THAILAND FLOODS 2011
-CAUSES AND FUTURE MANAGEMENT SYSTEM-

Assoc. Prof. Dr. Sucharit Koontanakulvong
Faculty of Engineering, Chulalongkorn University
Bangkok, Thailand.

***ABSTRACT*:**

During July-November 2011, Central Plain of Thailand suffered from the serious flooding started from July in the northern area and the flood went downward to middle area and near Bangkok area in September and October. It was the first time that flood water reached the inner city of Bangkok and caused flash flood to many main industrial estates in the suburb of Bangkok. The damages of this flooding was estimated to be more than ten times of the previous major past flooding especially to the industrial sector and in the ranking number four of disaster damage in the world. The floods also induced huge impacts to the world's insurance and hard disk industries.

Hydrological data were collected and analysed to investigate the flow peak and volume compared with the past flood events and regulating rules. The investigation on flooding causes were also conducted via interviews, field visit and data collection. During the floods, flood reporting system via social network was developed to response to the need of community on flood situation and it was found to be useful to convey the real time flood information apart from general mass public channels. Via these information channels, lessons learned from flood operation were summarized. Besides, the Government had set up a strategic committee and working teams to review and draft the long and short term flood prevention measures which included future flood management system.

The study summarized the hydrological analysis and the causes of flooding. The developed flood reporting system was introduced and based on these information the lessons learned from flood fighting and the review of the Government's measures and the flood management system were conducted and commented.

KEYWORDS: floods, causes, reporting system, measures, management system

1. INTRODUCTION

During July-November 2011, Central Plain of Thailand suffered from the serious flooding started from July in the northern area and the flood went downward to middle area and near Bangkok area in September and October. It was the first time that flood water reached the inner city of Bangkok and caused flash flood to many main industrial estates in the suburb of Bangkok. The damages of this flooding was estimated to be more than ten times of the previous major past flooding especially to the industrial sector. The World Bank estimated 1,425 billion baht (US$ 45.7 Bil.) in economic damages and losses due to flooding, as of 1 December 2011 and it ranks as the world's fourth costliest disaster as of 2011 surpassed only by the 2011 earthquake and tsunami in Japan, 1995 Kobe earthquake, and Hurricane Katrina in 2005.

During the floods, the government had setup an ad hoc task force to oversee the flood operation, thought, the situations changed rapidly and the communication seemed not to be reliable and mixed up. There were many information based web setup during the flooding to help transfer and share the flood information based on individual information input to counter with their own flood mitigations which proved to be quite successful.

After the floods, the government had also set a strategic committee to draft the long and short term flood prevention plan and enacted the financial bill to set up the flood mitigation fund to counter with water infrastructure upgrading including flood management system.

The study collected the floods data, analyzed hydrological data and summarized the causes of flooding. Based on these analysis and the information gained from the developed reporting system, and lessons learned from flood fighting and the review of the Government's measures and the flood management system integration were conducted and commented.

2. OBJECTIVES AND METHODOLOGY

The study set the objectives as follows.

1) To collect and analyse hydrological data,
2) To collect the flood operation data and the government measures,
3) To review the flood causes,
4) To comment on the proposed flood management system.

The study were conducted in the following procedures, i.e.,

1) collected hydrological data, flood satellite data collection via web during May-November 2011 in the area downstream of dams till river mouth,
2) collected responses and comments from flooded people obtained from the open web sites,
3) collected and reviewed the official government measures of both short and long term,
4) analysed the water path and flood causes based on hydrological data and responses from flooded people,
5) made comments on the future flood management system based on past operation records.

3. FLOODS PHENOMENA AND CAUSES

Thailand flood 2011 were basically caused by the more than average with the characteristics of high and long runoff pattern. These were attributed from the series of typhoons (four hits) from South China Sea (compared with two hits in average). The runoff from June and July in the north hit with the storms in August and September and produced high and long hydrograph (about 4600 cms compared with the 3600 cms at river bank) at Nakornsawan (C2, inlet of the Lower Central Plain) and last for almost two months. The high hydrograph in the Chao Phraya River broke the gates along the river (started in September 14, 11 at Bang Chomsri Gate) and let river water flowed into the paddy field and caused sheet flood flow into the area including urban area (reached north Bangkok on Oct 19, 11). This sheet flood flow then caused huge damages to the industrial estate and housing area.

