JAPAN - IRRI - ASISOV

Implementation Plans to Disseminate Submergence – Tolerant Rice Varieties and Associated New Production Practices to Southeast Asia

(IRRI Reference Number DPPC2007-22)

Proiect: *Dissemination of submergence - tolerant rice varieties and associated new production strategies*

Component 2 and 6: A case in Central Vietnam

Report by Dr. Nguyen Thanh Phuong

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A. BASIC INFORMATION

1. Title of the Component

Implementation Plans to Disseminate Submergence Tolerant Rice Varieties and Associated New Production Practices to Southeast Asia: A Case in the central Vietnam

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4. Implementing agency

Lead Agency for the component: **Dr. Hoang Minh Tam,** Director, Agricultural Science Institute for Southern Coastal Central of Vietnam (ASISOV)

5. Project location (s)

Two sites selected based on agreed criteria in Phuoc Thuan commune - Tuy Phuoc district and Nhon Hanh commune - An Nhon district – Binh Dinh province

B. TECHNICAL DESCRIPTION

Rationale

Most *Oryza sativa* cultivars die within a week of complete submergence-a major constraint to rice production in south and southeast Asia that causes annual losses of over US$1 billion and affects disproportionately the poorest farmers in the world (Xu, et al., 2006). The IRRI-Japan Project has developed submergence-tolerant rice varieties (rice varieties with the sub1 gene), and now, seeks to formulate implementation plans to disseminate such varieties and their associated new production practices to South East Asia, including Vietnam. In the country, Annually, southern coastal zone of Vietnam is greatly damaged to production from typhoons, especially in winter-spring crop and wet crop. The survey results for the period 1998-2005 indicated that the total rice production areas damaged by flooding were about 144,956 hectares equaling to 14,495 hectares yearly.

Binh Dinh province in the Central Vietnam were chosen as target sites for the dissemination. However, not much effort has been done to fully understand farmers' production constraints which may hinder the adoption of the varieties to be disseminated in the areas.

Characterization of the farm households and rice production environments are essential to fully comprehend the current situation of farm households in the target sites. Agricultural scientists, plant breeders, social scientists and extentionists should have a good grasp of the ecosystem they are addressing and the farmers' response to the sub1 technology. With this information, implementation plans to disseminate the technology would be appropriate to the specific needs of the target clientele.

Collection of secondary data will be conducted to have village basic information. The household survey will provide the information on farmers' characteristics, farmers' problems, their preference of rice traits for submergence tolerance. We also collect the impact of flood and submergence on farmers and their copping mechanism. Focus Group Discussion to supplement the information of farmers preference, needs, and problems in the flash flood areas to have suitable dissemination of submergence tolerant rice varieties. The evaluation of the participatory varietal selection will be conducted.

PART I. ECONOMIC COSTS OF FLOODING AND FARMERS' COPING MECHANISMS IN RICE FARMING COMMUNITIES IN CENTRAL VIETNAM

Submergence tolerant rice varieties in Central Vietnam
A Baseline Survey Report in Central Vietnam

1. Introduction

The damaging effects of flooding remain as major sources of concerns among millions of rice farmers worldwide. Most *Oryza sativa* cultivars die within a week of complete submergence-a major constraint to rice production in south and southeast Asia that causes economic losses and affects the poor farmers. Under the socioeconomic aspects of the Japan – IRRI project titled, ***"Dissemination of submergence-tolerant rice varieties and associated new production strategies"***, In the country, Binh Dinh province in the Central Viet Nam was chosen as target site for the dissemination. Central Viet Nam will conduct a study that will assess the economic losses and risks associated with flooding or submergence incidences, the consequences and the response mechanisms of affected farming communities. This assessment will serve as one of the sound bases for developing a response plan to reduce the magnitude of economic impacts and ultimately contribute to reduction in poverty and socioeconomic transformation in targeted rice communities.

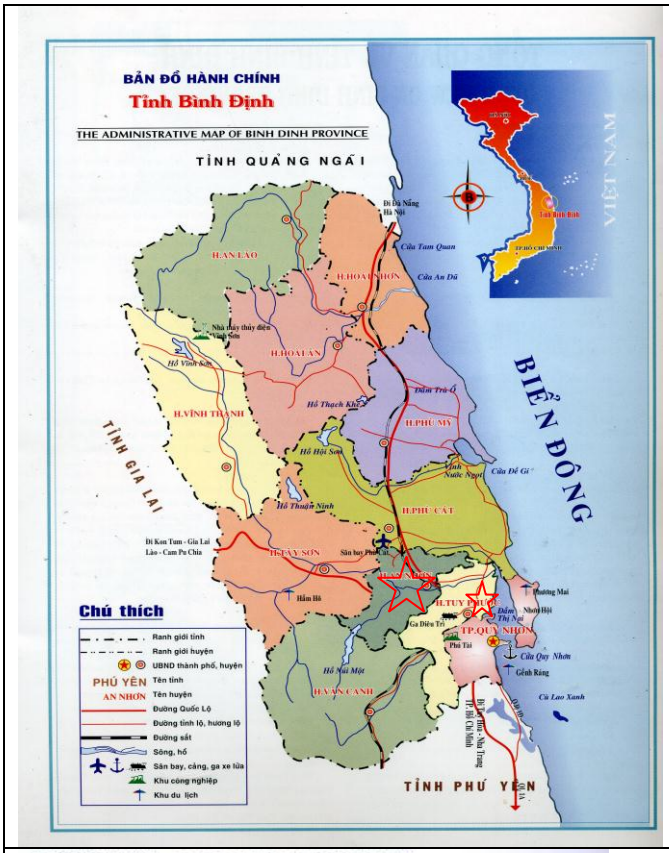
The analysis will cover both the impact of flooding at the aggregate farm-household levels. As in other stresses in rice farming, impacts of flooding can be direct to the farmers. Impacts can also be short-lived or lingering for an extended period causing more damages that can be irreversible. In which case, national policy (local goverment such as: province) to alleviate the consequences may be necessary. The study will make use of secondary and primary data collection in the project sites in the two districts and would entail cross-nation analysis to allow for additional knowledge from relationships, experiences and learning in commune of similar conditions.

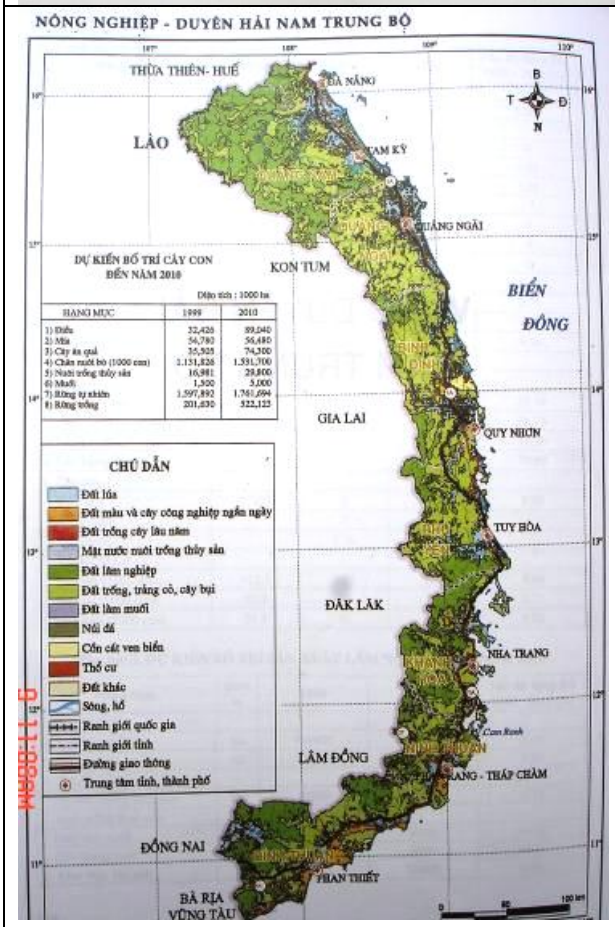
1.1. General description and location of the sites:

- In Phuoc Thuan commune, Tuy Phuoc district have 276 ha (Nhan An village: 140 ha, Quang Van village: 136 ha). Population have 5,641 persons (Nhan An: 3,522; Quang Van: 2,119).

- In Nhon Hanh commune, An Nhon district have 127 ha (Duong Xuan village: 52 ha, Hoa Tay villge: 75 ha). Population have 1,322 persons (Duong Xuan village: 606, Hoa Tay villge: 716)

Nhan An and Quang Van villages of Phuoc Thuan commune (Tuy Phuoc district of Binh Dinh province); and Duong Xuan and Hoa Tay villages are located in the down stream of Kon river. Binh Dinh province is adjacent to Quang Ngai, Phu Yen provinces. All selected villages are lowland rice area and affected by flash flood. Flash flood occurs due to heavy rain, typhoon and flood-tide.





The South Central Coast region consists of 8 provinces stretching from Da Nang city to Binh Thuan province. The total natural land is 4,425,700 ha, in which:

+ Agricultural land: 829,100 ha occupying 18.7%.

+ Waste land: 1,516,900 ha occupying 34.3%.

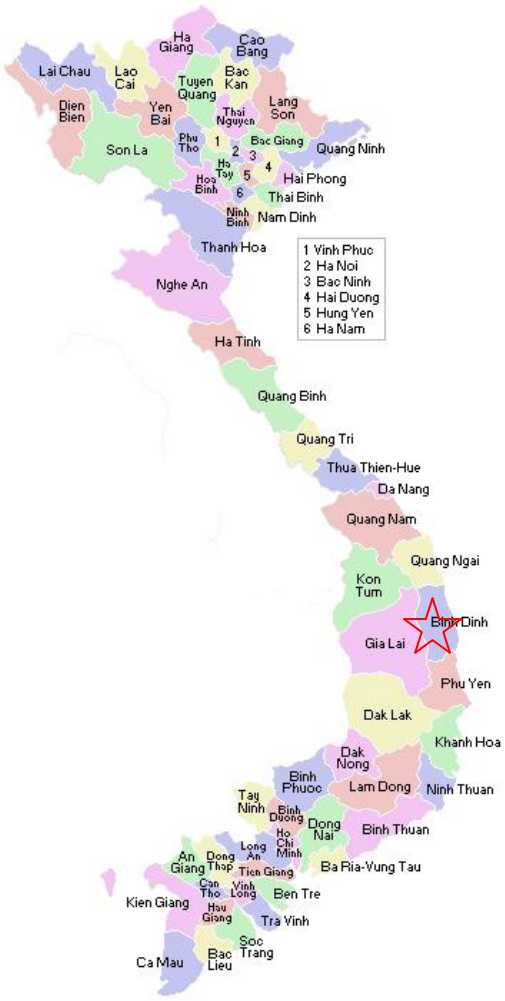
+ The main kinds of lands: alluvial soil, sandy coastal soil, emaciated grey soil, feralit soil, bazan… distributing at the altitute of 0-1,000m against the sea level.

The total population of the region are 8,672,300 people, the population living and working in rural areas are 6,057,500 people occuping 69.8%

The region features tropical and monsoon climate and is clasified into 3 main agricultural ecology sub-regions: Nam - Ngai, Bình - Phu and Nam Deo Ca (South Ca pass).

The South Central Coast region having narrow strip of land, complicated terrain, large slope occurs a huge heat, dry, heavy rain, flooding, typhoon frequently…and suffer the most risks in the country.

Figure 1: Location of Binh Dinh province in the South Central Coast region



1.2. Trends in rice production – yield, production, area

- ***Country:*** The rice production and yield have been in Vietnam slightly increased meanwhile the rice area has been decreasing due to urbanization and industrialization (Figure 2)

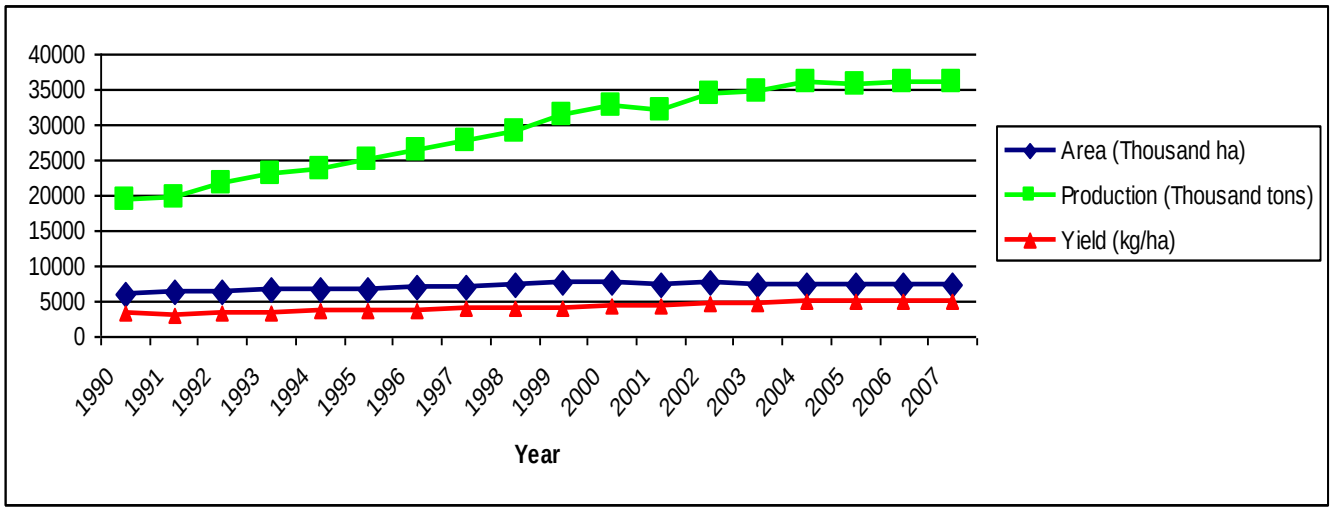


Figure 2: Trend of rice area, rice production and yield for Vietnam (whole country) (Source: Vietnam Statistics Office, 2007)

- ***Provinces selected:***

In Binh Dinh province and the South Central Coast region, the rice area has been slightly increased since 1996. The trend of rice production and yield in the South Central Coast region and Binh Dinh province has been increasing and suitable area in 2006 (Table 1).

Table 1. Rice production status of some Southern Centre provinces Planted area and yield of paddy by Southern Centre provinces

Province	Year	Total		Spring		Summer		Autumn	
		Area (ha)	Yeild (ton/ha)	Area (ha)	Yeild (ton/ha)	Area (ha)	Yeild (ton/ha)	Area (ha)	Yeild (ton/ha)
Quang Nam	1996	105,260	3.17	41,708	3.21	18,920	4.14	44,632	2.73
	2000	94,470	3.49	41,227	3.57	8,185	3.82	45,058	3.36
	2006	8,363	4.61	40,826	4.90	-	-	42,805	4.33
Quang Ngai	1996	89,509	3.30	34,123	3.48	24,125	4.06	31,261	2.50
	2000	86,603	3.60	33,923	4.04	24,637	4.18	28,043	2.55
	2006	75,211	5.01	36,848	5.22	27,727	5.47	10,646	3.08
Binh Dinh	1996	124,024	3.54	45,873	3.83	38,432	3.98	39,719	2.79
	2000	126,873	4.12	46,523	4.68	40,888	4.26	39,462	3.33
	2006	121,000	5.02	47,200	5.60	40,200	5.02	33,600	4.09
Phu Yen	1996	57,595	4.72	23,669	5.72	21,735	5.16	12,551	2.05
	2000	57,690	4.81	24,464	5.23	23,030	5.57	10,196	2.03
	2006	58,318	5.41	25,381	6.10	22,700	6.06	10,300	2.29

1.3. Importance of flood-prone environments in rice production.

In the South Central Coast region, flood affected to life and rice production. But 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 1 cm form the soil surface).

