MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT (MARD)

REPORT ON

FLOOD MANAGEMENT AND MITIGATION IN THE MEKONG DELTA

NARBO SECOND GENERAL MEETING
IN JATILUHUR, INDONESIA, 14th -16th FEBRUARY 2006

Prepared by: NGUYEN XUAN HIEN

Position: Deputy director
Organization: Sub-Institute for Water Resources Planning
Country: Vietnam

HO CHI MINH CITY, JANUARY, 2006

CONTENT

I. INTRODUCTION

II. FLOOD MANAGEMENT AND MITIGATION IN THE MEKONG DELTA

2.1. Characterization of the flood in the Mekong Delta

2.2 Flood impacts on socio-economy and environment

2.3 Objectives of flood management and mitigation

2.4 Structural Measures

2.5 Non-Structural Measures

2.5.1 Preparedness Measures

2.5.2 Response Measures

2.5.3 Recovery Measures

III. CONCLUSION AND RECOMMENDATION

I. INTRODUCTION

A large area in Northern part of the Vietnamese Mekong Delta is flooded annually. The flooded area is approximately from 1.2 million hectares to 1.8 million hectares in high flood years and flooding lasts from 3 to 6 months with water depth between 0.5 to 5.0 meter. Flooding has serious negative impacts on production and on the lives of the people.

Recognizing the special important role of food production in the Mekong Delta, the Communist Party of Vietnam (CPV) and the Government of Vietnam (GOV) have invested to exploit the abundant potential of the Mekong Delta over the past two decades. The construction of a series of hydraulic works in order to divert freshwater, drain acid water, prevent saline water and drain inundated water and numerous kilometers of dikes for protecting Summer-Autumn rice against floods in combination with application of new rice-seed and advanced agricultural technique have created premises and conditions for changing seasonal–crop structure; have increased rice production of Mekong Delta from single rice production with low yield to double and triple rice production with high yield, from 4.7 million tons of rice product in 1976 to 13 million tons of rice product in 1995 and 17 million tons of rice product in 2000, playing an important role to national food security strategy.

However, a lots of problems related to floods still remain which we do not have enough time, knowledge, experience or capital to tackle in order to develop more stable agriculture and aquaculture production of the Mekong Delta. At present, floods have become the most dangerous disaster, not only damaging people's properties and threatening people's lives, but also hindering progress of industrialization and modernization in the Mekong Delta.

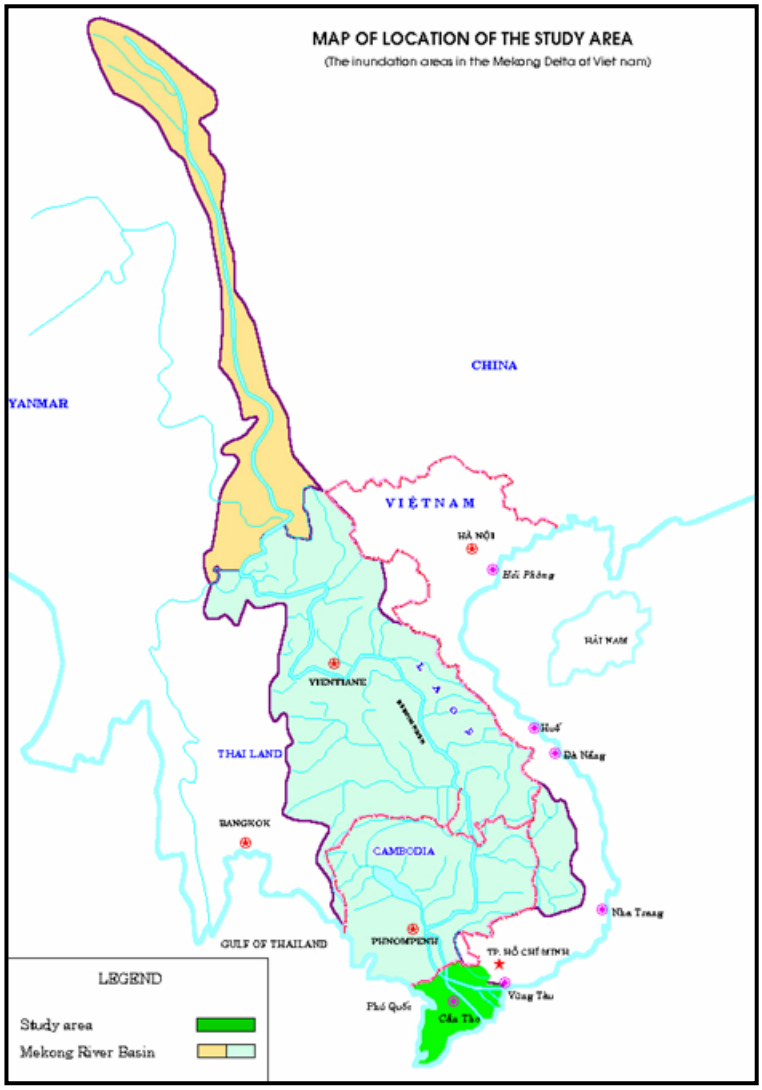
Nevertheless, floods also have positive effects, floods carry sediments to enrich the rice fields, increase aquaculture production, leach toxic ions from acidic soils and generally cleanse the land.

