

## CHARACTERIZING FLOOD EVENTS AND ITS IMPACTS ON RICE PRODUCTION IN THE MEKONG DELTA, VIET NAM.

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### ABSTRACT

*A significant percentage of rice areas in the Mekong Delta are vulnerable to various degrees of flooding. Flash floods that occur with short duration at early rice stages could increase farm inputs, but can be avoided to reduce production losses. Farmers have developed their own coping strategies to avoid/reduce the risks. Viet Nam government also provides mitigating and relief programs to cushion the impacts of submergence. This study used secondary and household-level data to characterize flood events and estimate its impacts on rice farming households. Significant findings indicated that there are two to three flood events in the Mekong River. Stagnant floods in July to November, with >1.0m depth can cause serious inundation. Flash floods (20-60 cm depth) of 7 to 20 days duration at the early rice stage in November/December can be avoided by re-sowing and adjusting the cropping calendar. Floods decrease yield and production by 20-100% if there is no adjustment adopted. From 2000 to 2001, heavy rains and tidal movement in the Mekong Delta inundated 422,032 ha rice and destroyed 87,106 ha of agricultural land. Submergence-tolerant rice varieties are critical to addressing the poverty situation in the rice areas. Breeders should develop more rice varieties that withstand the excess water and are adaptable under varying flooding conditions. As women become increasingly involved in farming, they should have equal opportunities as men in acquiring knowledge, making decisions on which varieties to use and appropriate management practices should be adapted under the complexity of conditions in flood-prone areas.*

**Key words:** flash flood, flood events, stagnant flood, submergence

### INTRODUCTION

The damaging effects of flooding remain as major sources of concerns among millions of rice farmers worldwide. The weather change due to various reasons causing unexpected and sudden flood in recent years has negative impacts on rice farming and people life. This paper is to document the characterizing of flood and flood in the Mekong Delta and to see how does it influence people and agriculture. This documentation will serve as one of the sound bases for developing the strategies in reduction the magnitude of negative impact on people life and agricultural production in the Mekong Delta, South Viet Nam.

### METHODOLOGY

The secondary data and qualitative information were collected from various governmental agencies in the Mekong delta as well as from the printed materials and the internet. The primary data in two special sites of Hau Giang and Long An provinces in the flood prone area for the information on flood and flash flood events in relation to the rice farming were gathered through the household baseline survey, focus group discussions (FGDs), and key informant interviews.

Simple random sampling was used in selecting the households. Data on farm practices and livelihoods during “normal” and “flood” years served as basis for the analyses. Flood was classified ad flash flood and stagnant flood. Flash flood lasts for less

than 3 week and stagnant flood was longer ( $\geq$  one month).

## RESULTS AND DISCUSSION

### 1. Characterizing of flood events and economic losses

Being located in the monsoon tropic humid area, Vietnam has not only diversified climate and plentiful resources but also suffers many natural disasters, especially flood and typhoon (Nguyen Viet Thi 2003). In Vietnam, the annual average amount of rainfall is 1960 mm. In annual average, there are about eight typhoons and tropical low-pressure events in Vietnam each year, most of them occurring in July to October. Annually, in main rivers in Vietnam, there are 4 to 12 flood events occurring mainly in 3 months in flood season: from July to October in the North; from September to November in the Central. Particularly, there are two to three flood events occurring in Mekong river but lasting from July to end of November and causing serious inundation state in Mekong delta area. Flood and inundation are always the biggest threat to people's life and social-economic activity. In recent years, heavy rainfall, flash flood, landslide have occurred more and more frequently. Because of particularities on appearing suddenly of flash flood, normally appearing in the night, short-activating, tremendously devastating capacity, it is very

difficult to forecast and warn flash flood. The damages caused by these natural disasters rise rapidly with VND 4,000 billion; 8,000 billion; 14,000 billion; 5,400 billion; and 5,100 billion in 1984, 1986, 1997, 1999 and 2000, respectively. There were tremendous damages on people's lives and environment (Nguyen Viet Thi 2003).