1.4. Vulnerability of rice producing areas in the country, in general and in the study sites:

Rice production in Viet Nam is vulnerable due to the affect of weather change as typhoon, tropical low pressure with long lasting and heavy rains, flood, and drought, salinity and submergence, acid sulphate soil.

1.5. Poverty incidence in the country and the project sites

Vietnam is one of the poor countries in Southeast Asia. According to Cao Viet Sinh (2002) at the State level, the target of hunger elimination and poverty reduction toward 2010 includes to reduce the poverty rates according to international standards; to create jobs for about 1.4 -1.5 milion working people per year, (ii) to increase the ratio of female labor in the total new jobs to 50% by the year 2010; (iii) to universalize, and to improve the quality of, education, to enhance the quality of education for all, especially for the poor people; (iv) to reduce the fertility rate, the mortality rate and malnutrition rate of children; (v) reproductive health, epidemics, HIV/AIDS and social diseases; (vi) to develop culture and information, and to enhance the spiritual life of the people; (vii) to enhance the livelihood and to preserve the culture of ethnic minorities; (viii) to secure environmental sustainability; (ix) to reduce

vulnerability and to develop the safety net and social security, to provide support to the disadvantaged and the poor; (x) gender equity and women empowerment; and (xi) to accelerate the public administration reform program, and to provide knowledge on legal matters for the poor.

In 2007, with the old poverty line of 200,000 VN dong income per month per capita in rural area and 260,000 VN dong income per month per capita in urban, the poverty incidence in Vietnam was 14.8% (Vietnam Newspaper, 2009 and VTV 1, Feb. 1, 2009). According to Vietnam news spoken on television in Hanoi (VTV 1, Feb. 1, 2009), poverty incidence of the whole country in 2008 was 13.5%. In 2009, the new poverty line of 300,000 VN dong income per month per capita in rural area and 390,000 VN dong income per month per capita in urban, the poverty incidence in Vietnam was 17.4% with 3 million poor households (Vietnam Newspaper, 2009).

In Long An province, with old poverty line, the poverty incidence of the province was 12.37% with 39,943 poor households (Long An People Committee, 2008). In 2007, the poverty incidence in Hau Giang province was 16.34% and the province is targeting to reduce 2% (Hau Giang People Committee, 2007)

2. Objectives of the Study

2.1. General objectives:

The main objective of this study is to understand the sources and causes of submergence phenomenon, describe and estimate its economic costs at various levels, document and assess the farmers' coping mechanisms in the selected villages and project sites of the flood-prone rice-growing areas, and recommend suitable varieties and associated management practices under a response plan for the project in major rice-producing in Central Vietnam. An underlying objective is to have a better understanding of the interphase between biophysical and socio-economic conditions faced by the rice farmers in the flood-prone areas, identify farming communities' constraints, opportunities, needs and preferences to ensure identification of reliable and effective interventions.

2.2. Specific objectives:

- To understand the agro-ecological, socio-economic and cultural characteristics of the farming communities affected by submergence;
- Facilitate the evaluation and adaptation of rice varieties for submergence and typhoon prone countries through the PVS;
- To determine the farmers' preferences for varieties/lines and their selection criteria;
- To determine how the methods and steps on understanding farmer's needs and preferences can be incorporated in the conventional process of setting breeding goals, and
- To indentify suitable target areas and upscaling strategies.

3. Analytical Framework

Household level of analysis: The household survey will provide the information on farmers' characteristics, farmers' problems as well as their farming practices related to the environmental conditions as soil types and flooding in the place where they do farming. The analysis to know how much farmers like adopt the new submergence tolerance rice varieties for development the strategies in dissemination in the Central Vietnam.

There are two main types of analyses to be used in the study. The first one involves the characterization of flooding and the estimation of aggregate value of production loss (as part of economic loss) resulting from flooding. The second type relates to the assessment of impact of flooding at the farm-household level and their coping mechanisms.

4. Methodology

4.1. Sampling procedure: The list of rice farmers in the selected village was collected from the village head. The random sampling was used to select rice farmers for survey. In each district, we selected one commune with occurrence of natural flash flood, then selected two villages in each commune where there is flash flood occurred and which have same conditions. The random 50 farmers in two villages were selected for household survey. Total of 96 farmers were selected in 2 districts of Binh Dinh province.

4.2. Data collection

- Description of the secondary data used in the project: The rainfalls and rice production at the studied sites were collected to see the relevant of these secondary data to the stagnant and flash flood at the studied site. The deepest water level was able to collect in one site to know the relative topography of the land where farmers are doing farming.
- General description of household survey: The survey was conducted by using the structured questionnaires after pre-tested. This was direct interview. The enumerators were trained by using enumerator instruction manuals with definitions of terms and key variables as well as explanations of how questions are asked and measurements are made. The survey methods enable collection of relevant data and information that link directly to project goals and objectives
- Other methods of data collection: Focus group discussion with farmers and informal discussion with the key informant at commune and village levels to know information about the sites as flood and flash flood problem and for village characterization by using village descriptor guide.

4.3. Site Selection

- Criteria for site selection/ selection of villages: Site selection was based on the following criteria:

- Rice production is important in the site: Binh Dinh province are representative for important rice production in the Central Vietnam.
- Extent of the flood or submergence problem: Based on informal discussion with key informants, An Nhon and Tuy Phuoc districts of Binh Dinh province were selected as the site having flash flood problem aside from stagnant flood. Informal discussion with key informant also help to select Hoa Tay and Thai Xuan villages in Nhon Hanh commune (An Nhon district) and Nhan An and Quang Van villages in Phuoc Thuan commune (Tuy Phuoc district) as the sites for this study. These were selected based on the list of all villages in the commune with all information of rice area, submergence area due to flash flood, and affected households in each village. The villages were selected based on high extent of problems (the largest area and highest number of households affected with flash flood) and biological scientist did testing submergence tolerant rice varieties.
- Extension staff in the sites of Binh Dinh province are very cooperative. In general the staff at all levels in 8 provinces in the Central Vietnam are very cooperative in

testing, demonstration and dissemination of new innovation. The extension staff at commune level at Nhon Hanh commune and at Phuoc Thuan commune are very active and cooperative.

- Accessibility of the site: The sites are easily to access by transportation means as by motorcycles, auto, car...
- Presence of extension and research station: Binh Dinh site is relatively near to Agricultural Science Institute for Southern Coastal Cental of Vietnam (ASISOV) aside from extension center of the province.
- Willingness of the government: the government is very supportive to this project
- Not many projects in the site: Binh Dinh site do not have many projects.
- Willingness of farmers: Farmers are willing to plant new tolerant rice varieties at Binh Dinh and 7 provinces in zone.

- Determining the benchmark year: To determine the benchmark year, we based on the formation collected from the informal discussion with the key informants in the communes. The key informants comprised of the extension staff of the commune, president of people committee of the commune, leader of farmers' association of the commune, staff of transportation and irrigation of the commune, president of red cross group of the commune and he was concurrently farmer who tested submergence tolerant rice varieties. In Nhon Hanh and Phuoc Thuan sites, flood year selected was 2007 and the normal year was 2003.

4.4. General description of information was collected:

In household survey, socio-economic characteristic of the household, farm profile as land use, land type and soil type related to submergence and flood, cultural management practice for rice, rice production and disposal, income source during flood year and normal year, relief program were collected.

4.5. Pre-testing of questionnaires and initial site inspection:

Questionnaires were pre-tested for suitable to the situation in Central Vietnam, revised, translated into Vietnamese before training the enumerators for doing survey.

4.6. Data Analysis:

The descriptive statistic was used to summarize the data in the form of mean, frequency and percentage.

To calculate the cropping intensity index, gross cropped area and net cropped area had to be known. Gross cropped area is the sum of the area planted in all seasons. Net cropped area is operational area = owner-cultivated area + leased-in area. Cropping intensity index is the ratio of gross to net cropped area.

Diversification index = 1- Sum of the square of (area planted to each crop / total planted area)

5. RESULTS AND DISCUSSIONS

5.1. Characterizing Flooding Events that Affect Rice Production

5.1.1. Definition of flooding; Nature of flooding – typology

Located in monsoon tropic humid area, being contiguous to South China Sea and the West–North of the Pacific Ocean, Vietnam not only has diversified climate and plentiful. In Vietnam, the annual average amount of rainfall is 1,960 mm. In annual average, there are about 8 typhoons and Tropical low-pressure events in Vietnam each year, most of them occurring in July to November. 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 Cuu Long River but lasting from July to end of November and causing serious inundation state in Cuu Long delta area. The variation in water flow is very big in Vietnam. The maximum of the discharge is 10 times to 30 times larger than the annual average value and hundreds of times larger than the minimum value. In general, in any main river system in Vietnam, flood and inundation are always the biggest threat to people's life and social-economic activity. In recent years, because of effects of global climate changes and ENSO phenomena, Hydro-meteorological natural disasters in general and heavy rainfall, typhoon, flood in particular unfold more and more complicatedly and have abnormal sign on effect-scale, range of impact. The intensity and rate of natural disasters have increasing trend. Especially, in recent years, heavy rainfall, flash flood, landslide have occurred more and more frequently. In some areas, they have occurred in many years continuously and many times in one year. 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. However, flash flood forecasting and warning have been implemented in the National Center for hydro-meteorological forecast. Along with the social-economic development in the country, the serious damages caused by natural disasters, especially by heavy rainfall, flash flood, and landslide have increased more and more. For example, the damages caused by natural disasters rise rapidly with 4,000 billion VND in 1984; 8,000 billion VND in 1986; 14,000 billion VND in 1997; 5,400 billion VND in 1999; and 5,100 billion VND in 2000. There were tremendous damages on people's lives and environment (Nguyen Viet Thi).

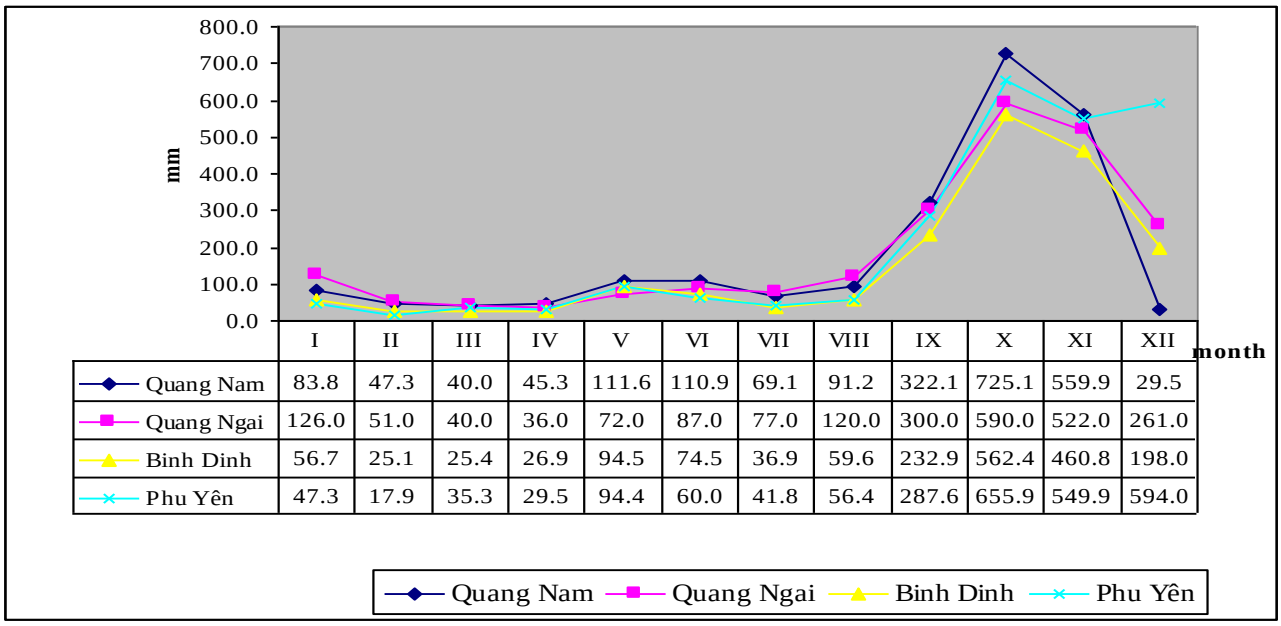
Flood is not only harmful to the crop but also dangerous to the life of people. Flash flooding in central Vietnam last month (December, 2007) killed 76 people while another 36 died in August after flooding in November. The disasters, mainly in the central region, also damaged over 400,000 houses, and many hectares of subsidiary crops and irrigation works, causing total property losses of over 3.4 trillion Vietnamese dong (VND) (212.5 million U.S. dollars) on November, 2007. The disasters also made 340,300 people or 0.67 percent of Vietnam's farming population face hunger, said the report. The Vietnamese government has recently approved the National Strategy on Natural Disaster Prevention, Response and Mitigation by 2020. Natural disasters, including typhoons and hails, killed 339 people, left 274 people missing and injured 2,065 others in Vietnam in 2006. The estimated losses totaled 18.6 trillion VND (nearly 1.2 billion dollars) in the year (Tin Que Huong, 2007). Floods raged throughout southern and central Vietnam starting on August, 2006 the floods submerged 9,300 houses and 50,000 hectares of farmland, causing more than a million dollars of damage (Earth Observary). The Vietnamese capital has been inundated with some 20 inches of rain over a three-day period in November, 2008. The rains made the ground being saturated and ponds and lakes are already overflowing their banks (IRIN, 2009).

The average deepest water in Nhon Hanh commune (An Nhon district) was 120 cm and Phuoc Thuan commune (Tuy Phuoc district) was around 100 – 150 cm.