How to minimize the negative impacts and maximize the benefits of flood in the Mekong delta are the main mission of the flood management and mitigation.

II. FLOOD MANAGEMENT AND MITIGATION IN THE MEKONG DELTA

2.1. Characterization of the flood in the Mekong Delta

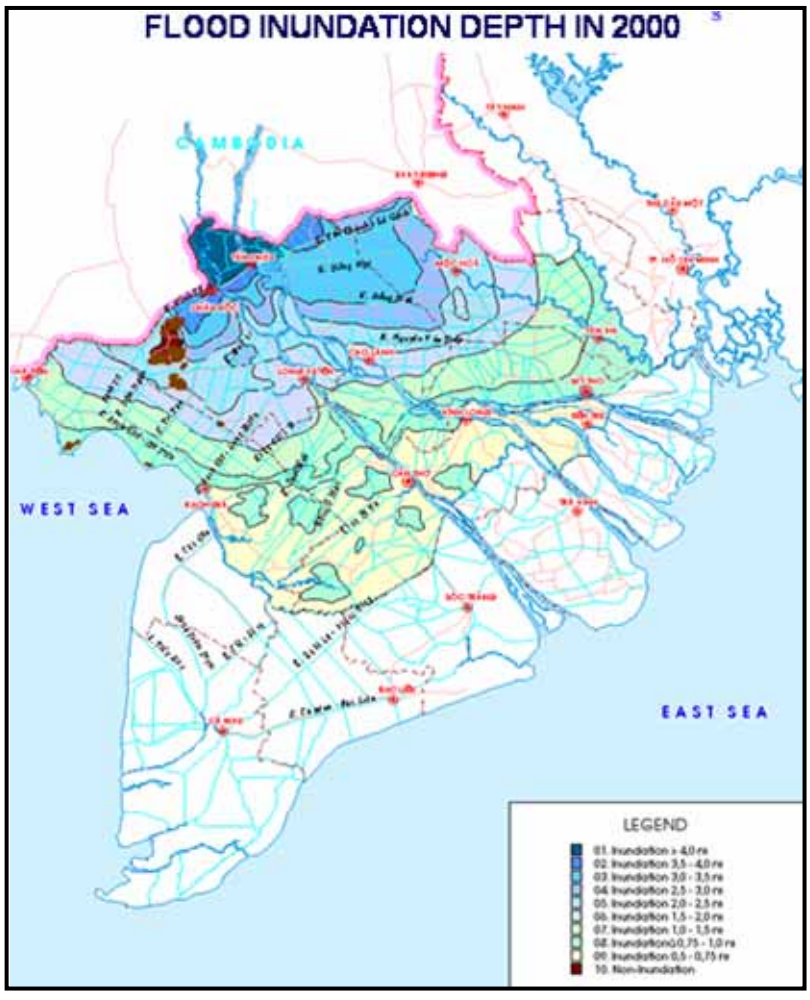
In the flood season the river system does not have sufficient capacity to discharge the total amount of water. Consequently, this results in storage and overland flow in flood plains in Cambodia and Vietnam. The flooding starts downstream of Kompong Cham in Cambodia, from Kompong Cham, flood is regulated by many large depressions.



