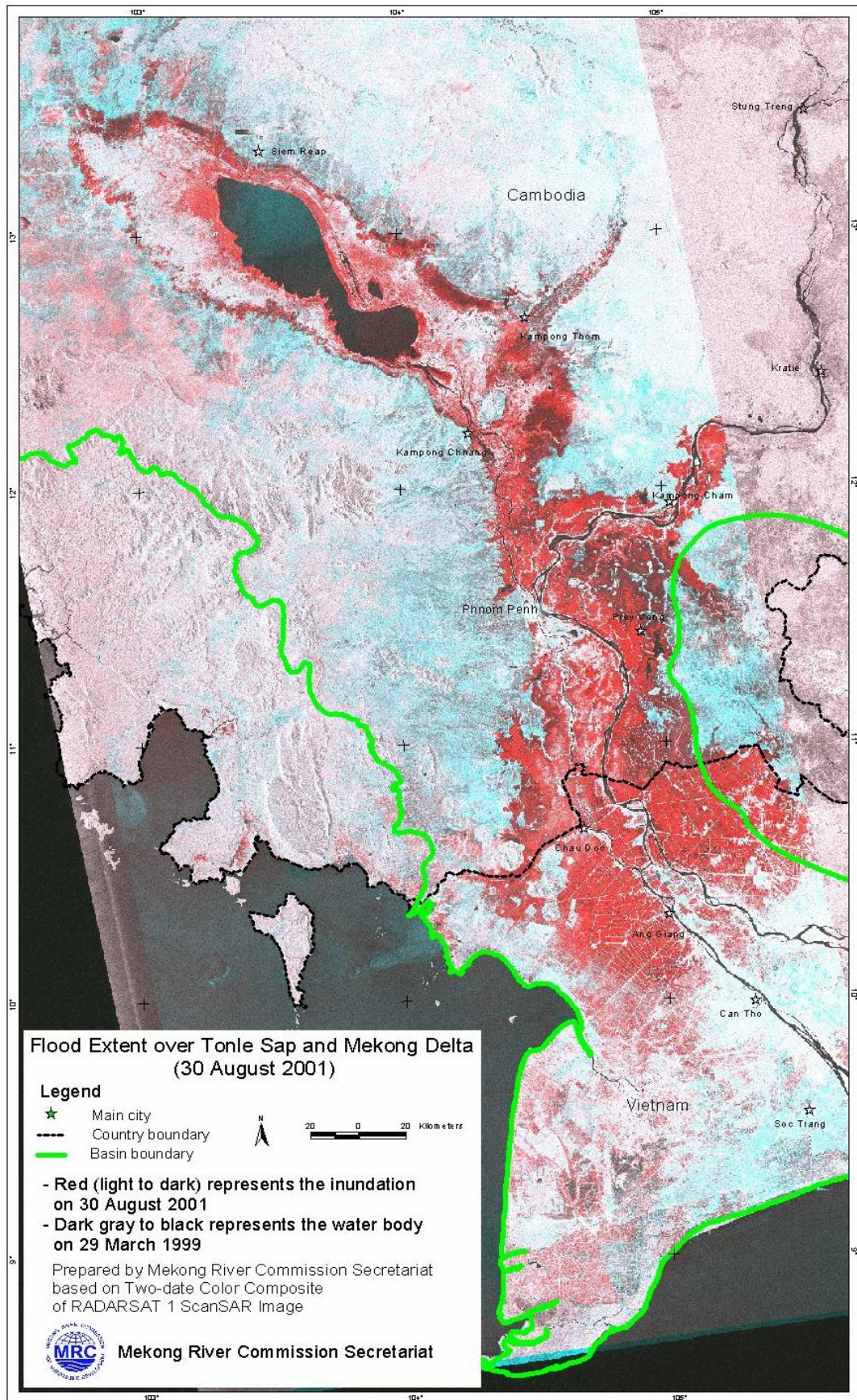
<div style="text-align: right;">Role</div> <div style="text-align: left;">Element</div>	Strategic Role 1: PROVIDING TECHNICAL PRODUCTS AND SERVICES	Strategic Role 2: ADDRESSING DIFFERENCES AND FACILITATION	Strategic Role 3: CAPACITY BUILDING AND TECHNOLOGY TRANSFER
For Flood Preparedness	<ul style="list-style-type: none"> • Improve and maintain an accurate and user oriented flood forecasting system • Assure that forecasting is accurate (quality assurance), and indicate level of uncertainty • Support the dissemination of the forecasts through better understanding of users' needs • Develop instructions for the use of flood forecast, flood map information, etc. • Weather forecasting reflected in the flood forecast uncertainty • Support reliable and accurate real time data collection and transmission for the flood forecasting • Support a (regional) flood warning system • Establish a Regional Flood Information Center (data repository, flood risk maps, satellite remote sensing and GIS based information on flood extent, flood behaviour analysis, evaluation of efficiency/ effectiveness of flood preparedness, lessons learned, scenarios' simulation of flooding by incorporation up to date information on land-use, structural development, etc) • Combining flood forecasting and flood prone areas' information (inundated areas, villages, population density, flood extent/depth/duration, etc.) • Flood mapping at local/community level (Pilot areas in the riparian countries). • Set up guidelines and provide assistance for flood warning and information dissemination (warning preparation, dissemination, interpretation) • Set up guidelines for flood preparedness (regional and community based preparedness), <i>(TO BE CONSIDERED AS NATIONAL ISSUE)</i>. 	<ul style="list-style-type: none"> • Set up common standards on hydro-meteorological data collection and transmission (<i>COMMENT: already set by WMO</i>) • Establish standard data exchange format • Establish data and information exchange and sharing • Establish a network for efficient dissemination of flood preparedness information 	<ul style="list-style-type: none"> • Act as a forum of consultation and experiences sharing • Provide (Master) Training on flood forecast and flood map interpretation • Flood warning dissemination to the areas concerned • Act as data/information and knowledge center • Act as capacity development center • Preparedness planning (at national, provincial and community level) • Act as technology transfer center

<div style="text-align: right;">Role</div> <div style="text-align: left;">Element</div>	Strategic Role 1: PROVIDING TECHNICAL PRODUCTS AND SERVICES	Strategic Role 2: ADDRESSING DIFFERENCES AND FACILITATION	Strategic Role 3: CAPACITY BUILDING AND TECHNOLOGY TRANSFER
For Emergency Management:	<ul style="list-style-type: none"> • Provide timely information and data from geographic information systems (flood maps, thematic maps, and satellite imagery) in a form that is easily understandable, and easily retrieved by field workers in emergency operations. Link to the MRC general procedures on information exchange and sharing. • Prepare and recommend common standards for reporting damage assessment, and linking needs assessment results with other flood information systems. • If possible, develop and forward timely information about appropriate evacuation channels and safe havens, both for preparation and for “real time” flood emergencies. 	<ul style="list-style-type: none"> • Promote trans-boundary data and information exchange and sharing through such measures as annual flood management meetings involving emergency managers. • Provide appropriate and efficient communication and coordination channels for supporting trans-boundary emergency operations, in cooperation with existing international and national mechanisms, as appropriate. • Facilitate formation of agreements to mobilize resources between lower basin countries in support of emergency management 	<ul style="list-style-type: none"> • Conduct practical training for emergency managers to bridge the gap between scientific study and practical tools (NDMCs, relief agencies) • Provide training opportunities through joint simulation exercises, incorporating new technologies and information. • Advocate for national capacity building support with donors.

Satellite Image: Flood Extent in the LMB 2000



Satellite Image: Flood Extent in the LMB 2001



1 INTRODUCTION

1.1 BACKGROUND

1.1.1 Problem Setting

Flooding of the Mekong River is a recurrent event, as can be seen from the two satellite images above. Almost every year, it takes hundreds of lives and causes damage to agriculture, rural infrastructure and human activities. But flooding of the Mekong and its tributaries is also an important source for the wealth in biodiversity, abundance of fish, and soil fertility in the Mekong River Basin.

The degree to which floods occur, varies and may reach disastrous dimensions, with severe losses in human lives and food production. The Mekong River Basin has experienced several of such major floods within this century. The floods in 1961 and 1966 were quite disastrous in the central part of the Basin. In 1996 and in particular in 2000, floods were exceptionally serious in the lower part, towards the Delta. But the year 2001 almost shows a similar pattern, with even higher flood levels in some of the stations along the river (see the [hydrographs](#) on page 64).

The negative effects of floods regularly counteract efforts for economic development and poverty reduction in various places throughout the Lower Mekong Basin. The damage caused by the flood 2000 was indeed dramatic. In Cambodia, 347 persons were reported dead, and 448 in Vietnam. More than 3.5 Million people in Cambodia and 5 Million in Vietnam were affected, and many of them had to be evacuated from their flooded homes for several weeks. The agricultural production in the delta was seriously affected, and thousands of kilometres of national and provincial roads were damaged. The total flood damage in Cambodia amounted to US\$ 145 million, and US\$ 285 million in the Viet Nam Delta. Production losses of approx. US\$ 20 million were also reported in Lao PDR, and around US\$ 21 million in Thailand. According to statistics, the probability of occurrence of a similar flood (called the 'return period') ranges from 3–10 years in Laos and Thailand, to between 20 and 60 years in Cambodia, and 30 years in the delta area of Viet Nam.

It is against this background of fatalities, damage, and the basin-wide nature of these floods that the MRC Council has asked the Mekong River Commission Secretariat at its meeting in October 2001 in Pakse to develop a strategy for dealing with the threat of future flooding in the Basin.

1.1.2 Flood Management and Mitigation and MRC

Flood management and mitigation is a prominent function among a wide variety of stakeholders. Not only does it concern the community of water resource planners and engineers who must consider floods from a more technical perspective. Floods are a major topic of national and local emergency agencies, and – since they are seen as an underlying factor to vulnerability among populations – also for international organisations and donors.

With the formulation of the strategy, however, MRC can only identify those aspects of flood management and mitigation that are covered by its mandate. **It is not a flood management strategy for the Basin, or for the member countries, but it is the strategy for this regional organisation**, i.e. what the organisation shall do to respond to flood hazards and to effectively contribute to national or basin-wide strategies.

The strategy formulation process took a comprehensive perspective on flood management, and communicated this during consultations. This choice was welcomed, and in fact applauded by most of the stakeholders as timely and appropriate. While regional groups such as ESCAP promote integrated flood management, there is no other agency so uniquely qualified as MRC to deal with water and related resources in the Mekong Basin, while having such direct links with the national interests of the riparian countries.

At the same time, this imposes special obligations on MRC to ensure that all stakeholders have the same basic understanding of what is meant by integrated flood management, and that this is consistently communicated in its work.

1.2 OUTLINE OF THE STRATEGY FORMULATION

1.2.1 The MRC Council's Request and its Follow-up

In response to the 2000 devastating floods, and following the request of the Council, the MRC Secretariat established a Flood Management and Mitigation Task Force comprising of professionals from all relevant MRC programme sectors. The Task Force started at once with the following tasks:

- Making an inventory of all MRC relevant studies, projects, master plans, etc. made so far on flood management, flood forecasting, etc.;
- Preparing a critical review and assessment of previous and on-going regional initiatives, defining conclusions on their viability and effectiveness, and identifying outstanding needs;
- Preparing and compiling a complete damage report from the recent floods in the whole basin;
- Preparing a report covering the scientific reasons behind the phenomenon of the recent extreme floods;
- Preparing a project proposal for the formulation of a Regional FMM Strategy and Programme;
- Organizing a Consultation Workshop on the Formulation of a Regional Strategy for Flood Management and Mitigation in the Mekong River Basin.

The Consultation Workshop was held early February 2001 as a kick-off for a new involvement of MRC with regards to flood management and as the first step in the formulation of a regional strategy. The major conclusions of this workshop were:

- Floods in the Mekong Basin are part of the daily life of the people. But alleviation of hunger and poverty, and sustainable development are not possible with extreme flood events that cause great loss of life, significant loss of property, and severe disruption of livelihood;
- Support by NMCs and stakeholders of MRC is required to develop a regional flood management and mitigation strategy that includes a list of ranked measures to reduce flood hazard and suffering;
- Emphasise on better preparedness by people (ie greater flood awareness) to minimise loss of life;
- Reflect a balance between optimising the positive and minimizing the negative aspects of flooding in the Lower Mekong Basin.

The MRC Secretariat then formed an FMM Strategy Formulation Team, consisting of secretariat staff, NMC staff and international consultants.

1.2.2 Objectives and Process of the Strategy Formulation

In line with the results of the Regional Workshop, the present strategy formulation was then commissioned, financed by the Government of Germany. It has the following **objectives**:

1. To bring up-to-date the information on the flood management and mitigation situation in the Lower Mekong Basin, including review of the recent flood events and organisational response, and to review the available data, studies, reports and ongoing activities by MRC;
2. To determine the role of the MRC and its strategic approach towards the regional flood management and mitigation;
3. To formulate an MRC strategy for flood management and mitigation in the Lower Mekong Basin;
4. To formulate a programme to implement the strategy including detailed action plan and bankable programme components.

The process for formulating the MRC FMM strategy consisted of the following distinct stages:

- Assembly of the Strategy Formulation Team at MRCS in Phnom Penh and review of the study methodology.
- National Fact Finding Missions to the four riparian countries.
- Preparation of a 'National Working Paper' for each member country that describes the principles of Integrated Flood and Floodplain Management,

presents the project team's findings on flooding and flood management issues in that country, describes how MRC could possibly assist with flood management in the member countries – and importantly – how MRC is or may be limited by legal, human resource and capacity constraints from undertaking a number of these activities, and identifies various policy elements that may be of interest to the country.

- Presentation of the National Working Paper findings at National Workshops in each of the four countries. These workshops provided each country with the opportunity to comment on the Team's understanding of flooding and flood management issues in the member countries, and to present national opinions of issues, needs and priorities regarding flooding and flood management.
- Preparation of National Workshop summary reports.
- Finalisation of a Draft Strategy Report by MRCS, based on the Strategy Formulation Team's inputs and findings. This – present - report considers and outlines general elements and possible fields of intervention for implementing the Strategy.
- Presentation of the Draft Strategy Report at a regional workshop in Phnom Penh in October 2001, where all four countries have the opportunity to comment on the proposed policy.
- Finalisation of the Strategy Report by MRCS for submission to the MRC Council for approval at its meeting on 1st November 2001.

If the draft FMM Strategy is approved at the Council Meeting, the following tasks will follow:

- Based on the strategy preparatory works, formulate a draft Programme including detailed bankable programme components - Elaborate the details of the action plan;
- Review of the draft Programme and action plan by the four countries;
- Conduct a Regional Workshop to discuss the detailed Programme and the Action Plan;
- Finalise the Action Plan and the detailed Programme components;
- Incorporate the Programme for FMM into the MRC Work Programme.

1.2.3 Public Participation and Strategy Formulation

The degree and efficiency of public participation is different in the member countries. While there appears to be a robust system of accessing all affected members of a community in Thailand and Cambodia, the way how local interests are translated into policies may still deserve improvement. In the case of Lao and Vietnam, national policies dictate a gradual process of increased public participation.

These aspects have to be respected and reflected in MRC's strategy and involvement.

Public participation is considered as a process to which MRC feels itself committed in all its programme activities. The relevance of public participation was also recognised for the Flood Management and Mitigation Strategy Formulation process.

Identifying key stakeholders was done at the beginning of the FMM consultation process, and augmented along the way as more information became available. The NMCs were instrumental in identifying government agencies, while Civil Society Organisations, UN agencies, and donors assisted by either providing direct input, referring the team to other stakeholders, or representing community interests through their work. During consultations in the countries, over 40 line agencies and non-governmental agencies were interviewed.

The concerns and issues raised by these stakeholders were used in a number of ways. First, they helped to identify categories of stakeholders, which in turn helped to define the workshop groups. Secondly, their interests and concerns were used in the content of the Working Papers, which were shared with workshop participants and others. Third, the issues raised, along with any accompanying documentation we could access were used in the Needs Analysis of the Working Papers. Finally, the Workshops themselves constituted a special stakeholder consultation of line agencies and their input was taken into account in the prioritisation of potential MRC roles.

1.2.4 Report Outline

The Introductory Chapter 1 of this report, besides outlining the topic, defines the characteristics and dimensions of flooding in the Mekong River Basin and its natural setting.

Chapter 2, "Conceptual Issues and Findings", covers three aspects: What should be done ideally? How do the countries see the problem and what is needed to be done with it? Who is responsible for it? And: What have the different players in this field, including MRC, been doing about it so far?

This analysis leads to the conclusion on an MRC strategy that is presented as [Chapter 3](#), pp. 67ff: What should MRC do? The MRC Strategy is derived out of the needs expressed, the expectations towards the organisation, and the roles that the organisation can take according to its mandate.

The resulting Strategy is composed of different fields of intervention that are derived out of a combination of the **three strategic roles** of MRC, and **four different kinds of measures** that have to be taken according to modern understanding of floodplain management. These fields of intervention are described by focussing on the **need** as it was expressed and experienced in the member countries, and the possible **co-operators** and **clients** who are expected to use the MRC products and services.

1.3 NATURE AND DETERMINING FACTORS OF FLOODS IN THE LMB

1.3.1 The Natural Setting of the Mekong

The Mekong is one of the world's largest rivers. Its drainage area in the Lower Mekong Basin alone, where the river flows through Laos, Thailand, Cambodia and Viet Nam, is more than 600,000 sq.km. With this, the Lower Mekong Basin comprises almost the whole of the Lao PDR and Cambodia, one-third of Thailand and two-fifth of Viet Nam. In addition to this, the flow of water from the Upper Mekong Basin in China and Myanmar accounts for around 18% of the total.

Steep mountains, erosion prone slopes and dissected relief characterise the Northern Highlands area of the Basin in southern Yunnan, Myanmar, northern Thailand and northern Laos. Further South, the Mekong river then changes to an alluvial channel, flowing through and over its old alluvium, and follows a more sinuous course through Laos, northeast Thailand and Cambodia, fed by tributaries from an ever-broadening catchment.

The Korat plateau, which forms the Mekong Catchment area of northeast Thailand, has an elevation of 100 to 200 meters above MSL and is characterised by broad tributary valleys draining in an easterly direction to the Mekong. This landform complex also extends to the lower reaches of the westerly draining Mekong tributaries of central Laos. Although a poor and semi-arid rural area, the Korat plateau supports a sizeable agrarian population in both Thailand and Laos and has considerable potential for water resources development.

To the east of the Mekong River in Laos, the catchment area consists of the western slopes of the Annamite Chain, a range of mountains that rises up to 2,500 meters above MSL and forms the border between Laos and Vietnam. The area is remote and sparsely populated. Due to steeper slopes, the northern region of the Annamite catchment area has potential for hydropower development, whereas the tributary valleys of the south have potential for irrigation.

The southern Uplands forms the western area of the catchment in Cambodia, which is characterised by high rainfall and low population.

The Mekong River exits the Korat Plateau via the 35-meter Khone Falls and then flows through the Cambodian lowland and delta areas. The Mekong Plain, which includes the floodplains and wetlands of Cambodia as well as the Mekong Delta of Vietnam, is the most densely populated and productive agricultural region of the basin. At Phnom Penh, the Tonle Sap lake and river system (the Great Lake) join the Mekong, which then divides to form the Bassac River. The Mekong and Bassac Rivers then flow into South Viet Nam and drain in a south-easterly direction to enter the South China Sea via the multiple outlets of the tributary channels of the Mekong Delta.

1.3.2 Hydro – Meteorological Conditions and Flood Patterns in the Mekong River Basin

The dimensions of flooding as an important issue in the Basin can be seen in Figure 1 which presents an overlay of the flood prone areas of the river system with the population densities. Central Cambodia and the densely populated delta in Vietnam are the areas with the highest number of people affected by floods. But also in Laos, floods threaten the main population centres of the country, and the flood-prone areas close to the river in Thailand are very densely populated as well. (See Map 1, p. 4, showing flood prone areas and population densities in the LMB)

The climate of the Mekong Basin – which is the immediate cause of floods – is dictated by two distinct seasons, the Southwest Monsoon and cool, dry air masses from Northeastern directions. Most of the rainfall in the Basin is generated by the Southeast Monsoon, which delivers moisture laden air from the Indian Ocean from mid-May to September. The Northerly system, which lasts from mid-October to March, is much drier and accounts for only about 10 per cent of the total basin rainfall. The interim periods, April-May and October-November, are characterised by frequent and heavy storms. Table 2 shows details of Basin rainfalls.

Table 2: Annual Rainfall in the Mekong Basin

<i>Region</i>	<i>Annual Rainfall (mm)</i>	
Lancang River Basin	Variable.	600 mm in North, 2700 mm in South
Northern Highlands	Wet.	2000 to 2800 mm
Korat Plateau	Relatively Dry.	1000 to 1600 mm
Annamite Chain	Wet.	2000 to 3200 mm
Southern Uplands	Very Wet.	Up to 4000 mm
The Mekong Plain	Variable.	1100 to 2400 mm

Source: MRC, Appropriate Improvement of Hydrological Network, 2001

The discharge behaviour of the Mekong River, which is reliable but strongly seasonal, is characterised by wet season and dry season flows that reflect the underlying seasonality of monsoon rainfalls. At the Cambodia-Viet Nam border, the wet season runs from June to November with flood flows in the Mekong-Bassac system peaking in September-October. The dry season runs from January to May, with discharges falling to minimum values in April. Minimum and maximum flows in the Mekong can occur one to two months earlier at upstream location

The upper reaches of the Mekong (Lancang) are fed by snowmelt in summer. Because of this, the ratio of flood flow to dry season flow is significantly less than in the lower reaches. At Yunjing-Hong gauging station on the Lancang River (which has a catchment area of 13,800 km²), the average flood season discharge is 3,100 m³/s and the average dry season discharge is 870 m³/s, a wet to dry season discharge ratio of about 3.5.