5.1.2 Characterization of rainfall - temporal variability; Rainfall spatial variability; Actual and long-term average and monthly patterns

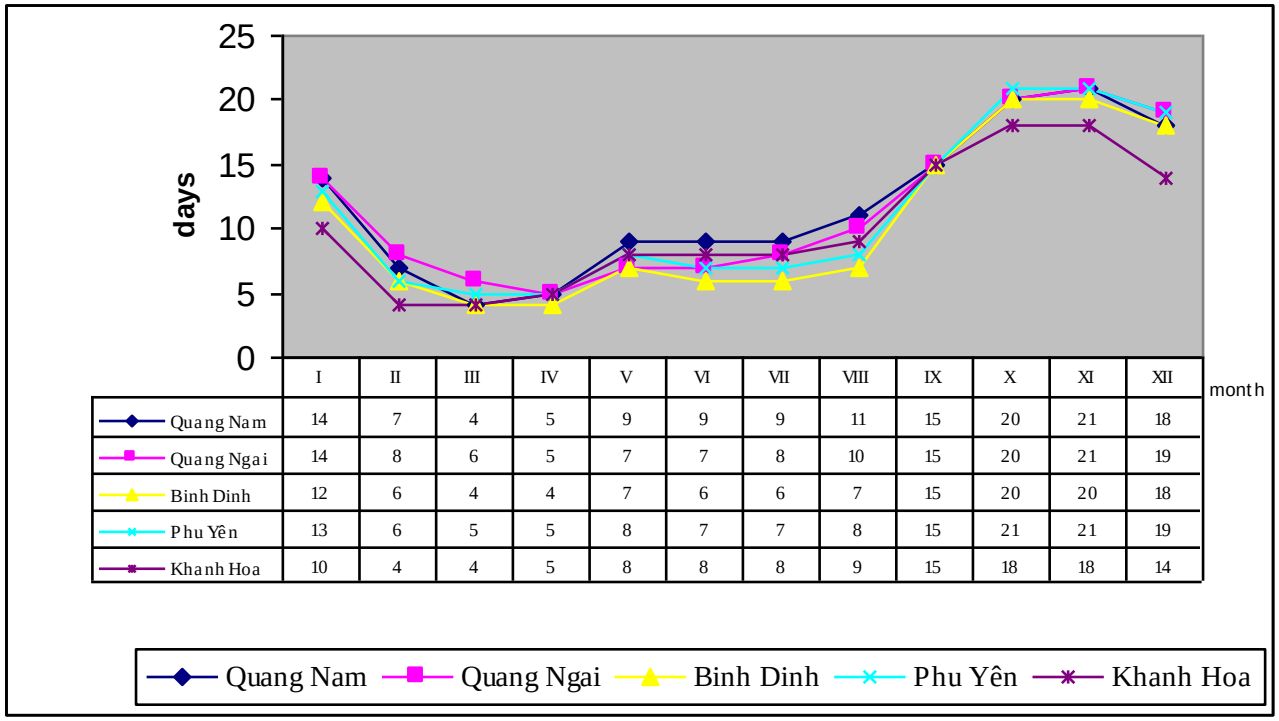
Figure 3, Figure 4 and Figure 5 show the total monthly mean rainfall, monthly mean of rainy days and maximum daily rainfall pattern in the studied sites (An Nhon, Tuy Phuoc disticts, Binh Dinh province) and Southern Central provinces. The rainfall in Binh Dinh was between more than 1,600 to 3,000 mm. Average rainfall is 1,921 mm. However, it was more than 2,500 mm in some years in North province site.

**** Weather condition in some Southern Central provinces of Vietnam***



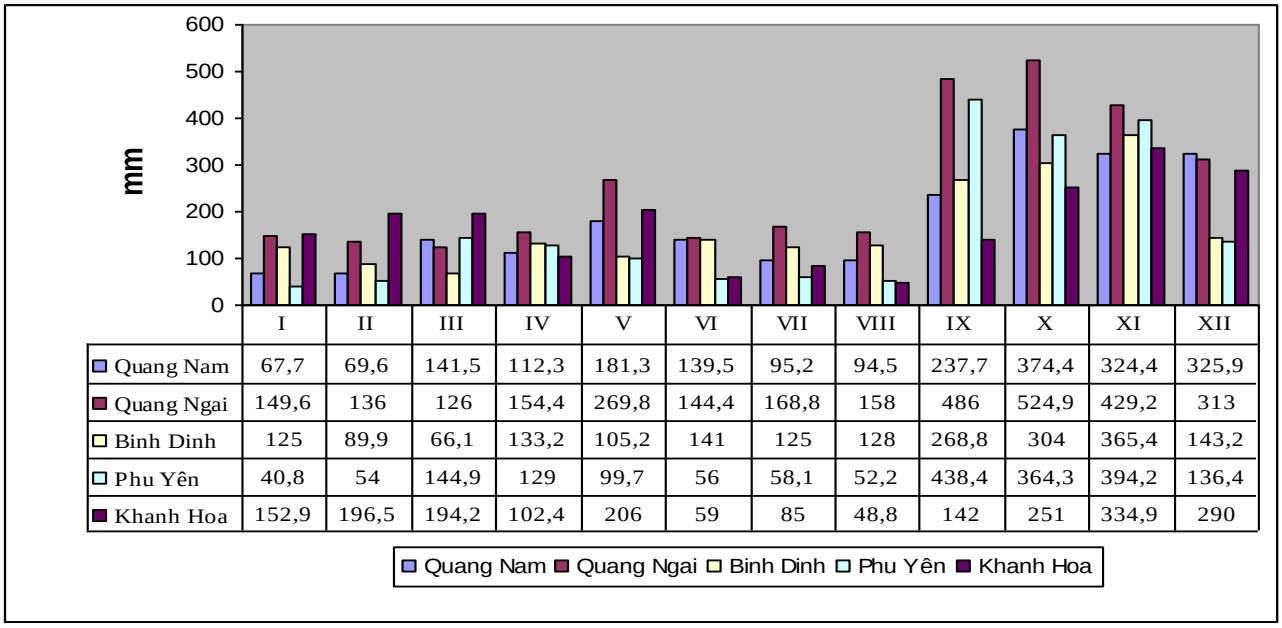
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
month												
Quang Nam	83.8	47.3	40.0	45.3	111.6	110.9	69.1	91.2	322.1	725.1	559.9	29.5
Quang Ngai	126.0	51.0	40.0	36.0	72.0	87.0	77.0	120.0	300.0	590.0	522.0	261.0
Binh Dinh	56.7	25.1	25.4	26.9	94.5	74.5	36.9	59.6	232.9	562.4	460.8	198.0
Phu Yên	47.3	17.9	35.3	29.5	94.4	60.0	41.8	56.4	287.6	655.9	549.9	594.0

Figue 3. Total monthly mean rainfall (mm)



	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
month												
Quang Nam	14	7	4	5	9	9	9	11	15	20	21	18
Quang Ngai	14	8	6	5	7	7	8	10	15	20	21	19
Binh Dinh	12	6	4	4	7	6	6	7	15	20	20	18
Phu Yên	13	6	5	5	8	7	7	8	15	21	21	19
Khanh Hoa	10	4	4	5	8	8	8	9	15	18	18	14

Figue 4. Monthly mean of rainy days (mm)



Figue 5. Maximum daily rainfall (mm)

(Source: the average data of the period 1979-2005, Weather forecast station of Da Nang)

The monthly rainfall patterns in Binh Dinh sites are shown in figure 4. In flood year (2007) in Binh Dinh the rainfalls from September to December were higher than those in the normal year (2003) even rainfall in December of normal year being very low, which cause flash flood in this period.

5.1.3. Details of typhoon occurrences and other factors that contribute to flooding events

A typhoon is a violent tropical hurricane/cyclone that occurs in the west Pacific and the Indian Ocean. The important feature of typhoon in Vietnam is its occurrence. Due to thick density of atmosphere in the northern west Pacific Ocean, typhoons move to Vietnam territory, often from May to December. The typhoons happen along with heavy rains that cause flooding. The damage caused to crop and people is due to the synchronized affect of raining, cyclones, and big waves from typhoon phenomenon. Typhoon in Vietnam has specific characteristic due to the variation of terrain from coastal area to inland. The sudden change in typhoon direction and speed is very popular. The direction and speed of winds in typhoon also dramatically fluctuate with big ranges. The occurrence of typhoon in Vietnam is unusual and more dangerous than before due to the affects of weather change in worldwide in recent years (Construction Center, 2007). Tran Van Sap (2007) reported that the typhoons moving to Vietnam seaside had strong wind forces from 10 to 11 degree exception of Xangsane typhoon (typhoon No. 6) in 2006 moving to Da Nang city with the wind force of 13-14 degree. Considerable damage and loss was assosiated with Severe Tropical Storm Xangsane during the first two weeks of October, though much of this was the result of very strong winds which brought about structural damage, cash crop losses and disruption to transport and communication. Major regional damage was brought about by Tropical Storm Durian during the first week of December, 2006, though most of this was the result of high winds and coastal storm surges and was not attributable to hydrological flooding or intense storm rainfall. Over 6,000 households were urgently evacuated and more than 68,000 people moved to safe refuges (Annual Mekong Flood Report 2006, Mekong River Commission). According to ND (2008), Viet Nam country locates in the tropical monsoon region, the average annual rainfall is 1,900mm but its distribution is uneven in terms of time and space, 70-75% of the rainfalls

concentrate during the months of raining season. The two deltas of Red River delta in the north and Mekong river delta in the south Vietnam do not only sustain the rainfall in their places but also receive the water flow from outside the country. Thus, in the raining and typhoon season, big floods often occur widely in the Mekong delta and breaking the dike system happens in the north. Because of the narrow and steep geography and terrains in the provinces in Central Vietnam, this area is directly affected by many typhoons and low tropical pressures from the eastern ocean. Thus there are many heavy rains with high rainfalls which cause severe flood in the coastal delta.

*** Damaged caused by flood and flash flood from review of literature**

In South and South East Asia and the Pacific, it is estimated that an area of more than 13 million hectares of agricultural land are prone to floods. These occur mainly in Bangladesh, India, Burma, Thailand, Vietnam and Cambodia and are caused primarily by an accumulation of rainwater, river discharge to basins forming deepwater bodies, and tidal movements (FAO, 2001). Viet Nam has a long history of subjecting to calamities and there are several measures of coping when they occur. The weather changes in recent years have caused high tidal flow and high rainfall in the raining season leading to big flood in many regions in Vietnam. 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, which threatens the national food security. The weather changes increase the frequencies of occurrence of calamities that influence the timing of crop planting. 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 reduces 17% in 2070 in the North and 8% in 2070 in the South. From 1996 to 2005, flooding and typhoon caused 2.3 millions 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. In 2006, the two typhoons named as Chanchu and Xangsane caused 21.548 ha rice submerged and damaged in the Central Viet Nam (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. This typhoon caused loss of 300 to 400 thousands of rice productivity due to submergence and unfilled grains. HMDC (2004), ministry of agriculture said that the heavy rains from 20 to 23 July 2004 had caused submergence of 217,000ha of rice, of which 116,000ha of rice were totally sunk in water. About 60,000ha of aquaculture were not able to harvest. The severe damage was found in Thai Binh and Nam Dinh province where raining were on just transplanted rice. In Nam Dinh province. 20, 068ha of rice were totally submerged (occupied 95.9% total transplanted rice area). Ha Yen and Ng.Tam (2006) reported that raining had caused 60,000ha of rice in Thai Binh province under submerged and had to re-transplanting about 20,000ha . The agricultural loss was about 300-500 billions dong. In August, 2006, heavy rains with rainfall of 173mm caused nearly 33,500ha of sunk in the water in Ha Tinh, Quang Binh, Quang Tri, Thua Thien, Binh Thuan, Dong Nai, Lam Dong, Dak Lak and Dak Nong provinces.

- Damage in some provinces in the North: In 2004, there were more than 116.000ha rice lost due to heavy rain which caused flooding, landslide and submergence in wet season. This happened in Thai Binh, Nam Dinh, Hai Duong, Hung Yen, Hai Phong and Ha Giang provinces. Submergence occurred when the young rice plants were just transplanted which their capacities to recover is low. Department of agriculture directed people to drain water out of the fields to save rice and take care of dikes. Farmers were asked to sow seeds to have seedlings for re-transplanting at the area with plant died and should use the rice variety with below 120 days. After water drainage, farmers should observe the plant, if the roots were still white, the stem still hard, they should applied fertilizer and take care for the plant to recover faster (Ha

Yen, 2004). Continuous raining for 3 days (8, 9 and 10 September, 2003) and an other 2 days of raining (13 and 14 September, 2003) in Thai Binh province caused loss of 600 billions dongs due to rice under submergence. The local government directed to maximize the capacity of pumping machines at pumping stations to pump out water from the fields. This took about 10 days (25 September) for the water level in the fields became normal (TN,TP 2003). In An Ninh commune, Tien Hai district of Thai Binh province, due to drought in the onset season, the transplanting delayed 7 days as compared to the planting season. After transplanting 5-7 days, the heavy and long lasting rain from 16-21 August 2006 with addition of high tidal caused hundreds of hectares of rice submerged. Of which, totally 100 ha of rice was submerged. The duration of submergence was 6-7 days. When water flows out, all rice plants were died. Farmers used bio-fertilizer called "AH" produced by Thanh Ha company and found that the rice recovered after submerged (Kim Chau, 2006). On the heavy rain on the night 9 May 2008 with the rainfall of 200mm in Nho Quan district (Ninh Binh province) caused hundreds of hectares of rice submerged. To save the rice plants, even in the night three water pumping stations with 19 pumping machines operated 24 hours to drain out water. People gathered together to consolidate the damps and bunds to prevent the water from rivers flowing inside the field. They saved 150 ha of rice. There was 80% of rice saved from flood. The rests totally died (Hanh Chi, 2008). According to VOV News (2006), raining caused submergence of 225 ha monsoon rice in Cao Bang province, 858 ha rice in Tuyen Quang, 309 ha in Lang Son province were damaged. Hong Duc (2005) reported that in Nam Dinh province, the typhoon no. 7 in 2005 for 5 days and high tidal at the same time caused flooding of 259 ha in Thinh Long town due to broken dikes. Tung (2007) reported that flooding rains in beginning October in 2007 caused submergence and damage of 30,965 ha of rice in Northern Central and North Vietnam. The loss from damage from rice and other infrastructures were 2000 billion dongs

- Damage in some provinces in the central Vietnam: In Central and Central High Land, due to off-season raining in January, 12,500ha of dry rice crop was submerged (NNOL, 2008). Le Ha (2005) reported that the heavy rains due to affecting of typhoon in December (2005) caused 3,114ha rice at flowering stage and 21,782ha of rice were just sown under submergence in Binh Dinh province. At the same time, there were 11,056 ha of rice were just sown under submergence in Quang Ngai province. The provincial government supplied rice seeds for farmers to timely re-sow the dry rice season.

In Phu Yen province (Central Vietnam), the heavy rain in the late October in 2007 caused 648 ha of rice of Dong Xuan district under submergence and logging. There were 317 ha of monsoon rice crop under submergence and caused loss of 75-85% rice yield. In Song Cau district, the flooding also caused 120 ha rice submerged (VietnamNet, 2007). The continuous raining for 3 days due to tropical low pressure and cold air caused submergence on a lot of rice fields in Phu Yen province. The rainfall was 259.7mm. There were more than 5000 ha of rice and upland crop submerged in Dong Hoa district of Phu Yen province. On 17 January, 2008, among 4,555 ha of dry season rice crop area, 3,025.8 ha were submerged, of which 238 ha of rice was at 7 days old (Phu Yen News, 2008). In Quang Ngai province more than 3,285 ha of dry rice crop (2006-2007) were submerged due to long days of raining, of which 1,353 ha had to be re-sown (V. H. ,2007). In October, 2007, there were 2,100 ha of rice area in Duc Linh district, Binh Thuan province flooded, of which the rice plants in 600 ha were totally died. This was lower than in 2006 with nearly 4,000 ha damaged due to long days with raining and high sea water level (Minh Hang, 2007). VOV News (2007) reported that the heavy rains for 4 days in August caused submergence in many locations in Dac Lac province. This was about 90% of area with 3,500ha. ND (2007) reported that two big floods at early Novermber and early December in 1999 from Quang Tri province to Khanh Hoa province cause damage upto 4,756 billion VN dongs.

