FLOOD MANAGEMENT IN THE RED – THAI BINH RIVER BASIN

1. INTRODUCTION OF THE RED – THAI BINH RIVER BASIN

The Red – Thai Binh river basin (RRB) is situated at 20° to 30°30' of the north latitude, 100° to 107°10' of the east longitude in the tropical monsoon region. Total area of the entire basin is 169,020 km^2 including the part in Vietnam's territory of 86,720 km^2 (or 51%).

In Viet Nam territory, the RRB covers surface lands of 26 provinces and cities including the Hanoi capital. The total population is 26.6 million people (in 2003). The agricultural lands occupy 1.95 million ha. Many key economic bases of the country are also established in the RRB.

The RRB consists of 2 parts, i.e., the upper RRB and the Red river delta.

- The Upper RRB include sub-river basins of Thao river (mainstream of the Red river), Da river, Lo river, Gam river, Chay river, upstream Thai Binh river (including Cau, Thuong, and Luc Nam rivers) and upstream of Day river (including Tich and Boi rivers).
- The Red river delta covers 9,840 km^2 with a dense network of tributaries and canals such as Duong, Luoc, Tra Ly, Dao Nam Dinh, Ninh Co, Kinh Thay, Kinh Mon, Van Uc rivers and others.

  Located at the elevation of 0.4 to 9 m above the sea level, the Red river delta comprises 58.4% of its surface below +2.0 m elevation, 72% below 3.0 m elevation. In particularly, Hai Phong, Thai Binh, Ha Nam, Nam Dinh and Ninh Binh provinces have more than 80% of their surface lands below +2.0 m elevation.

Rainfall that accounts for80 to 85% of total annual rainfall, concentrates in 6 months of the flood season from May to October in the river basin. Average rainfall in the upper basin (in China territory) represents about 1100 mm a year whist the average annual rainfall in the Viet Nam territory part is about 1900 mm which demonstrate the different rainfall distribution in space and time.

2. FLOOD SITUATION IN THE BASIN

2.1. Flood situation in the past

Since 1960s, there have been 7 extreme floods happened in years 1968, 1969, 1971, 1983, 1986 and 1996 when water level at Hanoi reach above 11.5 m and at Pha Lai above 6.5 m (in years 1971, 1980, 1985, 1995, and 1996). Floods are caused by continuous heavy rains in periods of 8 to 10 days. The flood rainfalls are measured at 100 to 300 mm, or 500 to 700 mm at some places, the numbers are 700 to 800 mm in the middle and upper parts of Da, Thao, Lo, Cau, Thuong and Luc Nam rivers at the rain concentration areas.

- Flood combinations in rivers: According to statistics since 1902; frequencies of flood combination between the tributaries and the Red river is shown below:

  + Da river with Red river: 68%

  + Thao river with Red river: 44%, and

  + Lo river with Red river: 47%

- Historical floods:

  + Flood in August 1945:

    - maximum discharges of 33,500 m^3/s at Son Tay (on 20 August 1945)
    - restored water level at Hanoi: 14.05 m
    - 52 sections of dike breaks causing serious inundation in 11 provinces

- Total inundation areas: 312,000 ha, total damages of 14.3 millions tons of paddy

+ Flood in August 1971:

- Average basin rainfall: 255 mm
- maximum discharges of 37,800 m^3/s at Son Tay (on 21 August 1971)
- measured flood peak at Hanoi: 14.13 m, restored flood level: 14.85 m
- flood was diverted to Day river and retarded to Tam Nong and Thanh Thuy areas
- Total inundation areas: 250,000 ha, 2.71 millions people affected.

2.2. Flood caused damages in recent years

Due to impacts of global climate changes, increasing harmful climate fluctuations and deforested watershed, occurrence of floods and flash floods is more frequent. Floods happen on larger scale. In line with the socio-economic development in the RRB, hazards due to floods become clearer and more significant.