In the lower reaches of the Mekong River, the wet to dry season discharge ratio can reach a value of 35 to 50. However, the Tonle Sap system, which acts as a natural reservoir and regulates discharges to downstream areas, mitigates ex-

tremes between maximum and minimum flows. During the wet season, the discharge capacity of the Mekong and Bassac Rivers south of Phnom Penh is inadequate to handle flood flows. This results in backflow up the Tonle Sap River and into the Great Lake, where water levels can rise up to nine or ten meters.

The Great Lake and the Tonle Sap River have a significant effect on flood flows and flood level in Cambodian and Vietnamese Delta. Total natural storage capacity of the Great Lake and the Tonle Sap is estimated to some 150 billion m³. Depth and reservoir area are shown in Table 3.

Table 3: Depth and Reservoir Area of the Great Lake

<i>Description</i>	<i>Dry season</i>	<i>Wet season</i>
Depth of water	1-2 m	9-10.8m
Water Surface	250,000-300,000ha	1,000,000-1,400,000ha

During the dry season, when flows in the Mekong fall, the Great Lake releases the stored water and sustains the low flow delivered to downstream areas. This regulating effect is seen in the magnitude of flood and dry season flows upstream and downstream of Phnom Penh. Flood stage, which can vary considerably along the Mekong River and Tonle Sap systems, is of relevance to the type of automatic water level monitors installed at gauging stations along these systems. Upstream of the Mekong Plain, water levels can rise up to 20 meters during annual floods. In the Great Lake, the water levels rise nine to ten meters, while at the Cambodian-Vietnam border, the rise of the water level during the annual flood only amounts to five meters.

The flood patterns of Thailand, Laos, Cambodia and Viet Nam are very different with respect to causes, sources of flooding and effects, rising speed, time and duration of flooding, frequency and extension of the inundated area. There are furthermore local variations within each country, mainly due to differences in natural conditions, man-made structural measures and other human activities.

Laos suffers from floods nearly every year. Floods generally occur as a result of a combination of high rainfall due to typhoons and the occurrence of the southwest monsoon. The combined effects of the resulting large flows from tributaries and, at the same time, the main river, cause serious damage. A feature of floods in Laos is that they are very much influenced by tributary flows. According to MRC estimates, 80% of the rural flooding and 20% of the urban flooding is caused by tributaries. Consequently, the four major flood prone areas are situated along the main stream near large tributaries: (i) Vientiane Plain, (ii) Khammoune Province (Thakhek town), (iii) Savannakhet Province and (iv) Champasak Province (Pakse town).

In the Mekong Basin part of Thailand, flooding results from tropical disturbances, typhoons, or a combination of the two. The heavy rainfall on the Lao side swells the Mekong River, which at places bursts its banks or, by backwater effects, creates severe flood conditions in the basins of tributaries. Urban areas along the Mekong River are regularly flooded. During the last couple of years, dikes have been constructed along the Thai side of the Mekong River around urban areas, as a flood protection to these areas. The material losses in the tributary basins in Thailand

due to flooding are often severe. In recent years, three high floods in the Mekong Basin have affected Thailand, with widespread inundation of productive lands and settlements that caused remarkable damage and suffering for people.

In Cambodia the Mekong enters into the low part of the delta and becomes a slow flowing river with a major bifurcation. The area is very flat, and flooding is generally related to the main river system. When flooding occurs, it often covers large areas of Cambodia. The dynamic river junction at Phnom Penh, where the Mekong bifurcates in the Bassac and the Lower Mekong and where the Tonle Sap River starts, is also an indication of the flatness of the land and of the complexity of the river system. Flooding is not only attributable to the Mekong, but also partly to backwater effects from the Tonle Sap River and Lake system. Each year up to 4 million ha of lowland areas are inundated. In some areas along the river, regulating structures have been built on tributaries, allowing farmers for a short period of time to control inflow from the raising rivers to the low land areas.

In Viet Nam the Mekong River forms a highly fertile and productive delta, which is heavily influenced by tidal effects from the South China Sea, high discharge from the Mekong River coming from upstream Cambodia, and heavy rain in the delta itself that comes with the monsoon and typhoons originating over the South China Sea. Flooding in the delta often results in an almost complete inundation of the flood plain. Up to a certain flood level, people living in the area have come to get adapted to the situation. Viet Nam has considerable experience in regulating structures which allow for longer agricultural use during the year. Although these structures hold back the flood waters in some areas during the early floods, the high floods still cause enormous damage.

1.3.3 Factors Affecting Flood Discharges and Flood Levels

In general, one can say that floods in the Mekong Basin are caused by prolonged, heavy rains on saturated soils. This leads to an increase in surface run-off that can only slowly be discharged through the river system into the South China Sea, especially if coinciding with high tides such as in the year 2000. If the combination of these factors is further aggravated by the flooding effects of local rains and typhoon-induced surges of water into the Delta, the resulting overflow over the riverbanks may last for several weeks.

It is clear that a number of factors beyond these hydro-meteorological aspects contribute to the dynamics of flood events in the Basin. Contributing factors also include eventual global climatic changes such as the global warming effect, and the El Niño/La Niña phenomena of recent years.

And there are a number of man-made interventions that positively, but more often negatively affect the natural flood patterns. The expansion and growth of urban, industrial, and agricultural areas along the Mekong River are definitely factors putting stress on the river system. A variety of structural measures are commonly used to protect these areas and to reduce flood discharges and flood levels. However, structural flood measures have to be seen as a double-edged sword – whilst they might reduce flood discharges and flood levels at locations of interest, they also increase flood levels (and possibly discharges) at other locations.

In general, flood discharges and the associated flood levels can be influenced in three ways: by reducing - or increasing - the volume of flood runoff, by providing extra – or eliminating existing – storage capacities, and by constructing flood diversion channels.

Land Cover as a Determinant to Flood Runoff Volumes

Vegetation slows down the infiltration process of water in the soils and reduces soil moisture levels by evapotranspiration. By clearing land these natural mechanisms lose their function and the soil water levels rise. This effect is most pronounced when forests are cleared. Not only does land clearing increase the volume of runoff, it increases the rate or speed of runoff, which also increases peak discharges and peak water levels.

These impacts on downstream locations are most pronounced for small and medium sized floods. In relative terms, it is much less for major floods – which are generally associated with such an excess of rainfall that the initial value of soil moisture at the start of the storm is largely irrelevant.

The effects of land clearing are likely to be of much more significance immediately downstream of the cleared areas, ie for tributary flooding rather than for mainstream flooding along the Mekong River. This is because the further the flood moves downstream – both along the tributary and the Mekong itself - the greater the volume of floodplain storage the flood wave moves through and the greater the associated reduction in peak discharges. This effect could already be observed in the recorded river stages at Pakse and Vientiane which have shown a significantly faster and more sensitive reaction to rains in the surrounding sub-catchments in recent years. This is most likely to be attributed to changes in the physical characteristics of these catchments.

But there are also aspects related to land clearing that accumulate and influence flood hazards at a regional scale. Soil erosion from the denuded hills leads to a sediment deposit in the main river channels. This can dramatically reduce the drainage capacity of the river.

While the land clearing that increases such flood risks has been going on in the Basin at sometimes alarming rates, there is also a certain potential to reduce flood volumes and associated peak flood discharges and peak flood levels by reforestation of cleared areas.

Change in Flood Storage

Any increase in flood storage delays or retards the flood wave as it moves downstream and reduces peak discharges and peak flood levels at downstream locations. Conversely, any loss of flood storage speeds up the flood wave as it moves downstream and increases peak flood discharges and peak flood levels at downstream locations.

Flood embankments are a simple structural flood measure aimed at keeping floodwaters out of protected areas. Prior to the construction of these embankments, floodwaters would have spread over and inundated the protected area. Thus, any use of flood embankments has an associated loss of floodplain storage and causes the flood waters to flow downstream without the mitigating effects of

that storage. Whilst the impact of one embankment may not be that great, the cumulative effects of many embankments can result in the loss of a significant volume of floodplain storage, with a consequent increase discharges and flood levels at both upstream and downstream locations. The increase in flood discharges and flood levels is generally most pronounced for small and medium floods. If a major flood overtops the flood embankments, the floodwaters again 'experience' the mitigating effects of the 'lost' floodplain storage.

Another common way in which floodplain storage is lost is by '**Infilling**' of low areas for other land-uses, such as agriculture. Typically lake and swamp areas are 'reclaimed' in this fashion. While the reclaiming of a small area of the floodplain may not be of that much consequence, the cumulative effects of all infilling can result in a significant loss of floodplain storage.

A direct way of increasing flood storage is to construct a **flood mitigation dam** (or a multi-purpose dam that is used for flood mitigation purposes). Whilst such dams can have a major mitigating effect on small to medium sized floods, the effectiveness in reducing the peak flood discharges associated with major floods is generally much less – the available flood storage in a dam is generally much less than the volume of the flood wave of a major flood. To achieve maximum effectiveness, a dam has to be operated to maximise the available flood storage or 'air space' before the incoming flood peak arrives. This requires a timely and accurate forecasting system of incoming flood flows. If incoming flood flows are not well forecast, it may be necessary to make emergency releases from the dam. This may increase flood flows in the river reaches immediately downstream of the dam.

Another way of increasing flood storage is to develop '**retarding basins**' to provide temporary storage of the floodwaters as they move downstream. For major tributaries and river systems, it is generally not possible to develop 'new' flood storage areas of sufficient capacity to significantly reduce major flood peaks. Rather, the question is one of preserving enough of the natural flood storage areas of the floodplain – which are increasingly subject to development pressures - to ensure they continue to function and alleviate downstream flood discharges.

Flood Diversion Channels

A flood diversion channel acts to divert floodwaters away from significant hazard and damage areas into locations of lesser hazard and damage. In this way, downstream flood discharges and flood levels are reduced. To be effective for major floods, flood diversion channels often have to be very large (and expensive). Their feasibility must be studied very well. The benefits may not outweigh the high capital and yearly maintenance costs, including the costs to the environment.

1.3.4 Classification of Flood Issues

With respect to the MRC realm, it is useful to distinguish **local, national, regional,** and **trans-boundary** flood issues. In order to make such a distinction, "issues" in this respect include a look at the **causes** and determining factors of floods, where the **impacts** are felt, and how all of these are to be dealt with most efficiently by different **floodplain management measures**.

Floods are much more influenced by river basin boundaries and regional weather systems than they are by national or political boundaries. Hence, it is misleading to view floods only as a national problem, especially in an international river basin. It is true that local intense rain of modest duration from a convective weather system over the Mekong basin can cause highly localised flooding in a sub-basin of one country with few effects in sub-basins in other countries. However, intense rain of long duration from a large monsoonal weather system may produce enough rain over a large number of sub-basins to create flooding in more than one country. Furthermore, if the monsoonal system produces rain over upper sub-basins, the resulting flood wave will travel downstream and possibly cause flooding in countries that were not immediately affected by the monsoonal weather system. Similarly, major dams in upstream countries delay and to some extent reduce the peak discharge of the flood wave as the flood passes through the dam, perhaps reducing peak discharges and flooding in downstream countries. Such dams also have the capability to increase dry season discharges and so provide more water for beneficial use.

The range of issues that may be considered in this framework includes the management implications of naturally occurring flooding, as well as human effects on flooding, for example through the construction of structural flood management measures such as dams, flood protection embankments, major road embankments and bridges. Other issues that need to be addressed from within this framework include non-structural measures, such as flood monitoring and forecasting, floodplain zoning, flood mapping, disaster warning and response, and public education. Moreover, for both structural and non-structural issues, there are planning and implementation components as well. Finally, each flood provides a lesson, including the cause, duration, and effect of floods, and how communities, nations and regions should react and respond.

The **classification** of local, national, regional, and trans-boundary flood issues is not simple. Some countries may undertake for themselves a particular institutional responsibility that other countries may suggest be institutionalised in bi-lateral or multi-lateral organisations, such as the MRC. The construction of a dam may affect flooding of countries downstream, whereas the construction of a major road or other discharge-retarding structure in a flat floodplain area - where river velocities are slow - may cause backwater effects and increase the intensity and duration of floods in upstream areas. In addition, some inherently national activities, such as community-based response to flooding, may also be considered as a trans-boundary issue if there is benefit to countries adopting common approaches to response. These differing points of view influence greatly policy elements to be included in the MRC Flood Management and Mitigation Strategy.

The following distinction is intended to be illustrative rather than definitive. What is important is that each flood-related issue be examined to understand the implications of a country addressing this issue by itself, addressing the issue in cooperation with a neighboring country(ies), or addressing the issue in cooperation with the MRC and other international organisations.

Local Flood Issues

Local Impacts are experienced in close proximity to the factor causing the impact. Such impacts are local or national in 'nature' – they are limited to the particular

country in which the causative factor is located and do not spill over into neighbouring countries.

All of the factors described above have local impacts – they affect peak flood discharges and peak flood levels locally. The impact is generally greatest close to the causative factor and then dissipates as one moves both upstream and downstream away from the causative factor.

Local floodplain management measures focus on appropriate land-use planning, raising flood awareness of the communities in flood prone areas, delivering flood warnings to the areas that are likely to be affected, as well as managing the emergency efforts in the aftermath of a flood event in the field.

National Flood Issues

Local flood impacts have to be dealt with at the local, or – if the capacities to handle major impacts are not sufficient and floods are affecting larger national areas at the national level. In general, national floodplain management issues are those that are inherently a national responsibility. These include weather and river monitoring, flood forecasting for tributaries of the Mekong, flood emergency response and recovery activities, including community-based response activities - such as delivery of relief, flood inundation mapping at the local level and the rehabilitation of housing, schools, hospitals, and other buildings - and floodplain zoning. These issues can be addressed independently, on a country by country basis. Pilot projects however will be considered for capacity building and for identifying effective mechanisms to be used in other parts of the Basin, if they fit into the overall objective setting of the FMM strategy.

Regional Flood Issues

Regional flood issues are those common issues that are inherently regional in extent, ie common issues that occur in more than one of the riparian countries. Regional issues can be addressed independently by each country at the national level, but they can also be considered on a common basis at the regional level. For example, regional flood mapping done to a regional scale and using common techniques is highly useful to major donors and relief agencies as they decide how best to deploy their resources in a flood emergency, where additional resources are needed, and so forth. Similarly, if common weather- and river-monitoring techniques are adopted by all the riparian countries, the cause, extent, and duration of weather systems and flooding in one country can be better understood, when viewed from the regional perspective. Cooperation on weather and river monitoring enables regional organisations, such as the MRC, to forecast river flow and floods over the entire main stem of the river system.

Trans-Boundary Issues

Trans-Boundary Impacts are those that are not only experienced in the country where the causative factor is located. They are also felt across the boundary of a neighbouring country and possibly in other countries further away.

Some trans-boundary issues are non-structural by nature, such as land clearing in one country affecting the frequency, extent, and duration of floods in downstream countries. Others trans-boundary issues are structural in nature, such as major dams that are used for out-of-basin transfers of water, dams that are used to max-

imise the generation of electric power with little regard for flood control, and flood protection embankments that protect one area, yet induce more severe flooding and erosion in other areas, both within a country and in neighbouring countries. There are trans-boundary water-quality implications of floods because water-quality pollutants, such as agricultural pesticides, become attached to the fine sediment particles mobilised by floods, which may carry them across national boundaries.

All factors described above as influencing flood pattern and magnitude also have the potential to create trans-boundary impacts. The closer the causative factor is to an international boundary, the more likely it is that the local impacts will spill over into the neighbouring country. The following observations on trans-boundary impacts are made:

- **Local impacts** will generally be **greater** than trans-boundary impacts.
- **Land clearing** increases runoff volumes. This can have trans-boundary effects in downstream countries, ie it can increase flood discharges and flood levels. However, the more remote the downstream boundary is from the areas of land clearing, the lesser the trans-boundary impact is likely to be.
- The construction of **flood embankments** – and the associated loss of floodplain storage – increases local peak flood discharges and water levels, both upstream and downstream of the embankment. If the flood embankments are close to an international boundary and have significant local impacts, this can result in trans-boundary impacts.
- **Clearing or deepening the river** (e.g. to improve navigation), changing its flow direction, or accelerating the flow velocity may contribute to increased flooding downstream.
- The construction of **flood mitigation dams** can have beneficial trans-boundary impacts, ie the dams can reduce peak discharges and flood levels in downstream countries. Again, the more remote the international boundary is to the dam, the lesser the beneficial impacts.

All these flood issues with ‘spill over’ effects, whereby an action or activity undertaken in one country affects flood behaviour or flood hazard in another country, need to be addressed through trans-boundary dialogue and cooperation.

1.3.5 Appropriate Consideration of all Flood Issues

One of the challenges of flood and floodplain management in the Mekong River Basin is to understand that there are positive and negative effects of flooding and to strike a balance between these two. It needs to be realised that there can be both positive and negative effects associated with national, regional and trans-boundary flood issues. These positive and negative effects need to be determined and addressed in both the national and regional flood and floodplain management processes.

Positive Effects

Flooding in the Mekong River is part of the rhythm of the life and economy of the peoples of the basin. Especially in the downstream countries, floods annually introduce fine sediments and nutrients that renew the fertility of the land and aquatic habitats. In a region where the overwhelming majority of the people dedicate their lives to agriculture and fishing, loss of the beneficial effects of flooding has the potential to lead to unacceptable levels of economic and social disruption.

Negative Effects

The negative effects of flooding in the Mekong basin are well known, with loss of life and damage to public and private property being the principal adverse effects. However, floods can also have negative effects on water quality, aquatic habitats, navigation, tourism, water supply, and wildlife protection. Many of these effects are not well understood at present. The negative effects of flooding are likely to increase as more and more people inhabit historical floodplains and human-induced changes in land-use and flood behaviour change the frequency of occurrence, intensity and nature of Mekong River floods.

Conclusions on Dealing with Mekong Floods

Solutions to problems in flood and floodplain management need to be viewed in the context of whether flood effects are positive or negative, and whether the effects are national, regional or trans-boundary in scope.

National issues should be addressed nationally through the mandate of a national strategy for flood and floodplain management and mitigation. It is important to remember that floods of the magnitude experienced in the Mekong cannot be managed, though a mix of management and mitigation measures can lessen many of the negative effects listed above. If the flood effects are regional or trans-boundary, solutions have to be found in cooperation with neighbouring countries. This can be done bilaterally or it can be facilitated by the MRC or other international organisations. Regional cooperation and dialogue on flood issues provide an opportunity to minimise loss of life and damage to property across the basin.

It is in particular regional and trans-boundary issues that can be addressed by a regional strategy for flood and flood management and mitigation that is being developed by the MRC. The particular capacity and mandate of the organisation determine how MRC can most effectively contribute to floodplain management in the Mekong Basin.

2 CONCEPTUAL ISSUES AND FINDINGS

2.1 *THE FLOODPLAIN MANAGEMENT PROCESS*

The following section gives an overview over the concept of 'floodplain management' as a process and describes the measures that are included in this approach. In order avoid confusion, a few key terms that are frequently used in this respect need to be clarified:

- **Flood Control** is a common expression which is not used in this report. One cannot control floods, at best one can manage their detrimental effects. The word flood control is therefore not used in this report.
- **Flood Mitigation** refers to reducing the magnitude of flood discharges and flood levels at a specified location by dams, retarding basins or diversion channels.
- **Flood Management** refers to all the actions society can take on a basin-wide basis to reduce the hazard and suffering caused by floods. Flood mitigation is included under flood management.
- **Floodplain Management** refers to all the actions society can take to responsibly, sustainably, and equitably manage the areas where floods occur and which serve to meet many different social, economic, natural resource and ecological needs. Since this includes to reduce the hazard and suffering caused by floods, Floodplain and Flood Management consist of many common activities. However, Floodplain Management recognises explicitly that other factors of a social, economic, natural resource management and ecological nature also have to be taken into account in 'managing' floods.

For the purposes of this report the floodplain is defined as that area subject to flooding by the most severe flood possible (the Probable Maximum Flood). By this definition, everyone and everything on the flood plain is exposed to flood risk and the associated flood hazard.

Both flood risk and flood hazard vary across the floodplain. Flood risk depends upon the frequency of flooding. Flood hazard depends upon the depth, velocity, rate of rise and other characteristics of the floodwaters, together with the presence or absence of possible evacuation routes. Small floods are relatively high-risk low-hazard events, ie the likelihood of occurrence is high, but the risk to life and limb and damage to property is relatively low. Large (severe) floods are low-risk high-hazard events, ie they occur infrequently, but cause great damage and the hazard to life and limb is high.

2.1.1 **Integrated Floodplain Management as a Process**

Floodplain management is to be considered as a **process** that provides a framework for identifying and assessing various ways of reducing the impact of flooding

on flood-prone communities and individuals. This is done within a larger framework that also considers the social, economic, natural resource management and ecological needs and uses of the floodplain. Floodplain management decision-making involves compromise or striking a balance between the costs and benefits of various activities on the floodplain.

Floodplain management recognises that we cannot eliminate flood risk and flood hazard – they are a given for everyone living on or using the floodplain. If we are to continue to live on the floodplain – and these are among the most fertile and heavily populated areas of the planet - we must learn to **‘Live with Floods’**, or to reduce flood risk and flood hazard to acceptable levels within social, economic, natural resource management and ecological constraints.