In Binh Dinh province: Due to affected from cold air contacting to high east wind zone, so that from 24th – 30th December, 2008, in Binh Dinh province was heavy rain, rainfall was 150-230 mm and cause of flash flood in large area. There were 12,500 ha planting rice to be submergenced and 5,240 ha must be replanting. Binh Dinh' s goverment spent the 1.5 billion VND to buy rice seed issusing farmer. (Tuoi tre newpaper online, TTXVN, 31/12/2008)

- Damage in some provinces in the Mekong Delta: Anh Linh (2007) reported that heavy rains together with rapidly and highly tidal raising starting from 25 October 2007 caused many crop areas submerged in Can Tho, Soc Trang, An Giang, Bac Lieu, Kien Giang provinces. Many dikes in Ben Tre province was broken. On 28 October 2007, water level went up to 50cm from the transportation road. Farmers were very worried because of sudden raising water due to high tidal. They loss fish from the field about 10 millions dong. Some places in Can Tho, Soc Trang, An Giang, the highest water level was 150cm. From 25 October to 30 October 2007, 6,371 ha rice and other crops in Bac Lieu town and Vinh Loi district of Bac Lieu province were submerged due to raising of tidal coincide with the heavy rains. The Irrigation Exploiting and Management Center kept water pipes open to control crop rotting. Tran Nga (2008) reported that the weather changes with sea water level increase, 5,000 km2 in the Red River Delta and 15,000-20,000km2 in Mekong Delta will be submerged and the food production in Viet Nam looses about 12 % (equal to 5 million tons). The area for rice production looses about 12-14% due to water submerge. Nhat Ho (2004) reported that in Bac Lieu province (Mekong Delta) the long lasting rain affected 10,000 ha rice area, of which 100 ha wet rice season in Hong Dan district were severely damaged in 2004. The damaged was from 20 to 30%. The department of agriculture directed farmers to build damps for drainage water due to heavy rains and asked farmers to have earlier sowing for the next wet rice season.

5.3. Characterizing the Villages: Biophysical and Socioeconomic Interphase

5.3.1. General description

Nhan An and Quang Van villages of Phuoc Thuan commune (Tuy Phuoc district) and Duong Xuan and Hoa Tay villages of Nhon Hanh commune (An Nhon district), Binh Dinh province) were selected as studied sites.

The agricultural land in the selected villages in Tuy Phuoc and An Nhon districts site are 100%. Of which, rice area occupies 100%. The dominant people in the selected villages are Vietnamese (Table 1).

Table 2. Socio-demographic characteristics of the selected villages in central Vietnam, 2008

Socio-demographic characteristics	**Village 1: Nhan An** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province	**Village 2: Quang Van** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province)	**Village 3: Duong Xuan** (Nhon Hanh commune, An Nhon district, Binh Dinh province)	**Village 4: Hoa Tay** (Nhon Hanh commune, An Nhon district, Binh Dinh province)
Area of the village (ha)	140	136	52	75
Population	3,522	2,119	606	716
Total number of households:	818	523	148	167
Total Household Farming (or households engaged in agriculture)	817	498	148	167
- Rice crop farming	817 (99,9%)	498 (95,2%)	148 (100%)	167 (100%)
- Non rice crop farming	0	0	0	0
• Livestock	0	5 (4,8%)	85 (57,4%)	5 (3,0%)
• Fishing	0	0	1 (0,7%)	2 (1,2%)
• Industry	0	0	0	0

• Others • Total Household Landless	1 (0,1%) 0	0 0	3 (2,1%) 0	4 (2,4%) 0
% Agricultural area % area and proportion under rice % area and proportion other crops	 99.9 0.1	 95,2 4.8	 39.9 60,1	 93.4 6.6
Average family size	5	4	4	4
Percent household with electricity (%)	100	100	100	100
Dominant ethnic group	Vietnamese (Kinh)	Vietnamese (Kinh)	Vietnamese (Kinh)	Vietnamese (Kinh)

In Phuoc Thuan site, rice farmers occupies 95,2 – 99,1%. There was 4,5% of non-rice farmers in Quang Van village, meanwhile there is 99,1% of rice farmers in Nhan An village. Farmers do not plant any other crop; no multiple nor relay cropping only monocropping.

In Nhon Hanh site, rice farmers occupies 100%.

In both sites, rice farmers participated in different income generating activities as livestock and fishing and small trading. All most of households have land (Table 2).

5.3.2. Resources and infrastructure

In the selected sites, the infrastructure are good. There are elementary schools in the villages and highschools in near villages. It is easy in transportation to the selected villages. The canal systems are goverment and man-made. Gravitational system from village pond of water, water is allowed to flow to farmers' fields when needed. Farmers get water by doing gravity and pumping. Most of the households access to electricity. The number of threshers, rice mills and dryers are limited in the villages. The number of diesel engines and irrigation pumps was low in Duong Xuan village compared to the other selected villages (Table 3).

Table 3. Infrastructure facilities in selected villages in central Vietnam, 2008

Descriptors	**Village 1: Nhan An** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province	**Village 2: Quang Van** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province)	**Village 3: Duong Xuan** (Nhon Hanh commune, An Nhon district, Binh Dinh province)	**Village 4: Hoa Tay** (Nhon Hanh commune, An Nhon district, Binh Dinh province)
Type of infrastructure	Road: good; Market: good; School: good Healthy station: good	Road: good; Market: good; School: good Healthy station: good	Road: good; Market: good; School: good Healthy station: good	Road: good; Market: good; School: good Healthy station: good
Percent household with electricity (%)	100	100	100	100
No. of diesel engine in the village	18	15	28	28
No. of irrigation pumps in the village	817	498	59	156
No. of thresher in the village	7	4	6	3
No. of plough	11	6	6	5
No. of rice mill	4	2	2	1
No. of dryer	1	1	3	0
No. of the stores (inputs)	1	1	0	0

5.3.3. Institutional linkages

Most of farmers access to farm machinery easily. There are farmers who own machines in the villages doing services as threshing, land preperation. All selected village have no

financial institution except Duong Xuan village and seed grower but all have farmers' association except Quang Van village (Table 4).

Table 4. Institutional linkages in the target villages in central Vietnam, 2008

Descriptors	Village 1: Nhan An (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province	Village 2: Quang Van (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province)	Village 3: Duong Xuan (Nhon Hanh commune, An Nhon district, Binh Dinh province)	Village 4: Hoa Tay (Nhon Hanh commune, An Nhon district, Binh Dinh province)
No. of financial institutions (cooperatives, banks etc.)	0	0	1	0
Presence of farmers associations	Yes	Yes	Yes	Yes
Presence of seed growers	Yes (Agriculture cooperative)	No	Yes (Agriculture cooperative)	Yes (Agriculture cooperative)
Access to farm machinery (specify)	irrigation pump (there is access to the village communal water system. Other farm machinery (such as land preparation machines and threshing machine) are easy to rent)	irrigation pump (there is access to the village communal water system. Other farm machinery (such as land preparation machines and threshing machine) are easy to rent)	irrigation pump (there is access to the village communal water system. Other farm machinery (such as land preparation machines and threshing machine) are easy to rent)	irrigation pump (there is access to the village communal water system. Other farm machinery (such as land preparation machines and threshing machine) are easy to rent)

5.3.4. Agroecological environment/ flooding condition

Table 5. Flooding environment in the selected villages in central Vietnam, 2008

Descriptors	Village 1: Nhan An (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province	Village 2: Quang Van (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province)	Village 3: Duong Xuan (Nhon Hanh commune, An Nhon district, Binh Dinh province)	Village 4: Hoa Tay (Nhon Hanh commune, An Nhon district, Binh Dinh province)
Types of flooding (flash flood, stagnant, deep water)	Flash flood	Flash flood	Flash flood	Flash flood
Duration (days)	10 – 15	10 - 15	7 – 10	7 -10
Frequency - no. of times in a year - no. of times for the last 5 yrs	 3 – 4 times 2 – 3 times	 3 – 4 times 2 – 3 times	 3 – 5 times 3 – 4 times	 3 – 5 times 3 – 4 times
Depth (maximum, in cm)	150	100	120	120
% of area planted to rice that is being flash flooded (average for the last five years)	30.00	21.00	28.84	16.00
Months when flash	January, May,	January, May,	May, September,	May, September,

flooding occurs	June, December	June, December	October, November, December	October, November, December
Flooding environment	Flood comes from heavy rainfall; overflow of river	Flood comes from heavy rainfall; overflow of river	Flood comes from heavy rainfall; overflow of river	Flood comes from heavy rainfall; overflow of river
Indigenous knowledge of knowing if flooding occurs (if any)	Flash flood in December is due to high tidal flow. Sometimes it is due to heavy rain plus high tidal	Flash flood in December is due to high tidal flow. Sometimes it is due to heavy rain plus high tidal	Flash flood in last wet season is due to heavy rain	Flash flood in last wet season is due to heavy rain

In selected villages, the flash flood occur from 7-15 days. In Phuoc Thuan is one of the lowest land of Binh Dinh province and the flash flood cccur from 10-15 days. In Tuy Phuoc site, the flash flood in village Nhan An is more severe than Quang Van village because the area of flash flood in Nhan An is 30% and it is 21% in Quang Van village. In Nhon Hanh site, flash flood area in Duong Xuan village (28,84% of the rice area in the village) is higher than those in the Hoa Tay village (16% of the rice area in the village). The flash flood occurs 1-2 times a year in dry season (May to June), at seedling stage (7-15 days after sowing). The flash flood occurs in from December to January in Phuoc Thuan site and December in Nhon Hanh site due to later heavy rain and somtimes it affected by typhoon. Sometimes it is due to heavy rain plus high tidal in December in Phuoc Thuan site due to high tidal flow but the farmers cannot predict the level of water and duration of tidal. The depth of water due to flash flood was 100-150 cm in Phuoc Thuan site and 120 cm in Nhon Hanh site (Table 5). Beside from this flash flood with short duration, there is flash flood which lasts for more than 15-30 days in the site during wet season (from October to November). The peak of flash flood is in November with the depth of water is more than 150 cm. Most of farmers cropping 3 seasons/ year were affacted harvest their rice and yeild, production to redue.

5.3.5. Farming Characteristics of the Villages

Dominant cropping pattern in Phuoc Thuan site is double rice and Nhon Hanh site is three rice seasons. The ecosystem of the selected village in both districts are irrigated and water mainly from gravity and pump) (Table 6).

Table 6: Dominant cropping patterns in different ecosystems in selected village in central Vietnam, 2008

Ecosystem	**Village 1: Nhan An** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province	**Village 2: Quang Van** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province)	**Village 3: Duong Xuan** (Nhon Hanh commune, An Nhon district, Binh Dinh province)	**Village 4: Hoa Tay** (Nhon Hanh commune, An Nhon district, Binh Dinh province)
Irrigated	Rice – Rice (water mainly from gravity and pump)	Rice – Rice (water mainly from gravity and pump)	Rice – Rice – Rice (water mainly from gravity and pump)	Rice – Rice – Rice (water mainly from gravity and pump)
Partially irrigated	-	-	-	-
Strictly rainfed	-	-	-	-

In Tuy Phuoc site, in the normal low land, the winter spring crop is from December to April, so that it need the water from Juanary to March; and summer autumn is from June to October, so that it need the water from June to August. In An Nhon site, the farmer plant 3 crops, it need water very much. The water were used mainly from gravity and pump.

*** Other information from the PRA:**

(1) RESULTS OF THE PROBLEM TREE ANALYSIS IN TUY PHUOC AND AN NHON DISTRICT

a/ Main problem:

- Field is underwater – inundation/ flooding (central – submergence);

- 2 weeks inundation, about one meter depth;

- Low elevation – relatively low topography contributes to flooded situation;

- Inundation is due to weather disturbances like heavy rainfall and typhoon occurrence. There is poor drainage – water is difficult to drain from the fields;

- Effect of flood includes lodging – due to weakening of plant during flooding;

- There is high incidence of pest and diseases, like thrips and brown spots, grain spots;

- Because of inundation, there is growth of moss that covers the stem and plant body. This limits the tillering capacity of plant. There is slow development of the crop stand;

- From these effects, there is low yield. Low yield, in turn, results in low income or income losses;

- Aside from these, there are high input costs due to need for more fertilizers, costs of labor for replanting and costs of additions seeds.

From these, there is effect on human life in terms of crop production losses that can lead to farmers' incurring debt; children cannot pursue education because of lack of money. Family resorts to migration to earn off-farm income. The husbands usually migrate to other provinces. They engage in construction work, or other farm production activities in nearby provinces. They borrow money from private informal sources or money-lenders to be able to pay off the debt, used for input purchases. Some farmers have to sell rice even before harvest. The buyer takes the risks of losing the crop due to unforeseen circumstances, but the farmers get very low price for their produce.

b/ Coping mechanism:

Farmers build themselves the temporary bunds to prevent the impact of water from flooding. But this is not that strong and can easily give way when strong flooding occurs.

c/ Farmers suggestion:

Improvement of field condition by government providing physical barriers to flood waters and establishing canal system for proper drainage. Another suggestion is to have rice varieties that can tolerate lodging and submergence conditions; rice vatieties can anti diseases, anti pests. Farmers agree to contribute some funds to the government for building the structures like boundaries to control floodwater inflows. Govervement should find market of production and support technology.

Table 7. Cropping calendar

– incorporate in the graph the timing of flooding from Oct - December, last December is rain and water is reduced, then farmers start to plant; but sometimes during last Dec and January there is flash flood due to heavy rain, and high tidal combined with high rainfall affected by heavy rain.

Month	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
Quang Van and Nhan An village (Phuoc Thuan commune, Tuy Phuoc district)						Summer Autumn crop						Winter – spring crop				
Duong Xuan and Hoa Tay village (Nhon Hanh commune, An Nhon district)				Summer Autumn crop				Autumn Winter crop (Third crop)				Winter Spring crop				

Related to farming, all farmers in all selected villages practice direct seeding with wet seeding. In Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province, have only 2 crops. The Winter Spring crop starts from 20 to 30 December of the previous year and harvests from 10 to 15 April of the following year; the Summer Autumn crop starts from 25 to 30 June and harvest from 05 to 10 October. In Nhon Hanh site, there are 2 crops. The cropping calendar of Winter Spring crop starts from 4 to 8 December and harvests from 15 to 20 March. The Summer Autumn crop starts from 04 April and harvests from 15 to 20 July. The Third crop (Autumn Winter) start from 15 August and harvests from 25 to 30 November (Table 8).

Table 8. Farming characteristics and productivity in selected villages in central Vietnam, 2008*

Descriptors	**Village 1: Nhan An** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province	**Village 2: Quang Van** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province)	**Village 3: Duong Xuan** (Nhon Hanh commune, An Nhon district, Binh Dinh province)	**Village 4: Hoa Tay** (Nhon Hanh commune, An Nhon district, Binh Dinh province)
Method of crop establishment (% of farmers) a. Transplanting b. Direct seeding - dry seeding - wet seeding c. Both	 - - 100 -	 - - 100 -	 - - 100 -	 - - 100 -
Date of establishment Sowing Transplanting Direct seeding	- (DS) Winter Spring crop: from 20 to 25 December; - (WS) Summer Autumn crop: from 25 to 30 June;	- Winter Spring crop: from 25 to 30 December; - Summer Autumn crop: from 25 to 30 June;	- Winter Spring crop: from 4 to 8 December; - Summer Autumn crop: from 4 April; - Autumn Winter (Third crop): from 15 August	- Winter Spring crop: from 4 to 8 December; - Summer Autumn crop: from 4 April; - Autumn Winter (Third crop): from 15 August
Date of harvesting	- Winter Spring crop: from 10 to 15 April; - Summer Autum crop: from 05 to 10 October.	- Winter Spring crop: from 10 to 15 April; - Summer Autum crop: from 05 to 10 October.	- Winter Spring crop: from 15 to 20 March; - Summer Autum crop: from 15 to 20 July; - Autumn Winter (Third crop): from 25 to 30 November	- Winter Spring crop: from 15 to 20 March; - Summer Autum crop: from 15 to 20 July; - Autumn Winter (Third crop): from 25 to 30 November

Table 8 (continued) shows that most of farmers in the selected villages adopted high yielding rice varieties (100%). The popular high yielding rice varieties in Tuy Phuoc site were DV 108, DB 06, TBR 1 with the average yield in Winter Spring crop from 5.5-6.0 t/ha and 5.0-5.5 t/ha in Summer Autumn crop. Hybrid rice varieties was Nhi uu 838 with the average yield from 6.5-7.0 t/ha. The common high yielding rice varieties in An Nhon site were DV 108, Ma Lam 48, Ma Lam 49, TBR 1, U ai 32 with the average yield in Winter Spring crop of 5.0-6.0 t/ha and in Summer Autumn crop from 5.0-5.5 t/ha, the average yeild in third crop of 3.5-4.0 tons/ha. All rice varieties planted by farmers are not tolerant to submergence.