From the hydrological data and satellite data, the flood in 2011 started from July 2011 in the northern area already and the flood continued to flow to the southern area till November 2011 as shown in Fig. 1. The flood water flowed to the lower central plain where many cities were located through the main station C2 and the peak hydrograph was shown compared with the past flooded year in Fig. 2. It is noticed that the peak of the year 2011 was not high but the duration was longest compared with the past records. The peak discharge was 4600 cms and equals to 90 year return period (see Fig. 3). The water balance of the inflow (through C2) and the outlet to the sea at river mouth was conducted and shown in Table 1 and the results showed the balanced net storage in the lower central plain is about 17729 MCM which needed to be stored or drained for the future plan based on 2011 flood data. The flooded area and balance net storage, as shown in Fig. 4, was well correlated and verified the assumptions of this calculation.

The causes of the floods 2011 were then summarized as follows, i.e.,

- rainfall pattern and volume (caused higher volume than drainage capacity),
- water management for irrigation (reflected to the drainage operation),
- damages of main structures (due to the high and long hydrograph) and caused the flash flooding,
- ineffective flood warning system (due to the overflow phenomena),
- unsystematic rescue/communication system (due to the unplanned flood event).

4. WEB BASED FLOOD SUPPORTIVE INFORMATION SYSTEM

The flood situation was so fast when coming closed to the urban area (two days to Nakornsawan, two weeks to Ayuthaya). This gave a panic atmosphere in the surrounding area of Bangkok and people seeked for water situation to prevent flooding of their houses. The questions of " flood or not" and "how deep the flood will be " were common at that stage. Chulalongkorn University then gathered the ground level information and key water gauge stations and put into the web called "Chula-Flood.org" so that people can inform the flood situations (called crisis reporter) and also click in and look for the level in the main roads near their houses (called crisis planner) as shown in Fig. 5. With the information of ground level and water level in the nearby gauge station, they can estimate the flood depth approximately and use the information to build self defense schemes (such as sand bag

fence, pumping facilities etc.). The web were used in average more than 10,000 times a day which became a new means for people to share information and gain knowledge for their self help scheme.

These information gave good explanations on how water penetrating into the urban and surrounding area which can be used for flood analysis and future flood operation also.

5. LESSONS LEARNED FROM FLOODS 2011

From the hydrological data, flood system feedbacks, the lesson learned from the floods 2011 can be summarized as follows, i.e.,

- insufficient flood prediction system which made authorities concerned and affected people not aware enough,
- not on time flood warning system caused by overflow phenomena but induced panic situations to the urban area people,
- unsystematic flood fighting system depending on each local administrative authorities with no single command system which caused indecisive flood fighting activities and supporting measures,
- irregular facilities maintenance caused the broken, not ready to work and inefficient drainage/protective facilities
- social and political involvement in unsystematic and unprepared ways caused confrontation and conflicts on flood operation.

By the way, during the flood fighting operation, there were also well admired merit activities. Many communities gathered and set their own self help activities to help each other in the community to survive during the floods. Other activity is the private volunteer activities to deliver equipments and foods to supply to the flooded area which helped the government and local administrative authorities to deliver various suppliers during the floods. These also should be mentioned and prepared for the next flood relief plan.

6. FUTURE MEASURES AND FLOOD MANAGEMENT SYSTEM

Thai Government set up a strategic flood committee to draft the long and short term measures to counter with future floods. Fig 6 described the long term flood preventive measure concept which focused on the following plans, i.e.,

- upstream plan (to reforestation and build new reservoirs)
- midstream plan (to prepare for flood plain management)
- downstream plan (to manage the land use plan and control the development and consider flood way to the sea)
- administrative aspect (to set up single command organization, with compensation regulations, data base, prediction and warning)
- social aspect (to facilitate the understanding, acceptance and participation to the government measures) .

However, since the preparation and implementation of the long term measures take time, the short term measures were decided to be implemented with the following measures, i.e.,

- to make use of existing structures with the consideration of local characteristics in each area,

- to enhance storage and drainage capacity,
- to prevent flood in community and economical zones by providing adequate drainage capacity and well protected zones in the lower area : east and west,
- to provide supportive measures (e.g., procurement procedure etc.),
- to repair the main gates to protect overflow,
- to establish control chart and points (at C2 Nakornsawan and Bangsai),
- to align and enhance drainage capacity (by dredging, pumping, dyke heightening),
- to control flooded water level and volume at C2 (upper area),
- to utilize storage capacity as retention (in both upper and middle area),
- to set up the flood warning system and single command unit.

