Concluding Report
"Roadmap toward effective Flood Hazard Mapping In Viet Nam"

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A) The role of flood hazard maps to mitigate flood damages in Viet Nam

- ***The flood status in Viet Nam***

Vietnam is located in the Southeast Asia area with its population of 80 million inhabitants (figure1). Its weather is influenced by the tropical monsoon climate. The result is very high rainfall; the mean annual precipitation is about 2,000 mm. The availability of water is also very abundant, the total annual runoff generated over the country is 928 billion m^3, of which the surface water resources are 880 billion m^3, and the ground water resources are 48 billion m^3. There are 14 major river basins in Vietnam; the biggest rivers are Red River and Mekong River (figure 2).

Vietnam exists in a tropical monsoon region and near one of the five of the biggest storm outbreaks in the world. River and streams often have high slopes leading to fast flood. Rainy season coincides with stormy ones so we always confront natural disasters of flood and storms. Runoff at high-flow season accounts for about 60-85% of the total annual runoff. Total runoff in high-flow season in the central and southern littoral areas may be 60-70% of total annual runoff despite its short 3-4 month period. Highest flow levels occur in July and August in the north and north-central area, September and October in the south-central and central highlands, and October in November in the southern area. The flow in those months is about 20-30% of the total annual flow. The highest flooding also occurs in those months.

Flooding in small rivers rises and falls quickly, from 1-5 $m^3/s/km^2$ to over 20 $m^3/s/km^2$. Flashfloods in mid-size and small rivers often occurs in some mountainous provinces in the central region. High and extreme floods resulted in a high loss of life and extensive property damage by inundation in downstream lowlands in the Red River in 1945 and 1971, in the central littorals in 1964 and 1999, in the Dong Nai River in 1952, and in the Cuu Long River delta in 1961, 1966, 1978, 1994, 1996, 2000.

Floods happen at different times every year in different rivers, but tend to be later towards the south, and the interval between areas is about 1 month. Rivers in the north and north of Thanh Hoa province usually flood from June to October. Rivers in the littorals from south of Thanh Hoa province to Ha Tinh province see floods from July to November, and rivers in the littorals from Quang Binh province to Ninh Thuan province flood from September to November. Rivers in the south and plateau regions have floods from July to November.

Northern Lowlands and Mid-Lands In spite of a large system of dykes and flood control structures such as Hoa Binh and Thac Ba reservoirs, Day dam for flood diversion, and flood retarding zones, the flood control infrastructure is not capable of eliminating the danger of flood destruction in the north. The northern river dyke system has been in existence for hundreds of years. However as the construction was mainly made manually, and because it has been in and out of operation for long time periods with very little consolidation, the system is starting to weaken, and the strength of structures and their foundations has become degraded. Settlement, cracking of structures, leakage, seepage, and boilers exist in a many important dyke sections of various rivers. Dyke consolidation and strengthening are carried out annually, including the treatment of potentially risky phenomena like leakage, boilers, enlarging of dyke cross sections, and revetment of upstream side slopes. Preparing human resources and materials for warnings and emergency actions, coordinating between rescue forces of various sectors for a rapid response in case of emergency or disaster are also undertaken annually.

Although the dyke level in Hanoi and corresponding locations downstream has been heightened to cope with historical levels of 13.30 m and 7.21 m at Hanoi for the Red River dyke and Pha Lai for Thai Binh River dyke respectively. When very high flows occur at the same time as a flood tide and strong typhoons, dykes may be broken and devastating damage may result. The flood in 1945 caused nearly 2 million deaths from starvation as the result of the flooding of 312,000 ha of rice production area. During the historical flood in 1971, dyke failure caused serious inundation of 250,000 ha in many Northern provinces, with consequences for 2.7 million people.

Cuu Long Delta Flooding occurs over a three to five month period and often inundates over two-thirds of the delta area. Great floods happened in 1961, 1966, 1978, 2000, 2001,

and 2002. The “Co-existence with Flood” solution is applied in addition to structural and non-structural measures to minimize the damages from floods and maximize its advantages. High floods, floods combining with high tides and water level rise due to typhoons, are events of great concern. To mitigate and eliminate the negative impacts from floods, the sea dyke system in the Cuu Long River delta needs to be upgraded to secure salinity prevention and to withstand strong winds. The embankment system should be capable of withstanding early floods to protect summer and autumn crops. Flood protective areas should be established in both shallow flooded and deep flooded regions.