The disasters also made 0.67 percent of Vietnam's farming population face hunger. The estimated losses were VND 18.6 trillion (nearly \$US 1.2 billion) in the year (Tin Que Huong 2007). Floods raged throughout southern and central Vietnam starting on August, 2006 the floods submerged 50,000 hectares of farmland, causing more than a million dollars of damage (Earth Observatory 2006). The rains made the ground being saturated and ponds and lakes are already overflowing their banks (IRIN 2009).

Unusual typhoon, low tropical pressure, heavy rains, high tides and outbreak of pests are challenges to both farmers and agricultural researchers. South Vietnam is easily affected by high tidal water from the river and plays as a basin of the flood. The unusual tide and flood heights and timing of occurrence cause difficulty in farming management. Farmers are unable to predict the water level and timing of these unusual phenomena. Table 1 shows the extent of flood and tide in the Mekong Delta.

**Table 1.** Area affected by flood in the Mekong Delta (2007, 2008)

Province	Total natural area (ha)	Area affected by flood		Area affected by tide		Source
		Area (ha)	Percent (%)	Area (ha)	Percent (%)	
Can Tho	138,959	94,394	68	44,590	32	Department of Planning and Investment of Can Tho city (2007)
Vinh Long	147,913	25,732	17.4	44,598	30.15	Department of Planning and Investment of Vinh Long province (2008)
Tien Giang	248,177	140,000	65.41	248,177	100	Department of Planning and Investment of Tien Giang province (2008)
Long An	449,187	297,699	66.27	10,203	0.22	Department of Irrigation of Long An province (2008)

Province	Total natural area (ha)	Area affected by flood		Area affected by tide		Source
		Area (ha)	Percent (%)	Area (ha)	Percent (%)	
Dong Thap	337,400	337,400	100	337,400	100	Department of Irrigation of Dong Thap province (2008)
An Giang	353,678	118,796	35.59			Department of Planning and Investment of An Giang province(2007)
Kien Giang	634,600	120,000	18.9	55,000	8.7	Department of Planning and Investment of Kien Giang province (2008)
Hau Giang	160,059.69	121,785.59	76.09	160,058.77	100	Department of Planning and Investment of Hau Giang province (2008)
Tra Vinh	229,282	19,300	8.4	229,282	100	Department of Planning and Investment of Tra Vinh province (2007)
Ben Tre	230,019.77	0	0	167,360	72.7	Department of Planning and Investment of Ben Tre province (2008)
Total	2,929,275.46	1,275,106.59	43.5	1,296,668.77	44.3	

Aside from regular stagnant flood, the irregular flash flood caused by high tides and heavy rains affected rice cultivation.

In observed villages, the flash flood occurs from 7-10 days. In some area, flash flood retained until 20 days. In Hau Giang, the flash flood occurred from 54 to 100% of rice area meanwhile it was from 9 to 30% in Long An province. It occurred at the seedling stage of rice growth (7-10 days old) in dry season, from 3<sup>rd</sup> week of November to 2<sup>nd</sup> week of December due to high tidal flow, heavy rains, off-season typhoon and low tropical pressure. The water depth of flash flood varied from 20-60cm. Farmers know the high tide at full moon time, but they think that the submergence does not last long then will be gone soon. However, the water level during high tide at full moon cannot be predicted. In wet season, the time of flash flood occurrence cannot be known because it depends the time of heavy rains.

Aside from flash flood with short duration, there is stagnant flood, which lasts for more than one month during wet season (from August to

October). The peak of stagnant flood is in October with the depth of water is 100 cm.