- On the left side of the Mekong river, the Tongle Toch river from 9 km downstream of Kongpong Cham runs parallel with the main river and submerges a large low-lying area at Prey Veng, then reconnects to the Mekong river at Ban Nam.
- On the right side of the Mekong river, the Prek Dang Kom and Mul KomPul rivers submerge the area between the Mekong river and TonleSap river.
- The Great Lake, connected to the main river by the Tonle Sap, plays a very important role in flood water regulation. At elevation of +11 m, the lake has 12,000 Km^2 of water surface with a volume of 80 billion m^3. From May until September, Mekong water feeds into the Great Lake and drains back into the river from October until April next year. In the first haft of the flood season, maximum flow into the Great Lake can reach 11,000 m^3/s, and causes a reduction in the peak of the flood at downstream. Outflow from the Great Lake usually occurs in late September or early October. Highest outflow from the lake is about 10,000 to 12,000 m^3/s. The effect of the Great Lake in reduction of the flood peak is significant for early, fast and high flood. The flooding conditions become more serious if the second peak of flood occurs when the Great Lake is already full and starts to release water into the Mekong river.
- Downstream of Phnom Penh, about 80 to 85% of the total flow drains through the Mekong while only 15 to 20% through the Bassac. This distribution is changed at

downstream in the Vietnamese Mekong Delta. About 1/3 of the discharge in the Mekong is transferred into the Bassac through the Vam Nao.

- Before entering the Vietnamese Mekong Delta, on the left side of the Mekong river, water flows in the Stung Slot river (or Tonle ProSat river) towards the South. Near the Cambodia-Vietnam border, water in the Mekong overflows the low river bank and drains into some canals connecting to the Stung Slot river. It combines with flood water from upstream of the Stung Slot and submerges the large area along the border of the two countries. After that, most of the flood water flows into the Plain of Reeds through the low embankment of the So Ha canal. This is the main source of flooding and causing severe damages in the Plain of Reeds. The remain flows into the So Thuong river and back to the Mekong river.
- On the right of the Bassac river, flow from the Prek Thnot river from the Western side of the delta, it combines with flow from some canals which convey flood flow from the Bassac river forward downstream, parallel with the Bassac river then connect with the Chau Doc river in Vietnam. Near the border, the TaKeo river originates from the South-western hill zone of Cambodia. All flows of these tributaries connect together and submerge a large area at the border, the main part of flow crosses seven bridges on the Chau Doc-Tinh Bien road into the Long Xuyen quadrangle, a part flows through the Vinh Te canal to the Gulf of Thailand and the remain flows back to the Bassac river.
- Flood enters Vietnam following the Bassac and Mekong rivers and two large overland flows: on the left to the Plain of Reeds, on the right to the Long Xuyen Quadrangle. The inundation map and the distribution of inflow and outflow in the Vietnamese Mekong Delta in the 2000's flood season are shown in following figures.



- In a high flood year, the total average discharge is about 45,000-55,000 m^3/s, of this, 75-80% flows through the main river and the other 25-30% or 10,000-15,000 m^3/s flows over the border. Of the over-flow floods, about 2,000-4,000m3/s flows to the Long Xuyen Quadrant, and about 8,000-12,000m3/s flows to Plain of Reeds. In the main river, a discharge of 23,000-25,000m^3/s sharing 82-86% flows through Tan Chau and a discharge of 7,000-9,000m3/s sharing 14-18% flows through Chau Doc. Total flood volume brought into the Mekong Delta of Vietnam is about 400-500 billion m^3 of which 80-85% is from the main river and the other is from the border over-flow floods. There is a difference in terms of water level between the Mekong river and the Bassac river. At the same time, the water level at Tan Chau is 40-60 cm higher than the water level at Chau Doc. So, water is always diverted from the Mekong river to the Bassac river through connected canals such as Tan Chau-Chau Doc, Vam Nao… of these, the Vam Nao canal is the largest canal. Due to this water diversion, water flows of the Mekong river and Bassac river at My Thuan-Can Tho are almost the same (51% and 49%). Most of the floods of the Mekong Delta in Vietnam flow into the South China Sea through the main rivers, and some flow into the Gulf of Thailand through the canal system.

2.2 Flood impacts on socio-economy and environment

Floods of the Mekong Delta in Vietnam have low transmission speed but cause deep and long-term inundation of large areas. This situation causes a lot of constraints to socio-economic development, agricultural production, settlement and development of infrastructure as well as to people's lives, transportation, education, and disease treatment. It can be said that floods limit land reclamation, rural development, and urbanization as well as the improvement of population education and modernization of society.