The upper basin has known with more flash floods. According to the survey on flash floods caused damages carried out by the Hanoi Water Resources University in 2003, hundreds of flash floods causing death of thousands people, destroying hundreds hydraulic, transport works and other infrastructures occurred. Notably, the flash flood on July 19, 2004 at Yen Minh (Ha Giang province) causing death and missing for 45 people; the flash flood on July 23, 1994 at Muong Lay town (Dien Bien province) with total of 17 people died and 46 injured.

The Red river delta is also menaced by flood impacts on the mainstream. For instance, the flood in August 1996 on Da river with maximum discharges of 22,000 m^3/s on 18 August 1996 which was of the same amplitudes as the historical flood in 1945. Thanks to flood regulation by Hoa Binh reservoir, the water level at Hanoi reduced by 1.2 to 1.5 m (otherwise the water level at Hanoi would have been above 13,00 m). However, serious damages have be resulted with 290 people died, 503 people injured, some ten thousands of houses and public infrastructures destroyed.

The table below provides information on damages caused by floods and other natural disasters from 1996 to 2005 in the RRB.

Item	Unit	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Number of people died	People	300.0	40.0	73.0	22.0	95.0	76.0	56.0	23.0	99.0	112.0	896.0
Number of people missing	People	45.0	-	6.0	-	4.0	1.0	3.0	-	2.0	5.0	66.0
Collapsed, swept houses	10^3	38.3	1.0	1.7	0.0	0.6	1.0	1.0	1.2	0.4	1.5	46.7
Inundated, destroyed houses	10^3	626.1	32.0	17.4	1.0	10.4	53.0	15.3	16.5	7.1	55.7	834.4
Inundated paddy areas	10^3 ha	380.6	69.6	12.7	6.7	16.5	26.6	8.9	170.5	260.2	256.6	1.209
Fully lost paddy areas	10^3 ha	77.5	5.1	0.9	-	1.7	7.2	1.5	39.3	82.3	2.8	218.2
Road destroyed	Km	8,653	77	10	-	784	133	2	8.889	1.231	231	20,010
Total damaged	Billion VND	3,024	99.4	111.2	6.0	84.6	793.1	220.3	-	85.0	3,260	7,684

3. FLOOD PREVENTION AND CONTROL MEASURES AND STRUCTURES

In the river basin, 6 main flood prevention and control measures are being applied at present.

3.1 Dike systems

In the Northern midlands and delta, the dike systems constitute basic structural measures. The systems have been built for thousands years to protect 38 flood prone areas where live about 19 million people on 1.44 million ha of natural surface lands.

From 1954 to 1998, the dike systems were strengthened with supplementary earth embankment of 270 million m^3 (MCM) making an average of 6 MCM a year and some tens MCM of masonry. The total length of the dike systems is about 2400 km in the basin including 1580 km of the Red river dike to protect against the water level of 13.1 m at Hanoi, and 750 km of Thai Binh river dike to protect against the water level of 7.2 m at Pha Lai. The average height of the dike systems is 6 to 8 m, or 11m at some places. In the whole systems, about 600 covered revetments and about 3000 sluices.

Being long built in the past with backward construction techniques whilst some sections were built on soft topography, hundreds kilometers of the dike systems are not strong enough against floods. In case flood water levels on Red or Thai Binh river reach the 3rd warning level, dike incidents may happen at places with landslide, erosion, leakage, etc which menace safety of the dike systems.

3.2 Regulation reservoir system

3.2.1 Existing reservoirs

- Thac Ba reservoir has been in operation for flood regulation after 1971. The initial flood storage capacity was 574 MCM. Since 1986, normal water level of the reservoir has been increased from 55.5 m to 56.5 m corresponding to the flood storage capacity of 450 MCM. The reservoir can help to reduce the Red river water discharges by 300 to 1900 m^3/s (equivalent to the flood in 1971) and reduce water level at Hanoi by 10 – 20 cm.
- Hoa Binh reservoir has been gone in operation since 1971 with flood storage capacity of 5 BCM

The operation of these reservoirs, i.e., Thac Ba and Hoa Binh can ensure flood prevention for the Red river delta at the probabilities of 0.8% or the return period of 125 years.