## 2. Impact of flood

Table 2 shows that rice production in flood year was relatively lower than those in normal year about 15%. The rice yield in the flood year was also reduced from 4t/ha to 3.73 t/ha. The gross household income in the flood year was relatively lower than those in the normal year (about 18%). Of which, the reduction in rice income was 19%. This caused reduction in the net income from rice production in the flood year. The reduction in gross income was mainly from selling animals, fish and rice. Flash flood in the flood year had decreased the income from selling assets as compared with the normal year, especially selling of animals due to the animal loss affected by flood. The animals died due to flood were chicks, chickens, ducks, fish, pigs, piglets. Catching fish in the flood year contributed to the household income, however the households with fish raising in the rice field would be lost if water spilled over the filed boundary.

**Table 2.** Impact of flood on rice production and income

Item	Hau Giang		Long An		All sites	
	Normal year	Flood year	Normal year	Flood year	Normal year	Flood year
Rice yield (t/ha)						
Wet season	3.48	3.38	2.98	2.72	3.24	3.09
Dry season	4.54	4.08	4.94	4.53	4.74	4.31
All seasons	4.01	3.73	3.98	3.73	4.00	3.73
Rice Production (kg/HH/year)	8625	8063	29979	24597	19302	16330
Rice Gross income (in '000 dong/HH/year)	11987	11973	71070	52704	36194	29355
Sale of animals (in '000 dong/HH/year)	1820	1217	2351	1971	2085	1594
Sale of fish (in '000 dong/HH/year)	55	67	635	44	345	56
Household Gross income (in '000 dong/HH/year)	24561	23539	106661	81694	60277	49633
Household Net income (in '000 dong/HH/year)	19916	10184	74472	28990	45012	19587

(Source: Data Surveyed in Long An and Hau Giang)

Regarding to farmers' adjustment practices and experience during the flood year. Farmers increased labour for rice establishment in flood year (increased 0.25 – 2days) for field gap filling and for land preparation before re-sowing. Some of farmers changed in the date of crop establishment, 6% of them established earlier and 9% established later to cope with flash flood. Farmers also increased the amount of seed rates (9%) to have more seedlings for gap filling (dead plants due to flash flood). They increased about 43kg seeds per hectare. Some of farmers (6%) changed in rice varieties. Farmers also increased fertilizer amount in the flood year to help the plants grow faster in their height to be higher than the water level and to have more seedlings for gap filling. They increased the amount of DAP

fertilizer to have more seedlings and increased Urea fertilizer to increase to height of the rice plants (increased about 60kg DAP per hectare and 50kg Urea per hectare). Some of farmers decreased fertilizer amount in the flood year because they observed that the silt deposition due to flood make the soil be more fertile. They reduced about 20 kg to 38 kg Urea/ha depending on the level of silt from flood.

There were more than half of the households in the flood prone had to do re-sowing or replanting if the flash floods appeared early. Nearly half of the households stored seeds for re-sowing or replanting in the flood prone area. Majority of farmers in the flood prone are willing to grow submergence-tolerant rice varieties

**Table 3.** Scoping with flood affect and impact on farmers' practices

Item	Hau Giang	Long An	All
% of households with fish ponds damaged by flood	41	16	29
% of households with animals dying due to flood	9	15	12
Percentage of households increased labors for gap filling		25	23
Percentage of households increased labors for re-sowing		25	23
Percentage of households increased seed rates	100	36	43
Percentage of households increased fertilizer amount	12	18	15
(Increase in fertilizer quantity (kg/ha) )	44	30	71
% of households stored seeds for replanting/re-sowing	31	57	44
% of households willing to grow submergence-tolerant rice varieties	65	76	70

(Source: Data Surveyed in Long An and Hau Giang)

If the sea level continues to increase 30cm due to weather change in the year 2050, the important agricultural areas in the Mekong Delta and Red River Delta will be under submergence. The forecasting reveals that the calamity reduces the rice productivity of wet crop season from 3 to 6% in the year 2070 compared to the period 1960-1998, the rice productivity of dry crop season may reduce 17% in 2070 in the North and 8% in 2070 in the South. From 1996 to 2005, flooding and typhoon caused 2.3 million ha of rice under submergence in the North and Northern Central. From 2000 to 2001, flooding in the Mekong Delta caused 422,032 ha rice under submergence and destroyed 87,106 ha agricultural land (Khanh Lan 2007). Phuong (2005) reported that meeting from flood-typhoon control committee revealed that the typhoon No. 7 in beginning of October in 2005 caused loss of 0.5% GDP.