Four major groups of management measures¹ to reduce flood risk and flood hazard across the floodplain can be distinguished:

- **Land-use Planning Measures** are aimed at *‘keeping people away from the floodwaters’*. Land-use measures on the floodplain aim to ensure that the vulnerability of a particular land-use activity is consistent with the flood hazard on that area of land, ie the objective is to keep people and vulnerable activities out of the most hazardous areas of the floodplain.
- **Structural Measures** are aimed at *‘keeping floodwaters away from the people’*. Typical structural measures include flood mitigation dams, embankments and flood detention basins. Development and Building Controls can be seen as a particular kind of structural measures for urban and settlement areas, aimed at reducing flood damage to buildings. Typical building controls include minimum floor levels to eliminate nuisance flooding, and the use of building materials and building designs that enable rapid and effective cleanup after a flood.
- **Flood Preparedness Measures** recognise that - no matter how effective the above types of management measures are - an overwhelming flood will always occur. They aim at *‘getting people ready for floods before they come’*. In a number of cases, Flood Preparedness and Emergency Measures may be the only type of management that is feasible or economically justified. Flood preparedness measures embody flood forecasting, flood warning, and raising the general flood awareness of the potentially affected population groups.
- **Flood Emergency Measures** deal with the aftermath of such an event by *‘helping affected people to cope with floods’*. Flood Emergency Management, like Floodplain Management, is a process that typically encompasses preparation, response, and recovery. In addition to flood prepar-

¹ The present report on an MRC Strategy does not follow other classifications, such as distinguishing between "structural" and "non-structural measures", or listing "Development and Building Controls" as a separate kind of measures, while including "Flood Preparedness" into the category "Flood Emergency Management Measures". This is, because for the dimensions of the problem in the region, one has to differentiate very different kinds of "non-structural measures" that have different actors, responsibilities, and impacts. Similarly, for the MRC discussion, Flood Preparedness is a totally separate category in which MRC is playing a central role. Throughout the MRC Strategy, the four categories of flood management and mitigation measures presented here are consistently applied and discussed, with regard to their requirements, dimensions, and responsibilities.

edness, the flood emergency management process embodies evacuation planning and training, emergency accommodation planning, flood clean-up planning and the restitution of essential services, and social and financial recovery measures.

Integrated Floodplain Management involves an integrated and coordinated mix of the above four types of management measures that reflects:

- The flooding, flood risk and flood hazard characteristics of the particular floodplain;
- The specific social and economic needs of the flood-prone communities; and
- Environmental and resource management policies for the floodplain.

2.1.2 Floodplain Management Measures

2.1.2.1 Land-use Planning Measures

Description

Land-use planning measures are the most cost-effective means of reducing the costs and hazards of flooding. Land-use planning centres on matching up the vulnerability of a particular land-use at a given location on the floodplain with the flood hazard at that location. Thus, if an area of the floodplain is characterised by deep and swiftly flowing floodwaters, it is much more sensible to use it for agricultural purposes or as an open recreation area, than to build a hospital there. A hazard map of the floodplain is essential to effective land-use planning. Hazard maps are generally prepared in the 'Flood Study' phase of a floodplain management investigation (see above).

As part of the land-use planning process, it is necessary to document existing land-use and to assess likely future land-use, which depends on community wants and needs and government policies (agricultural, environmental, urban and industrial development, fisheries, forestry, natural resource management, etc). Future land-use will determine the future vulnerability of the area to flooding.

In addition to flood embankments, a number of other land-use developments can significantly affect flood behaviour, eg road and railway embankments, bridges, irrigation canals, river port developments, filling of areas for urban or industrial development, etc.

In undertaking a floodplain management investigation, it is important to liaise with all infrastructure agencies (stakeholders) having existing or proposed future infrastructure on the floodplain. The impact of existing infrastructure on flood behaviour needs to be investigated, as does the effect of proposed future infrastructure. Infilling of the floodplain for agricultural, urban or other purposes results in a loss of floodplain storage, which in turn increases flood levels and discharges. The effect

on flood behaviour of proposed future infilling of the floodplain – as defined in the land-use plan – needs to be investigated. Again, these investigations are generally done as part of the 'Flood Study' (see above).

It is important that the impacts of land-use developments on flood behaviour are assessed 'cumulatively'. Any one development assessed individually may not have a significant effect on flood behaviour. However, if all developments are assessed together (cumulatively), the effect on flood levels and discharges could be quite significant.

Land-use in other areas of the catchment can also affect flood behaviour across the floodplain. For example, both logging and slash and burn cultivation remove vegetative cover and increase both the volume and the rate of runoff into the river system, which in turn tends to worsen flooding in downstream areas. In relative terms, the increase in flood discharge is greatest for small to moderate floods, ie minor flood events tend to occur more frequently. The relative increase for large floods that is attributable to land cover in the upper catchments is significantly less.

Land-use Planning Issues

Issues that need to be addressed in the fields of land-use planning include:

- Is there a single agency that can oversee an effective land-use planning process and formulate and implement an enforceable land-use development plan for the floodplain that addresses flooding, social, economic, natural resource management and ecological issues in an effective and technically competent way?
- Are all stakeholders – at the State, Provincial District, Commune and Village level – included in this planning process?
- Have all of the land-use developments that can affect flood behaviour been identified and investigated? Has the investigation been done on the basis of the cumulative effects of all developments?

2.1.2.2 Structural Management Measures

Description

Structural management measures act to either mitigate (reduce) flood discharges (flood mitigation dams and detention basins), to keep floodwaters away from property (flood embankments) or to divert floodwaters away from vulnerable areas (diversion channels).

Development and building control measures can be considered as a special kind of structural measures that recognise that overwhelming floods will occur and inundate buildings on the floodplain. Consequently, they aim to minimise flood damage to the buildings and to minimise the detrimental effects of buildings and associated infrastructure on flood behaviour.

Flood Mitigation Dams

Both Thailand, Lao PDR and Viet Nam have large hydro-electric and water conservation dams on major tributaries of the Mekong (Pak Mun and other reservoirs in Thailand, Nam Ngum Reservoir in Lao PDR, and Se San Reservoir in Viet Nam). China has two large hydroelectric dams across the Mekong itself, is currently constructing a third, and apparently has plans for additional reservoirs.

Flood mitigation dams reduce peak flood discharges by holding some of the floodwaters in temporary storage as the flood wave passes through the reservoir. The larger the 'airspace' that can be made available in the reservoir, the greater the reduction in peak flood discharge. The effectiveness of dams in reducing peak flood discharges depends upon the relative size of the airspace that can be made available in the dam and the volume and 'peakiness' of the flood.

All major reservoirs, often multipurpose, have operating rules that try to balance benefits of the reservoir for flood control, hydropower generation, public and agricultural water supply and other purposes. To maximise the benefits of flood mitigation dams, it is important that the size and nature of flood events can be reliably forecast. If this is not the case – and a flood is bigger and rises more quickly than expected – emergency releases may have to be made from the dam. Such emergency releases may imperil both national and trans-boundary communities living downstream of the dam.

Un-notified releases from the dams in China result in sudden increases in water level in the upper Mekong in Lao PDR. In the past, unexpected emergency releases from major dams in upstream countries have resulted in flood damage and even deaths in national and trans-boundary communities.

Flood Retarding Basins

A flood retarding basin acts in the same way as a flood mitigation dam – the temporary storage of floodwaters diverted into the basin during a flood causes a reduction in downstream flood discharges.

Tonle Sap Lake acts as a major and very effective flood detention basin. During a typical flood, water levels in the lake rise by 10 m and the surface area of the lake increases largely. The effect of this temporary storage is to significantly reduce peak flood discharges: the year 2000 maximum peak flood discharge upstream of the lake (at Kampong Cham) was 45,000 m³/sec; but at the same time, the maximum peak flood discharge downstream of the lake (combination of Koh Khel and Neak Leoung) was only 37,000 m³/sec.

Flood Embankments

Flood embankments act by preventing floodwaters from reaching the protected areas. Flood embankments are used widely along the Mekong and throughout its delta by the four MRC member countries to provide flood protection to agricultural land and communities. Although simple in concept, there are several potential drawbacks with flood embankments.

- First, flood embankments increase flood levels around the protected area. The constriction to flood flows caused by the embankments and the loss

of floodplain storage in the protected area act to increase flood levels and tend to increase flood discharges (ie in the opposite way to a flood mitigation dam).

- Second, total protection can only be achieved if the embankments are properly engineered and designed for the Probable Maximum Flood. This is rarely the case anywhere in the world and is certainly not the case in the Mekong basin. Thus, all flood embankments will ultimately be overtopped or undermined, leading to potentially catastrophic flooding of the protected areas – it is not a case of ‘if’ but of ‘when’. The unpreparedness of protected communities to deal with this event markedly increases potential hazard and damage.
- Finally, there are well known environmental benefits of flooding – recharging the water table, distributing fertile silt across the floodplain and providing triggers and vectors for wildlife movement and breeding, especially fish. The loss of flood storage in protected areas disrupts these processes. One way to reduce these detrimental effects is to design the embankment system to allow ‘controlled flooding’ of protected agricultural areas. In these circumstances, the embankments offer protection against smaller floods but are overtopped in a controlled fashion by larger floods allowing silt deposition to occur and fish access to the protected areas. Many of the flood embankments in the Mekong Delta in Viet Nam are designed along these principles.

Diversion Channels

Diversion channels act by diverting floodwaters away from one location and delivering them to another location where they cause less harm. Diversion channels reduce discharges and water levels in downstream areas of the original system. In a study undertaken by the Korean International Cooperation Agency for MRC, the following works have been identified as possible diversion channel options: (1) a channel from Takeo to Kep (Bassac-Gulf of Thailand), (2) a diversion channel from Mekong to Tonle Sap lake, (3) the Tan Than - Lo Gach channel in the East Mekong area, (4) a channel from Sarai to Than Hung in the Plain of Reeds of Vietnam, and (5) a combination of the diversion channel options.

Development Controls

Certain areas of the floodplain act as ‘floodways’ or preferred flow paths for flood waters. Floodways deliver, transport and remove much of the flow of floodwaters onto, across and off the floodplain. Floodways are typically identified in the Flood Study component of a floodplain investigation. The construction of buildings, roads or other infrastructure in or across a floodway will interfere with the flow of floodwaters and is likely to increase flood levels at some locations.

Development controls aim at siting buildings and infrastructure in those areas of the floodplain where their interference with flood behaviour is minimal. To be effective, it is essential that development controls are incorporated in the land-use plan.

Building Controls

There are two common types of building controls that are aimed at minimizing flood damage to buildings and facilitating their cleanup and reoccupation in the aftermath of a flood: minimum floor levels and 'flood proofing'.

- Minimum floor levels are set to eliminate frequent nuisance flooding and reduce the risk of over-floor flooding to an acceptable level. This is especially important for key flood emergency buildings, such as police stations, hospitals, telephone exchanges, electricity sub-stations, water supply and sewerage treatment works and evacuation buildings (such as schools).
- Flood proofing refers to the use of building materials and methods of construction that are resilient to floodwaters and are easy to clean after a flood. Such building methods include the use of bricks and tiles for floors and walls and the lifting of power outlets as high as possible.

There is considerable opportunity to reduce flood damage to public infrastructure by adopting 'flood resilient' designs. For example, the electric motors of water supply and sewerage pumping stations and treatment works can be designed to be readily uncoupled and transported to flood free locations during the onset of a flood. This facilitates the return of these services after the flood has subsided.

Structural Management Issues

In assessing the appropriateness of structural management measures for an integrated floodplain management plan, the following issues need to be addressed:

- Have the social, economic and environmental costs and benefits of the proposed structural measures been objectively assessed and are the costs justified? In other words, is there an appropriate planning process that addresses social, economic and environmental issues?
- All structural management measures are two-edged swords – they reduce flood levels and discharges at key locations, but they increase flood levels and discharges at other locations. Have the hydrologic and hydraulic consequences of the proposed measures been investigated in full? Are the adverse consequences acceptable? Does the increase in discharge and flood level at other locations restrict future land-use opportunities there?
- Regarding flood mitigation dams, is there an appropriate 'flood operation' system in place? Are incoming floods forecast accurately enough to permit effective flood operation? Is there a reliable warning system in place to alert downstream communities of emergency releases from the dam? Or are the upstream countries informed when gates and sluices, which control the inflow of river water to the adjacent fields, are being closed?
- Regarding flood embankments, is there an appropriate preparedness plan in place to train and sustain residents living in protected areas with the knowledge of what to do to minimise personal hazard and damage to

their possessions when the embankments are overtopped? Is there an appropriate flood forecasting and flood warning service in place to warn residents of impending embankment overtopping?

- Has a Flood Study of the floodplain been undertaken to identify floodways and especially hazardous areas? Have appropriate development controls (zones) been incorporated in the land-use plan that recognise the importance and hazard of these areas and protect their hydraulic function?
- Have minimum floor levels for buildings been defined? Is this information available to the general public? Are minimum floor levels being adopted in new buildings as intended, especially for key public buildings?
- Are guidelines on the 'flood proofing' of buildings available to the general public and public agencies? Are private, and more importantly, new public building constructed according to flood proofing principles?
- Are 'flood resilience' guidelines available for the design and construction of public infrastructure? Are these guidelines being implemented in new and upgraded infrastructure?

2.1.2.3 Flood Preparedness Measures

Description

It is necessary to recognise the probabilistic nature of floods – a bigger flood that overwhelms other management measures in place can always occur. The likelihood of occurrence of such a flood may be small, but the flood will certainly occur – it is not a matter of 'if' but of 'when' and whether flood-prone communities can successfully manage the onset, occurrence and aftermath of such a flood. Preparedness Measures are therefore required to assist the flood-prone community dealing with such a situation.

Three basic measures of Flood Preparedness are to be distinguished: Flood Forecasting, Flood warning and Flood Awareness. The success or otherwise of flood emergency management will be judged solely by the real-life flood experience of flood-prone individuals and communities. It is pointless having the best flood forecasting system that money can buy if flood warnings cannot be effectively delivered to flood-prone communities. Similarly, the benefits of flood warning are largely lost if flood-prone individuals do not know how to effectively respond to flood warnings (flood awareness).

Flood Forecasting

Flood forecasting or flood prediction aims to estimate the size, timing, and extent of a flood before it actually occurs. Flood forecasts of downstream discharges and flood levels are typically based on rainfalls and water levels measured in upstream catchment areas, soil moisture and other conditions in the catchments and on forecast rainfalls over the catchment. The reliability and lead-time of forecasts depends largely on the size of the catchment, the larger the catchment the better and longer forecasts can be. Thus, for the mainstream of the Mekong, it is possible to

provide good forecasts up to 5 days ahead. For the tributaries of the Mekong – which respond much more quickly than the mainstream – it may only be possible to provide forecasts up to several hours in advance. It is impossible to effectively forecast flash floods unless rainfall can be reliably forecast before it occurs. All flood forecasts contain uncertainties and errors. It can be misleading to accept forecasts as ‘totally accurate’, especially if forecast water levels are close to some critical level. The question should always be asked - ‘What are consequences if the forecast is wrong?’ In other words, how sensitive is the resulting hazard to the accuracy of the forecast. A situation where there is a marked change in hazard depending on the accuracy of the forecast will require a different response to a situation where hazard is insensitive to the accuracy of the forecast.

Flood Warning

Flood warning aims to alert flood-prone communities of an impending flood. In the four MRC member countries, a hierarchical series of agencies are typically involved in the warning process. Forecasts and the associated warnings are typically generated by a central (State) agency, that then delivers the warnings to a provincial agency, that in turn delivers the warnings to a district agency, that in turn delivers the warnings to villages. There is the potential for considerable delay in this warning process. The delivery of warnings can be made much quicker by using radio and television. Typically, such warnings can be only general in nature. The most effective warning systems use both channels – mass media and agencies.

Flood Awareness

Even if a warning is reliable and timely, its benefits will be diminished if the population at risk does not know how to respond effectively to reduce personal hazard and damage to their goods and possessions, ie if the flood awareness level of the flood-prone population is low. Training programmes at the village level are required to increase and sustain flood awareness so that villagers obtain the best value from flood forecasts and warnings.

Flood Preparedness Issues

- How effective is the current flood forecasting system - is it adequately accurate, reliable and timely? How can it be improved? Are additional forecast points needed?
- Do agencies or communities conduct a post-flood assessment and map the communities that flood as a result of a flood of a particular intensity?
- How effective is the current flood warning system – are warnings accurate, timely, believable and believed? Are the mass media being used effectively to disseminate warnings? Is there good integration between flood forecasting and flood warning activities? Is there good and effective integration between the warning activities of the various agencies (State, Provincial, District, Commune and Village) involved in the flood warning process?

- How prepared are flood-prone communities to deal with a flood emergency, ie what is the level of flood awareness? Are training programmes in flood awareness and preparedness available for delivery to villagers? How often are such programmes delivered?

2.1.2.4 Flood Emergency Management Measures

Description

Flood emergency management measures are aimed at managing and minimising the damaging effects of 'overwhelming' floods. Such measures can be divided into two categories: Response Measures to reduce flood hazard during the occurrence of a flood, and Recovery Measures to assist the flood-prone community rebuild social and financial ties after the flood is over.

Flood emergency management – like floodplain management – is a process, and if flood emergency management is to be successful and effective, preparedness, response and recovery measures must be integrated and coordinated.

Response Measures

Given that a flood is occurring, there are a variety of response measures that authorities and individuals can undertake to reduce flood hazard and damage. These include temporary protection measures, safety audits of flood protection structures, evacuation of the population at risk, provision of temporary accommodation and relief for evacuees, disaster reporting, etc.

Good planning in non-flood times (preparation) is essential if responses measures are to achieve their full potential. During an actual flood event, there is considerable confusion, and uncertainty, because communications may be disrupted, etc. It is unrealistic to expect effective response measures to be organised 'on the spot'. It is far more effective to concentrate on implementing contingency plans designed and prepared in non-flood times. Such plans identify the activities required to be undertaken, identify the necessary human and material resources, assign roles and responsibilities for these activities, describe communication and liaison systems with disaster management agencies, etc.

The most important factor in effective flood response is 'preparation'. This preparation needs to be integrated and coordinated at all institutional levels (State, Provincial, District and Village). The most effective way of 'preparing' is through the formulation of contingency plans. Note that contingency plans should include a section on training aimed at facilitating implementation during a flood emergency.

The use of 'Flood Maps' showing the likely maximum extent of flooding associated with an incipient flood event and the variation of flood hazard across the flooded area (ideally) obviously facilitate the design and implementation of effective flood response measures.

Temporary Protection Measures. In general, a number of temporary protection measures can be taken to minimise damage to public infrastructure and to the community as a whole. It may be possible to protect critical public infrastructure,

such as telephone exchanges and hospitals, with sandbags. It may be possible to reduce the damage to water supply pumping stations by removing electric motors, etc. Depending on the forecast size of the flood, it may be practical to increase the height of embankments with sandbags. The nature and effort devoted to temporary protection of public and private infrastructure will (or should) depend on forecast flood levels. It is pointless spending time and effort sandbagging if water levels are going to well and truly overtop the sandbags. The time may well be better spent concentrating on evacuation. The importance of reliable flood forecasts – both peak water levels and time of occurrence of peak levels – is readily apparent.

For temporary protection measures such as those described above to be effective, it is necessary for each community to develop a contingency plan that identifies what needs to be done during the onset and occurrence of a flood, what materials and other resources are required (including human resources), where these resources are located, whether or not resources should be stockpiled, etc.

Safety Audits. During a flood, embankments and other structural protection measures may fail through damage caused by floodwaters (eg erosion) or by lack of maintenance in the past. Consideration should be given to auditing the safety of flood protection structures during a flood to identify and if possible rectify potential problems. Again, a contingency plan is required to effectively implement this activity.

Evacuation. In a severe flood, it may be necessary to evacuate flood-affected communities or to have them evacuate themselves. This is generally a major exercise that requires careful planning. Where are the evacuees to be housed, how are they to be fed, how will emergency relief and medical aid be provided? Again, a contingency plan is required if evacuation is to be orderly and effective.

Disaster Reporting. To ensure that response measures are as effective and focussed as possible, it is essential that there is a timely and reliable means of reporting conditions and problems in flood-affected areas and evacuation zones to the appropriate authorities in charge of organising response measures (typically a national disaster management committee of some type). Effective disaster reporting requires trained people in the field and at the receiving centre, and possibly an emergency communications system (eg, VHF radios). Again, a contingency plan is required to ensure that the appropriate equipment and people will be in place in an emergency.

Recovery Measures

After the flood and flood threat have passed, it remains to cleanup the flooded area, repair flood-damaged public infrastructure, buildings, agricultural areas and other private assets, return evacuees to their homes and businesses, and to assist the community rebuild itself and return to normality.

The social, community and financial recovery of a flood-affected community can take a considerable time. This process can be facilitated by judicious assistance from appropriate State agencies and Civil Society Organisations through the provision of emergency food supplies, medical aid, seed grain, low (or no) interest loans to help businesses restart, emergency schooling, etc. The effectiveness of these activities will be enhanced by the integration and coordination of recovery activities and through the preparation and use of Recovery Measure Contingency Plans.

Flood Emergency Management Issues

- Are flood maps showing the extent and hazard (ideally) of flooding for different sized flood events available?
- Has a contingency plan been prepared to enable the temporary protection of key public infrastructure assets during a flood?
- Has a contingency plan been prepared to inspect and repair flood protection infrastructure, such as flood embankments, during a flood?
- Has a contingency plan been prepared for the evacuation of the community? If a community is protected by flood embankments, has consideration been given to the potentially more perilous nature and hazard of flooding when the embankments overtop?
- Have contingency plans been prepared to provide temporary accommodation, relief and medical assistance to evacuees?
- Is the current disaster reporting system effective? Is the current emergency communications system appropriate or does it need upgrading? Are adequately trained field staff and receiving centre staff available?
- Are post-flood recovery activities appropriately organised and coordinated between the various national, internal and civil society agencies?
- Have contingency plans been prepared to assist with the post-flood recovery of flood-affected communities?