3.2.2 Ongoing built and proposed reservoirs

On the Gam river, Tuyen Quang reservoir is being built with flood storage capacity of 1.0 BCM. On the Da river, the construction of Son La hydropower plant has been recently started. On Nam Mu stream (1st level tributary of Da river), Ban Chat structure is under construction. Other studies on further reservoirs such as Lai Chau (on Da river), Bao Lao (on Gam river) for flood regulation purposes are proposed.

With their completion of construction, the flood storage capacities of reservoirs are estimated at 7 to 10 BCM and about 1.5 BCM on Da river and Lo – Gam rivers respectively.

Flood prevention probabilities:

- With Tuyen Quang reservoir: 0,4 % for Hanoi and 0.67% for other areas
- With Tuyen Quang, Son La reservoirs and others:
    - If total flood storage capacities of reservoirs on Da river are 7 BCM: 0.2% for Hanoi and 0.33% for other areas;
    - If total flood storage capacities of reservoirs on Da river are more than 7 BCM: <0.2% for Hanoi and <0.33% for other areas;

3.3 Flood diversion into Day river

Day river basin is a natural sub-basin of the Red river. Day dam is an important structure to prevent Red river floods into Day river. In years with big floods, Day dam is open to divert Red river floods into Day river in order to mitigate flood peak for Hanoi capital. From 1937 to 1954, Day dam has been open for 5 times in years 1940, 1941, 1942, 1945 and 1947.

After 1971, the Day flood diversion system was rehabilitated to allow a maximum flood diversion discharge of 5,000 m^3/s and total diverted flood volumes of 1.1 to 1.3 BCM. According to an assessment made by the Institute of Water Resources Planning, the flood diversion capacity via Day Dam, nevertheless, cannot be more than 3,000 m^3/s at water level of 13.4 m at Hanoi because of incomplete flood ways.

3.4 Flood retention

Before there were some flood retention areas such as Tam Thanh, Luong Phu, Chi Linh, Ba Tong, etc in the midlands and lower basin aiming to reduce flood peak on the Red and Thai Binh rivers. However, this measure is no longer applicable due to difficulties in operation of those flood retention areas and also to poor effectiveness of this flood retention measure.

3.5 Enhanced flood discharge capacity of the channels

The flood ways of bypass rivers are located inside the protection areas of the 2 main dike systems. To maintain and enhance flood discharge capacity of those channels and flood plains is also one of the important measures in flood prevention and control.

Some tens bridges have been built in line with the development process, many residential areas have been established in flood plains. Embankments have also been built (at present there are 28 big polders of 500 to 2000 ha), notably the Red river sections in Hanoi which were completely safe in the flood season of 1986 when flood water level was above 12 m.

At the river estuaries, narrowing or blocking of the river mouths makes decreased flood discharge capacity more serious. This is clearly seen on Day river (from Phu Ly to Gian Khau), on Thai Binh river, Lach Tray river, Rang river, etc.

Narrowed flood ways together with deposited flood plains result in higher flood water level in rivers. According to an analysis for the 1930-1990 period (before operation of Hoa Binh reservoir), at the same discharge of 29,000 m^3/s at Son Tay the water level at Son Tay has increased by 0.8 to 0.9 m and at the same discharge of 20,000 m^3/s at Hanoi the water level at Hanoi increased by 0.4 to 0.5 m in 60 years.

At present, the issue of dredging and deepening the channels are not yet addressed because of huge volumes and unsustainability. Therefore, it is necessary to carry out a comprehensive research into development rules of the estuaries and to improve their flood discharge capacity as well.

3.6 Development of watersheds

The planting and protection of watershed is one of the non-structural measures to protect and reserve water resources, avoid land erosion, exhaustion and flash flood, especially in areas not available of reservoir, midland and upland of Thai Binh river basin. According to 1999 statistics, there are 3.37 million ha of forest in the river basin, or 32.29% of total coverage.