Tran Nga (2008) reported that the weather changes with sea water level increase, 5,000 km<sup>2</sup> in the Red River Delta and 15,000-20,000km<sup>2</sup> in Mekong Delta are submerged and the food production in Viet Nam loses about 12 % (equal to 5 million tons). The area for rice production loses about 12-14% due to water submerge.

In the Mekong Delta, the stagnant flood has vast negative impact on rice and other crop productions. Farmers experienced the regular stagnant flood and they did adjusting crop calendar to avoid the peak of flood. However, the abnormal stagnant floods in recent years have caused many difficulties in coping by both farmers and government. However, the stagnant flood is very important in fertile the soil, it also brings to farmers a plenty of fish for their fishing. The silt deposited from the flood makes to soil more fertile and farmers can get better yield in the following rice season. Flood is after wet rice season, the silt deposited is good for the flowing dry season depending on the level of siltation (2 or 1cm from the soil surface). After flooding, farmers can reduce urea fertilizer about 20kg/ha (equal to 9.2kg N/ha) in the dry rice season (Source: focus group discussion with farmers for social component under Mega project, 2002).

Floodwater was also manipulated to plant rice on the raised bed called as 'Lua Liep' in Hau Giang.

In the relatively higher topography in the low land area, farmers raised bed for sugarcane production. The height of bed is 40 cm. After harvesting sugarcane, farmers plant rice on bed to use high water level from flood. Water recedes and becomes dry at the time of harvest.

### 3. Farmers' coping strategies

The flash caused dead plants leading to increase cost of seeds and labors for re-planting and reduce benefit from rice production. Coping by building boundary by farmers themselves is not easy in some cases as in Hau Giang because the soil is so soft and difficult to solid soil for strong boundary.

The villages with relatively lower land than others will be submerged first and last for longer from high tide, which delayed the sowing schedule leading low harvest due pest attack. Farmers only can build semi-boundary themselves as in Long An. They get soils around to build boundary, which is not permanent, they build within their farm as well as at the common place for few fields to prevent inflow of water. They cope with flood by pumping water out through their own building boundary. Thus, farmers need the rice varieties, which are tolerant to flood and acid sulfate soil with all good characteristics.

#### *Flexibility in decision making:*

Farmer did adjustment practices in crop production during the flood year. They increased labour days for rice establishment in flood year (0.25 days in Hau Giang and 2 days in Long An) for field gap filling due to dead plant caused by flood and for land preparation for re-sowing. Farmers stored seeds for re-sowing or replanting in the flood prone area. Some of the farmers changed in the date of crop establishment, either earlier or later to cope with flash flood. Farmers also increased the amount of seed rates to have more seedlings for gap filling. They increased about 43kg seeds per hectare. Some of farmers tried to change in rice varieties. Farmers also changed in timing of fertilizer application by applying fertilizer earlier with higher amount fertilizer to help the rice plants grow faster than the water level raising up and to have seedlings for field gap filling. They increased about 60kg DAP per hectare and 50kg Urea per hectare. Some of them

applied fertilizer later due to waiting for receding of flash flood. Some of farmers decreased fertilizer amount in the flood year because they observed that the silt deposition due to flood make the soil be more fertile.