2.1.3 The Institutionalisation of Public Participation and Community Consultation

To be effective, all stages of the floodplain management process must involve public participation (by line agencies) and community consultation (at the village and township level). It is necessary that all stakeholders feel ownership of the process and its outcomes. Floodplain management is all about reaching agreed compromises, especially with respect to land-use development. Stakeholders must be actively and effectively included in the floodplain management process if they are to accept successfully implement the agreed outcomes and accept those outcomes that are not in their direct interests. These include stakeholders at the State, Provincial, District, Commune and Village levels, as well as the communities living in flood prone areas and the private sector.

In many countries, a 'Floodplain Management Committee' is formed that includes representatives of all stakeholders, as appropriate to the particular floodplain situation, affected by the land-use implications of floodplain management decisions. These stakeholders include those affected by flooding (flood-prone communities), those with the potential to affect flooding behaviour (private enterprises or public works agencies that construct, e.g., embankments), those affected by flood management decisions (natural resource and environmental agencies) and those delivering flood emergency services. This committee is typically chaired by the agency

in charge of implementing the land-use development plan for the particular area of the floodplain.

What type of institutional arrangement is appropriate to oversee, coordinate and direct this complex, inter-related planning process, that in addition to flooding considerations, needs to also address social, economic, natural resource management and ecological issues across the floodplain? In order to answer these questions for the Lower Mekong Basin, one may have to have a look at the different categories of stakeholders and their characteristics with respect to floods, flood risks, and flood pattern influencing behaviour.

Floodplain Communities

The hazards and suffering caused by floods are imposed on floodplain communities. A basic objective of floodplain management is to reduce the community hazard and suffering to acceptable levels. Floodplain communities are the social group most directly affected by floods and decisions concerning floods, but are often the least consulted of the stakeholders.

Within communities are groups of people accustomed to coping with floods (a high level of flood awareness), those who rarely get flooded (a low level of flood awareness) and newly resettled families who are unaware of flood risks (no flood awareness). These last two groups are obviously most at risk during flood events (there is some evidence that many of those who were drowned in the Year 2000 Floods belonged to these last two groups).

Community consultation activities can include input to effective early warning methods, monitoring of local flood conditions, and better understanding of needs for safe evacuation at times of severe flooding. Civil Society Organisations, and in the case of Thailand, the Civil Defence Unit of the Ministry of Interior, are increasingly acting as advocates and informants on behalf of communities in relation to community-based flood preparedness.

Provincial, District and Sub-District Agencies

Local governmental bodies, including people's committees, youth and women's associations, are most often responsible for implementing national policies that affect the floodplain, for making local flood emergency management decisions during and after floods, and for reporting local flood conditions.

Public participation activities can include consultation, better training and capacity building so that local agencies better understand the effects of national policies on floodplain communities, enhancing emergency response, recovery and rehabilitation measures delivered by local government, and consultation with regard to improved flood reporting standards during and after flood emergencies.

National Public Agencies

National agencies are largely responsible for the development of policy and legislation affecting floodplains (land-use, natural resource management, environmental, etc), providing technical expertise and allocating resources to local government, establishing national standards, and at times enforcing regulations pertaining to land-use developments on the flood plain.

Public participation activities can include consultation, better training and capacity building to clarify the understanding of responsibilities and linkages between relevant line ministries, existing and proposed floodplain management policies, resource allocation and management on the floodplain. It also includes to facilitate basin-wide collaboration, and to determine national and basin-wide priorities for improving priorities flood and floodplain management.

Civil Society Organisations, International Agencies and the Donor Community

Civil Society Organisations, International Agencies and the Donor Community are sources of technical and financial support to all Management levels. In addition, they act as advocates for vulnerable groups or global issues. As such, these stakeholders have an abiding interest in flood and floodplain management, and in particular flood emergency measures. These stakeholders represent a wide variety of interests.

They may provide support for various flood management activities such as policy development, structural management measures; emergency response, recovery and rehabilitation activities; and national adherence to international conventions. Consultative activities include identification of resources, enhancing strategic objectives, and developing clear guidelines for meeting international responsibilities.

Regional Agencies may promote learning, cooperation between countries, and the efficient pooling of resources within their organisational mandates. There are productive lessons to be learned from the experience of various agencies, such as the Federation of the Red Cross and Red Crescent Society, as well as opportunities for collaboration to address common flood management issues, as with FAO or ESCAP.

A number of International Organisations and Civil Society Organisations work directly at the community level in flood prone areas, especially in Laos, Viet Nam, and Cambodia. Civil Society Organisations such as Care and OXFAM usually work on their own, rural development programmes such as the ones supported by the European Union or GTZ rather through national counterpart agencies at the provincial and district levels. These kind of programmes are often effective advocates for flood-affected communities and individuals through their use of participatory research and implementation arrangements. In addition, such organisations can be effective partners to test innovations in flood management at the community level. Consultative activities can include testing of information products or new methodologies for flood management or advice on impacts of different flood management activities. In case of emergency relief measures, they usually also provide effective channelling mechanisms for donor assistance to the affected communities.

2.2 NATIONAL, TRANS-BOUNDARY, AND REGIONAL ISSUES AND NEEDS

So far, the four MRC member countries have devoted much of their 'flood management' effort to flood emergency management ('disaster management') only, rather than to the larger endeavour of floodplain management. With respect to institutional arrangements, no 'Floodplain Management Committee' exists to date in the four MRC member countries. Although all countries have a National Disaster Management Committee of some type – which is focussed on Flood Emergency

Management – none of them has a Committee in place that would be responsible for overseeing floodplain management investigations and formulating and implementing a floodplain management plan.

The MRC Secretariat has prepared a separate document describing the results of the national workshops. The following section summarises the results. It tries to identify commonly addressed problems and needs for improvements. Although there is a certain bias towards aspects that could be dealt with by MRC, the listing of issues and needs was done in general and goes beyond what this organisation will be able to address. The four conceptual topics of integrated floodplain management are covered here, differentiating between national, trans-boundary, and regional issues and needs.

2.2.1 Land-use Planning

National Issues and Needs

A general need was expressed for improved land-use planning that explicitly includes floodplain management issues in the planning process. This also requires awareness raising with regard to the links between land-use planning and flood management among decision makers, and the formulation of a policy and guidelines for land-use in flood prone areas. The concept of Integrated Floodplain Management Principles and the role of land-use planning in this process also have to be included in capacity building measures.

Improvements in the land-use planning process are expected through the introduction of new technologies for data collection and analysis, and additional human and financial resources. As technical services for land-use planning flood hazard maps have to be produced. The application of appropriate models need to be improved to predict the impact of land-use changes on flooding.

Besides techniques and training for flood hazard mapping, flood damage risk mapping and modeling, capacity building needs in the land-use planning process also include data collection and a better use of the resulting and processed data. Finally, best practices about the concept of "living with floods" should be documented and demonstrated.

Trans-Boundary Issues and Needs

With respect to land-use issues, such as the effect of large-scale land clearing in upstream countries on flood volumes further downstream, neutral scientific analyses of causes and effects were mentioned as important trans-boundary issues in some countries. Issues to be addressed in this respect would also include improved conflict resolution and conflict prevention mechanisms.

Regional Issues and Needs

At the regional level, the need for an improved data exchange with downstream and upstream countries was strongly felt. A basin-wide classification system for certain land-use data might help to facilitate such a data exchange.

Capacity building in land-use planning and its integration into the floodplain management process could also be strengthened through regional forums.

Further cooperation on regional land-use planning among all riparian countries was mentioned as an issue as well. A regional monitoring network might be useful for data collection and impact assessment, e.g. how land-use changes affect flooding.

2.2.2 Structural Measures

National Issues and Needs

In general, a lack of awareness of principles of Integrated Floodplain Management seem to prevail in the relevant Line Agencies. Without a Central Organisation to oversee Floodplain Management and Planning, there is no coordination and cooperation between these Agencies.

Human Resources Development was seen as urgently needed in the fields of Hydrology and Hydraulics. Training measures in integrated floodplain management should cover the principles of assessing hydraulic effects of floodplain development (such as road embankments and land-use) on flood behaviour. This should also include the use of computer models.

Also, the introduction of guidelines for the design, construction, operation, maintenance and repair of embankments and other floodplain developments would be seen as helpful at the national level.

Trans-Boundary Issues and Needs

A lack of data and information concerning structural measures in neighbouring countries and their effects on flooding behaviour was a concern mentioned in almost all national workshops. This also refers to flood hazards caused by large releases from dams in upstream countries, including China. To overcome such problems would require a better exchange of information and national experience with other riparian countries (cooperation) concerning the assessment and management of structural measures. This could also be done through an agreed forum and methodology for jointly resolving the differences and difficult trans-boundary issues. In this respect, it was seen as important to also involve China and Myanmar in discussions of trans-boundary issues of flooding. There was a general understanding that agreements must be negotiated on notification of releases from—or plans to construct—structural measures in the riparian countries.

Capacity building in the assessment and management of the hydraulic effects of floodplain development measures would also help to solve trans-boundary issues. This could be done, eg through information exchange at regional forums, training measures and study tours.

Regional Issues and Needs

Appropriate (basin-wide) hydrologic and hydraulic models have to be reviewed for their applicability and use in the four riparian countries to assess the hydraulic effects of floodplain developments. The use of such models should then be consid-

ered and promoted as a standard in the four riparian countries. This could help to come to a regional assessment of the effects of floodplain developments on flood behaviour in general.

Also, common regional safety guidelines for the design of structural measures and floodplain developments should be developed.

2.2.3 Flood Preparedness

National Issues and Needs

At present, there seems to be a general lack of background information for flood forecasting and warning, such as data bases, models, precipitation forecasts, flood maps and other supporting information. Strengthening the national data-collection network, including setting of standards, modernizing technology, improving maintenance, improving reporting and exchange of data, for example via the Internet, is of high priority in all countries. This requires a developing of staff capacity at national, provincial, and district levels.

Furthermore, improving data-processing, forecasting technologies, and access to international sources of rainfall data, was considered important issues that also require staff capacity development.

An improvement of coordination of forecasting and warning with response agencies was seen as another necessity. Vietnam reportedly also needs assistance in learning how to facilitate public participation in this respect.

In Thailand it was suggested to take a fresh look at new forecasting and warning models that also consider flash floods and floods in tributaries.

Trans-Boundary Issues and Needs

As trans-boundary issues in flood preparedness, the need for better cooperation on exchange of data on forecasts, and releases from reservoirs was mentioned. This especially needs further treaties or agreements with upstream countries on water management, including Myanmar and China.

A system of models in the basin is required, with snowmelt and rainfall-runoff models for the upper parts of the basin and hydraulic models for the Great Lake in Cambodia and the Delta in Vietnam, with the latter being able to include effects of tides and storm surges. Flash flood models and warning systems are needed virtually everywhere.

Vietnam would like to have a forecasting system in place throughout the year, with the cooperation of its upstream neighbour countries. In the low-flow season a weekly forecast would suffice to monitor salt-water intrusion into agricultural areas in the Delta.

Regional Issues And Needs

At the regional level, it was recommended to maintain historical data bases from throughout the Mekong basin, to be used for many types of hydrologic and hydraulic analysis.

The flood forecasting accuracy should be improved by increasing the number of forecast points on the Mekong River itself and on tributaries, to be agreed upon at the regional level. It is seen as useful for all the countries in the basin to adopt basin-wide standards for flood forecasting warnings.

Regional coordination in flood forecasting could also be strengthened through establishing annual meetings among the responsible agencies. This would strengthen personal relationships with counterparts in other countries, and would promote the use of the Internet, and adoption of common methods, technologies, and standards.

2.2.4 Emergency Management

National Issues and Needs

Although after the recent flood events, national action plans for disaster management have been established or updated, more detailed plans and supplementary training are needed to implement these. So far, most of the planning work has been at central level, and this needs to be extended to the local level as well.

Capacity building is required to better understand the role of flood emergency management. Assistance may be needed for preparing capacity building proposals for emergency information systems and public participation at all levels. Response and recovery agencies would like to improve their capacity in the interpretation of hazard mapping, particularly in the area of relating hazards with response and recovery plans. Also, strong interest was expressed in improving damage assessment methods at times of severe floods through pilot projects, workshops and training.

Also, there is the need for better coordination during flood events, particularly information exchanges and clear lines of responsibility between local and central levels. This requires an improved emergency communication network between provinces and remote villages. The Vietnam response and recovery group identified the need for an Information Transfer Centre in Viet Nam, which should be linked to MRC.

Finally, public awareness and community preparedness measures have to be integrated in flood response and recovery efforts. As an example it was mentioned that warning messages without the public understanding how to interpret and use them can create speculative situations, or false expectations.

Trans-Boundary Issues and Needs

With respect to trans-boundary issues in flood emergency management, it needs to be clarified what bilateral mechanisms can best address such a situation.

Regional Issues And Needs

Capacity building is needed through information exchange at regional forums, training, and study tours to review best practices and to facilitate a common regional understanding about appropriate response and recovery operations and management and regional assistance. In order to draw up better national emergency plans, there is a need for such an exchange of experience at the regional level.

There is also a need for regional flood hazard and vulnerability mapping, based on a common regional GIS-based system for the collection and assessment of potential of flood damage risk.

Enhancing and broadening communication systems and channels should allow fast, efficient conveyance of essential emergency information to all levels. The present MRC web site is a suitable tool, but not all people in need can access it.

In coordination with the ADPC, all six Mekong riparian countries should come to a common understanding of public participation in flood emergency management. Models and guidelines that address flood emergency response approaches, including aspects of public participation and better preparedness, would be very useful to provide a reference for national efforts.

2.3 THE MAIN STAKEHOLDERS IN FMM

The following section highlights the responsibilities of the various agencies involved in floodplain management. This applies first of all to the national agencies who are responsible for the tasks comprised in the four categories of measures distinguished by the concept of integrated floodplain management. Also, the involvement of international players that are of relevance in the Region is explored here. Only MRC itself is rather treated separately, in Section 2.4, below.

2.3.1 National Agencies Responsible for Land-use Planning

In Cambodia, the **Ministry of Land Management, Urban Planning and Construction (MLMUPAC)** is the principal land-use planning and mapping agency. Land-use planning proceeds via a sequence of 5-Year, 10-Year and 20-Year Plans. At present, land-use mapping is hampered by a lack of resources. Currently, MLMUPAC is concentrating on preparing maps of present land-use. Land-use mapping is concentrating on urban areas first. To date, seven major cities have been mapped, but the Government has only approved the maps for one city. MLMUPAC was involved in assessing the flooding in Cambodia caused by the emergency release from Ialy Dam on the Sae San River in Viet Nam. It was regarded as a land management issue – the flooded land had never been flooded before. It appears that Cambodia has a set of maps on flood extent and flood hazard, apparently produced by UNTAC in 1993. The maps distinguish shallow, medium and high depths of flooding, which were determined through discussions with villagers.

Because their mandate includes land cover, land-use and land-use planning, **the Department of Agronomy and Agricultural Land Improvement (DAALI) and the Department of Forestry and Wildlife (DFW)** of the Ministry of Agriculture, Forestry and Fisheries (MAFF) are also involved. The DFW is in charge of reforestation, and DAALI for national food security, which includes reporting flood damage to agricultural land and enterprises in the aftermath of a flood.

In Lao PDR, the **Ministry of Agriculture and Forestry (MAF)** and its line agency, the Department of Agriculture and Extension (DAE), are responsible for the preparation of sectoral land-use development plans. Data on agricultural issues related to land-use are provided by village-level informants to the District Officers, who then transfer the data to province authorities and finally to the Division of Statistics at DAE. The **Department of Forestry (DF)** within MAF is re-directing its focus in master planning procedures to the watershed unit. A new participatory inter-agency approach is proposed, whereby planning and implementation of forestry-based issues is to be done in partnership with district administration and local stakeholders. The **Forestry and Land Inventory Office** has recently been established under the National Agriculture and Forestry Research Institute (NAFRI), with a mandate to consider the overall coordination and planning of biodiversity and watershed projects. Other key national agencies associated with land-use planning and management in Lao PDR are the **National Agriculture and Forestry Research Unit (NAFRI)**. Its Office of Forest Inventory Planning and Watershed Management is responsible for the implementation of watershed management plans.

In Thailand, land-use planning is done through One and Five-Year National and Regional Master plans. The **Land Development Department** is responsible for management and protection of land and soil resources. Recently, a more community-based land-use planning process has been introduced which involves communities in the planning and decision making process. The **Office of Environmental Policy and Planning** has an important role in producing flood hazard maps. The responsibilities of the **Royal Forest Department** within the Ministry of Agriculture and Cooperatives include forest resources surveys, planning activities, enforcement of forest laws, issuance of permits and control of logging concessions, study and protection of watershed areas, study and promotion of forest products, determination of wildlife sanctuaries and recreation areas, planning forest plantation programmes, issuance of permits for use of land in forest reserve areas and the survey and allocation of land for forest villages.

In Viet Nam, the **National Institute of Agricultural Planning and Production (NIAPP)** and its counterpart agency in Ho Chi Minh City – the **Sub-NIAPP** – are responsible for agricultural planning in the Mekong Delta. Both of these organisations form part of MARD. NIAPP and Sub-NIAPP are principally survey and land planning agencies. Given the extensive agricultural base of the Mekong delta in Viet Nam, Sub-NIAPP is a key land-use planning and zoning agency. Through its Integrated Resources Mapping Centre, Sub-NIAPP has extensive facilities and experience in the preparation of all types of GIS based

maps, primarily dealing with environmental conditions, including soil classification, suitability analyses for different crops, rainfall, and agro-ecological zones, and forest cover. Sub-NIAPP provides crucial links between agriculture and flooding in the Delta, including saltwater intrusion and acid-sulphate soil issues. They are currently undertaking a survey of land-use in the Delta, including primary and secondary data collection and are preparing a survey on the socio-economic situation of households in flood areas of the Delta. Sub-NIAPP also prepares recommendations for better living with floods, related to small areas within the delta, which are assessed by MARD.

The **Sub-Institute for Urban and Rural Planning (SIURP)** which forms part of the Ministry of Construction, is responsible for addressing the social and economic consequences of floodplain developments. SIURP are responsible for the classification of flood zones in terms of their effect on settlements and for planning resettlement of flood-affected populations. They advise on options, give information on flood levels and recommended measures, but it is up to the local committees to decide on what option is actually used.

2.3.2 National Agencies Responsible for Structural Measures

In Cambodia, the responsibilities for structural measures for flood management are divided among several agencies. The **Ministry of Water Resources and Meteorology (MOWRAM)** is responsible for the design and construction of floodplain developments, and for the development and implementation of water resources law and policy. The **Department of Engineering (DOE) and the Department of Irrigation and Drainage (DID)** of Ministry of Water Resources and Meteorology (MOWRAM) are responsible for a number of floodplain developments, eg the construction and rehabilitation of irrigation and drainage schemes, the rehabilitation of canals, river banks, etc, and is also presumably responsible for assessing the hydraulic impacts of floodplain developments. However, DOE and DID do not appear to have any hydrologic or hydraulic models to be used for this purpose.

The **Ministry of Public Works and Transport** is responsible for a number of projects to improve the transport and trade situation in Cambodia. Floods are an important impediment in this respect. The impacts by floods on the waterway development infrastructure and roads and bridges, goes under the responsibility of this Ministry.

The **Department of Energy (DE)** of the Ministry of Industry, Mines and Energy (MIME), Cambodia, is responsible for preparing the hydropower planning and development. DE's and MIME's role in flood and floodplain management is limited to the possible flood mitigation aspects of hydropower dams. But at present, Cambodia has only one small hydropower dam in the Mekong catchment (1 MW capacity in Ratnakiri Province), which is too small to produce any significant flood mitigation effect for downstream communities. Most prom-

inent among the agencies concerned about the impacts of structural measures in Cambodia, and therefore involved as a stakeholder as well, is the **Department of Fisheries** under the Ministry of Agriculture, Forestry and Fisheries (MAFF). It worries that large dams in the upper and lower Mekong could alter the seasonal flows into and out of Tonle Sap Lake and seasonal water levels, thereby interfering with fish breeding and habitat, and affecting the vital fish industry in the country.

In Lao PDR, it is the **Ministry of Communication Transport, Post and Construction (MCTPC)** who is responsible for construction of any kind of flood protection embankments. However, it does not appear to have any hydrologic or hydraulic models to be used for this purpose. Currently, there are three medium-sized hydropower dams in Lao PDR on tributaries of the Mekong with plans for a fourth. The three dams have the capacity to mitigate tributary floods. **Electricité du Laos (EDL)** of the Ministry of Industry and Handicraft (MIH) is responsible for hydropower planning and development. EDL is also responsible for dam operating rules drafting with close cooperation with the **Department of Meteorology and Hydrology (DMH)** of Ministry of Agriculture and Forestry (MAF). But the actual release is the responsibility of the Dam Operator, who has to get prior approval for the proposed quantities from the MIH. For such water releases, alarm systems have been set up in some sub-basins such as the Nam Ngum.

In Thailand, the **Royal Irrigation Department (RID)** of the Ministry Agriculture and Cooperatives (MAC) is responsible for water resources development particularly for irrigation development in the country. Providing raw water for irrigation purpose and domestic water supply (not water supply system), construction of multipurpose dams, irrigation canals and other related structures are major duties of the RID.

The **Electricity Generating Authority of Thailand (EGAT)** is responsible for generating electricity to meet national increasing demand. Some seven dams in the Mekong basin part in northeast Thailand are operated by EGAT, e.g. Nam Pung, Ubolratana, Chulabhorn, Sirindhorn, Pak Mun dams. Flood control has been introduced in some schemes operated by EGAT.