The future management system was set up under the Prime Minister Office with new organization (acted as a single command unit). The system comprised of data gathering & clearing, warning system, flood operation control and information communication. The unit will gather related information and control the release of water from main reservoirs, drainage of water from main pumping stations and utilize of retention area in the upper and midstream prepared area if needed to protect the urban area and drain flooded water into the sea more efficiently. The new dam operational rule was set (to be 45 % in May to prepare for storage during typhoon period) and the two million rai (about 160,000 ha) of retention are prepared as emergency storage. During this summer, before August 2012, dredging and pumping facilities improvement will be conducted in the main streams. The emergency waterway and flood way are setup by heightening the dyke to counter with flood flow as in the year 2011. Lastly the social acceptance talk is scheduled to be conducted and communicated before May 2012 for preparedness.

The newly flood management system setup is based on information input and analysis tools at the unit, though, the flood management covers more aspect such as social, local administrative aspect and more linkages among upstream, middle stream and downstream area which up to now the unit has not yet indicated any involvement in joint planning/operation in these aspects. From the past flood operation data and information as indicated above, these may affect to the effectiveness of the real operation of the flood management system and mutual discussions need to be considered soon.

7. CONCLUSIONS

Central Flood 2011 was caused from changing climate with different pattern of rainfall, i.e., rainfall started on June, and number of (typhoons were beyond expectation and came early in June. With classical water management rules (dam & diversions), water control could not reduce the peak and make structural (dikes, levees, diversion works) breakdown. This caused the water flow into the plain and create rapid sheet flow flood. The flooding lasted for more than two months in many areas and caused huge damages to socio economical situations of the country.

The hydrological analysis indicated the inadequate drainage capacity of the system facing with high volume of runoff. The warning system and flood operation were conducted under unsystematic and not well prepared ways. The web based flood information system was introduced and shared the

real time information for flooded people to better adapt themselves with flood situations.

The combination of measures (both structural and non structural) had been planned in the Government's long term flood prevention plan and short term plan for the short term had been set and implemented at the moment. The flood management system was set up as a single command unit under the office of Prime Minister to cover the data collection & clearing, warning system, flood operation and communication activities to the publics.

The newly flood management system setup is based on information input and analysis tools in the unit, though, the flood management covers more aspect such as social, local administrative aspect and more linkages among upstream, middle stream and downstream area which up to now the unit has not indicated any involvement in joint planning/operation in these aspects. From the past flood operation data and information as indicated above, these may affect to the effectiveness of the real operation of the flood management system and mutual discussions need to be considered soon.

REFERENCES

Patinya Hanittinan, Anurak Sriariyawat and Sucharit Koontanakulvong, Sukhothai Flood Analysis and its Response under Climate Changes, USMCA2011, Chiengmai, Thailand, Oct 2011.

SFCWRM, Immediate Term Flood Mitigation Report, Jan, 2012 (in Thai).

SFCWRM, Long term Strategy for Flood Prevention and Mitigation in Chao Phraya Basin, January 14, 12.

Sucharit Koontanakulvong., et. al., Floods 2011 Situations, Technical Report, Chulalongkorn University, November 2011 (in Thai).

Sucharit Koontanakulvong, Anurak Sriariyawat, Thailand Flood 2011-causes and future scenario- , USMCA 2011, Chiengmai, Thailand, Oct 2011.

Sucharit Koontanakulvong, Sukhothai flood analysis and its response under climate changes, UNU Conference, Tokyo, Japan, November 2011.

Sucharit Koontanakulvong , Short and Long term Flood Prevention and Mitigation Plan after Bangkok Floods 2011, presented at Technical Committee, JIID, Tokyo , Feb 7, 2012.

Sucharit Koontanakulvong, Lessons learned from Bangkok Floods 2011 and what's next ? , presented at the 10th Kyoto University Southeast Asia Forum 2012, Thailand , March 17, 2012.

Sucharit Koontanakulvong, et. al., Flood Rest – Flood Support System, Technical Report submited to Chulalongkorn University under University Special Fund, March 2012.