#### ***Mitigation and relief program:***

Regarding to mitigation programs, there were community-level management practices. Farmers attempted to prevent damage or minimize loss due to flood. Farmers worked together to build or prepare the boundary, prepare irrigation system to pump water out, share cost to build boundary. They shared labor and cost among themselves. Each household contributed 1-5 laborers and worked together. Each household paid VND 0.5-1 million for repairing boundary. They shared expenses based on area, individual paid cost of building or preparing dikes or boundary based on the length of dikes and boundary falling on their land. There was assistance provision from the government. Government provided information about flood status. They encourage farmers, organize farmers, guide them and work with them to build or prepare boundary to pump out water. They support wood to prepare boundary and gasoline to pump water out. Farmers are also willing to participate in insurance programs due to flood. Some of them expected the insurance program to provide fund, varieties and fertilizer in case of flood damage

Related to relief program, in fact, the relief program for flash flood was negligible. The relief program for the stagnant flood in the Mekong delta is more important to help the people in the flood area to maintain their living during flood period. Very few farmers received cash and other materials from the government for relief from flash flood. They received a small amount from VND 150,000 to 300,000 per year. The government provide 1 boat for very few farmers as the mean for fish catching. Few of them also received medicine, milled rice or noodles. Few farmers participated in the relief program. However, most of farmers perceived that the relief programs benefit to the poor. The most important need in the flood year was seeds and fertilizer followed by preparing the water source system. Credit to purchase input is the third important.

Related to the relief programs, farmers suggested to build higher dikes; help prevent flood; maintain irrigation system; construct electric pump station in lowland area; construct canal for rice production; provide boat and fishing net, capital for land preparation, rice establishment, buying inputs, fertilizer, pesticide to improve life during flood year; provide training on agriculture and water management.

#### **4. Technology adoption**

Though farmers have not heard or known about submergence -tolerant rice varieties, they could adjust some cultural practices in rice production through their experience of flood. For instance, increased labours in re-sowing, nutrient management depending on the situation of occurrence and level of flood.

In focus group discussion with both male and female farmer group who experienced flash flood in their fields indicated that farmers were willing to have technologies to increase yield and rice income for their specific fields. In the area with relatively shallow than the other villages, farmers were not able to raise the land up because shallow land spread for the whole community in the village. Based on their experience, they can adjust practices as much as they can. For a long run with more sustainable, there should be strategies for land levelling, water adjustment aside from spreading tolerant rice varieties for the whole area of the community.

To have information on technologies related to rice varieties and related cultivation technologies in general, farmers accessed information from two kinds of channel. The first channel was from the State as extension workers and mass media (television, radio). The second channel was from the intermediate agents such as from other family members, neighbours or other farmers. Weather is important to farmers because it affects to crop production. Weather forecast was important to farmers to make decision making on planting, fertilizer and pesticide application, or date of harvest. Farmers obtained information about weather forecast from television and radio mainly.

#### **5. Government's response to flood situation in agricultural areas**

Actually, the awareness of the affect of flash flood on crop production by the government was not clearly seen. What they noticed was more on the stagnant flood with high water level and last long (more than one month). There were relief programs mainly for stagnant flood rather flash flood. The flash flood occurred at site- specific villages might not be seen by high level people. The village leaders as well as the extension staff at commune level understood well situation of flash flood in their specific site. However, at the State level, the directions regarding flash flood have not been seen. With the prediction on environmental erosion by gas emission, the weather change related to temperature increase and water raising up from the sea, the land at low topography as Mekong delta must adopt the new technologies as stagnant – and flash flood tolerant rice varieties and appropriate directions from the government.

### **CONCLUSIONS AND ECOMMENDATIONS**

The nature of flood events become complicated in recent years due to affecting from unusual typhoon, low tropical pressure, heavy rains and high tides. Aside from yearly stagnant flood results from water flow from the Mekong river due to its location at the downstream, the flash flood occurred in short period in the Mekong Delta resulted the harder afford in rice production. The stagnant flood occurs regularly but the extent of water level was not stable. This type of flood causes severe agricultural economic and human resource loss, especially in the rural area. The flash flood occurred mostly in dry season during November and December. This flash flood lasts for 7-10 days at the early stage of the rice plant. The factors that caused flash flood included the relative low level of the rice field, high tide, heavy rains, typhoon affects. Rice farmers were not able to predict the extent of these factors. Thus, they faced the problem of dead plants. They had to do replanting and filling the gaps with available seedlings or re-sowing again. Farmers coped with this problem by storing extra seeds or using high seed rates to have seedlings for gap filling. They also increased the inputs as labors and fertilizer during the flood year. After first experience on flash flood, farmers tried in building the boundary carefully and higher, pumping water out, repairing irrigation system either by farmer community