In Viet Nam, the **Department of Dyke Management and Flood Control (DDMFC)** forms part of the Ministry of Agriculture and Rural Development (MARD) and is responsible for the 'management' of river and sea dykes, including approving the construction of all dykes and the maintenance of sea dykes (small dykes are maintained by villagers). Another Departments of MARD with responsibilities in this field is the **Department of Water Resources and Hydraulic Works Management (DWRHWM)**. The **Institute of Water Resources Planning (IWRP)** and its southern counterpart in Ho Chi Minh City - the **Sub-Institute of Water Resources Planning (SIWRP)** form part of DWRHWM. They are the primary agencies responsible for water resources planning in Viet Nam and the Mekong Delta respectively and. SIWRP is responsible for addressing flooding issues in the Mekong basin in relation to new water resource development

projects and floodplain developments in the Mekong delta of Viet Nam, including assessing the hydraulic impacts of all water control works and floodplain developments. To assist in this task, SIWRP has developed a large mathematical computer model of the delta – VRSAP. This model is used to assess the impacts on flooding of proposed changes to flood control embankments, road embankments, etc. SIWRP do technical assessment of the impact of proposed dykes on flood behaviour. IWRP is also represented in the Energy Committee which decides on the flood operation and emergency releases from dams. Part of SIWRP is the **Southern Institute of Water Resources Research (SIWRR)** which undertakes applied research and training in the fields of hydraulic engineering and water resources engineering.

2.3.3 National Agencies Responsible for Flood Preparedness

In Cambodia, the **Ministry of Water Resources and Meteorology (MOWRAM)** is the main water resources manager in Cambodia, with responsibilities for data collection, weather and flood forecasting and others (see 2.4.2). The **Department of Hydrology and River Works (DHRW)** of this Ministry monitors water levels and discharge on Mainstream, tributaries of the Mekong River and in the Tonle Sap system. DHRW is responsible for flood forecasting in the country. DHRW forward water level and rainfall data to MRCS, where it is used to generate regional forecasts. DHRW uses its own forecasting models (simple regression relationships between water levels at upstream and downstream stations), to provide 3-day flood forecasts for the mainstream stations. No forecasts are made for tributaries. Flood forecasts are sent to the mass media and to National Committee for Disaster Management. Weather forecasting and collecting the weather data is done by the **Department of Meteorology (DOM)** of MOWRAM.

In Lao PDR, the **Department of Meteorology and Hydrology (DMH)** of Ministry of Agriculture and Forestry (MAF) is responsible for monitoring water levels and rainfall in tributaries of the Mekong and in catchment areas of dams, and for forecasting inflow floods to the dams and water levels along the Mekong. DMH is also responsible for the issuing of flood warnings in Lao PDR. DMH forwards water level and rainfall information to MRC for flood forecasting purposes. The **Waterways Administration Division (WAD)** of the Ministry of Communication Transport, Post and Construction (MCTPC) is monitors water levels and discharges at four key stations along the mainstream of the Mekong and forwards this information to MRC for flood forecasting purposes.

In Thailand, there are as yet no agencies responsible for flood forecasting in the Mekong basin. The **Thai Department of Meteorology (TMD)** is responsible for nationwide weather forecasting and early warning. The TMD plays a key role in providing and disseminating weather forecasts and warning information to the NCDC, relevant agencies, media and the public. The TMD has provincial offices and weather and

hydrological stations. The TMD contributes to the MRC flood forecasting activities by providing rainfall data. Particularly when high rainfall intensity is recorded, warnings for flash floods are sent out to mountainous areas. The Royal **Irrigation Department (RID)** of the Ministry Agriculture and Cooperatives (MAC) operates own hydro-meteorological stations in the Thai part of the Mekong Basin and is working on improving its flood forecasting system. The **Department of Energy Development and Promotion (DEDP)** operates an extensive hydrometeorological network in northeastern and northern Thailand. Daily real-time hydrometeorological data from the Mekong mainstream stations are sent to the MRCS for flood forecasting.

In Viet Nam, the **Hydro-Meteorological Service of Viet Nam (HMS)** and its southern counterpart in Ho Chi Minh City – the **Southern Region Hydro-Meteorological Centre (SRHMC)** monitor hydro-meteorological processes, including meteorological variables (basic climate and weather variables and solar radiation, ozone levels and UV radiation), water levels and discharges, and oceanographic parameters of interest (wave heights, tidal water levels, wind set up, etc); to provide short, medium and long-term meteorological and hydrological forecasts, and to collect and provide hydro-meteorological data to paying customers. The **Institute of Hydrology and Meteorology (IHM)**, which belongs to Hydro-Meteorological Service (HMS), is primarily responsible for research activities and the training of staff. IHM uses a large hydraulic mathematical computer model – HYDROLOGIS - to predict flood levels and the impact of floodplain developments on flood levels across the Mekong Delta. The **National Centre for Hydro-Meteorological Forecasting (NCHMF)** forms part of the Institute of Hydrology and Meteorology (IHM). It is responsible for short-term weather forecasts (1-2 days), medium and Long-Term (3-10 day and 10-30 day forecasts), hydrological forecast, research and to develop hardware and software for forecasting models, and to collect all hydro-meteorological data in Viet Nam as well as international hydro-meteorological data. The **Hydrological Forecast Division (HFD)** forms part of the NCHMF and provides forecasts of river levels at 20 key stations throughout Viet Nam. Two of these are in the Mekong Delta close to the Cambodian border – Tan Chau (on the Mekong River) and Chau Doc (on the Bassac River). These forecasts are based on simple regression relationships.

2.3.4 National Agencies Responsible for Emergency Management

In Cambodia, the **National Committee for Disaster Management (NCDM)**, which was formed in 1994, is responsible for the coordination of flood (and other) emergency response and recovery activities in Cambodia. There are Provincial and District committees of the NCDM. The Governor chairs the Provincial committee; the District Chief chairs the District committee. The NCDM acts as the central coordinator to mobilise resources from other line agencies and civil society organisations in response to disasters in Cambodia, including flooding.

- In Lao PDR, the **Lao Flood Management Committee** includes representatives of the Prime Minister's Department, the Department of Electricity (Dam Operations), DMH, and the Departments of Agriculture and Planning to monitor flooding and to work with Provincial agencies. The **National Disaster Management Office (NDMO)** acts as the secretariat for the Lao National Disaster Management Committee (NDMC). The NDMC is a high-level committee, chaired by the Minister of Labour and Social Welfare. It is responsible for disaster preparedness and management and acts as the national centre to coordinate disaster management in Lao PDR.
- In Thailand, the **National Civil Defence Committee (NCDC)** is responsible for drawing up civil defence policy, approves the master plan for civil defence, determines methods of inspection, follow up evaluation, training and financial management. The NCDC members are from various line ministries concerning with disaster management such as MOI, MAC, MTC, Bureau of Budget, Ministry of Public Health, TMD, Department of Public Welfare, etc. The committee is chaired by the Minister of Interior. The **Civil Defence Division (CDD)** runs the office of the Civil Defence Secretariat (CDS), Department of Local Administration acts, as CDS is responsible for the implementation of the policy set by the NCDC. The CDS has duties in carrying out studies, researches, analysis and disseminate technical information, make and review the national civil defence master plan and provide training, coordination in intra-organisation operation.
- In Viet Nam, the **Department of Dyke Management and Flood Control (DDMFC)** plays a key role in the management of response and recovery activities during flood emergencies, including (i) Coordination of the response and recovery activities of State and Provincial agencies, (ii) Relaying flood warnings and decisions of the Central Committee for Flood and Storm Control (see below) to their provincial counterparts via Email, from where the warnings and instructions are relayed to District Centres and then onto villages; (iii) Survey and reporting of flood damage data as part of the response and recovery processes. Villages report damage and needs to provincial agencies, which in turn report this information to DDMFC, who relay it to the CNDFM, (iv) Assembly of flood damage data into a national database; (v) Provision of training at local level; and (vi) Planning for response and recovery activities. The **Central Committee for Flood and Storm Control (CCFSC)** is directly under the Prime Minister's Office and has representatives from all key response and recovery agencies in Viet Nam, including MARD, HMS, Police, Military and a number of disaster response agencies. The Committee is chaired by MARD and serves to mobilise and direct national and provincial resources to where they are required. The Committee has Provincial and District counterparts through which DDMFC works.

2.3.5 International Agencies Engaged in Floodplain Management

Several regional organisations that deal with various aspects of regional flood management have offices in the Mekong countries. Most of these organisations

are based in Bangkok, with the exception of UNDP, which is based in Phnom Penh, where the process of strategy formulation is undertaken. The provisional list below summarises some of the principal activities and main interests of these organisations. In addition to the agencies listed below, CARE, Save the Children, UNICEF, and CRS also have regional offices in the Mekong Basin.

Regional donor agencies provide technical assistance and response and recovery services across the four countries of the Lower Mekong Basin. As such, they are in a good position to assess regional needs in flood and floodplain management and the relative strengths and needs of the national agencies of the four countries. This section on the international players also highlights their expectations towards MRC and possible entry points for co-operation.

The United Nations Development Programme (UNDP)

The UNDP has played a leading role in organizing centrally based disaster management information systems that provide information at the provincial and district levels. The development of the Disaster Management Unit (DMU) - and its website - provide important services in flood emergency efforts. DMU develops GIS images of extent of flooding from Radarsat images of flooded areas in Viet Nam. This information is passed onto the Central Committee of Flood Storm Control, which feeds the information into the disaster management process. Future activities of UNDP are now under consideration in its Five-Year programme planning cycle.

The United Nations Development Programme (UNDP) has been the most active in promoting collaboration and partnership on flood management issues with MRC. Since the early 1990's, UNDP has supported the establishment of national disaster management entities in Lao PDR, Cambodia and Viet Nam, although direct support will be reduced at the end of this year. In addition, UNDP has sponsored general capacity building projects for the National Mekong Committees. Most recently, UNDP Cambodia has sponsored technical appraisal missions with the MRC to explore the potential for regional flood management. This is an ongoing initiative that will be further discussed in the near future.

ESCAP

ESCAP, the Economic and Social Commission for Asia and the Pacific, has been involved with flood control and related river problems throughout Asia and the Pacific since 1949, most recently through its Water and Mineral Resources Section. Their main activities have been directed towards exchange of knowledge through workshops and publications, as well as providing advisory services on request.

Because of the increased frequency and impact of flooding in most of Asia in recent years, ESCAP is placing an increasing focus on supporting further efforts towards integrated flood management. In October of 1998, this culminated in a workshop, the proceedings of which were published, including case studies and discussion of emerging flood management trends in the region. One of the important issues to emerge has been the urgent need to integrate flood management processes into the main agenda for economic and social development of flood-affected countries, ie to foster a truly integrated approach to flood and floodplain management. Part of this process is to facilitate awareness of the need to treat flood management measures as specific items in national budgets.

In relation to the Mekong Basin, ESCAP has shown interest in promoting future collaboration between its Typhoon Committee and the MRC, in order to better exploit meteorological data for the benefit of the peoples of the Lower Mekong Basin. This issue is being addressed in 2001.

Another ESCAP initiative is collaboration with the World Water Council and the International Association of Public Participation in an inter-regional symposium on flood preparedness and response. This symposium recognises the need to better integrate preparedness activities and other non-structural measures into the flood and floodplain management process of countries and regional entities. From the ESCAP perspective, MRC can play important roles as a proactive avenue of cooperation, stabilisation and core function, creating conditions for projects to be implemented.

FAO

In the past, the Food and Agricultural Organisation (FAO) of the United Nations has worked on a collaborative basis with MRC to support early efforts towards better flood forecasting, including computer modelling. A joint workshop on these matters was held in Lao PDR in March 1998. Since then, the FAO regional office has made disaster management one of its four core programmes. Within this disaster management framework, the most recent flood management initiative undertaken by FAO has been the Asia Pacific Conference on Early Warning, Prevention, Preparedness and Management of Disasters in Food and Agriculture. FAO presented a discussion paper on river basin strategies for flood and drought prevention and mitigation.

FAO promotes an integrated approach to flood and floodplain management that emphasises public participation, non-structural solutions, economic principles and basic ecosystem requirements. A prominent feature of FAO's perspective is recognition that flood management and food security issues need to be treated in an integrated fashion, and in particular, restoration of agricultural systems in the aftermath of flooding. There is a strong recognition by FAO of the importance of the lower Mekong flood plain to national and regional food security.

The strengthening of risk analysis and environmental and social impact assessment procedures is an important priority of FAO. Much of this effort relies on development of data collection and dissemination systems. FAO considers MRC to be the agency with 'primary responsibility for planning and coordinating flood management and encourages MRC to introduce improved techniques in flood monitoring and forecasting, including flood risk mapping on a regional level.

FAO has examined the 'perceived wisdom' of various flood and floodplain management issues. Among the many issues being considered is the premise that land clearing in upland areas is responsible for changes in the behaviour of major floods in downstream areas. Hydrological studies have so far indicated little effect from land clearing activities, although no definitive studies exist for large-scale land clearing.

While FAO is not a donor agency, it is interested in technical cooperation studies in a number of areas. Upstream/downstream linkages, through the study of tributary watersheds, methods of cost/benefit analysis in flood management, and examination of flood water storage systems are of particular interest. One point of spe-

cific interest is the mapping of the lower floodplain of the basin to identify natural 'flood regimes' for enhanced planning.

WMO

The World Meteorological Organization (WMO)² coordinates global scientific activity to allow increasingly prompt and accurate weather information and other services for public, private and commercial use, including international airline and shipping industries. The WMO was created in Washington, D.C. at the Twelfth Conference of Directors of the International Meteorological Organization (IMO), which succeeded the latter organization in 1947. WMO commenced operations as the successor to IMO in 1951 and, later that year, was established as a specialized agency of the United Nations by agreement between the UN and WMO. Most of the funding for WMO programmes come from the member countries and WMO can not be considered a donor agency.

The WMO Hydrology and Water Resources Programme assesses global water resources and proper planning for their conservation is now recognized as a worldwide problem. Water resource management cuts across political boundaries. WMO facilitates cooperation within water basins shared between countries. Management of the quality and quantity of water resources serves a wide range of human needs. A new problem emerging is the management of water supplies to the world's growing megacities and agricultural regions. Floods are a major threat to life and property and specialized forecasts aid communities and governments in flood-prone areas.

To strengthen the partnership between MRC and WMO the two organizations signed a Memorandum of Understanding in which they agreed to

- (i) Work in close cooperation and consult each other regularly with regard to matters of common interest, so as to ensure optimum benefits for operations and research in the fields of meteorology, hydrology, flood management and water resources;
- (ii) Keep each other informed of their relevant programmes of work and projected activities which might be of mutual interest, and exchange publications concerning these and related fields;
- (iii) Cooperate in the development of programmes within the Mekong River Basin. These activities will be defined according to the evolving needs that will be identified by both parties;
- (iv) Collaborate in improving flood forecasting and warning systems for the benefit of the people in the Mekong Basin.

² This statement is paraphrased from the WMO website.

Other UN Agencies

Several other UN agencies have recently established regional disaster management offices in the Mekong Basin, staffed by professional officers, and are linked closely with Office of Coordination of Humanitarian Affairs. (OCHA).

The **World Health Organisation (WHO)** is primarily concerned with the health and medical aspects of flood disasters.

The **World Food Programme (WFP)**, because of its relatively large emergency portfolio, concentrates on logistics and contingency planning for regional development, particularly in Cambodia and Lao PDR, where WFP is the lead agency in UN disaster response to flooding. WFP would be most interested in collaborating with MRC and national agencies with regard to flood forecasting and early warning, hazard mapping at basin wide level, and collaborating in relation to vulnerability mapping through interpretive radar imagery.

IFRC

The International Federation of Red Cross (IFRC) has promoted close cooperative ties through regular meetings and communications with MRC. The regional IFRC office in Bangkok has two delegates addressing disasters, one emphasizing preparedness, the other response. Disaster Management is a relatively new regional concept for IFRC, although it forms one of the agency's three core programmes. IFRC is continuing to formulate its disaster management strategy through participation and consultation with national agencies and IFRC country delegations. The main priority of this process is to enhance national capabilities and processes.

Generally, IFRC found that flood preparedness continued to be a weak point in national flood management efforts in the region, with national agencies having a relatively poor understanding of the potential benefits of reduced flood damage and flood hazard to affected people when preparedness is strong. Consistent with this finding, IFRC also notes that damage assessment tends to be oriented more towards physical infrastructure rather than towards vulnerability of people and humanitarian aspects. The opportunity for MRC to provide technical support to promote better reporting real-time flood and damage reporting protocols is of interest. It is important to note that IFRC recognises the importance of full ownership of initiatives by national agencies. This implies the definition of longer term strategies developed over five years or more.

IFRC is strongly interested in exploring further cooperation with MRC in the areas of regional hazard mapping, flood forecasting and early warning systems. With the unique advantage of extensive field networks in the lower basin countries, IFRC could assist with the ground-truthing of mapping activities, and help test early warning systems. Because the Federation shares with MRC the common attributes of networking with national agencies, this would offer opportunities for a wide range of collaboration at both local and regional levels.

Asian Disaster Preparedness Centre

The Asian Disaster Preparedness Centre (ADPC) has undertaken an inventory of hydro-meteorological early warning systems in Cambodia, Laos, Vietnam, Indonesia and the Philippines. They have started to organise networking of all organisa-

tions and regional bodies for collaboration on issues such as trans-national disaster management, early warning systems, resource mobilisation, and stock-taking of disaster information systems in the different countries.

Bilateral Donors

With respect to emergency relief measures after major flood events in the LMB, considerable assistance has been provided by bilateral donors. After the recent floods in 2000, the Governments of Germany, Japan, and others donated several millions of dollars for emergency relief operations and the rehabilitation of the damaged infrastructure in Cambodia and Vietnam.

Civil Society Organisations

Civil Society Organisations provide extensive assistance in the form of credit, local infrastructure improvement, and agricultural support. A number have been particularly active in preparedness measures and emergency relief. These include CARE, OXFAM, World Vision, MSF, Action Against Hunger, and Partners for Development. Preparedness measures have varied from incorporating community disaster preparedness as part of community development planning (e.g. PFD) to comprehensive surveys exploring community coping strategies. Regarding the latter type of measures, CARE and OXFAM have both released important survey reports concerning the 2000 flood.

After nearly 20 years of working in South-east Asia, OXFAM has refined its regional focus to those areas where it can have the greatest impact on poverty alleviation in the Mekong Region, which includes Viet Nam. Oxfam America's Mekong Initiative has been developed collaboratively with regional partners, including 12 other Oxfam agencies operating in the region to create a mutually reinforced network of support between micro-and macro level activities. This integrated approach seeks to address issues common to the poor of all six riparian countries of the GMR to develop common programmes and advocacy activities and to realise regional solutions. One of its top priorities is to support improved disaster preparedness and humanitarian assistance in cases of natural disaster, including floods. Other priorities related to MRC and flood management include poverty reduction, and responsible infrastructure development such as hydroelectric dams.

A major part of disaster preparedness includes long term solutions that assist the objective of "living with floods", for example affordable structural solutions for homes in the flood plain. Primarily, the regional office is working out a rights based approach to knowledge and information for all stakeholders with regard to flood management issues. In addition to ensuring openness of information, there is great interest in further developing databases linked to GIS, which are in turn related to key issues associated with their strategic objectives. The OXFAM Mekong Initiative is developing a website, which allows each member agency to update their project information, in turn linked to GIS.

CARE is both a relief and development agency. This organisation believes that building on local coping mechanisms is critical to both reducing vulnerability and increasing capacity on all levels. This requires a knowledge of what communities do to cope with emergency situations such as flooding. CARE is implementing pro-

jects funded by the Programme for Disaster Prevention, Mitigation and Preparedness (DIPECHO). DIPECHO published a Diagnostic for South-East Asia and recommended that the enhancement of local response and relief capacity and community vulnerability reduction be priority areas. It also recommended that "Disaster planning, at all levels, including national, has to be responsive to and reflective of community needs". The DIPECHO strategy is attempting to promote "new thinking" in South-East Asia which would place greater emphasis on the adoption of sustainable mitigation and preparedness approaches.

World Bank

The World Bank (International Bank for Reconstruction and Development) is a major donor of MRC through its support of the Water Utilisation Programme, a Global Environmental Facility (GEF) initiative. The World Bank's regional Water Resources Officer based in Beijing, is responsible for working the MRC. The Regional Water Resources Section is also working with the Vietnamese Government on the Mekong River Basin Development Plan, in keeping with the new Water Law. After the 2000 flood, World Bank provided approximately 16 million dollars for rehabilitation of infrastructure in Cambodia.

ADB

The Asian Development Bank (ADB), with a technical assistance grant from the Swiss Agency for Development and Cooperation (SDC), is implementing the regional technical assistance project *RETA 5783: Strategic Environmental Framework for the Greater Mekong Subregion* (SEF Project). The six countries of the Greater Mekong Sub-region (GMS) are participating in the project: Cambodia, Lao PDR, Myanmar, Thailand, Viet Nam, and Yunnan Province, Peoples Republic of China (PRC).

As part of this process, ADB has formed a partnership with MRC and UNEP for technical support. Although primarily engaged with transport and energy development, the GMS initiative is also looking at opportunities for taking the approach to water resource management, which may include flood management issues.

The overall goal of the SEF Project is to assist GMS country governments and the ADB improve environmental protection by helping to ensure the environmental and social sustainability of economic development undertaken within the GMS in general, and in particular within the energy/water resource and transportation sectors of the ADB's Greater Mekong Subregional Programme and of the GMS countries. A key component is to help ensure that environmental and social aspects are considered at an earlier stage in the planning process than currently takes place.