Table 8. Farming characteristics and productivity in selected villages in central Vietnam, 2008* Continued.

Descriptors	**Village 1: Nhan An** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province	**Village 2: Quang Van** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province)	**Village 3: Duong Xuan** (Nhon Hanh commune, An Nhon district, Binh Dinh province)	**Village 4: Hoa Tay** (Nhon Hanh commune, An Nhon district, Binh Dinh province)
Varieties adoption rate				
a. HYV adoption (%)	100	100	100	100
b. Submergence tolerant varieties (%)	0	0	0	0
c. Local (%)	0	0	0	0
d. Both (%)	0	0	0	0
	0	0	0	0
Name of common rice varieties planted in the area				
• HYV	DV 108, DB 06, TBR 1	DV 108, DB 06, TBR 1	DV 108, Ma Lam 48, Ma Lam 49, TBR 1, U ai 32	DV 108, Ma Lam 48, Ma Lam 49, TBR 1, U ai 32
• Hybrid	Nhi uu 838			
• Submergence tolerant varieties				
• Local				
Average rice yields (t/ha)				
c. HYV	W S crop: 5.5 - 6.0 T/ha; S A crop: 5.0 - 5.5 T/ha;	W S crop: 5.5 - 6.0 T/ha; S A crop: 5.0 - 5.5 T/ha;	W S crop: 5.0 - 6.0 T/ha; S A crop: 5.0 - 5.5 T/ha; Third crop: 3.5 - 4.0 T/ha	W S crop: 5.0-5.5 T/ha; S A crop: 4.5 - 5.0T/ha; Third crop: 3.5T/ha
d. Hybrid	WS crop: 6.5-7.0 T/ha			
e. Submergence tolerant varieties				
f. Local				

Table 9 presents the farm size in the selected villages. Farmers in Phuoc Thuan site have larger farm than those in Nhon Hanh site. 100% farmer in Phuoc Thuan va Nhon Hanh site have the land.

Table 9. Farm size (% of households) of selected villages in central Vietnam, 2008

Classification	Village 1: Nhan An (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province	Village 2: Quang Van (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province)	Village 3: Duong Xuan (Nhon Hanh commune, An Nhon district, Binh Dinh province)	Village 4: Hoa Tay (Nhon Hanh commune, An Nhon district, Binh Dinh province)
Marginal (< 1 ha)	94.99	95.22	97.98	98.21
Small (1-2 ha)	4.89	4.78	2.02	1.79
Medium and large (> 2 ha)	0.12	0	0	0
Landless (% of households)	0	0	0	0
Total	**100,0**	**100,0**	**100,0**	**100,0**

In Phuoc Thuan site, rice production was distributed for food, animal raising and selling for cash. On the other hand, rice in Nhon Hanh site (20-55%) was sold for cash and 15-30% was animal raising. Regarding to rice straw management, all rice straw was spread in the field and burnt after harvesting dry season in Phuoc Thuan site. In Nhon Hanh site, farmers used the straw to livestock fodder and fule. (Table 10).

Table 10. Rice diversity in selected villages in central Vietnam, 2008

Rice diversity	Village 1: Nhan An (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province	Village 2: Quang Van (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province)	Village 3: Duong Xuan (Nhon Hanh commune, An Nhon district, Binh Dinh province)	Village 4: Hoa Tay (Nhon Hanh commune, An Nhon district, Binh Dinh province)
% of rice after harvest used for:				
Food	50.0	50.0	30.0	50.0
Animal raising	5.0	-	15.0	30.0
Gifts	-	-	-	-
Cash/sold	45.0	50.0	55.0	20.0
Ceremonies/special occasion	-	-	-	-
Others (please specify)	-	-	-	-
% of rice straw used for:				
Livestock fodder	2.5	-	50.0	50.0
Fuel	-	-	50.0	50.0
Thatching	-	-	-	-
Others (others please specify)	97.5% spreading in the field and burn after harvesting dry season	100% spreading in the field and burn after harvesting dry season		

5.3.6. Farming Practices

About farming practices in Nhan An and Quang Van villages of Tuy Phuoc site, farmers used variety DV108, DB06, TBR1 and the seed rate of 120-150 kg/ha for high yielding rice and 50 kg/ha for hybrid rice (Nhi uu 838). The source of seeds was from self production 70% and bought 30% with HYV. The hybrid seed bought 100%. The manual direct seeding was applied for high yielding rice and hybrid rice. The rice straw of high yielding rice was burnt after

harvesting dry season, feed to animals selling for the person doing something. The rice straw of hybrid rice was all burnt after harvesting dry season. In high yielding rice, the important insects were Leaf folder, caseworm, green leafhopper, brown planthopper, stemborer, rice bug controlled by chemicals, IPM, water management. The important disease on high yielding rice were Blast, bacterial leaf blight and they were controlled mainly by chemicals and IPM. The destructive weed in the high yielding rice field included Water grass, Molasses grass controlled by hand and they were controlled by hand weeding. In hybrid rice variety, the important insects were leaf folder, brown planthopper and were controlled by chemicals. The important disease of hybrid rice was Blast and was controlled by chemicals. The destructive weed in the high yielding rice field included Water grass, Molasses grass controlled by hand and they were controlled by hand weeding (Table 11).

Table 11. Farmer's management practices of different rice varieties in Nhan An and Quang Van villages, Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province in central Vietnam, 2008

Management factors	**HYV**	**Hybrid**	Traditional	Submergence tolerant varieties
Common variety	DV 108, DB 06, TBR 1	Nhi uu 838		
Seeding rate (kg/ha)	120 – 150	50		
Sources of seeds	Own: 70% Bought: 30%	Bought: 100%		
Method of crop establishment	Direct seeding with 100% hand broadcasting	Direct seeding and Use drum seeder		
Type of seeding (if direct seeding)	Wet seeded	Wet seeded		
Rice straw management	- Spreading on the field and burn after harvesting dry season - Remove out of the field - Feed to animals - Cash	- Spreading on the field and burn after harvesting dry season		
Destructive insects and insect control	Leaf folder, caseworm, green leafhopper, brown planthopper, stemborer, rice bug controlled by chemicals, IPM, water management	leaf folder, brown planthopper controlled by chemicals		
Common disease of rice and disease control	Blast, bacterial leaf blight controlled by chemicals, IPM	Blast controlled by chemicals, IPM		
Destructive weed and weed control	Water grass, Molasses grass controlled by chemical and hand weeding	Water grass, Molasses grass controlled by chemical and hand weeding		

In Duong Xuan, Hoa Tay village of Nhon Hanh site, similar farming as Phuoc Thuan site was found, however farmers didn't use hybrid rice. They used higher seed rate of 150-170kg/ha for high yielding rice. The source of seeds was from self production (75%) and buying (25%). The manual direct seeding was applied for high yielding rice. The rice straw management was feeding to animal and cash. In high yielding rice, the important insects were leaf folder, caseworm, green leafhopper, brown planthopper, stemborer, rice bug controlled by

chemicals . The important disease on high yielding rice were blast, sheathbligh, bacterial leaf blight controlled by chemicals, IPMs. The destructive weed in the high yielding rice field was mainly water grass, molasses grass controlled by chemical and hand weeding. (Table 12).

Table 12. Farmer's management practices of different rice varieties in Duong Xuan and Hoa Tay villages, Nhon Hanh commune, An Nhon district, Binh Dinh province in central Vietnam, 2008

Management factors	HYV	Hybrid	Traditional	Submergence tolerant varieties
Common variety	DV 108, Ma Lam 48, Ma Lam 49, TBR 1, U ai 32			
Seeding rate (kg/ha)	150 – 170			
Sources of seeds	Own: 75% Bought: 25%			
Method of crop establishment	Direct seeding with 100% hand broadcasting			
Type of seeding (if direct seeding)	Wet seeded			
Rice straw management	- Feed to animals - Cash			
Destructive insects and insect control	Leaf folder, caseworm, green leafhopper, brown planthopper, stemborer, rice bug controlled by chemicals			
Common disease of rice and disease control	Blast, sheathbligh, bacterial leaf blight controlled by chemicals, IPM			
Destructive weed and weed control	Water grass, Molasses grass controlled by chemical and hand weeding			

5.3.7. Gender Division of Labor

Regarding to gender division of labor in rice production in the submergence and flood prone village, by focus group discussion we found that, in An Nhon and Tuy Phuoc site, men traditionally participated more than women in heavy tasks. Table 13 presented the gender division of labor in the flood prone area. On own rice farms, the wives participated more than the husbands in drying, food preparation for labors, harvesting, manual weeding, pulling weeding, raising weeding, removing off-types, selling in the market rice products, transplanting. The husbands participated more than the wife in land preparation, application of fertilizer and chemicals, and seed selection. Husband and wife equally shared in keeper of cash, manual threshing, storing seeds.

On the other income generating activities, the wife get more than husband in bussinessman and the husband get more than wife in fisherman, livestock, tricycle driver.

Table 13. Gender division of labor (% of Husbands/Wives)

	An Nhon						Tuy Phuoc						All	
	Duong Xuan		Hoa tay		Both		Nhan An		Quang Van		Both			
	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife
No. of Husbands/Wives	22	23	18	20	40	43	23	24	23	26	46	50	86	93
Who works on the farm?														
Application of chemicals	91	57	94	45	93	51	104	4	104	12	104	8	99	28
Application of FYM	91	83	83	15	88	51	65	17	39	4	52	10	69	29
Drying	68	91	78	80	73	86	61	83	61	88	61	86	66	86
Food preparation	0	87	11	80	5	84	9	96	9	100	9	98	7	91
Harvesting	95	91	94	85	95	88	74	100	91	81	83	90	88	89
Keeper of cash	5	83	22	95	13	88	4	92	9	100	7	96	9	92
Land preparation	95	83	106	70	100	77	109	21	96	27	102	24	101	48
Manual threshing	0	0	22	10	10	5	9	17	4	4	7	10	8	8
Manual weeding	9	78	44	50	25	65	0	21	4	23	2	22	13	42
Pulling seedlings	0	0	0	0	0	0	4	46	0	38	2	42	1	23
Raising seedlings	23	26	0	5	13	16	22	88	30	54	26	70	20	45
Removing off-types	14	91	6	0	10	49	30	25	35	15	33	20	22	33
Seed selection	27	91	6	0	18	49	74	17	87	23	80	20	51	33
Selling in the market	0	91	89	90	40	91	30	79	39	96	35	88	37	89
Storing seeds	9	87	6	5	8	49	39	17	87	35	63	26	37	37
Transplanting	0	0	0	5	0	2	9	25	4	38	7	32	3	18
Who works on other farmers' fields as hired labor or exchanged labor?														
Application of chemicals	0	0	0	0	0	0	4	0	9	0	7	0	3	0
Application of FYM	0	0	0	0	0	0	0	0	9	0	4	0	2	0
Drying	0	0	0	0	0	0	0	0	9	12	4	6	2	3
Food preparation	0	0	0	0	0	0	0	0	4	4	2	2	1	1
Harvesting	0	4	0	0	0	2	4	4	61	54	33	30	17	17
Keeper of cash	0	0	0	0	0	0	0	0	4	8	2	4	1	2
Land preparation	0	0	0	0	0	0	9	0	17	15	13	8	7	4
Manual threshing	0	0	0	0	0	0	0	0	9	8	4	4	2	2
Manual weeding	0	0	0	0	0	0	0	0	4	4	2	2	1	1
Pulling seedlings	0	0	0	0	0	0	0	4	0	15	0	10	0	5
Raising seedlings	0	0	0	0	0	0	0	8	4	42	2	26	1	14
Removing off-types	0	0	0	0	0	0	0	0	4	4	2	2	1	1
Seed selection	0	0	0	0	0	0	0	0	4	4	2	2	1	1
Selling in the market	0	0	0	0	0	0	0	0	4	8	2	4	1	2
Storing seeds	0	0	0	0	0	0	0	0	4	4	2	2	1	1

Transplanting	0	0	0	0	0	0	0	0	0	4	0	2	0	1
Other income generating activities														
businessman	0	0	0	0	0	0	0	0	0	4	0	2	0	1
fisherman	0	0	0	0	0	0	17	0	17	0	17	0	9	0
livestock	55	52	0	0	30	28	4	4	0	0	2	2	15	14
non-rice crop farming	0	0	6	5	3	2	0	0	0	0	0	0	1	1
tricycle driver	0	0	0	0	0	0	0	0	4	0	2	0	1	0

Table 18 shows that the male and female wage rates and tractor rate in Tuy Phuoc site were lower than those in Nhon Hanh site because Nhon Hanh is near National road No 1 and near the town/ city and industrial zones.

Table 18. Cost of inputs (average wage /rent per unit) in selected sites in central Vietnam, 2008

Particulars	**Village 1: Nhan An** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province	**Village 2: Quang Van** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province)	**Village 3: Duong Xuan** (Nhon Hanh commune, An Nhon district, Binh Dinh province)	**Village 4: Hoa Tay** (Nhon Hanh commune, An Nhon district, Binh Dinh province)
Male labor wage ($/day)	3.12	3.12	4.37	4.37
Female labor wage ($/day)	2.50	2.50	3.12	3.12
Tractor rate ($/ha)	68.75	68.75	82.50	82.50

The formal sources of information on rice production in both Phuoc Thuan and Nhon Hanh sites included government institutions and mass media as television, radio,…. Besides, in Phuoc Thuan are conducting NGOs' project so that received infomation from NGOs. The informal sources of information were co-worker/ co-farmers and members of the family. (Table 19).

Table 19. Source of information in the village in Binh Dinh province, central Vietnam, 2008

Sources of information	**Village 1: Nhan An** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province	**Village 2: Quang Van** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province)	**Village 3: Duong Xuan** (Nhon Hanh commune, An Nhon district, Binh Dinh province)	**Village 4: Hoa Tay** (Nhon Hanh commune, An Nhon district, Binh Dinh province)
Formal source				
Government institutions	√	√	√	√
NGOs	√	√	-	-
Banks	-	-	-	-
Others (media, TV, etc.)	√	√	√	√
Informal sources				
Farmer leader	√	√	√	√
Co-worker/co-farmers	√	√	√	√
Members of the family	√	√	√	√
Frequency of visit of the extension worker	3-4 times/sason	3-4 times/sason	4-5 times/sason	4-5 times/sason

5.3.8. Other information related to selected villages

Table 20. Other information

Village: Nhan An, Quang Van (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province	**Village: Duong Xuan, Hoa Tay** (Nhon Hanh commune, An Nhon district, Binh Dinh province)
Flash flood occurs in November, December, January but only affected to seedling in last December and January. Because this site is the lowest in province	Flash flood occurs in November, December but only affected to seedling in last December
There is 21-30% of area affected and the plant died. The duration flash flood is 10-15 days. The dept flash flood is 100-150 cm	There is 16-29% of area affected and the plant died. The duration flash flood is 7-10 days. The dept flash flood is 120 cm

5.4. Results of household survey

5.4.1. Farm household characteristics

Table 21 indicates that the average household size in the selected village was 5.7 and age of household head was 52. The household head experienced 6.6 years in schooling. All respondents are *Kinh* (or Vietnamese) people. Female members in the household occupied 34%, the rest of 66% were male. Most of family members reached primary and secondary school. Only 21% of them reached high school. Very few of them reached college or university (5%). Majority of household members were in labor age with the age range of 16-50 (64%).