Annually, floods cause damages to property, loss of lives as well as river bank erosion, sedimentation and destroy infrastructure such as roads, bridges, sluices, schools, hospitals etc…

The 2000 flood was one of the most serious flood during the last 70 years, it made heavy damage in the Vietnamese Mekong delta. List of damages in the high flood years of the Mekong river delta is presented in the table bellow:

List of damages in the high flood years of the Mekong river delta.

Items	Unit	1991	1994	1995	1996	2000	2001	2002
Dead people	Person	158	407	199	217	448	412	170
Damaged houses	Family	19747	50590	28240	78859	905283	17108	5209
Evacuated families	Family	7	6	11431	38735	50956	27826	6670
Relief families	Family	15600	20125	59262	175441	253107	193161	
Decreased rice productivity area	Ha	88837	202189	62399	107707	111907	33036	15777
- complete loss	Ha	171898	26868	11101	43249	33594	8955	365
Decreased Upland crop productivity area	Ha				50	4613	4925	1049
- complete loss	Ha				17466			
Submerged fruit area	Ha				76396	63560	32785	32142
Submerged fish ponds	Pond			16336	69505			
Submerged fishery farms	Ha					14053	13494	2446
Dead cattles	animal			242	18965	22600	490741	
Submerged classes	Room				11093	13712	6274	3223
Students were off school	Pupil			217412	905302	103270	266231	243855
Submerged medical stations	Station			156	509	385	105	51
Submerged canals	m3			5512226	443100			
Damaged bridges & sluices	Piece			2722	24478	2595	1684	519
Submerged highway and provincial street	Km						380 4662	119.6
Submerged district and commune Streets	Km							3934
Submerged Treasures and public areas	piece			372	2411	1036	675	534
Total damage	Billion VND	2217	2284	700	2181	4597	1456	457

The estimated cost of the 2000 flood damage was 4,000 billion VND about US$ 275 million.

Generally, the more economic development the more damages occur. In recent years, the damages to agriculture have been reduced but the damages to infrastructure have been increased. In agricultural production, the damages to rice and upland crops have been reduced but damages of fruit trees has been increased.

Floods of the Mekong Delta in Vietnam have brought some benefits. Floods bring abundant silt for farm sedimentation. Annually, the Mekong Delta in Vietnam is embanked by millions of tons of silt. And due to silt sedimentation, land stretches along the Mekong river and Bassac river are fertile, suitable for fruit trees, upland crops and paddy rice.

Water of the Mekong river and the Bassac river in the Mekong Delta of Vietnam contains lots of silt particles which come from the upper part. Concentrations of silt particles in these rivers is high in the flood season and low in the dry season. Silt concentration is reduced from upstream to downstream. At Tan Chau station, the average silt concentration is about 800g/m^3 in the flood season, and a highest number of 1000g/m^3 was recorded in August but an average silt concentration of only about 200g/m^3 was recorded in the dry season. At the Chau Doc station, a number of about 200g-300g/m^3 in term of average silt concentration was recorded in the flood season with the highest number of 400g/m^3 of silt

concentration being recorded. However, silt concentration of the Bassac river increased after the Vam Nao due to water diversion from the Mekong river.

Flood flows are good for environmental improvement and land reclamation. Floods can clean farm fields, dissolve toxic chemical, kill mice, and insect. Floods of the Mekong delta in Vietnam create float-water season in large areas and favorable environment for fresh-water fishery development. Fish and shrimp growth is closely related to the flood regime. Water species grow fast in the flood season due to the enlarged living environment. Generally, the more floods, the more fish. Annually, the Mekong river produces 35 million heads of fish with high value.

2.3 Objectives of flood management and mitigation

The objectives of flood management and mitigation in the Mekong Delta are to create conditions for comprehensive socio-economic development of the Mekong Delta in Vietnam, to protect the ecological environment as well as to develop rural areas of the Mekong Delta in Vietnam in trend of industrialization and modernization. This means that flood control must not only overcome and mitigate damages caused by floods; protect and improve the living standard of the people; protect inhabited areas, urban areas, infrastructure; develop agriculture but also exploit benefit of floods in order to increase silt amounts, fisheries, watering down acid water, and cleaning farm fields in the inundation areas. Therefore, the strategy of flood management and mitigation in the Mekong delta is **"Adapt living with floods"**