The SEF Project outputs will include a Strategic Environmental Framework Report (SEF Report), a programme of recommended GMS Technical Assistance projects and environmental investments, a set of maps and Geographic Information System (GIS) databases, GMS development scenarios illustrating the cumulative environmental and social impacts within the GMS, and a GIS-based GMS Early Warning and Information System (GMS EWIS).

2.4 THE INVOLVEMENT OF MRC IN FMM UP TO DATE

The Mekong Committee (now the Mekong River Commission) was formed in 1957 by Cambodia, Laos PDR, Thailand and Viet Nam, to promote and coordinate investigation and development of the LMB through regional cooperation. It was considered the institutional mechanism for the development of the Mekong resources, while the Mekong Secretariat (MS) was created as its operational arm.

Since its establishment, the Mekong Committee produced a number of flood-related achievements. Two indicative basin plans were prepared in 1970 and 1978 to provide guidance on development strategies and investigations/implementation of project options. The Mekong Secretariat also completed the inventory of Mekong tributary water resources projects (for multipurpose hydropower, irrigation and flood control) in the 1970s and 1980s.

Other achievements included comprehensive data collection programmes concerning such fields as hydrology, topography, hydrography and mapping. The compiled basic data/information are now stored in several digitised databases for basin and project studies, as well as made accessible to the riparian countries and the public. Programmes on the environment, fisheries, navigation, forestry and human resources development were also considered as successful.

Given that flooding is a perennial problem in the Mekong Basin, flood control has also been a major concern of the Mekong Committee. The low laying areas along the mainstream in Thailand and Laos PDR, the Mekong Delta from Kratie including the area surrounding the Great Lake are vulnerable to floods and are also fertile and densely populated.

In the previous concept of flood control and management it was perceived that large storage reservoirs would be required to significantly control the Mekong flows, for example if the Pak Beng, Pa Mong and Stung Treng with five tributaries dams including the Barrage on the Tonle Sap were to be built. But none of these dams on the mainstream of the Lower Mekong had ever been built. In this context early estimates pointed out that major flood control and damage prevention would save an average US\$25 million a year. With various form of water control including irrigation, drainage and diking, vast areas of fertile land could be put to more productive use to provide a better life for millions.

As a result, from the previous planning some multipurpose projects which included flood control component has been built e.g. Nam Ngum in Lao PDR, Nam Pong, Nam Phrom (Thailand) etc. including the improvement and rehabilitation of a network of canals dikes and sluices in Viet Nam. Major town and city such as Vientiane, Nong Khai, Phnom Penh etc. have been protected by dykes.

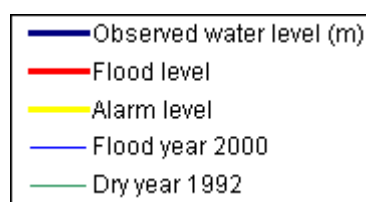
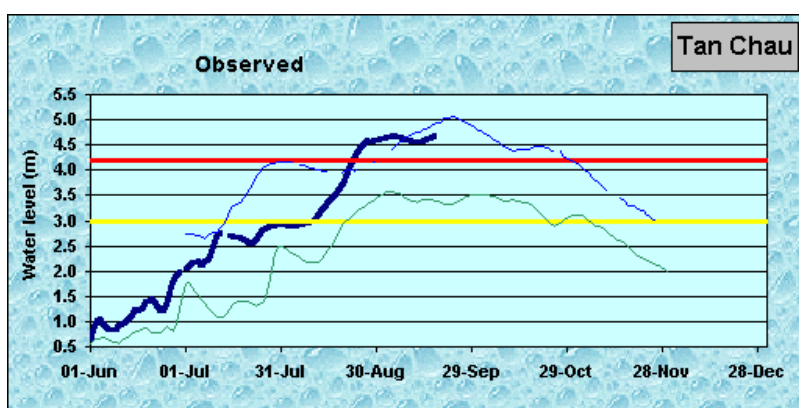
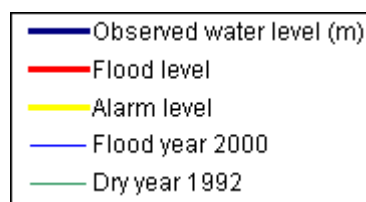
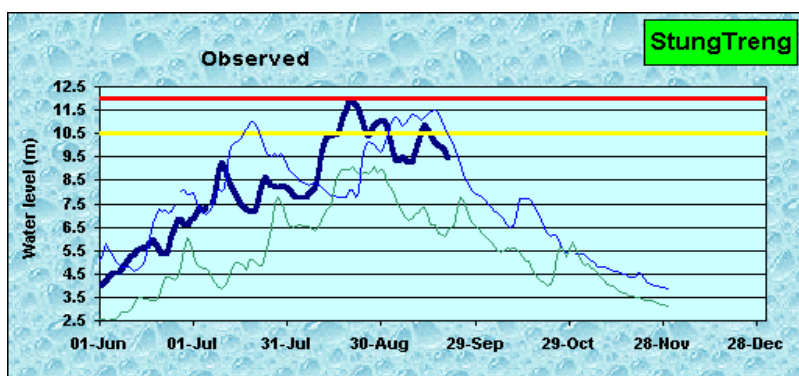
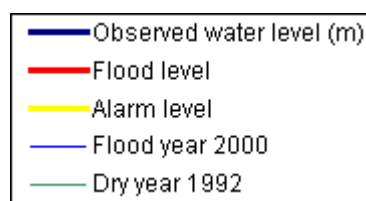
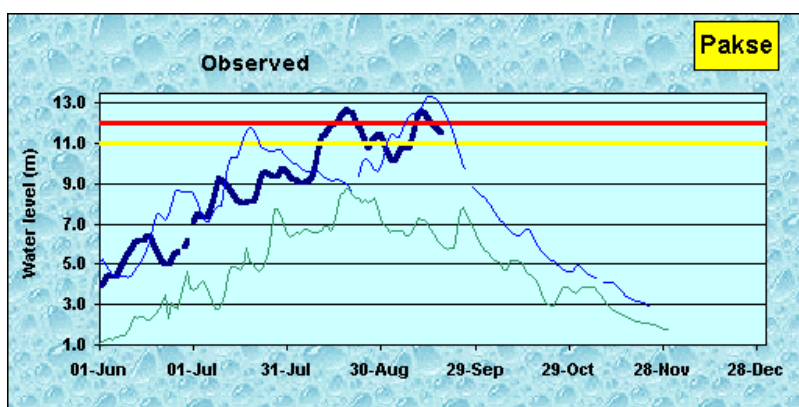
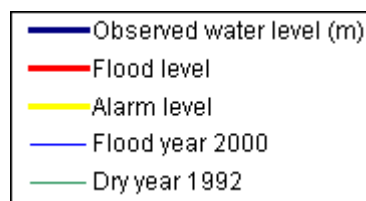
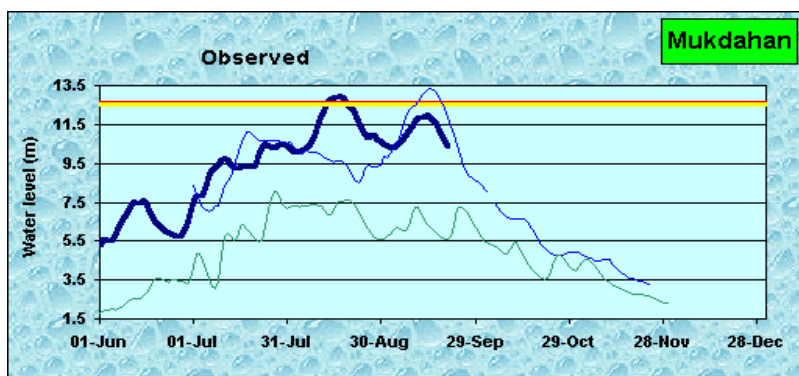
In 1998, MRC started a project, Flood Control Planning for Development of the Mekong Delta, financed by the Korean International Cooperation Agency. The objectives of the study were to define immediate action plans for flood control measures in Cambodia and Vietnam. The results of the study involved a number of structural measures such as diversion channels, as outlined above in Section 2.1.3 Structural Management Measures, p. 36. The Karlsruhe University has shown keen interest in the modelling activities of the project and its experts are currently analysing the study results.

On the non-structural side, MRC has been most active in flood forecasting. As a consequence of severe Mekong flood in 1966, a flood forecasting system was established and since 1970, the Mekong Secretariat (MS) has carried out an annual flood forecasting operation during the flood prone months from July to October by using two models namely the SSARR model for the upper reach from Chiang Saen to Pakse, and the delta model. The SSARR model and other tools such as HYSS were also use in the studies of the reservoir optimisation along the mainstream and major tributaries for flood management, hydropower, irrigation, navigation and environmental protection analysis.

The Delta model, a mathematical, hydrodynamic model was used to simulate flow in the Delta from Kratie to the Delta in Viet Nam. To date the SSARR model provides a five-day forecast at fifteen stations along the mainstream from July to mid-October. Further developed and improved version of the Delta model is extensively used in Viet Nam using data input from the SSARR model.

Following the 2000 events, the flood forecasting capacity at the MRC Secretariat has received special attention and is now under constant improvement. In order to reach a larger number of stakeholders in time, an internet web page has been added under the MRC web site since 16th July 2001 and shows daily water level observations, 5-day forecasts and maps on www.mrcmekong.org. An example for this service is given below.

Example of MRC Flood Forecasting Services 2001: Year 2001 and Historic Water Levels at 4 Key Stations



3 FLOOD MANAGEMENT AND MITIGATION - THE MRC STRATEGY

3.1 MRC MANDATE AND ROLES IN FMM

While national agencies have – according to the best of their capabilities - taken responsibility for all the different aspects of integrated floodplain management, there is a great expectation in MRC to join efforts to manage and mitigate floods in the Mekong Basin and to make it more efficient than to date.

The MRC Council Meeting of October 2000 gave the organisation a mandate to develop a ‘Flood Management and Mitigation Strategy’. But it is clear that MRC can only provide floodplain management services in accordance with the mandate of its legal charter and how this mandate is interpreted in subsequent MRC strategy documents and policy statements. In order to understand MRC’s role in floodplain management in the region, a brief analysis of MRC mandates is given below.

3.1.1 The Mandate of MRC for FMM

The ‘Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin’ - or the ‘1995 Agreement’ as it is informally known - documents the commitment of the four Member States Cambodia, Laos, Thailand and Vietnam to promote, support and coordinate the mutually beneficial cooperation in all fields of sustainable development and management of the Mekong River Basin with emphasis on joint and/or basin wide projects, programmes and basin planning. For example, in Article 1, the riparian States pledge to

‘...cooperate in fields of sustainable development, utilisation, management, and conservation of the water and related resources of the Mekong River Basin, including, but not limited to flood control...’

Additionally, Article 2 pledges the Member States to

‘...cooperate and coordinate in the development of the full potential of sustainable benefits to all riparian States, with emphasis and preference on joint and/or basin-wide development projects and basin programmes through the formulation of a basin development plan...to implement at the basin level.’

The above two Articles indicate that the Mekong River Agreement provides a broad mandate for the MRC in relation to basin-wide flood management that could generate a sustainable and basin-wide benefit by reducing the loss of life and damage caused by floods.

Article 10 covers Emergency Situations with respect to “water quantity or quality problems”. According to this article, MRC with its Joint Committee should be notified and consulted “without delay in order to take appropriate remedial action”.

Chapter V of the Agreement is on “*Addressing Differences and disputes*” on all aspects of water and related resources, putting the organisation in charge to “*make every effort to resolve the issue*” (Article 34). Only if the Commission with its Joint Committee and Council “*is unable to resolve the difference or dispute in a timely manner, the issue shall be taken to the Governments ... for resolution by negotiation through diplomatic channels*”. The Governments concerned may then “*request the assistance of mediation through an entity or party mutually agreed upon*” - which again could be MRC. (Article 35)

In the MRC Strategic Plan, the kind of services to be provided by the organisation are outlined, as well as how these are expected to contribute to development in the Basin. This is summarised in the Mission Statement of the Organisation:

To promote and coordinate sustainable management and development of water and related resources
for
the countries’ mutual benefit and the people’s well being
by
implementing strategic programmes and activities and providing scientific information and policy advice

The kind of activities MRC can get involved in are clearly outlined in this Mission Statement, i.e. the implementation of strategic programmes and provision of scientific information and policy advice.

The Strategic Plan further requires MRC to clearly focus on its role as an international river basin organisation, and to develop a flexible but strategic programme approach to basin-wide issues. Floodplain management issues in this respect are part of strategic sector programmes that are expected to contribute to the Basin Development Plan (BDP). Besides the Water Utilisation Programme and the Environment Programme, this BDP is one of three Core Programmes of the organisation as stipulated in the 1995 Agreement and further outlined in the Strategic Plan.

In the present organisational hierarchy of the MRC Secretariat, Floodplain Management is consequently allocated under the Water Resources and Hydrology Programme in the Operations Division, with contributions from the Technical Support Division, and under the envisaged guidance from the BDP.

3.1.2 Strategic Roles for MRC in FMM

According to this Agreement of 1995, MRC has a relatively broad mandate to participate in basin-wide floodplain management. How is MRC to do this? What roles could and should MRC play in this process?

As discussed above, floodplain management issues - based on the extent of their impact - can be of three types - National, Regional and Trans-Boundary. In defin-

ing possible roles for the MRC, it needs to be recognised that national flood impacts – ie impacts generated and experienced solely in a single country – remain that country's responsibility. However, there are valid roles – according to the above mandates – for MRC to assist the riparian countries with the management of Regional and Trans-Boundary flooding issues.

With view to the mandate of the organisation, possible roles for MRC can be grouped into three categories and include the following general aspects:

1. Providing Technical Products and Services

- Acting as a **repository of flood data and information** for the basin. The MRC is currently developing an integrated database for the basin as a whole. Flood data and information can be entered into this database for ready retrieval and use by member countries.
- **Provision of technically excellent analytical services** to the member countries in relation to flooding and flood issues. This activity could include the setting of standards in relation to flood management, so that all member countries use a common terminology, common data recording forms, common methods of analysis, etc.
- Provision of **flood forecasts** to the member countries. This activity has already commenced and will be enhanced when the telemetering network of water level (and rainfall) stations comes online early next year.

2. Addressing Differences and Facilitation

- Upon invitation, MRCS can act as a **neutral** assessor and facilitator for the member countries with regard to trans-boundary issues. The member countries respect MRCS for its neutrality, objectivity and technical excellence. This provides an excellent base for MRC to assess issues where countries and national agencies have different views and facilitate to find mutually agreeable solutions on disputed issues.
- **Coordinating the floodplain management** aspects of national programmes and MRC programmes. Elements of the WUP, BDP and Environment Programmes are of direct relevance to floodplain management and vice versa.³ For example, WUP will assess and develop appropriate models (hydrologic and hydraulic) for the basin as a whole. These models could be used for assessing the degree of trans-boundary impacts in 'receiving' countries. Compatibility between the WUP model(s) and the flood forecasting models must be guaranteed.
- Acting as the focal point for a **floodplain management forum** that addresses flood and floodplain management and flood preparedness. All member countries would be represented on the forum. Through this forum MRC could liaise and coordinate with Donor Agencies and Pro-

³ According to the MRC Strategic Plan, the Water Utilisation Programme (WUP), the Basin Development Plan (BDP), and the Environment Programme (ENP) are the three MRC Core Programmes, emanating from the 1995 Agreement.

grammes and run regional flood preparedness workshops before each flood season to assess the former year's flood and ready member countries for the coming flood.

3. Capacity Building and Technology Transfer

- Facilitating **capacity building and technology transfer** to the member countries in relation to regional and trans-boundary flooding issues. MRC could develop standard training programmes to be delivered to line agencies in the member countries, including the transfer of technology/know how and equipment.

It needs to be recognised that MRC itself will need capacity building and additional resources to deliver the above services. In fact, internal capacity building and resourcing issues will have to form part of the Strategy.

Looking at these roles, it becomes clear that MRC can only be one player in Integrated Floodplain Management in the Basin. The services that the organisation can provide are basically support services for others, such as national line agencies and emergency relief agencies, to more efficiently fulfil their own tasks in this field. The resulting strategy can therefore only be an "MRC Strategy for Floodplain Management Support".

3.1.3 The Role of the National Mekong Committees

These above outlined roles are to be played by MRC as an organisation made up of the MRC Council, Joint Committee and its Secretariat as well as the National Mekong Committees in the four member countries. The functions of the MRCS are outlined in Article 30 of the 1995 Agreement. The Secretariat is to provide technical services, financial administration, and advise, and carry out any other assignments requested by the Council or the Joint Committee.

The NMCs are national public agencies that represent the relevant national line agencies. With this, they also play a unique coordinating role in their respective countries between the MRC Joint Committee, its Secretariat and national interests.

Concerning flood management measures, the NMCs promote adopted positions of the MRC Council and Joint Committee to national agencies, provide insights on national concerns for guiding MRC's involvement with respect to the above-mentioned roles, and provide a forum for continued interaction with other stakeholders. Finally, the NMCs will have an important role in promoting and facilitating data exchange and sharing between the countries and MRCS.

3.2 PRINCIPLES AND OBJECTIVES

3.2.1 Principles of MRC Involvement in FMM

In formulating the flood management and mitigation strategy, a number of considerations that are linked to the nature of the organisation will affect the inclusion, ranking and treatment of possible strategy elements and projects.

- **Basin-wide significance.** With view to the MRC mandate, it is essential that any proposed flood management and mitigation activities undertaken or facilitated by the MRC are of basin-wide (regional) significance (ie the activities benefit and have the commitment of at least two member states, preferably all four). National issues, as the ones discussed above, have to be dealt with nationally and are not so much the concern of MRC. Nevertheless, training measures and pilot projects in one country could be considered as appropriate elements of an MRC strategy, as long as they help to understand and to deal with causes and effects of regional flood behaviour and MRC acts as a common denominator.
- **Participatory approach, coordination and partnerships.** The importance of public participation, coordination and the formation of partnerships is essential working principle for MRC. Implementation of the strategy and associated activities cannot be done solely by the NMCs and the Secretariat. A strong involvement and commitment from line agencies, from the public, and from other national and regional initiatives, from the commencement of strategy formulation down to the strategy implementation, is paramount.
- **Scope of activities to be in line with capacities.** Although a substantial amount of work can be distributed among the NMCs and line agencies, the technical, financial and human resources capacity of all these organisations is limited. The scope of activities that can be effectively managed has to be considered carefully. Initially, it may be necessary to concentrate on activities of a somewhat 'limited scope' that correspond to the prevailing capacities of MRC, NMCs and the line agencies.
- **Timing of activities.** It is proposed to classify initiating activities associated with the strategy as short-term (1-2 years), medium-term (3-5 years) and long-term (longer than 5 years). This will enable best use to be made of the existing limited capacity in the MRC, the NMCs and Line Agencies while capacity is built in these organisations.
- **Integrated and concerted action and avoidance of duplication.** Thorough coordination of strategy elements and associated activities with national policies and national and regional initiatives is crucial - including those of Civil Society Organisations, international organisations, donor community and investment banks. Moreover, close auditing and follow-up of MRC's core, support and sector programmes will avoid duplication and will ensure an appropriate and effective distribution and use of resources. Integrated and concerted action in the entire catchment area,

i.e. in the whole Basin, is a prerequisite for the success of the Basin strategy.

- **Social, economic, natural resource management and ecological implications.** If any activity is to be included in the Flood Management and Mitigation Strategy or addressed by MRC as part of the Strategy, it is essential that social, economic, natural resource management and ecological considerations are fully and effectively taken into account.
- **Upstream partners.** Human activities and certain natural occurrences/phenomena in the Upper Mekong Basin may have flood-related impacts on the four countries of the lower part of the basin. Cooperation with China on the upgrading of hydrological stations and the sharing of real-time water level and discharge data has already started. But this cooperation may need to be expanded in scope and also would have to include Myanmar, in order to cover all aspects and projects that influence flood behaviour in any part of the Basin.
- **International experience.** Lessons may be learned from the flood and floodplain management activities in other international river basins, such as the Rhine, Danube and Zambesi and from the flooding in other major river systems.
- **New technologies and emerging needs.** In formulating a floodplain management strategy, attention needs to be paid to the potential usefulness of new technologies for better and more effective floodplain management in the Mekong Basin, and to identifying emerging floodplain management needs in the basin. The early identification and proactive response to emerging needs will facilitate better floodplain management.
- **Global links.** MRC has already developed a number of 'global links', eg with the Asian Institute of Technology (AIT), with the National Oceanic and Atmospheric Administration (NOAA), and with the World Meteorological Organisation (WMO) in relation to flood forecasting. The technical expertise embodied in these links needs to be recognised and fed into the various activities, as appropriate, which emerge from MRC's Floodplain Management Strategy.

3.2.2 Objectives of the MRC Strategy on FMM

The Objectives of the MRC Strategy have to be in line with the principles, the mandate, and the roles of the organisation as outlined above. But they have also to realistically show MRC's contribution to management and mitigation of flood risks and hazards in the Basin.

In line with the Logical Framework terminology as applied in MRC, the **Development Objective** for the Strategy, indicating the **benefit for the riparian countries** that is expected to emanate from an MRC involvement in this field, is therefore proposed as follows:

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

The **Immediate Objective**, expressing the **utilisation of MRC Services by its clients**, has been formulated as follows:

Mekong floodplains are well managed, by making appropriate use of reliable flood-related information, land-use potential, structural measures, and effective emergency response.