In the 5 million ha forestation program, it is expected that by 2010 about 2.4 million ha of trees will be grown in the river basin to increase the plantation coverage to 55.55%.

4. ROLE OF RRBO AND IWARP IN FLOOD PREVENTION AND CONTROL

Flood controlling is one of the necessary tasks, which press RRBO and IWARP to closely cooperate in flood control and natural disaster mitigation, specifically:

- Planning of measures: in the flood control planning for Red – Thai Binh river basin, 6 measures have been proposed as mentioned above. In order to bring into play these measures, there should be different plans for each measure in which specific criteria, scope of design for dyke sites, reservoirs, retarding basins, watersheds, floodway etc… are identified.
- Calculation and operation of reservoir during flood season: the operation and regulation of reservoirs to absorb floods in Red – Thai Binh river basin are one of the sensitive issues as they directly relate to the flow process of the river system and affect the electricity generation. Therefore, the calculation and formulation of operation procedures for reservoirs during flood season should be carefully elaborated.
- Regular checking and monitoring the flood controlling. This is one of the important activities, which are carried out annually by the Flood and Storm Prevention, and Control Boards at all levels with the support and cooperation of local governments.
- Inspection and evaluation of actual operation of flood control structures in the system to detect problems, potential risks and critical locations in need of urgent repairing and monitoring throughout flood season.
- Checking the preparation of inputs, materials, human resource and the availability of evacuation plans for people and properties in the event of floods or any big risks.
- The broad propaganda will provide better awareness for local people so that they can knowledge and participate in the flood control and natural disaster activities in their locality.

5. DIFFICULTIES AND PROBLEMS IN FLOOD MANAGEMENT

- Together with global climate changing, our country also sees the visible increase of natural disasters.
- The forest management is not effective which is reflected in the damaged watersheds. This is the main cause to frequent flash floods raging in the river basin.
- Rising sea level caused by greenhouse effect explain for existing coastal flooding and reduced flood drainage in estuaries.
- The fast and constant growth of the economy is putting such a big pressure on population development, living quality and the society as a whole.
- Bridges and occupied flood plains in the process of urbanization and cultivation have narrowed the floodway and increase flood pressure for rising water level in dyke system.
- Retarding and diversion basins are also occupied during the urbanization, which hinders a lot the retarding and diverting of flood water as necessary.
- The mobilization of materials and resettlement for the construction of flood control structures are confronting difficult problems.
- Dyke system has been built for a long time so in many sections, dyke foundation and body do not meet design criteria for flood control. As flood water level in river system rises to above warning level 2 (equivalent to water level of 10.5m in Hanoi), water piping is detected in some dyke sections.
- The main flow is changing all the time, which causes the erosion in the flood plains and riverbed. This means the stability of flood plains and dyke system are greatly affected.

- The coastal area and estuaries (of Day and Thai Binh rivers) tend to silt up and stretch towards the sea, forming warp soil areas in the estuaries and obstruct floodway.

6. ACTIVITIES TO BE DONE BY THE RRBO IN THE NEAR FUTURE

- Accelerating the completion of trans-reservoir operation procedures to control flood for downstream.
- Accelerating the completion of flood way planning for Red river. This planning will be a basis for the construction of dyke system, levees and flood plains to meet flood control and economic development requirements in these areas.
- Studying of training of river channel and plains, which are under frequent threat of erosion. E.g. the Red river reach from Da river junctions to Son Tay, the Da river reach after Hoa Binh hydropower plant and others in the river system.
- Studying and assessment of the sedimentation of large-scale reservoirs, plains and estuaries in the river system.
- Studying and planning to identify areas under potential risk of flash floods. This will facilitate governments in midland and mountainous areas with the proper and prompt arrangement and evacuation methods for people and property before and in the event of floods.
- Accelerating the study of design criteria for sea dyke system basing on actual floods and storm faced in northern coastal delta.