5.4.2. Current farming conditions

Table 22 shows the farm characteristics of the household. The average farm size per household was 0.4ha. The minimum farm size was 0.3ha. Most of farmers had more than 1 parcel of land. All lands are belong to low land rice category. Most of the soil type was acid sulphate soil. Most of farmers are land owners (81%). The main source of water for farm irrigation is river and government irrigation system.

5.4.3. Farm and household level impact of floods

Table 23 shows the occurrence of submergence during the flood year. When submergence of flash flood occurred, 73% of the area were affected. This flash flood appeared on the 1^{st} and 2^{nd} week of December in An Nhon site and 2^{nd} – 4^{th} week of December and 1^{st} – 2^{nd} week of January in Tuy Phuoc site when the rice were at early stage (about 7-14 days after planting in An Nhon site and 9-10 days after planting in Tuy Phuoc site). Most of the land (42%) was affected with flash flood due to spillway, 32% was due to rain. The other due to rain together with high tide, rain and high tide and river. Within last 10 years, there were about 4.6 years having flash floods.

There was not much reduction in rice and other crop grown areas in flood year compared with normal year. Similar trend was found for the crop grown areas by season, cropping intensity index and crop diversification index (Table 24)

Rice production in flood year was lower than those in normal year about 11%. However, the gross income from rice in flood year in An Nhon site was not different from the normal year due to higher rice price in the flood year than normal year. On the other hand, in A Nhon site, the rice income in the flood year was higher than those in normal year because of higher rice price in the flood year than normal year. The quantity of rice sold in flood year was lower than those in normal year in both sites. However, the cash income from rice in An Nhon site in flood year was high than normal year 3% due to higher rice price in flood year. (Table 25).

About rice varieties planted by farmers, 45% farmers in An Nhon site planted TBR1 rice variety. In Tuy Phuoc, 63% farmers planted Ma lam 48 and DV108 rice variety. The rest of rice varieties were planted at low extent. Farmers planted TBR1 because of various reasons as hard stem, high yeild, test new variety, recommended by extension agent. Farmers planted Malam 48 because of reason as suitable soil condition; and planted DV108 because of many reasons as high yield, suitable soil condition, good quality, vegetative vigour, short duration, rice grain do not shatte, hard stem, do not lodge, flooding tolerant... (Table 26).

Table 5 shows the disposal of rice. Most of rice was sold in An Nhon and Tuy Phuoc (100%). In the flood year, the quantity of rice sold was reduced 4% in An Nhon and used for food increased 3%.

Table 21. General household characteristics

	An Nhon			Tuy Phuoc			All
	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both	
Household size	5,4	5,4	5,4	5,7	6,1	5,9	5,7
Age of household head (years)	56	48	53	50	52	51	52
Years of education	6,1	7,2	6,6	6,5	6,7	6,6	6,6
Gender of respondent (% of HHs)							
Female	32	35	33	20	50	35	34
Male	68	65	67	80	50	65	66
Household composition (% of HH members)							
Education							
Primary	26	22	24	27	22	24	24
Secondary	50	46	48	40	45	43	45
High school	14	18	16	25	26	25	21
College	1	1	1	1	1	1	1
University	7	4	5	2	4	3	4
Illiterate	1	4	2	1	1	1	2
Underage	1	6	3	4	1	2	3
Age group							
< 16	14	28	20	14	19	17	18
16-50	66	56	62	65	68	67	64
> 50	20	16	18	20	13	17	17
Dependency ratio	0,14	0,28	0,20	0,14	0,19	0,17	0,18

Table 22. Average farm size and area by land type

	An Nhon			Tuy Phuoc			All
	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both	
Average farm size (ha)	0,4	0,6	0,5	0,3	0,3	0,3	0,4
Average no. of parcels/HH	1,8	3,0	2,3	2,2	2,9	2,6	2,4
Average area of a parcel (ha)	0,2	0,2	0,2	0,2	0,1	0,1	0,2
% Area by land type							
Lowland	54	98	77	100	100	100	87
Highland	46	0	22	0	0	0	13
Vegetable garden	0	2	1	0	0	0	1
% Area by soil type							
Acid sulphate	100	100	100	100	100	100	100
% Area by tenure							
Owned	94	60	76	82	95	88	81
Rented-In	0	27	14	6	3	4	10
Government land	6	13	10	0	3	1	6
Sharecropped	0	0	0	3	0	2	1
Rented-out	0	0	0	9	0	5	2
% Area by source of irrigation							
River	61	0	29	77	75	76	48
Shallow	0	2	1	0	0	0	1
Government irrigation system	39	98	70	23	25	24	51
%Area irrigated during each season							
WS	100	100	100	100	100	100	100
DS	100	100	100	91	47	65	81

Table 23. Occurrence of submergence during the flood year

	An Nhon			Tuy Phuoc			All
	Duong Xuan	Hoa Tay	Both	Nhan An	Quang Van	Both	
% Area affected by flood	54	64	59	88	99	93	73
Time of occurrence of flood (month & week)	Nov 1st Nov 2nd	Oct 2nd Nov 2nd Dec 1st Dec 2nd	Oct 2nd Nov 1st Nov 2nd Dec 1st Dec 2nd	Dec 4th Jan 1st Jan 2nd	Dec 3rd Dec 4th Jan 1st Oct 4th	Dec 4th Jan 1st Dec 3rd Dec 2nd Jan 2nd	
Average no. of days after crop was established	7	14	11	7	10	9	10
Average of maximum water depth (cm)	87	46	63	33	54	46	51
Average no. of days of submergence for submergence-prone plots	6	5	5	14	16	15	12
Type of flood (% of parcels)							
High tide	0	0	0	9	24	18	12
Rain	0	97	59	46	0	17	32
Rain and high tide	48	3	21	0	0	0	7
River	52	0	21	0	0	0	7
Spillway	0	0	0	46	76	64	42
Average no. of flood occurrences in a year	4,3	2,5	3,8	2,2	6,4	4,8	4,6

Table 24. Crops grown

	Normal			Flood							% Diff (Flood - Normal)/Normal		
	An Nhon			An Nhon			Tuy Phuoc			All	An Nhon		
	Duong Xuan	Hoa tay	Both	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both		Duong Xuan	Hoa tay	Both
Total area (ha)	11	12	23	11	12	23	8	8	16	39			
Total planted area (ha)	32	15	47	32	15	47	14	15	29	77			
% of planted area													
By crop													
Rice	100	100	100	100	99	100	100	100	100	100	0	-3	-1
Vegetables	0	0	0	0	1	0	0	0	0	0			
By landtype													
Lowland													
Rice	100	100	100	100	100	100	100	100	100	100	0	-3	-1
Highland													
Rice	100		100	100		100				100	-1		-1
Vegetable garden													
Vegetables					100	100				100			
By season													
Autumn-Winter													
Rice	100	100	100	100	100	100				100	-1	-24	-4
Winter-Spring													
Rice	100	100	100	100	100	100	100	100	100	100	0	0	0
Summer-Autumn													
Rice	100	100	100	100	100	100	100	100	100	100	0	0	0
(blank)													
Vegetables					100	100				100			
Croppping intensity													
Area planted													
Autumn-Winter	10,8	1,6	12,4	10,7	1,2	11,9	0,0	0,0	0,0	11,9	-1	-24	-4
Winter-Spring	10,8	6,7	17,5	10,8	6,7	17,5	7,2	7,7	14,9	32,4	0	0	0
Summer-Autumn	10,8	6,7	17,5	10,8	6,7	17,5	7,2	7,2	14,5	32,0	0	0	0
(blank)	0,0	0,0	0,0	0,0	0,2	0,2	0,0	0,0	0,0	0,2			
Gross cropped area	32,4	15,1	47,5	32,3	14,9	47,1	14,5	14,9	29,4	76,5	0	-1	-1
Net cropped area	10,8	6,7	17,5	10,8	6,7	17,5	7,2	7,7	14,9	32,4	0	0	0
Cropping intensity index	300	224	271	299	221	269	200	194	197	236	0	-1	-1
Using total area as net cropped area													
Cropping intensity index	300	126	209	299	125	207	172	192	182	197	0	-1	-1

Table 25. Production (kg/household/year) and sale (local currency/household/year) of rice and non-rice crops

	Normal			Flood							% Diff (Flood - Normal) / Normal		
	An Nhon			An Nhon			Tuy Phuoc			All	An Nhon		
	Duong Xuan	Hoa tay	Both	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both		Duong Xuan	Hoa tay	Both
Production (kg/HH)													
Rice	6032	3751	5018	5655	2965	4459	2382	2317	2349	3338	-6	-21	-11
Vegetables	0	0	0	0	60	27	0	0	0	13			
Price (in '000 dong/kg)													
Rice	3,52	4,91	3,87	5,39	4,94	5,28	4,65	4,53	4,59	5,01	53	1	37
Vegetables	0,00	0,00	0,00	0,00	4,17	4,17	0,00	0,00	0,00	4,17			
Gross income (in '000 dong/HH/year)													
Rice	21224	18426	19406	30503	14649	23546	11071	10485	10774	16721	44	-20	21
Vegetables	0	0	0	0	250	111	0	0	0	52			
Quantity sold (kg/HH/year)													
Rice	3075	2195	2684	2670	1667	2224	972	966	969	1557	-13	-24	-17
Vegetables	0	0	0	0	50	22	0	0	0	10			
Cash income from sale (in '000 dong/HH/year)													
Rice	10860	13702	12123	13927	10762	12520	4260	4163	4210	8106	28	-21	3
Vegetables	0	0	0	0	250	111	0	0	0	52			
Rice self-sufficiency level (kg/capita/year)													
No. of HHs who are self-sufficient													

Table 26 - Reasons for growing a variety (% of HHs)

	An Nhon			Tuy Phuoc			All
	Duong Xuan	Hoa Tay	Both	Nhan An	Quang Van	Both	
DB 06							
good quality				20	0	18	18
high yield				30	100	36	36
suitable to soil condition				20	0	18	18
DV 108							
does not lodge	4	11	6	0	0	0	3
flooding tolerant	4	0	3	0	4	2	3
good quality	0	0	0	29	4	14	8
hard stem	8	0	6	0	0	0	3
high yield	0	67	18	12	38	28	24
rice grains do not shatter	0	11	3	0	0	0	1
short duration	21	0	15	0	0	0	7
suitable to soil condition	0	0	0	24	58	44	25
testing new variety	4	0	3	0	0	0	1
vegetative vigor	0	11	3	12	4	7	5
Ma Lam 48							
short duration	17		17	0		0	7
suitable to soil condition	0		0	63		63	36
Ma Lam 49							
does not lodge	9	0	7				7
flooding tolerant	5	14	7				7
high yield	0	86	21				21
short duration	18	0	14				14
tolerant to hot weather	0	14	3				3
tolerant to hot weather and high yield	0	14	3				3
TBR1							
hard stem	50	11	18				18
high yield	0	56	45				45
recommended by extension agent	0	11	9				9
testing new variety	50	33	36				36
U ai 32							
does not lodge	8	0	7				7
flooding tolerant	8	0	7				7
high yield	25	60	31				31
vegetative vigor	0	20	3				3

Table 27. Rice crop disposal

	Normal			Flood							% Diff in qty (Flood - Normal)/Normal			Diff in % pts (%Flood - %Normal)		
	An Nhon			An Nhon			Tuy Phuoc				An Nhon			An Nhon		
	Duong Xuan	Hoa tay	Both	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both	All	Duong Xuan	Hoa tay	Both	Duong Xuan	Hoa tay	Both
Total no. of households	25	20	45	25	20	45	25	26	51	96						
Rice																
% of HHs growing the crop	100	100	100	100	100	100	100	100	100	100	0	0	0	0	0	0
% of HHs who sold the crop	100	100	100	100	100	100	100	100	100	100	0	0	0	0	0	0
Prod (kg/HH)	6032	3751	5018	5655	2965	4459	2382	2317	2349	3338	-6	-21	-11			
% Share in production																
Autumn-Winter	25	8	19	25	7	20	0	0	0	12	-6	-33	-10	0	-1	0
Summer-Autumn	35	42	37	35	43	37	44	39	42	39	-6	-18	-11	0	1	0
Winter-Spring	40	50	43	40	50	43	56	61	58	49	-6	-21	-12	0	0	0
Uses (% of production)																
% Share in production																
Sold	51	59	53	47	56	50	41	42	41	47	-13	-24	-17	-4	-2	-4
Seeds	4	1	3	5	2	4	3	6	4	4	16	2	14	1	0	1
Feeds	9	8	9	8	10	9	2	1	1	6	-14	4	-9	-1	2	0
Payment	1	5	2	1	5	2	10	2	6	3	12	-17	-12	0	0	0
Other	3	5	4	3	6	3	4	1	2	3	-23	-14	-19	-1	0	0
Food	33	22	29	37	21	32	40	49	45	37	5	-26	-3	4	-1	3
Vegetables																
% of HHs growing the crop	0	0	0	0	5	2	0	0	0	1				0	5	2
% of HHs who sold the crop					100	100				100						
Prod (kg/HH)					60	27				13						
Uses (kg/HH)																
% Share in production																
Sold					83	83				83						
Food					17	17				17						

Table 28. Adjustments in rice management practices and experiences during Flood year.