The actual **services to be provided** by a future MRC Programme can be described by the following summary statement:

Reliable flood-related information, training, and scientific advice on the appropriate and well-coordinated management of the Mekong flood plains is provided.

3.3 FIELDS OF MRC INTERVENTION

In more detail, services that can be provided by MRC are grouped here according to the three **Strategic Roles of MRC** as outlined above:

- 1. Providing Technical Products and Services;*
- 2. Addressing Differences and Facilitation;*
- 3. Capacity Building and Technology Transfer.*

For an outline of a future MRC involvement in this field, the further definition of the MRC Strategy in this section is structured according to these three strategic roles and what can be done by MRC accordingly in the four fields of integrated flood management. This results in twelve possible fields of intervention that may be covered in a future MRC Programme Component. These fields were discussed and prioritised in the national as well as the regional workshop on the MRC Strategy. Based on the results of the national workshops the ranking of importance for MRC involvement can be summarised in Table 4:

Table 4: Relative Priority of MRC Involvement in FMM, by Strategic Roles and Categories of Floodplain Management Measures

Role Element	Providing Technical Prod. and Services	Addressing Differences and Facilitation	Capacity Building
Land-use planning	Field of Intervention 1.1	Field of Intervention 2.1	Field of Intervention 3.1
Structural measures	Field of Intervention 1.2	Field of Intervention 2.2	Field of Intervention 3.2
Flood Preparedness	Field of Intervention 1.3	Field of Intervention 2.3	Field of Intervention 3.3
Emergency Response	Field of Intervention 1.4	Field of Intervention 2.4	Field of Intervention 3.4

With:	High Importance	Medium Imp.	Lower Imp.
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(The numbers in the table are referring to the respective Field of Intervention covered below)

These 12 possible fields of intervention are outlined below with respect to their justification, possible activities, and implementation arrangements. They will be taken into consideration for the detailed programme phase. Also, a distinction is made there between co-operators and clients. **Internal co-operators** are the other MRC programmes, the Secretariat and the NMCs, while line agencies, Civil Society Organisations and other organisations are considered **external co-operators**, if they provide supplementary services or inputs that are necessary for MRC to produce its results. **Clients** are those institutions or people who request and make use of the products and services delivered by MRC. The benefit of floodplain management efforts for the people in the flood prone areas (i.e. the beneficiaries) is a result of the action of these clients or target group, and not of direct MRC intervention. The impact of MRC's contribution to improvements in the floodplain management process in the Basin therefore depends on how the organisation reaches its clients and how efficiently they use these inputs and support. This is what MRC has to ensure.

STRATEGIC ROLE 1: Providing Products and Services

FIELD OF INTERVENTION 1.1: Land-Use Planning

Needs and Justification

To improve land-use planning in flood prone areas in the Mekong Basin a comprehensive database is strongly needed in the countries. This includes updated GIS maps on present and future land-use, flood hazard zones and flood damage risk areas at a scale which is suitable for planning purposes at the provincial and district level. So far effective integration of flood management in the land-use planning process has been restricted in some areas as respective data were not available. However, data availability for these fields differ considerably among the four countries. To improve regional coordination and cooperation in land-use planning for floodplains and catchment areas of the Mekong Basin these data and respective GIS maps should be made available and freely exchanged among the member countries.

As a necessary condition for the provision of maps common definitions for “flood hazard zones” and “flood damage risk areas” need to be defined to increase regional comparability of data and maps.

Regional guidelines for land-use planning and land-use in the flood plains and catchment areas are seen as useful. These could serve the countries as an orientation for the integration of flood plain management in the land-use planning process and in the long term could improve land-use in the region.

Finally, there is a need for a better understanding about how present and future land-uses will affect duration and extent of floods in the Mekong Basin. Respective research is considered as crucial to reduce future flood damage from inappropriate land-use in the floodplains and catchment areas.

MRC's Involvement

As a first step MRC would develop together with the line agencies common definitions and criteria for flood hazard areas and for areas at potential flood damage risk.

By applying these criteria regional on present maps for flood hazard zones and flood damage areas will be produced and constantly updated in the Technical Support Division at MRCS while ensuring open access for all stakeholders, but not necessarily free of charge. A comprehensive data inventory is necessary to analyse present data availability and gaps.

To improve the understanding of the linkages between land-use changes and flood duration, flood intensity and frequency MRC could carry out research studies in selected areas of the Mekong Basin. Such information are important to ensure that future developments in the Basin will not increase the flood risk in critical areas of the Basin

Finally, to harmonize land-use planning and to improve land-use in flood prone and catchment areas MRC could develop common guidelines together with line agencies of all member countries. These can serve the countries as an orientation.

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Timing

A good database and information exchange on land-use and flood related data is generally seen as a priority which requires immediate action. However, once the database is established constant updating and improvement is necessary and requires long-term involvement. The quality of the database will increase with increasing capacity in the countries and in MRCS for data collection and analysis.

The definition of criteria and standards is considered as a necessary first step for the production of regional maps but harmonisation of information systems is a complex task which requires short and medium term action.

Assessing the impact of land-use changes on flooding on a regional level generally requires some long-term research. As the better understanding of the underlying causes of increased floods causes is of importance research studies should be

started soon after the programme has been formulated. Some analytical assessments of impacts of land-use changes on flooding on a local level could be done relatively quickly.

The formulation of regional guidelines on land-use in floodplains and catchment areas are considered more as a medium- and long-term activity which needs good preparation.

Cooperators

Coordination is especially necessary with MRC core and sector programmes. Hydraulic and hydrologic models which are elaborated under the WUP should be tested for their suitability to assess the impacts of land-use changes on flooding. The FMM programme can supply valuable information and analysis results to be taken into account when decisions are made for basinwide development under the BDP. Close cooperation with the AIFP is useful as an inventory of water and land resources and the production of land-use zone maps for Lao PDR and Cambodia is also part of that programme. Finally, research studies as a component of the Environment Programme will include further investigation of the underlying causes of floods. It has to be discussed if the impact of land-use changes on flooding is fully taken into account or if additional studies under the FMM programme are necessary. Finally, cooperation needs to be set up with the MRC project on "Formulation of a Master Plan for Waterborne Transport Sector in the Mekong Delta. In many parts of the Basin, road transport is not possible due to inundations sometimes for four to six months a year, including the period to repair the roads after the floods. Water transport is therefore crucial. Considerable amount of attention will be given to flood issues during the implementation of that project.

Besides the MRC programmes close cooperation with line agencies and NMCs is important as the maintenance of a comprehensive and regularly updated database is only possible if necessary, data and information are timely supplied by the national counterparts. As responsibilities for data collection are more and more taken over by national agencies fewer input is required from MRCS. Cooperation with international agencies and civil society organisations on data exchange could provide some valuable additional information. Close cooperation with the line agencies is also of special importance for the formulation of above-mentioned guidelines, criteria and definitions to ensure an agreement among all member countries and to promote their application in the countries.

Clients

An improved data repository at MRCS will be accessible for all stakeholders, especially line agencies involved in land-use planning, NMCs, International Organisations and Civil Society Organisations.

FIELD OF INTERVENTION 1.2: Structural Measures

Needs and Justification

High quality and neutral analytical services are needed to derive—within the best scientific and engineering tools available—objective analyses of the causes and effects of floods in the basin and how these are influenced by structural measures.

MRC's Involvement

With respect to flood analytical services MRC could undertake a wide variety of analyses requested by riparian states, such as hydrologic and hydraulic model analyses and risk assessment of embankments, dikes and dams. Especially hydrologic and hydraulic models of other MRC programmes should be tested for their appropriateness for the FMM programme. By developing, maintaining and updating basin-wide models and transferring appropriate models to the member countries, MRC could assume a function as a regional flood information centre.

Furthermore, MRC could compile all the information on existing and planned infrastructure in the LMB to facilitate access for the member countries.

With respect to building and development control, MRC should develop and promote guidelines on flood proofing.

Cooperators

Inputs for these services may be obtained from sources of high quality and objective analyses, such as science and engineering agencies in the basin and in the developed world, universities, and selected international consulting organisations, and the upstream countries China and Myanmar.

Clients

Clients would be mainly line agencies in the riparian countries that require objective analyses to (a) plan, implement, and assess the impacts of structural measures and (b) implement their flood management and mitigation missions.

FIELD OF INTERVENTION 1.3: Flood Preparedness

Needs and Justification

Data, information, and technical services are the core needs for flood forecasting and warning. Historical data are needed to characterise the hydrologic response of rivers to rainfall via the calibration of rainfall-runoff and other models in the upper part of the Mekong basin. Real-time data are needed to characterise the current state of the basin and to operate the models. Such real-time data include the current river discharges and levels in the main stem and tributaries of the Mekong, and weather systems that convey rain into the basin. The latter are very important in the preparation of flash-flood advisories throughout the basin. Flood forecasting in the lower part of the Mekong basin is done with hydraulic models that depend on topographic data—in digital or map-based form—and river channel cross section data. Topography and river cross sections themselves may change because of the dynamic nature of the Mekong, Tonle Sap, and Bassac Rivers. Moreover, if these data are to be comparable, they must be collected and quality assured with reference to agreed-upon, basin-wide standards. Flood forecasting and warning must be accurate and quality assured, and the competency of flood forecasting staff assured. Flood forecasting and warning also needs ancillary information, such as flood frequency estimates, topographic maps, flood inundation vulnerability maps, population distribution maps, and land-use maps. Even with high-quality data and

information, technical resources such as computer-based hydrologic and hydraulic models, data bases, and communications technologies are needed to prepare and convey warnings to the public, line agencies in the riparian states, non government organisations, and the international community. Finally, flood forecasting is inherently uncertain because weather forecasting, rainfall and river monitoring, and the models themselves are not perfect. The uncertainty must be included in the forecast so that the user knows how much confidence to have in the forecast.

MRC's Involvement

MRC established the precedent in the 1970's for flood forecasting the main stem of the Mekong River. Though in need of modernisation, MRC has the trust of the riparian community to provide flood forecasting services on the main stem and to assist the riparian countries strengthen their capacity for flood forecasting and warning on the tributaries. Through the - Immediate Improvement of the MRC Flood Forecasting System - 3 to 5-day flood forecasts are being displayed on the web (www.mrcmekong.org) on a daily basis. The forecasting system will be enhanced when the telemetering network of water level (and rainfall) stations comes online early next year, including two stations in China. A project proposal for the Flood Forecasting and Warning Dissemination System has been prepared by the MRCS.

To differing degrees, riparian line agencies do not share data and information sufficiently well enough to meet even domestic water-management and flood-forecasting purposes, and MRC can be the mechanism for sharing data between agencies within and between the riparian countries. Moreover, by building consensus among the riparian countries on a variety of standards, such as data collection, exchange, storage, and quality assurance, MRC can assure that the data are comparable, basin wide. With MRC serving as a centre of excellence in flood forecasting, and data and information archiving, it can assist the riparian counterpart line agencies achieve a common level of capacity and performance.

MRC should establish a Regional Flood Information Centre in the Secretariat that should act as a data repository, provide flood risk maps, satellite remote sensing and GIS based information on flood extent, flood behaviour analysis, evaluation of efficiency/ effectiveness of flood preparedness, lessons learned, scenarios' simulation of flooding by incorporation up to date information on land-use, structural development, etc.

In addition to this, it should set up guidelines and provide assistance for flood warning and information dissemination (warning preparation, dissemination, interpretation). Further guidelines to be set up are for flood preparedness (regional and community based preparedness). And MRC should develop instructions for the use of flood forecast, flood map information, etc.

Timing

Establishment of flood data, information, and analytical services will start from the existing base of flood forecasting services. There will be an initial planning phase to define the types and quantities of data and information to collect, methods of storage and retrieval—including on line as well as off line methods—classes of analytical services, and range of standards to be adopted.

Cooperators

MRC would be part of a team of cooperating agencies, in the private as well as the public sectors, that would build data, information, and technical services. Within the basin, public agencies would include line agencies responsible for data collection and archiving, and warning, at the national, provincial, and community level. Cooperators outside the basin would be international organizations or counterpart agencies in the developing world that have perfected monitoring, forecasting, mapping, warning and other analytical techniques that need to be imported to the Mekong Basin. These include, for example, rainfall assessment and modeling that are being provided to the MRC by NOAA and the US Geological Survey (USGS). Academic institutions, worldwide, can assist MRC with assessing or modifying hydraulic models that have application in the basin. International organizations, such as the World Meteorological Organization (WMO) and the International Standards Organization (ISO), can assist MRC and the riparian countries with the adoption of appropriate standards. Organizations such as the WFP and the FAO have established an excellent network of data gathering in the field which can be very useful for the MRC activities, and vice-versa.

Clients

The principal client is the public, with numerous government agencies at the national, provincial and district level as well as international organisations and Civil Society Organisations operating for them and on their behalf. Flood forecasts and warnings are intended to provide sufficient lead time for communities to minimise the loss of life and property by evacuation prior to the flood and for response agencies to react to flood damages. A flood data, information, and analytical services centre can provide the basis for studying the causes and effects of floods by academic institutions, line agencies, non-government organisations, and the international community. Such studies are the basis for improving flood management and mitigation planning.

FIELD OF INTERVENTION 1.4: Flood Emergency Management

Needs and Justification:

A number of technical services and outputs were identified as priorities during consultations and national workshops which would enhance flood response and recovery. These may be grouped in the following categories:

- Layers in digital format and Analyses derived from Geographic Information Systems for planning and reporting purposes.
- Model Guidelines for community-based risk maps linked to regional hazard maps, physical rehabilitation planning and management, and damage assessment and reporting linked to flood monitoring systems.
- Scientific Studies and pilot projects to examine special topics in depth, such as testing early warning systems or causes of severe and unusual flood impacts.

Most groups identified a large number of mapping or GIS products that would be of immediate and long-term benefit to response and recovery planning and reporting.

Products included interpretation of radar imagery that may be obtained from humanitarian agencies for determining flood extent, interpretation of layers for flood hazard classifications, and special interpretative work that may be required in a major flood emergency. In Cambodia alone, donors, disaster management agency sections and civil society organisations requested over four hundred maps during the 2000 flood which served as valuable references for planning response and recovery operations.

Groups and individuals also repeatedly raised the need for regional guidelines, models and standards in key information sectors related to emergency management. These products would allow for comparability between countries, which was considered a desirable objective by most stakeholders. Another cited benefit was economies of scale. By introducing appropriate formats for the region, countries are spared unnecessary expenses and time when resources are already limited.

MRC's Involvement:

Mekong River Commission holds a unique place in the basin as a centre of geographic information systems for the Mekong River's flood plain. As such, it is in a position to provide technical products and services as needed, such as flood maps, thematic maps, and satellite imagery. Services could also include timely information on appropriate evacuation channels and safe havens, both for preparation and for "real time" flood emergencies".

MRC could prepare and recommend common standards for reporting damage assessment and provide tools for linking needs assessment results with other flood information systems.

Implementation of the MRC-project: "Formulation of a Master Plan for Waterborne Transport Sector in the Mekong Delta". Reference is made to MRC's Involvement under Field of Intervention 1:1. Transport and good logistics are paramount flood emergency response. The Master Plan Study will address this need very carefully.

Timing:

Preparation of public information materials are considered both a short and mid-term set of activities. A limited number public information materials could be organised relatively quickly.

Cooperators:

Co-operators would include all agencies who provide inputs to MRC that are prerequisites that MRC can provide its services. This applies first of all to all kind of data that is to be provided by national line agencies in the field of hydrology and meteorology. This also includes ground truthing that could, e.g., be done by humanitarian agencies, national flood emergency management agencies, and Civil Society Organisations or international organisations working in the field. In addition, these organisations could provide valuable guidance and supplementary services to ensure that MRC's technical products are accessible to all stakeholders and can be understood and used by them.

Clients:

The primary clients of this strategic intervention area are the entire range of stakeholders engaged with flood response and recovery operations.

STRATEGIC ROLE 2: Addressing Differences and Facilitation

FIELD OF INTERVENTION 2.1: Land-Use Planning

Needs and Justification:

As certain land-use activities in one country might negatively affect flooding in a neighbouring country, they may form a reason for differing opinions and disagreement that need to be solved. In order to do so, better coordination among the member countries on land-uses planning in floodplains and catchment areas is necessary. In the case of conflicting land-uses a neutral institution may be able to facilitate an agreement, if no bilateral solutions can be found.

MRC's Involvement

MRC has to improve data exchange by ensuring that data on land-use, flood hazard areas and flood damage risk areas are included in existing agreements on information exchange and sharing among the four member countries.

MRCs involvement to foster coordination and cooperation in land-use planning to minimise flood damage was requested from all four countries. Generally, it is the task of the BDP to support the countries in formulating a basin development plan which will include flood management as an important component. If flood aspects regarding land-use are adequately taken care of in the BDP, such a framework plan can help to avoid disputes between communities and countries.

It is therefore an important task of the FMM programme to supply the BDP with adequate inputs that help to ensure that the consideration of flood aspects in land-use planning are fully being taken into consideration. Important steps to discuss such concepts are regular forums and workshops in which experiences on appropriate land-use in floodplains and catchment areas can be exchanged and best practices of "living with floods" can be discussed.

In the case of actual cases of differences in opinion over land-use, MRC could first provide neutral technical expertise to clarify the arguments. In a second step, it could then act as a facilitator, helping to find mutually agreeable solutions. Further clarification is needed to specify conditions and appropriate procedures for MRC's involvement in this respect in line with the 1995 Agreement.

Timing

Activities to improve data and information exchange and sharing should be closely linked to actions which are currently carried out under the WUP

Workshops and forums are short term activities which form a necessary basis for future cooperation in the field of land-use planning.

Acting as a facilitator for resolution of land-use issues that cause disagreement will be a task MRC will take up whenever invited by a country.

Cooperators

The WUP is currently discussing rules for data and information exchange and sharing. It has to be ensured that data on land-use and flood hazard areas, flood damage risk areas are included under the final agreement.

As mentioned earlier close integration into the planning process of the BDP is crucial. Workshops and forums are good opportunities to cooperate with other national and regional actors including international organisations and civil society organisations. Their experiences will form a valuable input for discussions and the formulation of regional concepts for "living with floods".

Clients:

Clients include primarily line agencies and provincial authorities which are involved in land-use planning as the ones mentioned in Section 2.3, above, and provincial authorities in border provinces who are involved in land-use planning and decision making. Also, private developers may be considered as clients to be involved in MRC's efforts to address differences and disagreement concerning flood aspects in decisions on land-use. With this, the overall benefit is directed to the people in the Basin who suffer from inappropriate land development and land-use with trans-boundary implications.

FIELD OF INTERVENTION 2.2: Structural Measures

Needs and Justification

The Mekong basin experienced several cases where structural measures in one country may contribute to – or helped to avoid - flooding in another. If these issues cannot be solved bilaterally there is a need for an invited neutral institution to assist the countries in solving trans-boundary problems. Such cases include, eg, changed flooding behaviour resulting from large release of water from dams located in upstream area, or from the extensive use of flood protection embankments. Such structural measures in one country maybe perceived to lead to a change in the magnitude, duration, and extent of floods in another country.

The magnitude of trans-boundary disagreement may be reduced via an objective, impartial scientific analysis of the conflicting issue itself. Moreover, many conflicts can be prevented by cooperation among counterpart organisations in the riparian countries.

MRC's Involvement

MRC is a creation of the riparian countries and is sufficiently trusted as an invited neutral advisor to provide analytical services for confidence building and to maintain ongoing coordination among the riparian countries. With respect to addressing trans-boundary issues, the MRC can provide neutral technical expertise from within

its own staff or from centers of excellence, worldwide. With respect to coordination, MRC can maintain standing committees of counterparts, annual flood assessment and planning conferences, on-line meetings, and any of a large number of mechanisms to help counterparts share their problems and solutions, and to access the experiences in the developed world. Also, the involvement of experts from other member countries that are not directly involved in a specific conflicting issue can be helpful.

If invited by riparian countries, MRC could also provide impartial technical expertise to address trans-boundary issues. Facilitation could be done on the basis of scientific analysis on effects of structural measures, though, e.g.:

- Providing impartial analysis and assessment on causes of flooding
- Installation of hydrological stations in possibly affected areas
- Put in place the hydraulic models at the MRC Secretariat and the Countries
- Foster regional exchange of information on gate/dam operating times (and quantity of release)
- Draft and promote guidelines for gate operating rule of dams and flood embankments
- Suggesting gate operating rule of dams and floods embankments
- Setting up common standard criteria for safety level
- Regional forum for exchange of experiences and discussion
- Undertaking and coordinating regional pilot projects.

Finally, MRC could promote notification, prior consultation and agreement wrt water use in cooperation with WUP.

Cooperators

Cooperators in this respect are all agencies, international organisations, and universities that could provide data inputs and conduct impartial analyses as additional neutral observers and advisors. This may also include expertise from China and Myanmar.

Furthermore, cooperation with another MRC programmes is essential.

Clients

Major clients are the responsible authorities, line agencies and affected communities in the respective countries, also in the upstream countries.

FIELD OF INTERVENTION 2.3: Flood Preparedness

Needs and Justification

With regard to flood preparedness and flood forecasting, common standards on hydrometeorological data collection and data transmission are required. Additionally, standards on data and information exchange, and sharing are needed, along with a network for dissemination of flood preparedness information.

MRC's Involvement

MRC could act in this respect and develop and propose common standards on hydro-meteorological data collection, transmission, and sharing. This would be facilitated by the active involvement of selected line agencies in the riparian countries.

In addition, common formats for data exchange could be developed and the exchange of information and data promoted in general.

Cooperators

Common standards could come from the World Meteorological Organisation (WMO) and the International Standards Organisation (ISO), who have these standards readily available. Other sources of standards include hydrometeorological organizations in other countries, other river basin organization, or professional societies.