- Due to "living with floods", the river, canal and structure system in the inundation areas of the Mekong Delta are responsible for not only supplying water, drainage, drainage of acid water but also drainage of floods. So that, the study of planning for transportation, inhabited areas and infrastructure must be considered in practical conditions in order to be suitable with flood management and mitigation. In view of water resource planning, flood management and mitigation must also pay attention to consider comprehensively the water supply, drainage protection of salinity intrusion, watering down acid water and land reclamation as a "planning of water resource utilization and conservation". Moreover, water resources planning must be combined with planning of transportation, construction, fishery and agriculture etc… in order to develop and construct the rural areas of the Mekong Delta in a trend of civilization and modernization. In the other word, ***flood management and mitigation should be based on comprehensive view to solve the multiple problems.***

- Flood protection for the Mekong Delta in Vietnam must be construction-measures and non-construction measures. Construction measures are the building of hydraulic works in order to initially control floods in accordance with objectives and purposes. Non-construction measures are measures in order to mitigate damages caused by floods such as long-term and short-term flood forecast for controlling floods; building of modern communications system in order to receive information immediately and orders as well as establishment of relief teams to respond to bad situations. Arrangement of production sectors; cultivation seasons must be suitable in order to avoid damages and to increase efficiency. A close combination between construction

measures and non-construction measures will bring much higher benefits and decrease investment cost.

- Mathematical models for describing and forecasting hydrological regimes of the Mekong Delta are the main tools used to forecast the changes of water levels and discharges at different sites in the inundation areas of the Mekong Delta in accordance with different scenarios**.** However, the hydrological and hydraulic regimes of the Mekong Delta in Vietnam are very complex and depend on lots of factors, which are difficult to define, such as overflow plains, low-lying areas, and the distribution of flows in dense canal system. Flood simulation models for the Mekong Delta in Vietnam have been studied over 20 years, but these still contain some constraints. Hence, it needs to be continued to upgrade mathematical models as well as review and analyze the simulation results seriously and when designing constructions considering safety coefficients. The experiences in construction of hydraulic works in a large areas of Mekong Delta in Vietnam are step by step construction parallel with monitoring in order to change when it is necessary.

- Floods affect not only to the inundation areas but also the whole area of the Mekong Delta in Vietnam. Flood control constructions will change hydrological regimes and the environment of the whole Mekong Delta in Vietnam. So, environmental impacts of flood management and mitigation scenarios need to be assessed in order to find out the benefits and ways to mitigate negative impacts on the ecological environment.

- Selection of flood management and mitigation scenarios must be based on objectives, economy, engineering, society and environment. Firstly, the given scenarios must be considered to the satisfaction of objectives. And these are the pivotal points for selection of scenarios**.**