	An Nhon			Tuy Phuoc			All
	Duong Xuan	Hoa Tay	Both	Nhan An	Quang Van	Both	
Change in area (% of HHs)							
Increase	4	0	2	0	8	4	3
Decrease	0	10	4	0	4	2	3
Change in date of rice establishment (% of HHs)							
Established early	76	0	42	8	0	4	22
Established late	12	70	38	40	62	51	45
Change in seeding rate (% of HHs)							
Increase	100	35	71	92	100	96	84
Increase in amount (kg/ha)	79	40	70	61	84	73	72
No changes	0	65	29	8	0	4	16
% of HHs who changed rice varieties	32	55	42	4	0	2	21
Change in time of fertilizer application (% of HHs)							
Applied early	8	0	4	4	0	2	3
Applied late	16	30	22	80	42	61	43
No application made	4	0	2	0	0	0	1
Change in quantity of fertilizer (% of HHs)							
Increase	0	10	4	76	88	82	46
Increase in quantity (kg/ha)	0	60	60	109	73	90	88
No changes	100	90	96	24	12	18	54
% of HHs who practiced resowing/replanting if flood is early	100	80	91	80	88	84	88
% of HHs whose seedbed was damaged during flood year?	4	15	9	80	88	84	49
% of HHs who stored seeds for replanting/resowing?	80	20	53	28	54	41	47
Change in manual weed management (% of HHs)							
Increase	0	5	2	0	0	0	1
Increase in labor (days/ha)	0	20	20	0	0	0	20
No changes	100	95	98	100	100	100	99
Change in herbicide application (% of HHs)							
Increase	0	0	0	52	54	53	28
Increase in herb cost (000 dong/ha)	0	0	0	199	160	179	179
Decrease	0	10	4	0	0	0	2
Decrease in herb cost (000 dong/ha)	0	190	190	0	0	0	190
No changes	100	90	96	48	46	47	70
Change in 2nd season crop if 1st season rice is damaged (% of HHs)							
Clear the canal system to drain water quickly	0	5	2	0	0	0	1

Finding the new flooding tolerant variety	4	0	2	0	0	0	1
continuous resoaking and resowing, working the soil from the beginning	0	0	0	0	4	2	1
continuous resoaking and resowing	0	0	0	0	8	4	2
adjustment according to co-operative's shedule	0	0	0	20	0	10	5
caculating dike flooding for safe seeding plan	4	0	2	0	0	0	1
noticing dike flooding date for better seeding plan	4	0	2	0	0	0	1
increasing a number of seeds when sowing	16	0	9	0	0	0	4
adjusting soaking time and sowing	4	0	2	0	0	0	1
initiating source of seeds, adjusting soaking date	4	0	2	0	0	0	1
forecasting sowing date	4	0	2	0	0	0	1
adjusting soaking & fermenting date	4	0	2	0	0	0	1
diking for irrigation	8	0	4	0	0	0	2
forecasting dike flooding time to caculate the process of fermenting	4	0	2	0	0	0	1
calculating sowing date, changing varieties	4	0	2	0	0	0	1
adjusting sowing date, fertilizing date	4	0	2	0	0	0	1
adjusting sowing date	16	0	9	0	0	0	4
identifying the stage of dike flooding for more suitable sowing plan	4	0	2	0	0	0	1
seed soaking and fermenting, forecasting the stage of dike flooding for more suitable sowing plan	4	0	2	0	0	0	1
following dike flooding date for more suitable sowing plan	4	0	2	0	0	0	1
applying muck and phosphate for dealkalinity	0	5	2	0	0	0	1
Other adjustments (% of HHs)							
banking high canal for water flowing from outside and pumping water inside field	4	5	4	12	0	6	5
continuous seed storing for water flooding precaution	0	0	0	4	0	2	1
increasing a number of seeds when sowing	4	0	2	0	0	0	1
bailing water out	0	10	4	0	0	0	2
investing water pump to deal in time	0	10	4	0	0	0	2
% of HHs who heard of submergence-tolerant rice varieties	4	0	2	0	0	0	1
% of HHs who planted submergence-tolerant rice varieties	0	0	0	0	0	0	0
% of HHs willing to grow submergence-tolerant rice varieties	96	90	93	96	100	98	96

5.4.4. Farmers' coping strategies and Technology adoption

Table 27 shows farmers' adjustment practices and experience during the flood year. Farmers did change some the method of crop establishment in the flood year. There were not much change in planted area during the flood year, 3% of farmers increased in rice area and 3% of them decreased rice area. In An Nhon site, a lot of farmers changed in the date of crop establishment, 42% of them established earlier and 38% established later to cope with flash flood. In Tuy Phuoc, they tended to change establishment late (51%). Farmers also increased the amount of seed rates (84%) to have more seedlings for gap filling (gaps caused by flash flood). More farmers in Tuy phuoc site (96%) than An Nhon site (71%) increased seed rate. They increased about 72kg seeds per hectare. Some of farmers (21%) changed in rice varieties. Farmers also changed in timing of fertilizer application by applying fertilizer later than because when the flash flood swept away (43%). The flash also lasts for long days (7 days) causing late application of fertilizer because farmers had to wait the receding of water. 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 (gaps caused by dead from flood).

There were 88% of the households in the flood prone had to do resowing or replanting if the flash flood appeared early. During the year with flash flood, 49% of the household faced the damage of the seedbed or young seedlings at early plant stage. Nearly half of the households (47%) stored seeds for resowing or replanting in the flood prone area. There was only 1% of the households decreased in labors for manual weeding because the water from flood suppressed the growth of the weeds. They reduced about 20 laborsday/ha. Most of them (99%) did not change in labor for manual weeding because the flash flood occurred in short period (7-10 days) which could not control weeds during the plant life cycle. Similar trend was found in changing herbicide application.

If 1st season rice is damaged due to flash flood, majority of farmers did adjustment in the 2nd season crop by building the boundary carefully and higher, pumping water out, repairing irrigation system, adjustment according to co-operative's shedule, increasing a number of seeds when sowing, diking for irrigation, banking high canal for water flowing from outside and pumping water inside field.

Most of the farmers have not heard of submergence-tolerant rice varieties and did not plant them. Some of them said that they experience the deep water rice, DV108 can tolerant to submergence. Majority of farmers (96%) in the flood prone are willing to grow submergence-tolerant rice varieties.

5.4.5. Impact of Flooding on Poverty

Regarding to impact on income, the gross income in Hoa Tay village was decrease (-13%), but both was increase (19%). In Hoa Tay site, the off-farm income by involving in production activities in the flood year was lower than those in the normal year at the flood prone areas (-13%), livestock was increase 36%, sale of farm implements decrease 100%.

Net income in Hoa Tay site was decrease 11%, but in 2 site were increase 19%. The off-farm employment, sale of farm implements was also decrease in net income and cash income from sale. (Table 29).

Flash flood in the flood year had decreased the rice production as compared with the normal year (11%), so that rice quantity sold was decrease (17%), but the rice price was increase (37%), so that gross income increase (21%) and cash income from sale was increase (3%). (Table 30).

Table 29. Income (local currency/household/year) from different sources

	Normal			Flood						Diff (Flood - Normal)			% Diff (Flood-Normal) /Normal		
	An Nhon			An Nhon			Tuy Phuoc				An Nhon			An Nhon		
	Duong Xuan	Hoa tay	Both	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both	All	Duong Xuan	Hoa tay	Both	Duong Xuan	Hoa tay	Both
Gross income (in '000 dong/HH/year)	35035	26633	30204	46278	23098	36065	17625	13627	15589	25147	11243	-3535	5861	32	-13	19
%Share in income																
Crop production	61	69	64	66	65	66	63	77	69	67	9279	-3527	4251	44	-19	22
Rice	61	69	64	66	63	65	63	77	69	66	9279	-3777	4140	44	-20	21
Vegetables	0	0	0	0	1	0	0	0	0	0	0	250	111			
Off-farm employment	1	5	3	1	6	2	6	0	4	3	-244	60	-109	-48	5	-13
Non-farm activitives	13	7	9	8	8	8	15	17	16	10	-937	0	2	-21	0	0
Livestock	21	11	17	23	12	20	0	0	0	13	3507	-68	1918	49	-2	36
Sale of farm implements	2	0	1	0	0	0	0	0	0	0	-800	0	-444	-100		-100
Borrowings	0	0	0	0	0	0	1	1	1	0	0	0	0			
Other sources	3	8	5	3	9	5	15	5	10	7	438	0	244	49	0	17
Net income (in 000 dong/HH/year)	27319	20752	23626	35189	18422	28084	13906	9978	11903	19474	7870	-2329	4458	29	-11	19
%Share in income																
Crop production	49	60	54	55	55	56	53	69	60	57	5906	-2321	2848	44	-19	22
Rice	49	60	54	55	54	55	53	69	60	57	5906	-2571	2737	44	-20	21
Vegetables	0	0	0	0	1	0	0	0	0	0	0	250	111			
Off-farm employment	2	6	4	1	7	3	8	0	5	3	-244	60	-109	-48	5	-13
Non-farm activitives	16	9	12	10	10	10	19	24	21	13	-937	0	2	-21	0	0
Livestock	26	14	22	30	15	26	0	0	0	17	3507	-68	1918	49	-2	36
Sale of farm implements	3	0	2	0	0	0	0	0	0	0	-800	0	-444	-100		-100
Borrowings	0	0	0	0	0	0	1	1	1	0	0	0	0			
Other sources	3	10	6	4	11	6	19	7	14	8	438	0	244	49	0	17
Cash income from sale (in '000 dong/HH/year)	24670	21909	22921	29701	19211	25039	10814	7305	9025	16532	5031	-2698	2118	20	-12	9
%Share in income																
Crop production	44	63	53	47	57	50	39	57	47	49	3067	-2690	508	28	-20	4
Rice	44	63	53	47	56	50	39	57	47	49	3067	-2940	397	28	-21	3
Vegetables	0	0	0	0	1	0	0	0	0	0	0	250	111			
Off-farm employment	2	6	4	1	7	3	10	0	6	4	-244	60	-109	-48	5	-13
Non-farm activitives	18	9	12	12	10	11	24	32	28	16	-937	0	2	-21	0	0
Livestock	29	13	23	36	15	29	0	0	0	20	3507	-68	1918	49	-2	36
Sale of farm implements	3	0	2	0	0	0	0	0	0	0	-800	0	-444	-100		-100
Borrowings	0	0	0	0	0	0	2	1	2	0	0	0	0			
Other sources	4	10	6	4	11	7	24	10	18	10	438	0	244	49	0	17

Table 30. Production (kg/household/year) and sale (local currency/household/year) of rice and non-rice crops

	Normal			Flood							% Diff (Flood - Normal) / Normal		
	An Nhon			An Nhon			Tuy Phuoc			All	An Nhon		
	Duong Xuan	Hoa tay	Both	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both		Duong Xuan	Hoa tay	Both
Production (kg/HH)													
Rice	6032	3751	5018	5655	2965	4459	2382	2317	2349	3338	-6	-21	-11
Vegetables	0	0	0	0	60	27	0	0	0	13			
Price (in '000 dong/kg)													
Rice	3,52	4,91	3,87	5,39	4,94	5,28	4,65	4,53	4,59	5,01	53	1	37
Vegetables	0,00	0,00	0,00	0,00	4,17	4,17	0,00	0,00	0,00	4,17			
Gross income (in '000 dong/HH/year)													
Rice	21224	18426	19406	30503	14649	23546	11071	10485	10774	16721	44	-20	21
Vegetables	0	0	0	0	250	111	0	0	0	52			
Quantity sold (kg/HH/year)													
Rice	3075	2195	2684	2670	1667	2224	972	966	969	1557	-13	-24	-17
Vegetables	0	0	0	0	50	22	0	0	0	10			
Cash income from sale (in '000 dong/HH/year)													
Rice	10860	13702	12123	13927	10762	12520	4260	4163	4210	8106	28	-21	3
Vegetables	0	0	0	0	250	111	0	0	0	52			
Rice self-sufficiency level (kg/capita/year)													
No. of HHs who are self-sufficient													

Table 31. Gender division of labor (% of Husbands/Wives)

	An Nhon						Tuy Phuoc						All	
	Duong Xuan		Hoa tay		Both		Nhan An		Quang Van		Both			
	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife
No. of Husbands/Wives	22	23	18	20	40	43	23	24	23	26	46	50	86	93
Who works on the farm?														
Application of chemicals	91	57	94	45	93	51	104	4	104	12	104	8	99	28
Application of FYM	91	83	83	15	88	51	65	17	39	4	52	10	69	29
Drying	68	91	78	80	73	86	61	83	61	88	61	86	66	86
Food preparation	0	87	11	80	5	84	9	96	9	100	9	98	7	91
Harvesting	95	91	94	85	95	88	74	100	91	81	83	90	88	89

Keeper of cash	5	83	22	95	13	88	4	92	9	100	7	96	9	92
Land preparation	95	83	106	70	100	77	109	21	96	27	102	24	101	48
Manual threshing	0	0	22	10	10	5	9	17	4	4	7	10	8	8
Manual weeding	9	78	44	50	25	65	0	21	4	23	2	22	13	42
Pulling seedlings	0	0	0	0	0	0	4	46	0	38	2	42	1	23
Raising seedlings	23	26	0	5	13	16	22	88	30	54	26	70	20	45
Removing off-types	14	91	6	0	10	49	30	25	35	15	33	20	22	33
Seed selection	27	91	6	0	18	49	74	17	87	23	80	20	51	33
Selling in the market	0	91	89	90	40	91	30	79	39	96	35	88	37	89
Storing seeds	9	87	6	5	8	49	39	17	87	35	63	26	37	37
Transplanting	0	0	0	5	0	2	9	25	4	38	7	32	3	18
Who works on other farmers' fields as hired labor or exchanged labor?														
Application of chemicals	0	0	0	0	0	0	4	0	9	0	7	0	3	0
Application of FYM	0	0	0	0	0	0	0	0	9	0	4	0	2	0
Drying	0	0	0	0	0	0	0	0	9	12	4	6	2	3
Food preparation	0	0	0	0	0	0	0	0	4	4	2	2	1	1
Harvesting	0	4	0	0	0	2	4	4	61	54	33	30	17	17
Keeper of cash	0	0	0	0	0	0	0	0	4	8	2	4	1	2
Land preparation	0	0	0	0	0	0	9	0	17	15	13	8	7	4
Manual threshing	0	0	0	0	0	0	0	0	9	8	4	4	2	2
Manual weeding	0	0	0	0	0	0	0	0	4	4	2	2	1	1
Pulling seedlings	0	0	0	0	0	0	0	4	0	15	0	10	0	5
Raising seedlings	0	0	0	0	0	0	0	8	4	42	2	26	1	14
Removing off-types	0	0	0	0	0	0	0	0	4	4	2	2	1	1
Seed selection	0	0	0	0	0	0	0	0	4	4	2	2	1	1
Selling in the market	0	0	0	0	0	0	0	0	4	8	2	4	1	2
Storing seeds	0	0	0	0	0	0	0	0	4	4	2	2	1	1
Transplanting	0	0	0	0	0	0	0	0	0	4	0	2	0	1
Other income generating activities														
businessman	0	0	0	0	0	0	0	0	0	4	0	2	0	1
fisherman	0	0	0	0	0	0	17	0	17	0	17	0	9	0
livestock	55	52	0	0	30	28	4	4	0	0	2	2	15	14
non-rice crop farming	0	0	6	5	3	2	0	0	0	0	0	0	1	1
tricycle driver	0	0	0	0	0	0	0	0	4	0	2	0	1	0

5.4.6. Household vulnerability to flooding

Percentage of area planted to rice that is being flash flooded from 16-30% (Table 32). The factors contribution to subjecting to flash flood due to the relatively low topography of the area as compared to the others. The flash flood occurred in dry rice season crop due to high tide, sometimes high tide and heavy rains together due to typhoon and low tropical pressure. According to Steve Morin, et al. (2004), regarding to field level, the difference between low, medium and high fields is very small. A high field is considered 10 cm above some middle point, while low fields are 10 cm below the midpoint. This is an important consideration when floods occurs, as higher fields are less often flooded, receive less silt, and are less likely to remain submerged for a long period of time. Higher fields may have a slight coloration, either yellow or red, while the lower fields tend be darker (resulting from greater deposition of silt). In a typical year, lower fields get about 15% less nutrients than high fields, probably due to lower levels of siltation. Thus, in the flood years, some of farmers reduce the using of Urea fertilizer to avoid weak plants due to over nutrients.

The vulnerability due to flash flood in the studied sites was not much severe to the livelihood due to farmers resowing or replanting or filling up the gaps due to dead plant during flood. They had to invest higher because they increased the labors as well as cost for resowing or replanting. Some of them increased expenses for increasing fertilizer for plant to grow faster.

The important affect on the livelihood in the studied site is the stagnant flood during wet season. During this stagnant flood, there is no rice crop in the field. The life of farmers is difficult in terms of children going to school, and dangerous to fish catching farmers due to strong and fast flow of water.