Central Littorals the center of Vietnam is constantly faced with natural disasters, the most frequent of which is floods. Floods occur after heavy rains, typhoons, and tropical depressions. They are often extensive and repeatedly inundate vast areas, even the whole region. Floods in central rivers are mainly flash floods and extreme floods that occur rapidly, rising and falling quickly. They are largely due to short rivers with steep gradients, and deforestation of watershed forests which deteriorates the ability of flow regulating as of heavy rains. In this region, the frequency of high floods and flash floods is higher than in other locations. Great and extreme floods occurred in 1964, 1969, 1975, 1978, 1998, 1990, 1992, 1993, 1995, and 1999. In addition to the construction of reservoirs upstream, sea dykes in the north-central region must be upgraded to withstand strong winds combined with high tides.

Mountainous and Central Highlands Areas Great floods in major rivers of these areas often caused inundation in river lowlands which last for several days. Rivers affected by such floods are the Tuyen Quang, Yen Bai, Ha Giang, Kon Tum, and Hoa Binh. Flood prevention and flood-related disaster mitigation should be comprehensive and include afforestation, forest protection, and prevention against water concentration downstream. Reservoirs should be built upstream for flood control. A number of national programs have been implemented such as 5 million ha reforestation and a bare hills afforestation. Flood diversion projects should be developed, along with an improvement of dykes. Protection of densely populated residential areas and concentrated economic zones should be implemented. Another recommended measure is the clearing of river channels for the easy discharge of the flood flow to the sea. Natural disaster and flood are serious issue for a long time. They have caused bad effects to the socio- economic development and environment in particular and the sustainable development of the Viet Nam. The flood can occur in any place, at any time in the catchments of our rives and springs. Together with the global climate changing, the situation of natural disasters, heavy rain and flood is getting more complex, more difficult to deal with, and the consequence caused is more heavy not only is our country but also in many countries in the Asian region and the world.

- ***The outline of the present countermeasures for mitigating flood damages in Viet Nam***

a. Non-structural measures

A forestation and forest protection; rearrange crop season and cropping pattern, and apply new kind of seeds that can be able to resist drought, inundation, salinity intrusion, and insects; reorganise for aquatic product catching activities, improve capacity of boats and ships operating at the deep sea, equip communication means, and life jacket; rearrange residential areas where frequently affected by disasters, particularly flash flood and mud flood; organise and establish observation network to monitor disasters and damage caused by disasters; establish information and alarming network from central level to local level; establish policy and mechanism for disaster prevention and mitigation activities, as well as rescue, aid relief, and compensate activities.

b. Structural measures

Participating in structural measures, the role of the whole community is very necessary. For simple measures, localities can mobilise all forces of local people to carry out, with partial support from the State. The four-on-the-spot guideline is applied for responding to not only flood and storm but also other types of disaster, including fire, environment problems, reservoir problems, landslide, forest fire, inundation, drought, etc.

Structural measures are as follows:

- For mitigating damage caused by typhoon or heavy storm: build storm shelter for medium-size and small-size boats and ships in coastal area and islands (refer to the example of the Bach Long Vi Island); build storm resistant houses (or trenches) for coastal inhabitant according to models proposed by program 06 B. Storm resistant houses or trenches should be constructed while considering storm surge with probability of 1 to 5 %.

- For mitigating damage caused by floods: build dyke system in the populous plain to resist floods with 5 to 10% of probability; build flood-release way by combining dyke system and river flat; build upstream reservoirs for multiple use like flood retention and flow regulation for dry season; build large scale reservoirs with design flood probability of less than 1% (as case of North and Central Vietnam).

+ In Central Vietnam, reservoirs should be multiple-used to control flood and regulate flow in dry season and generate electricity. Proper reservoir-operating process should be prepared to effectively control flood and fully store water for generating electricity (in Central Vietnam).

+ Build big reservoirs upstream to retain flood water for keeping flood water level under the design flood level for dyke construction; and dredge river bed and river flat for strengthening capacity of flood-release way.

+ Create new flood-release ways, flood retardation areas in case of that floods are higher than design floods (probability of 0.5% and 0.2%); in case of extreme floods (probability of 0.1%), it need to open more emergency flood-release ways (particularly in the Red River Delta).

+ Build sea dyke with proper height to resist tide water levels and storm surge caused by storm with the strongest wind force measured at Beaufort Scale 10 and above. For important sections of dyke system, revetment should be made so that when flood water overflow dyke surface, dyke will not be breached and as a result, area intruded by salt water will reduce (particularly in Middle and Southern Central Vietnam).

+ Build more reservoirs to supply water in dry season for the southern central region to control drought and desertification.

+ Build more electrically-operated drainage pumping stations in hardly gravity-drainage areas, particularly in the areas that have surrounding dykes (in Northern and Southern regions).

+ Build salinity flow regulators, particularly in the Mekong River Delta, downstream Dong Nai River, and on some rivers in the Centre. Salinity flow regulators should not affect capacity of flood release and inundation-water drainage.