World Bank, " The World Bank Supports Thaialnd's Post-Floods Recovery Effect", 13 December 2011. (Retrieved 25 January 2012).

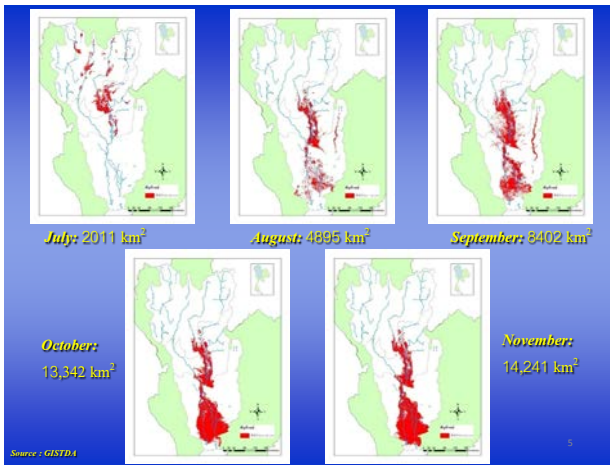


Figure 1 Historical development of floods in 2011

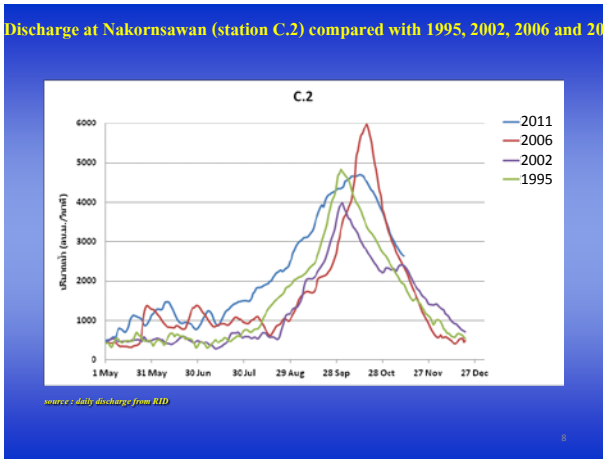


Figure 2 Flood peak at main station (C2) compared with last Floods

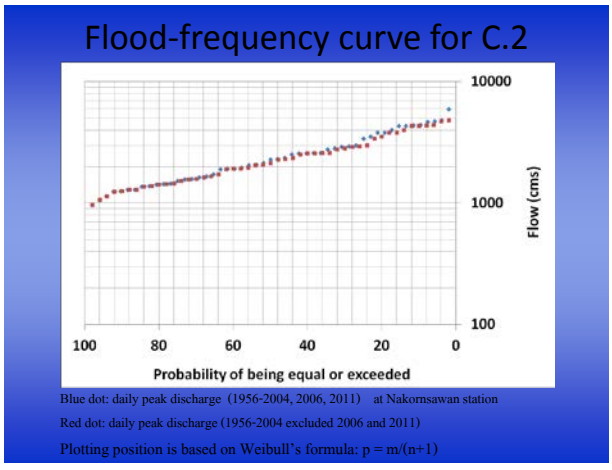


Figure 3 Distribution of peak discharge at the main station (C2:Nakornsawan)