Clients

The clients for these efforts would be the national line agencies responsible for data collection and interpretation in flood forecasting.

FIELD OF INTERVENTION 2.4: Flood Emergency Management

Needs and Justification

In case of emergencies in border areas, there is no mechanism in place for mutual help.

MRC's Involvement

MRC could assist by opening its communication and coordination channels for supporting trans-boundary emergency operations. Also for such cases, the promotion of data exchange will be an important task of the organisation. A first step in this direction could be the organisation of annual flood management meetings involving emergency managers. Some countries also suggested that MRC could provide common guidelines for disaster management.

Finally, MRC could facilitate formation of agreements to mobilize resources between lower basin countries in support of emergency management.

Clients

The clients for these support measures would be the emergency response agencies that are active on both sides of the border area where the flood problem has occurred.

STRATEGIC ROLE 3: Capacity Building and Technology Transfer

FIELD OF INTERVENTION 3.1: Land-Use Planning

Needs and Justification:

Apart from some good examples from the Vietnamese part of the Mekong Delta, no comprehensive concept which includes a national policy and respective guidelines for appropriate land-use in the floodplains and critical catchment areas exists. Flood-related data like flood inundation maps, flood hazard maps and flood damage risk maps do not exist or are not efficiently used in the land-use planning process. There is a strong need for technology transfer (e.g. GIS software, Remote Sensing Technologies) and training to improve the capacity for data collection and mapping. Besides that, reliable hydraulic models are needed to assess the impact of certain land-uses or future plans on floods, especially in Laos and Cambodia.

MRC's Involvement

MRC's involvement will depend on prevailing conditions in each country. Generally, MRC could assist the countries to improve their institutional capacity for data collection and data analysis, the production of GIS-based flood maps (flood hazard maps, flood inundation maps, flood damage risk maps), modelling to assess the impact of land-use changes on flooding, and the use of flood maps in the planning process.

It is important that MRC assists the countries not only with better technologies, but also promotes the efficient use of maps, data and hydraulic models in the land-use planning process. This could be achieved through on-the-job training, workshops and seminars. Pilot projects in selected areas could be carried out to demonstrate best practices for land-use planning in flood prone areas. In these pilot projects public education would be an important component to raise awareness among the people of the impact of land-use on flooding. To spread knowledge on such best practices for appropriate development in flood prone areas, assistance in the formulation of curricula could be provided to universities.

Timing

Capacity building for data collection, mapping and efficient data use in the planning process is generally seen as a high priority in the countries. Whereas in the short-term capacity building at MRCS will also be of importance, it should be the long-term goal to strengthen the capacity for data collection and data analysis in the countries themselves.

Cooperators

Good cooperation is especially needed with the MRC Capacity Building Programme, the Environment Programme, and the AIFP. Cooperation is further needed with universities for joint development of respective curricula and with international organisations and civil society organisations to share experiences of best practices.

Clients

Major clients for capacity building in this field include trainers and land-use planners in the line agencies involved in land-use planning, as well as NMCs. Universities may also be among the clients who may take up flood aspects into their curriculum on land-use planning.

FIELD OF INTERVENTION 3.2: Structural Measures

Needs and Justification

With new and sophisticated technology especially in modelling, there is a need to improve the capacity of the concerned officials in the countries as well as at the MRC Secretariat.

MRC's Involvement

In cooperation with the WUP, BDP, EP and other programmes MRC should continue to offer training in modelling to increase the awareness and cooperation between the countries and line agencies in floodplain management, and to improve individual and organisational skills at all levels, regional, national as well as local, wherever necessary. It should furthermore test the appropriateness of new hydrologic and hydraulic models for the Mekong Basin.

Cooperators and Clients

Cooperators are regional and international research and academic institutions. Concerned officials in the countries and the MRC Secretariat staff are considered clients for the capacity building measures in this respect.

As mentioned above close cooperation with other MRC programmes is important to avoid overlaps.

FIELD OF INTERVENTION 3.3: Flood Preparedness

Needs and Justification

Flood forecasting and warning is limited by insufficient human capacity—in the MRC as well as the riparian countries—and largely outmoded technologies. Hence there is a broad need to strengthen capacity and transfer technology into the basin from outside. The need for capacity development ranges from data collection and transmission, analysis and forecasting, product development—including flood modelling and forecasts, flood-inundation maps, and risk assessment—to warnings

and post-flood assessment. There is a need for common and modern technology to monitor the Mekong river and tributaries, rainfall basinwide, land-use, and the extent of flooding, and effects of structural measures on flood duration, geographical extent, and magnitude. And there also is a lack of technical and human capacity to transfer of the hydrological data from the field to the MRC Secretariat, which is necessary for daily modelling and flood forecasting.

MRC's Involvement

MRC's involvement in capacity development and technology transfer under this element is based upon its involvement in the other two Strategic Roles: Providing technical products and services and Addressing differences and facilitation. With respect to flood forecasting, capacity development and technology transfer are complementary tasks for these two functions, for which MRC has traditionally a strong position in the Region.

For flood forecasting, MRC should act as data/information and knowledge centre, a technology transfer centre, a capacity development centre, and a forum of consultation and experiences sharing. Furthermore, it should provide (Master) Training on flood forecast and flood map interpretation

Timing

In the sense of timing and schedule, capacity development is the limiting factor in strengthening flood forecasting and warning, with the development of MRC capacity as a prerequisite to developing riparian capacity. As these capacities are developed, appropriate flood forecasting and warning technologies can be introduced at the appropriate pace.

Cooperators

Cooperating organisations will include international organisations, such as the World Meteorological Organisation, and counterpart flood-related agencies in the developed world that have expertise in appropriate technologies. Private sector companies that manufacture and implement technologies, and academic institutions will cooperate with MRC in the capacity development of MRC and riparian staff.

OFDA would like to strengthen cooperation with MRC regarding financial and technical assistance for flood forecasting and early warning.

IFRC and CARE expressed interest at the regional workshop to cooperate with regard to data sharing. Through their network of volunteers, they have good access to flood data and damage/situation reports. They are regularly carrying out needs assessments which could provide some valuable inputs to improve data dissemination by MRC. Through their activities in the communities they could help to improve dissemination of MRC's flood and warning data down to the grass root level.

Clients

Clients largely will be officials from riparian line agencies that provide flood data-collection, transmission, forecasting, and warning services.

FIELD OF INTERVENTION 3.4: Flood Emergency Management

Needs and Justification:

There is a general agreement among emergency management stakeholders that training and enhanced ability to access technical services are urgently required in all four countries of the Lower Basin. In order for flood affected communities in the basin to benefit from improved flood forecasting or hazard mapping, managers responsible for transmitting this information must be able to confidently use such tools. Training needs identified in the workshops covered a wide array of skills, ranging from basic proposal writing skills, to use and interpretation of flood forecast information in village-based early warning systems. Access to technical services means having the proper orientation and knowledge to make proper use of products such as flood forecasts and inundation mapping.

More specifically, there was concern that emergency managers often work in a vacuum, where severe flood events trigger responses that are not often well integrated with other aspects of flood management. There is growing recognition that preparedness and public awareness makes the crucial difference in successful emergency responses. How to translate these concerns into a framework that can be used by practitioners remains a challenge.

Finally, as new technical services become available, there must be opportunities for testing their application before programmes go to scale.

MRC's Involvement:

While capacity building is provided by many of the international agencies in the lower basin, MRC holds a comparative advantage in sponsoring targeted training workshops and materials to bridge the gap between scientific study and practical tools for emergency managers. Capacity building measures that are best provided by MRC include:

- a) Regional workshops aimed at emergency managers for using MRC services and advanced technical products;
- b) Development of public information materials about integrated flood management principles;
- c) Checklists for use by other agencies when planning emergency assistance;
- d) Study tours to areas where emergency management is linked to integrated floodplain management, and;
- e) Appointment of a focal point in the MRC who will interact with flood emergency agencies.
- f) Advocate for national capacity building support with donors.

Timing:

Training and preparation of public information materials are considered both a short and mid-term set of activities. A limited number of special topic workshops and public information materials could be organised relatively quickly, but preparation of pilot projects and extended series of training on hazard mapping would require a two to three-year implementation window.

Cooperators:

Capacity building and flood emergency management involve several types of agencies in the Mekong Region. Partnerships or training agreements can be formed with civil society organisations, research institutes, and UN agencies who have specific expertise in this field or share similar goals. National Disaster Management Agencies are not only clients but are also expected to prioritise training needs. ADPC, IFRC, UNDP and UN-DMT who have a lot of experiences in regional, national and local training courses in community-based disaster management expressed particular interest at the Regional workshop to cooperate with MRC through joint projects for capacity building on flood preparedness and disaster management.

Clients:

But the primary clients of this strategic area are of course the managers and trainers within national disaster management agencies mentioned above. In addition to government staff, Civil Society Organisations who are directly engaged with emergency management, such as IFRC and national red cross agencies, should also be primary clients. These resource people in turn would be responsible for transferring knowledge and services to people at more local levels, such as government officials at province, district, and commune level.

3.4 CHALLENGES FOR IMPLEMENTING THE STRATEGY

Implementing the MRC Strategy on Flood Management and Mitigation will create a number of challenges for the MRC Secretariat. It may call for the introduction of new technologies, require new capacities within the Secretariat, and management of projects that are integrated with each other and with existing MRC programmes. The capacity of MRC staff will need to be built if MRC is to facilitate capacity building and technology transfer to the riparian States. These challenges raise at least four issues:

- **Management of policy implementation.** Project management and co-ordination within MRC will require sufficiently qualified staff to adopt modern project management techniques that track project objectives, deliverables, costs, schedules, and cross-cutting links to another project.
- **Technology transfer to MRC.** The MRC Secretariat will need to master new technologies before these technologies can be transferred to riparian States.

- **Capacity building in MRC.** It seems readily apparent that major capacity building efforts will also have to include MRC Secretariat staff and will be a continuing process.
- **Coordination and links.** There is a strong need for good Coordination among the MRC Programmes during their planning, formulation and implementation.
- **Funding.** And finally, the prospects for funding of the proposed MRC interventions need to be clarified and realistically assessed.

ANNEX

LIST OF ACRONYMS

ADB	Asian Development Bank
ADPC	Asian Disaster Preparedness Centre
ADRA	Adventist Development Relief Agency
AIFP	MRC Sector Programme: Agriculture, Irrigation, Forestry (Also: Sustainable Land and Water Use Programme)
AIT	Asian Institute of Technology
AusAID	Australian Agency for International Development
BDP	MRC Core Programme: Basin Development Plan
CARE	Cooperative for Assistance and Relief Everywhere
CB	Capacity Building
CCFSC	Central Committee for Flood and Storm Control (Viet Nam)
CDD	Civil Defence Division (Thailand)
CIDSE	Catholic International Cooperation for Development and Solidarity
CRS	Catholic Relief Services
DAALI	Department of Agronomy and Agricultural Land Improvement
DAE	Department of Agriculture and Extension
DANIDA	Danish International Development Assistance
DDMFC	Department of Dyke Management and Flood Control
DMH	Department of Meteorology and Hydrology
DMU	Disaster Management Unit
DWRHWM	Department of Water Resources and Hydraulic Works Management
ECHO	European Commission's Humanitarian Aid Office
ENP	MRC Core Programme: Environment Programme
ESCAP	The Economic and Social Commission for Asia and the Pacific
EU	European Union
EWIS	Early Warning and Information System
FAO	Food and Agricultural Organisation
FICAH	Food Industry Crusade Against Hunger
FMM	Flood Management and Mitigation
GEF	Global Environment Facility
GMS	Greater Mekong Subregion
GTZ	German Agency for Technical Cooperation
HVAs	High Value Areas
HYDROLOGIS	Hydrologic model of the IH&M
IFRC	International Federation of Red Cross
IHM	Institute of Hydrology and Meteorology
IIDRM	International Institute for Disaster Risk Management
ISO	International Standards Organization
LMB	Lower Mekong Basin
MAF	Ministry of Agriculture and Forestry (Lao)
MAFF	Ministry of Agriculture, Fisheries, and Forestry (Cambodia)
MARD	Ministry of Agriculture and Rural Development (Viet Nam)
MCTPC	Ministry of Communications, Transport Post and Communications (Laos)
MIH	Ministry of Industry and Handicraft (Lao)
MIME	Ministry of Industry, Mines and Energy
MLMUPAC	Ministry of Land Management, Urban Planning and Construction (Cam- bodia)
MOWRAM	Ministry of Water Resources and Meteorology (Cambodia)
MRC	Mekong River Commission
MRCS	Mekong River Commission Secretariat
MSL	Mean Sea Level
NCHMF	National Centre for Hydro-Meteorological Forecasting (Viet Nam)
NDMO	National Disaster Management Office
NGO	Civil Society Organisation (Non-Government Organisation)

NIAPP	National Institute of Agricultural Planning and Production (Viet Nam)
NMC	National Mekong Committee
NOAA	National Oceanic and Atmospheric Administration
NORAD	Norwegian Agency for Development Cooperation
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
OXFAM	Oxford Committee for Famine Relief
PDR	Peoples Democratic Republic
PRC	Peoples Republic of China
RCS	Red Crescent Society
SDC	Swiss Agency for Development and Cooperation
SEF	Strategic Environmental Framework
SIDA	Swedish Agency for Development Cooperation
SIURP	Sub-Institute for Urban and Rural Planning
SIWRP	Sub-Institute of Water Resources Planning
SIWRR	Southern Institute of Water Resources Research
SRHMC	Southern Region Hydro-Meteorological Centre
SSARR	Streamflow Simulation and Reservoir Regulation
TA	Technical Assistance
UNDMT	United Nations Disaster Management Team
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFPA	United Nations Population Fund
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UNWFP	United Nations World Food Program
USAID	United States Agency for International Development
USGS	United States Geological Survey
WFP	World Food Programme
WHO	World Health Organisation
WMO	World Meteorological Organisation
World Bank	International Bank for Reconstruction and Development
WRHP	MRC Sector Programme: Water Resources and Hydrology
WUP	MRC Core Programme: Water Utilisation Programme
WWC	World Water Council
WWF	Worldwide Fund for Nature

GLOSSARY

Basin—(Hydrology) A geographic area drained by a single major stream; consists of a drainage system comprised of streams and often natural or man-made lakes. Also referred to as Drainage Basin, Watershed, or Hydrographic Region. (Ref: Nevada Department of Water Planning)

Capacity development—See MRC Capacity Building Programme

Data—representations of facts, concepts, or instructions in a formalised manner, suitable for communication, interpretation or processing. (Ref.: Introduction to Information management through Geographic Information Systems and Remote Sensing, Environmental Technical Advisory Programme, UNDP/UNOPS-Cambodia, 1997, Dirk Vanderstighelen & Tom Kunneke).

Downstream—In the direction of the current of a stream. (Ref: Nevada Department of Water Planning)

Drainage basin—land area where precipitation runs off into streams, rivers, lakes, and reservoirs. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge. Large drainage basins, like the area that drains into the Mississippi River contain thousands of smaller drainage basins. Also called a "watershed." (Ref: US Geological Survey)

Flood Damage Risk Maps – By overlaying flood hazard maps with land-use maps and population density maps the potential damage risk from floods can be determined. The damage risk is defined by flood hazard and potential lost of value. Different degrees of damage risk can be defined and mapped for certain areas.

Flash flood—flood of a short duration with a relatively high peak discharge. (Ref: UNDHA)

Flood discharge—the volume of water that passes a given location within a given period of time. (Ref: US Geological Survey)

Flood hazard – Flood hazard depends upon a combination of factors such as flood frequency, flood depth and velocity of floodwaters. By taking these factors into account different degrees of flood hazard can be defined and mapped for certain areas (Flood Hazard Maps)

Flood return period—Average interval in years between the successive occurrences of some event, such as flood exceeding a certain level or discharge. (Ref: UNDHA)

Flood risk – The flood risk is determined by the frequency of flooding. Different degrees can be defined and mapped for a certain area.

Flood stage (or level)—The elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured. (US Geological Survey)

- Flood**—An overflow of water onto lands that are used or usable by man and not normally covered by water. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river, stream, lake, or ocean. (Ref: US Geological Survey)
- Floodplain**—A strip of relatively flat and normally dry land alongside a stream, river, or lake that is covered by water during a flood. (US Geological Survey)
- Hydrograph**—Graph showing variation of stage, discharge, velocity, or other property of water with respect to time. (Ref: US Geological Survey National Water Summary 1988-89, Hydrologic Events and Floods and Droughts)
- Information**—data that have been interpreted, processed and refined, and then displayed in a format that is convenient for management, decision making, planning or research purposes. In practice, the distinction between data and information is often difficult to maintain. Data become information when used in the context of making a specific decision or when applied to the solution of a particular problem. (Ref.: Introduction to Information management through Geographic Information Systems and Remote Sensing, Environmental Technical Advisory Programme, UNDP/UNOPS-Cambodia, 1997, Dirk Vanderstighelen & Tom Kunneke)
- Land-use**—The primary or primary and secondary used of lands, such as cropland, woodland, pastureland, etc. The description of a particular land-use should convey the dominant character of a geographic area, and thereby establish the types of activities which are most appropriate and compatible with primary uses. (Ref: Nevada Department of Water Planning)
- Management**—1. The act or art of managing: the conducting or supervising of something (as a business) (Ref: Merriam-Webster OnLine Dictionary)
2. Water Resources Management; the decision-making, manipulative, and non-manipulative process by which water is protected, allocated, or developed. (Ref: Nevada Department of Water Planning)
- Mitigation**—1. (Environmental, General) Actions designed to lessen or reduce adverse impacts; frequently used in the contest of environmental assessment.
2. (NEPA) Action taken to avoid, reduce the severity of, or eliminate an adverse impact. Mitigation can include one or more of the following; a. avoiding impacts; b. minimizing impacts by limiting the degree or magnitude of an action; c. rectifying impacts by restoring, rehabilitating, or repairing the affected environment; d. reducing or eliminating impacts over time; and e. compensating for the impacts by replacing or providing substitute resources or environments to offset the loss. (Ref: Nevada Department of Water Planning)
- MRC Basin Development Plan**—a plan to ensure coordination of development activities in the Mekong Basin, so that water flow and ecological systems are maintained while Basin resources are developed. (Ref: Mekong River Commission)
- MRC Capacity Building Programme**—a programme to ensure that the administrative and managerial capacities of the MRC Secretariat, the NMCs and line agencies in the four member countries are developing in line with the requirements for implantation of the operational programmes.

MRC Environment Programme—a programme to ensure adequate protection of the environment and ecological balance of the basin.

MRC Water Utilisation Plan—a plan to provide the MRC Member States with the technical framework for managing Mekong water, establish a comprehensive Basin hydrologic modeling package and integrated knowledge base on water and related resources, and formulate a series of “rules” regarding joint water management. (Ref: Mekong River Commission)

National—of, or relating to a nation. (Ref: Merriam-Webster OnLine Dictionary)

Non-structural Measures—(Flood Control) Measures such as zoning ordinances and codes, flood forecasting, flood proofing, evacuation and channel clearing, flood fight activities, and upstream land treatment or management to control flood damages without physically restraining flood waters. (Ref: Nevada Department of Water Planning.)

Participatory—1) characterised by or involving participation; especially : providing the opportunity for individual participation <participatory democracy> (Ref: Merriam-Webster OnLine Dictionary) 2) Participation is a process through which key stakeholders gain influence and take part in decision making in the planning, implementation, monitoring and evaluation of MRC Programmes and Projects. ("Public Participation in the Context of MRC")

Policy—(Water Planning) A statement of governmental intent against which individual actions and decisions are evaluated. The wording of policies conveys the level of commitment to action, for example, policies which the word “shall” are mandatory directions, while those using the word “should” are statements of direction to be followed unless there are compelling reasons to do otherwise. (Ref: Nevada Department of Water Planning)

Preparedness—The quality or state of being prepared. (Ref: Merriam-Webster OnLine Dictionary)

Recovery—the act, process, duration, or an instance of recovering. 2. A return to a normal condition. 3. Something gained or restored in recovering. . (Ref: The American Heritage® Dictionary of the English Language: Fourth Edition. 2000)

Regional—of, relating to, characteristic of, or serving a region <a regional high school. (Ref: Merriam-Webster OnLine Dictionary)

Response—something constituting a reply or a reaction, (Ref: Merriam-Webster OnLine Dictionary)

Scoping— to look at especially for the purpose of evaluation. (Ref: Merriam-Webster OnLine Dictionary)

Stakeholder—A stakeholder is any person, group of institutions that has an interest in an activity, project or programme. This includes both intended beneficiaries and intermediaries, those positively affected, and those involved and/or those who are generally excluded from the decision-making process ("Public Participation in the Context of MRC")

Standards—guidelines for data capture, data processing and data management that are recognised as best practice in their relevant scientific or technical disciplines, with the objective to minimise the transaction costs of using data. (Ref.: MDBC and Environmental Resource Information Network, Government of Australia)

Strategy—a careful plan or method. (Ref: Merriam-Webster OnLine Dictionary)

Structural measures—Measures that delay, reduce, or control flood flows. These measures include reservoirs, channel improvements, levees, and diversion channels. (Ref: Nevada Department of Water Planning)

Sustainable— capable of being sustained a) of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged <sustainable techniques> <sustainable agriculture> b) of or relating to a lifestyle involving the use of sustainable methods <sustainable society> (Ref: Merriam-Webster OnLine Dictionary)

Trans—on or to the other side of: across : beyond <transatlantic> (Ref: Merriam-Webster OnLine Dictionary)

Upstream— in the direction opposite to the flow of a stream. (Ref: Merriam-Webster OnLine Dictionary)

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