+ Upgrade reservoirs, strengthen spillways, upgrade flood release sluices on the North-South traffic ways both railway and road.

+ Establish forest fire prevention belts. Build water stores, or water canals for forest fire suppression.

+ Improve slope-side of mountains and hills where landslides probably occur and threat transportation roads (reduce slope degree, or cover slope-side by stone). Build ditches and sluices to drain rainwater.

+ Build revetment in coastal area in the Red River Delta, the North Centre, the South Centre, and some estuaries (Da Nang, Cai Nha Trang, Cai Phan Rang)

+ Dredge estuaries in the Red River Delta, the Centre, and the South to prevent from sedimentation.

- ***Flood hazard maps will be useful in Viet nam***

Natural disaster and flood are serious issue for a long time. They have caused bad effects to the socio-economic development and environment in particular and sustainable development of the country in general. The flood can occur in any place, at any time in the catchments of our rivers and springs. To gather with the go BAL climate changing, the situation of natural disasters, heavy rain consequence caused is heavier not only in our country but also in many countries in the region and the world.

In order to effective flood control, the role of flood hazard maps to mitigate flood damages in Viet Nam is an importan t issue. Only on basic, we can have proper and reasonable access to flood control in each region, river catchments and the way to collect necessary information for following, accurate and timely forecasting the situation, ensuring the implementation of the flood control measure effectively.

B) The allocation of roles in making flood hazard maps

- ***Organization should hold the main responsibility for making a fundamental map such as an anticipated inundation area map***

- Department for Dike Management and Flood Control of Ministry of Agriculture and Rural Development.

- ***Organization should hold the main responsibility for flood hazard maps, including:***

- Locals government.

C) The "Action Plan "of making flood hazard maps

- ***Which area do you choose for target river basin area? Why?***

The Kone River originates on the eastern slope of Truong Son Range, flows down to the southeastern direction, changes the river course to the east in Tay Son, and discharges to the South China Sea in the north of Quy Nhon city. The catchments area of the Kone River is 3,640 km2 and the river length is 160 km.

The existing discharge caring capacity of the Kone River in the downstream reaches is estimated at about 500m3/s only at bankfull capacity.

Flood often hit the Binh Dinh province, causing loss of production and living condition. In 1999 flood, 73 people were killed, 21 people were injured, 50,000 houses were affected, schools and clinics were inundated, 12,230 ha of paddy field were damaged, and crops, domestic animals and fertilizers were destroyed. Earth dams, gates, weirs and other irrigation works were destroyed, and canals, embankments, bridges and roads were damaged. Fishing boats sunk, shrimp ponds were destroyed, and stores of shrimps, fish and salt were swept away. Total loss is estimated at US$ 22million.

- ***What do you think is necessary to make flood hazard maps in the chose area?***

Preparation of a flood hazard map is also an inevitable part of flood control management plan. The role of flood hazard maps to mitigate flood damages in Kone river basin is an important. Only on basic, we can have proper and reasonable access to flood control and the way to collect necessary information for following, accurate and timely forecasting the situation, ensuring the implementation of the flood control measure effectively.

- ***We have some basis data in order to establish flood hazard maps.***

+ Topographic maps.

+ Land use maps.
+ Existing situation of urban central (their map and area in comparison with basin area)
+ Data on existing irrigation systems and reservoirs.
+ Traffic systems.
+ Planned scheme of province on village, regrouping zones for flooding avoidance and
+ Regrouping zones for rescue in urgent circumstances.
+ Data on hydrometeorology
+ Rainfall data
+ Data on flooding traces.

- ***What seems a problem in making flood hazard maps in Viet Nam***

- Knowledgeable and experience flood hazard maps of people are very limited.
- Flood area very big, flood duration very long and so much effected by sea water level, so that difficult to making flood hazard maps.
- Lack of data base and construction flood control.
- Limited budgets necessary for making flood hazard maps, training and transferring flooding hazard maps.

D) My advice/ suggestion for making this training course more meaningful?

+ This course is very comprehensive and allows the participants to understand everything that is involved in producing flood hazard maps.
+ The organization of course is very and equipped with training materials, facilities and very competent staffs.
+ The lecturers are very knowledgeable and experience flood hazard maps.
+ A survey to be carried out in the next five years to find out the progress of producing hazard maps for each countries and identify problems in carrying out this activity.

Finally, on behalf of my works and my Department and I knew more about Japan, japanese …
I would like to thanks to JICA and PWRI in allowing us to participate in this course and making ours stay very fruitful and enjoyable.
I would like to thanks Mss Shibata for taking good care of us.

Figure 1: Located of Viet Nam

Figure 2:

MAJOR RIVER BASINS