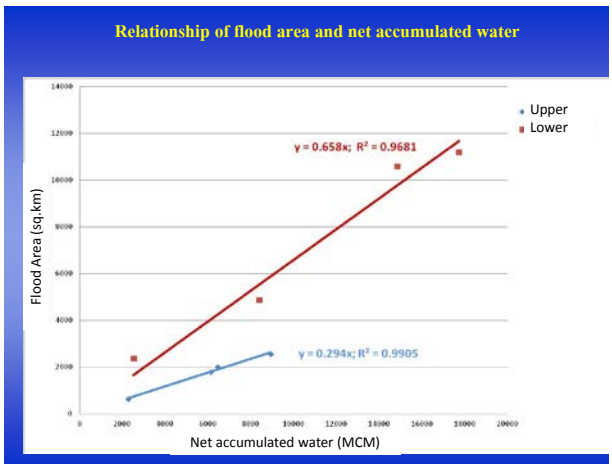


Figure 4 Correlation of flooded area and net accumulated water

Figure 5 Flood reporting system through volunteer network

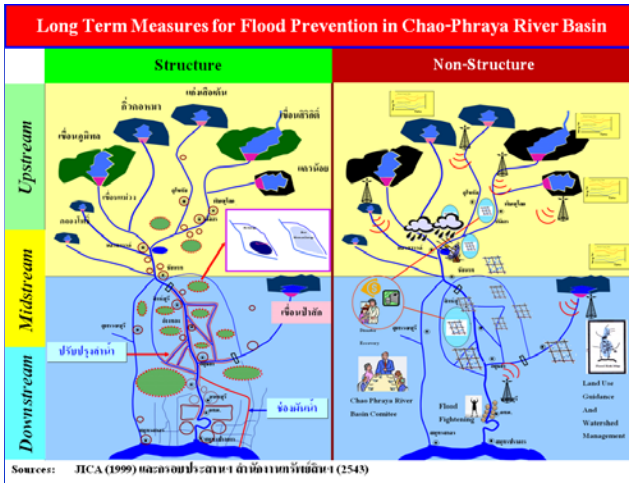


Figure 6 Long term national flood prevention measures

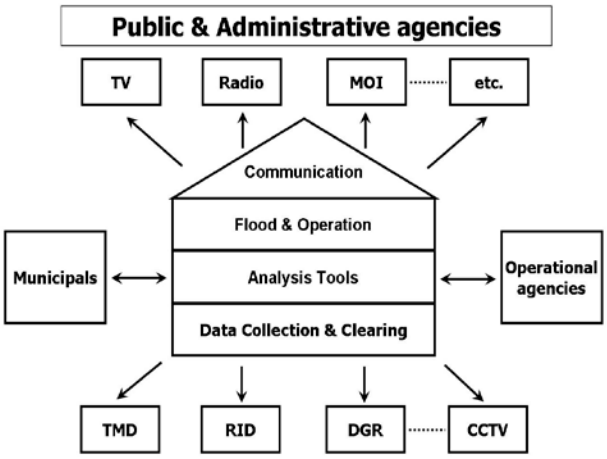
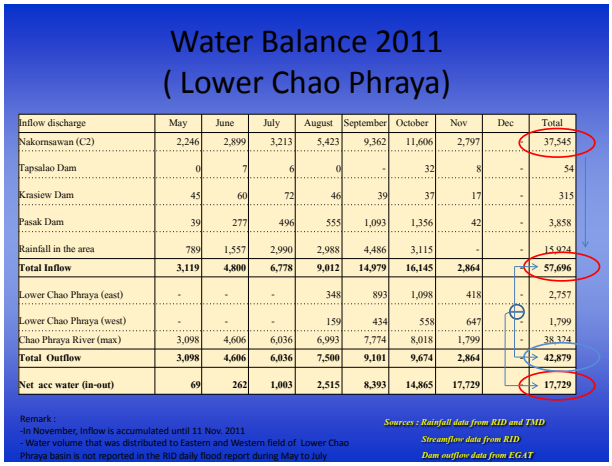


Figure 7 Proposed flood management system

Table 1 Water balance of inflow and outflow of the Lower Central Plain



Inflow discharge	May	June	July	August	September	October	Nov	Dec	Total
Nakornsawan (C2)	2,246	2,899	3,213	5,423	9,362	11,606	2,797		37,545
Tapsalao Dam	0	7	6	0	-	32	8	-	54
Krasiew Dam	45	60	72	46	39	37	17	-	315
Pasak Dam	39	277	496	555	1,093	1,356	42	-	3,858
Rainfall in the area	789	1,557	2,990	2,988	4,486	3,115	-	-	15,924
Total Inflow	**3,119**	**4,800**	**6,778**	**9,012**	**14,979**	**16,145**	**2,864**		**57,696**
Lower Chao Phraya (east)	-	-	-	348	893	1,098	418	-	2,757
Lower Chao Phraya (west)	-	-	-	159	434	558	647	-	1,799
Chao Phraya River (max)	3,098	4,606	6,036	6,993	7,774	8,018	1,799	-	38,324
Total Outflow	**3,098**	**4,606**	**6,036**	**7,500**	**9,101**	**9,674**	**2,864**		**42,879**
Net acc water (in-out)	**69**	**262**	**1,003**	**2,515**	**8,393**	**14,865**	**17,729**		**17,729**