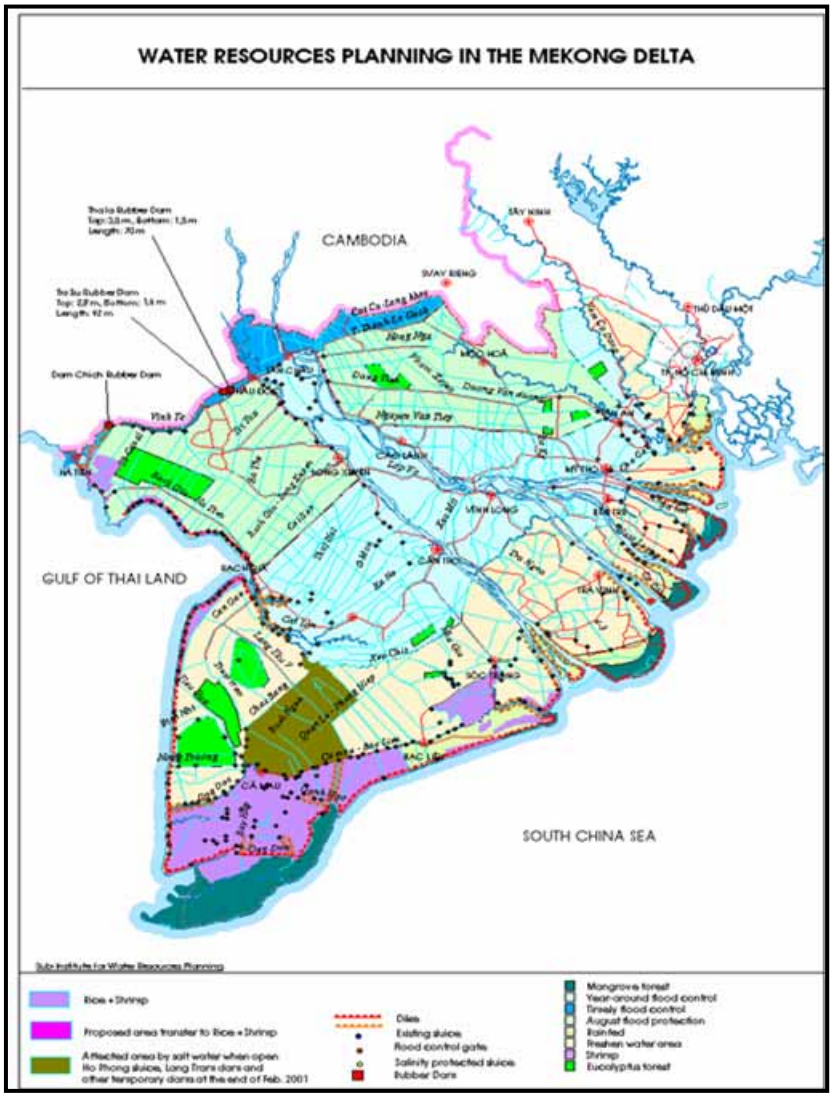
- Economic efficiencies are also very important standards for selection of scenarios. But floods of the Mekong Delta affect lots of sectors such as the economy, the society and the environment. At present, economic assessments are evaluated in much more detail by many methods. However, besides valuable economic coefficiencies, there are lots of un-valuable economic coefficiencies such as indirect economic coefficiencies. Hence, flood management and mitigation in the Mekong Delta in Vietnam must be considered not only to economic impacts but also to social and environmental impacts.

2.4 Structural Measures

"Living with floods" does mot mean to let floods freely flow to inundation areas. It means that floods have to be controlled, limiting less silt floods from Cambodia to the Plain of Reeds and the Long Xuyen Quadrant and find out ways to bring floods to the Gulf of Thailand, to the Vam Co river as well as bring back to the Mekong river and the Bassac river in order to reduce the inundation depth and creation to take silt floods from the Mekong river and the Bassac rive to farm fields. Living with floods but controlling them in order to prevent or limit early season floods aiming at safely harvesting Summer-Autumn rice and prevent or limit late floods in order to fast ensure steady double rice production (Winter-Spring and Summer-Autumn). In the main flood period, let floods flow to farm fields in order to reduce water levels in the border areas. Moreover, living

with floods but having control of them in order to exploit the benefits and limit the negative impacts of floods.

For the flood management and mitigation, based on the depth and duration of flood inundation and natural condition, the Vietnamese Mekong delta has divided into two areas, the deeply flooded areas and the shallow flooded areas. For each area, flood control measures will be applied with different levels. The flood management and mitigation for the Mekong delta is presented in the following figure.



The shallow flooded areas of the Vietnamese Mekong Delta such as the western area of Bassac river, the southern areas of Nguyen Van Tiep canal, the area between the Mekong river and Bassac river have rich agricultural potential and most of these areas cultivate double and triple crops per year. Hence, long-term orient is year around flood control planning for the shallow inundation for agricultural production in trend of civilization and modernization. It is noted that all shallow inundation areas are to be joined in flood drainage. So that, when building up year around flood control constructions in these areas, canals must be dredged in order to upgrade capacity of drainage of floods and avoiding increase of water levels for adjacent areas.

In the deeply flooded areas, the main strategy is to adapt to flooding conditions with restricted structural measures to stabilize existing double rice crops: winter-spring and summer-autumn. Existing embankments and dike will be reinforced to protect against early floods until august for safe harvesting of the summer-autumn crop. Drainage outlets will be enlarged to accelerate drainage capacity of the system. In order to protect the environment and the ecology in the inundation areas, it needs to build some ecological reservoirs as in the Tram Chim area of the Plain of Reeds and Long Xuyen Quadrangle.

For population protection, the rural population has been resettled into centers along roads at an elevation above flood level. Raised floors or pile houses have been built and public structures have been established in these population centers. In cities and urban centers, raised floor structures can be used or an enclosed dike to protect the whole communities can be built.