themselves or with the guidance of the government. Thus, negative impacts from this flash flood were low income from rice production as compared to the normal year. This may contributed to the poverty of the households and community. The sudden flash flood has been delayed the poverty alleviation process and slow down the target time for development of the rural area. The relief program for the flash was almost negligible and was not much noticed largely but only for stagnant flood. Farmers' knowledge on submergence tolerance rice varieties was negligible though farmers accessed to various sources of information for crop production. Though flood makes soil fertile from siltation and brings farmers the benefit from natural fish, it causes dramatically economic loss and prolongs the poverty situation in farming area.

### **Recommendations:**

- Research: In the flood prone area in the south Viet Nam, there is the need of rice varieties that are tolerant to both flash flood (sudden flood lasts for less than 3 weeks) and stagnant flood. Thus, the breeding goal in rice research should target to this concern.
- Policy: Government should financially and materially support farmer community in the areas where are vulnerable to both stagnant and sudden flash flood to consolidate the dikes/boundaries to protect the rice plants in both dry and wet season. The agricultural information on various sources should include the information of flash flood and submergence tolerant rice varieties.
- Farmers: Both male and female farmers in the flood prone area should form in community or group to receive and apply appropriate technologies, support knowledge and learning each other the measures to cope with the problems of flash flood and stagnant flood.
- Institutions and network: The research institutions, extension agencies, and farmers' association and social clubs should form a network to develop and disseminate the suitable and adaptable rice technologies for the flood prone area.

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### Tóm tắt

#### Hiện tượng ngập lũ và ảnh hưởng đến sản xuất lúa ở đồng bằng sông Cửu Long, Việt Nam

Diện tích lúa đồng bằng sông Cửu Long dễ bị ảnh hưởng ngập lũ với nhiều mức độ khác nhau. Hiện tượng ngập trong thời gian ngắn ở giai đoạn đầu của cây lúa trong mùa khô do thủy triều và đôi khi do kết hợp thủy triều và mưa bão làm tăng chi phí sản xuất để đảm bảo sản lượng. Nông dân có kinh nghiệm trong việc đối phó với ngập lũ để giảm thiểu thiệt hại. Nhà nước cũng có các chương trình giảm nhẹ thiên tai cho dân. Ở đồng bằng sông Cửu Long có hai đến ba sự kiện ngập lũ. Từ tháng bảy đến tháng mười một, lũ lụt xuất hiện với mực nước có thể cao hơn 1m và gây ra úng nghiêm trọng. Hiện tượng ngập trong thời gian ngắn gọi là ngập nhanh ở giai đoạn đầu của cây lúa kéo dài từ 7 đến 20 ngày với độ sâu mực nước từ 20-60 cm xuất hiện vào tháng 11 và 12. Ảnh hưởng này được nông dân đối phó bằng cách gieo sạ lại hoặc điều chỉnh lịch gieo sạ. Ngập lũ làm giảm năng suất và sản lượng 20-100% nếu không có cơ chế đối phó. Từ 2000 đến 2001, mưa lớn kết hợp thủy triều lên ở đồng bằng sông Cửu Long làm ngập 422.032 ha và thiệt hại 87.106 ha diện tích đất nông nghiệp. Vì vậy, giống lúa chống chịu ngập rất quan trọng cho vùng ảnh hưởng ngập lũ. Các nhà lai tạo và chọn giống cần phát triển giống lúa chống chịu các mức độ ngập lũ khác nhau cho vùng.