2.5 Non-Structural Measures

2.5.1 Preparedness Measures

Flood preparedness readiness in Vietnam is primarily responsibility of local authorities, with technical assistance and review by the regional offices based in Ho Chi Minh City. These arrangements have also been supported by national projects, primarily the MARD/UNDP programme improve communication systems and reporting during the response and recovery phases. With regard to flood warning arrangements, the Hydrometeorological Service of Vietnam informs provinces of mainstream water levels and expected flood effects, white the provincial authorities, primarily DARD, estimate local flooding affects from canals across the delta. Appropriate warnings are issued to districts, which in turn contact local authorities.

Community systems early warning have been greatly strengthened by the National Disaster Management Program undertaken by the Department of Dyke Management and Flood Protection of MARD, with support from UNDP. This program has improved communication links between Districts, Provinces, regional offices of ministries in Ho Chi Mink City, and national offices in Hanoi. There is now interconnectivity between all national and regional offices, provincial offices, district offices and some communities. Warning messages can be relayed more easily, and with more detail than before. This has been accompanied by a steadily building role of the Disaster Management Center, part of the government's Central Committee for Flood and Storm Control to provide continuous information about extent damage linked to water levels. The Vietnamese Government recognizes the importance of improving the early flood warning system in the Mekong delta, at least in the short to medium term.

2.5.2 Response Measures

Vietnam has a long history of emergency response operations, and activities are in general well defined. At the most local level, members of the Vietnam Fatherland Front and Women's Union are responsible for initial needs assessments, registrations, and delivery of relief supplies to families. They interact with District flood committees, who in turn report to provincial flood committee headed by MARD. The flow of information then

goes to the Department of Dyke Management and Flood Protection, from where it is circulated to line ministries and sent to national levels. Response activities also include a number of activities to mitigate damage, such as the rapid deployment of military for dike control and early harvesting, and orders for early harvesting. The Vietnamese Red Cross cooperates closely with the local authorities to ensure basic provision of relief and access to safe sites.

Damage reports are collected by the districts, sent to provinces, which compile and send to the Department of Dyke Management and Flood Protection in a summary form. There does not appear to be any effort at this time to link damage and assessment information with geographical information system.

2.5.3 Recovery Measures

There appear to be three tiers of recovery operations.

- At community level, families must rebuild or repair homes, replant crops or restore businesses, and begin accessing social services such as schools and clinics. This process is greatly assisted by the mass organizations and districts**.**
- At the provincial level, where the bulk of public take place. The three priorities for are reported to be rehabilitating roads, repairing and re-dredging irrigation systems, and ensuring that communities are engaged with activities that are more in keeping with "living with floods". While line ministries have responsibilities for public improvements planning such as school or clinic repairs, the implementation and sitting decisions tend to be made by provincial committee.
- In the case of the 2000 floods, a large amount of international emergency assistance was provided for recovery activities. These funds were channeled through the Ministry of Planning and Investment, who in turn released funds to Provincial People's Committees. While in large part this was an efficient method for ensuring rapid recovery, there were certain problems posed with regard to sitting and sizing of rehabilitated improvements, such as embankments.

III. CONCLUSION AND RECOMMENDATION

Flood and inundation in the Mekong delta are strongly impacts to socio-economic development. Moreover, floods and inundation are very complicated, affected by many factors. Therefore, flood control measures should have to be implemented step by step in order to supplement justify practically.

It is recommended to develop capacity building for engineers concerning with flood management and mitigation and increase regularly data exchange between the riparian countries. Also close communication between the riparian countries is indispensable in flood management and mitigation.

It is recommended to establish early flood warning system in the Mekong Basin. In the short and medium term, non-structural measures, such as hydrological forecasting flood and warning system are cheaper and more practical. Although flood warning can not

prevent flooding, but it can minimized the damage to property and lost of people's lives through timely and accurate flood forecasting in the Mekong Basin.

Mathematical models have now been used to simulate various alternatives for flood control in the Mekong delta. In the near future, effort will be made to improve models as essential tools in flood management and mitigation. A monitoring network is necessary to observe changes in flow regimes and to provide early identification of negative effects to the environment for studying mitigation measure.

Flooding in the Mekong Basin has both advantages and disadvantage, how can flood management and mitigation make full use of the advantage and limit disadvantage? Therefore, the international cooperation for support and exchange data, information, knowledge and experiences in flood management and mitigation is indispensable.