Table 31. Percentage of area planted to rice that is being flash flooded

Item	**Village 1: Nhan An** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province	**Village 2: Quang Van** (Phuoc Thuan commune, Tuy Phuoc district, Binh Dinh province)	**Village 3: Duong Xuan** (Nhon Hanh commune, An Nhon district, Binh Dinh province)	**Village 4: Hoa Tay** (Nhon Hanh commune, An Nhon district, Binh Dinh province)
% of area planted to rice that is being flash flooded	30.00	21.00	28.84	16.00

5.5. Government's and other entities' response when flooding occurs

Table 33 shows information related to relief programs. In fact, the relief program for flash flood was negligible. The relief program for the flash flood in the An Nhon, Tuy Phuoc 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 150,000 to 426,250 VN dong per year. 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 from affecting house; maintain irrigation system; construct electric pump station in lowland area; construct canal for rice production by reducing acid sulphate in soil and removing water out; provide boat and fishing net, capital for rice production as land preparation, rice establishment, buying inputs, fertilizer, pesticide; provide credit for production; provide more support and relief program to improve life during flood year; provide rice varieties, seeds for resowing; provide training on agriculture and water management. They also suggested to change new rice varieties for the whole village.

Table 33. Relief programs

	An Nhon			Tuy Phuoc			All
	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both	
Cash donations received (dong/HH/year, among those who received)							
Government relief program	150000		150000	426250		426250	189464
Participation in gov't relief program % of HHs							
Cash donations	96	0	53	16	0	8	29
Free food/Price subsidy on food	8	0	4	0	0	0	2
Input price subsidy	4	0	2	0	0	0	1
Free seeds	0	0	0	0	0	0	0
Free fodder and feeds/Price subsidy on fooder and feeds	0	0	0	0	0	0	0
Free fingerlings/Price subsidy on fingerlings	0	0	0	0	0	0	0
% of HHs satisfied with relief program	0	10	16	36	23	6	9
People benefitting from program (% of HHs)							
Poor	88	40	67	68	85	76	72
Non-poor	0	0	0	28	0	14	7
Important needs (rank with highest frequency)							
Seed/Fertilizer	1	1	1	1	2	1	1
Repair of water sources	3	1,2	2	2	1	1	2
Credit to purchase inputs	2	3	3	3	3	3	3
HHs reporting important needs (% of HHs)							
Seed/Fertilizer	96	100	98	96	100	98	98
Repair of water sources	96	100	98	92	100	96	97
Credit to purchase inputs	96	100	98	92	92	92	95
Other needs reported (% of HHs)							
It shuld improre irrigational system	0	0	0	4	0	2	1
pestilent insect	4	0	2	0	0	0	1
support variety	0	5	2	0	0	0	1
Suggestions regarding the program (% of HHs)							
Build station for pump out water from field	36	110	69	12	8	10	38
It should improve irrigation system	36	110	69	12	12	12	39
Support submergence-tolerant variety	16	15	16	8	15	12	14
Support submergence-tolerant variety and provide assistance on inputs like fertilizer and pesticides	32	15	24	80	8	43	34
Other help (% of HHs)							
Cash	0	0	0	0	12	6	3
Support tolerant submergenee variety	0	0	0	4	0	2	1
support variety	0	0	0	0	8	4	2

Table 34. Food consumption pattern (% of HHs)

	Total no. of households	Normal		Flood		Diff in % pts (%Flood - %Normal)	
		Daily	Occasionally	Daily	Occasionally	Daily	Occasionally
An Nhon							
Duong Xuan	25						
Cassava		0	64	0	64	0	0
Egg		32	60	24	64	-8	4
Fish		88	4	76	12	-12	8
Fruit		20	64	12	72	-8	8
Maize		0	96	0	96	0	0
Meat		8	88	0	96	-8	8
Milk		0	88	0	84	0	-4
Pea		4	84	4	84	0	0
Rice		96	0	96	0	0	0
Sticky rice		4	92	4	92	0	0
Sweet potato		8	92	8	92	0	0
Vegetables		88	4	88	4	0	0
Hoa tay	20						
Bean		85	15	85	15	0	0
Egg		30	65	30	65	0	0
Fish		60	40	60	40	0	0
Fruit		0	90	0	90	0	0
Maize		0	70	5	60	5	-10
Meat		30	60	30	60	0	0
Milk		5	90	10	80	5	-10
Ordinary rice		100	0	100	0	0	0
Sticky rice		0	100	0	95	0	-5
Sweet potato		0	35	0	35	0	0
Vegetables		95	0	95	0	0	0
Tuy Phuoc							
Nhan An	25						
Bean				8	72		
Cassava				4	20		
Egg				0	88		
Fish				96	4		
Fruit				4	88		
Maize				0	20		
Meat				24	72		
Milk				0	44		
Ordinary rice				100	0		
Sticky rice				0	84		
Vegetables				88	0		
Quang Van	26						
Bean				15	58		
Cassava				8	38		
Egg				0	62		
Fish				73	27		
Fruit				0	69		
Maize				0	12		
Meat				4	77		
Milk				0	23		

Ordinary rice				100	0		
Sticky rice				0	77		
Vegetables				100	0		
An Nhon	45						
Bean		38	7	38	7	0	0
Cassava		0	36	0	36	0	0
Egg		31	62	27	64	-4	2
Fish		76	20	69	24	-7	4
Fruit		11	76	7	80	-4	4
Maize		0	84	2	80	2	-4
Meat		18	76	13	80	-4	4
Milk		2	89	4	82	2	-7
Ordinary rice		44	0	44	0	0	0
Pea		2	47	2	47	0	0
Rice		53	0	53	0	0	0
Sticky rice		2	96	2	93	0	-2
Sweet potato		4	67	4	67	0	0
Vegetables		91	2	91	2	0	0
Tuy Phuoc	51						
Bean				12	65		
Cassava				6	29		
Egg				0	75		
Fish				84	16		
Fruit				2	78		
Maize				0	16		
Meat				14	75		
Milk				0	33		
Ordinary rice				100	0		
Sticky rice				0	80		
Vegetables				94	0		
All	96						
Bean		18	3	24	38		
Cassava		0	17	3	32		
Egg		15	29	13	70		
Fish		35	9	77	20		
Fruit		5	35	4	79		
Maize		0	40	1	46		
Meat		8	35	14	77		
Milk		1	42	2	56		
Ordinary rice		21	0	74	0		
Pea		1	22	1	22		
Rice		25	0	25	0		
Sticky rice		1	45	1	86		
Sweet potato		2	31	2	31		
Vegetables		43	1	93	1		

Table 34 shows that the flash flood did not affect the food consumption pattern of the households. Few of farmers ate more maize in the flood year and ate less meat.

Table 35. Food consumption behaviour and other adjustments

	An Nhon			Tuy Phuoc			All
	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both	
Number of meals/day during Normal year (% of HHs)							
2	0	5	2	0	0	0	1
3	96	95	96	0	0	0	45
Number of meals/day during Flood year % of HHs)							
2	0	5	2	52	100	76	42
3	92	95	93	48	0	24	56
% of HHs eating less quantity during Flood year	0	0	0	72	92	82	44
Other food items consumed during Flood year (% of HHs)							
cassava	0	0	0	0	0	10	5
maize, sweet potato	0	5	0	4	0	0	0
noodles	0	0	0	0	12	4	5
vegetables	0	0	0	0	4	0	1
vermicelli	0	0	0	0	12	8	7
% of HHs consuming at least one food item not normally consumed	4	0	2	28	42	35	20
% of HHs who deferred payment of loans during Flood year	4	0	2	28	69	49	27
% of HHs who depleted savings during Flood year	92	65	80	92	85	88	84
% of HHs who consumed the seed reserves during Flood year	96	60	80	56	92	75	77
% of HHs whose children dropped-out during Flood year	8	0	4	8	19	14	9
Other adjustments (% of HHs)							
decrease spend on holidays	0	15	7	0	0	0	3
Make-do with what they have.	0	0	0	4	0	2	1
Reducing unnecessary expense.	4	45	22	20	65	43	33

Table 35 shows food consumption behavior and other adjustments. The number of meals/day was not different between normal year and flood year. 42% of households in Tuy Phuoc have 2 meals/day meanwhile most of the households in An Nhon have 3 meals/day. Though the number of meals/day was no change, 44% households reduce the quantity of food in the flood year. Some of them ate more vermicellis, cassava, vegetables in the flood year. In the flood year, 20% households had to eat at least one food item not normally consumed. One-fourth households (27%) deferred payment of loans during flood year. 84% households depleted savings during flood year. They also consumed the seed reserves during flood year (77% of the households). The children of some of the households also dropped-out the school during flood year. Other adjustment during the flood year included using the savings, reducing household expenses as clothes, coffee, alcohol drink, soft drink, festivals, non-essential items, and food by catching fish for food.

Table 36. Food consumption by source

	Normal			Flood							% Diff (Flood-Normal)/Normal			Diff in % pts (%Flood - %Normal)		
	An Nhon			An Nhon			Tuy Phuoc			All	An Nhon			An Nhon		
	Duong Xuan	Hoa tay	Both	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both		Duong Xuan	Hoa tay	Both	Duong Xuan	Hoa tay	Both
% of HHs who made rice purchases																
Ordinary rice	0	0	0	0	0	0	12	42	27	15				0	0	0
% of HHs who stored rice for next year's consumption																
Ordinary rice	16	0	9	4	0	2	100	88	94	51				-12	0	-7
Cost of rice purchases made (in '000 dong/HH)																
Ordinary rice	0	0	0	0	0	0	440000	552308	497255	264167						
Amount of rice stored for next year's consumption (kg/HH, averaged among those who stored)																
Ordinary rice	160	0	89	20	0	11	506	569	538	291	-88		-88			
Source of income for rice purchases (% of HHs)																
catch fish	0	0	0	0	0	0	0	4	2	1				0	0	0
sell rice	0	0	0	0	0	0	8	15	12	6				0	0	0
to buy tick	0	0	0	0	0	0	0	8	4	2				0	0	0
to sell rice	0	0	0	0	0	0	0	8	4	2				0	0	0
worker	0	0	0	0	0	0	4	0	2	1				0	0	0

Table 37. Animal nutrition

	Normal			Flood							Diff in % pts (%Flood - %Normal)		
	An Nhon			An Nhon			Tuy Phuoc			All	An Nhon		
	Duong Xuan	Hoa tay	Both	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both		Duong Xuan	Hoa tay	Both
% of HHs with livestock	96	50	76	96	50	76	44	0	22	47			
Type of feeding (% of HHs)													
banana	58	0	41	92	0	65	9		9	51	33	0	24
bran	96	0	68	4	60	21	0		0	16	-92	60	-47
food	0	10	3	58	50	56	0		0	42	58	40	53
grass	58	60	59	42	0	29	9		9	24	-17	-60	-29
maize	46	0	32	58	0	41	0		0	31	13	0	9
cassava	4	0	3	29	0	21	0		0	16	25	0	18
rice	4	60	21	0	10	3	0		0	2	-4	-50	-18
straw	29	0	21	0	0	0	9		9	2	-29	0	-21
vegetable	8	0	6	8	0	6	0		0	4	0	0	0

Table 36 presented food consumption by source. There was not different between the normal year and flood year about purchasing rice food storing food for the following year consumption. Farmers mostly did not purchase rice food in both normal year and flood years because farmers usually store sufficient amount of seeds from the previous crop season for home consumption even about one-fourth of them had extra store for the following year.

Regarding to animal nutrient, table 37 shows that there was reducing the percentage of households using rice bran, grass, rice and straw to feed animal in the flood year. The percentage of household using banana, food, maize and cassava to feed animal increased in the flood year.

Regarding to mitigation programs by all entities, table 18 indicates the community -level management practices. Majority of the households reported efforts to prevent damage or minimize loss due to flood. Farmers worked together to build or prepare the boundary, prepare irrigation system pump water out, dredge canal, share cost to build boundary, assignment given by argriculture co-operative. They shared labor and cost among themselves. Each household contributed laborers and worked together. 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 and argriculyture co-operatives receive 94,400 VND or 100 kg rice/ ha. Near half of the households reported that there was assistance provision from the government. Government provided information about flood status. They encourage farmer, organize farmers and guide and work with farmers to build or prepare boundary to pump out water, they support wood to prepare boundary and gasoline to pump water out. 31% of the households are willing to participate in insurance programs due to flood. Most of them were not willing to participate in insurance programs because they did not understand about this program, and this program is not popular in the studied sites. Some of them expected the insurance program to provide fund, varieties and fertilizer in case there is flood damage.

Table 38. Community-level management practices

	An Nhon			Tuy Phuoc			All
	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both	
% of HHs reporting combined efforts to prevent damage or minimize loss	96	60	80	88	100	94	88
Preventive measures (% of HHs)							
actively digging a ditch by myself	0	8	3	0	0	0	1
actively digging a ditch, water drainage	0	8	3	0	0	0	1
against flooding, controlling weak points	0	0	0	0	4	2	1
assignment given by agriculture co-operative	0	0	0	36	0	17	10
build bank	0	0	0	5	0	2	1
build bank against flooding	4	0	3	0	0	0	1
build bank to avoid salinity problems	0	0	0	0	4	2	1
build bank to stop water, water drainage	0	0	0	5	0	2	1
build bank, do irrigation	4	0	3	0	0	0	1
build bank, dredge canal	0	0	0	9	0	4	2
build bank, paying labour days when harvest	4	0	3	0	0	0	1
build dike to avoid salinity problems	0	0	0	0	4	2	1
clear water flow	0	0	0	0	4	2	1
community against calamity	0	0	0	5	0	2	1
community work together to stop water	0	0	0	5	0	2	1
dam up, do irrigation	8	0	6	0	0	0	2
dam up, do irrigation, water drainage	4	0	3	0	0	0	1
dam up, repair bank	0	0	0	0	4	2	1
dam up, stopping salinity	0	0	0	0	4	2	1
dike maintenance	0	0	0	0	4	2	1
dike maintenance by myself	0	0	0	0	4	2	1
dike maintenance, stopping house together	0	0	0	5	0	2	1
do irrigation	8	0	6	0	0	0	2
do irrigation, seed exchange	8	0	6	0	0	0	2
do irrigation, seed support, water drainage	4	0	3	0	0	0	1
dredge canal	0	58	19	14	12	13	15
dredge canal by myself	0	8	3	0	0	0	1
dredge canal, canal management, water drainage	0	0	0	9	0	4	2
dredge canal, dam up	0	0	0	5	0	2	1
dredge canal, quit diking	0	0	0	0	8	4	2
farmers , authorities, military units mutually quit	0	0	0	0	4	2	1
guidance from agriculture co-operative	0	0	0	5	0	2	1

help one another against flooding when necessary	4	0	3	0	0	0	1
help one another to harvest crop fast before flood occurs	4	0	3	0	0	0	1
input support on seed, fertilizer and labor	4	0	3	0	0	0	1
labour exchange when flooding	4	0	3	9	0	4	4
mobilizing farmers	0	0	0	0	8	4	2
mutual stopping water	0	0	0	5	0	2	1
raise bank, clearing flow	0	0	0	0	4	2	1
repair damage	0	0	0	5	0	2	1
rice seed loan	4	0	3	0	0	0	1
seed support	4	0	3	0	0	0	1
seed support when rice areas died due to flooding	4	0	3	0	0	0	1
seed support, build bank	4	0	3	0	0	0	1
seed support, dike maintenance	4	0	3	0	0	0	1
seed support, dike maintenance, do irrigation	4	0	3	0	0	0	1
seed support, do irrigation	4	0	3	0	0	0	1
stop salinity, dike maintenance	0	0	0	0	4	2	1
water drainage	0	17	6	0	0	0	2
Sharing of labor and cost among farmers (% of HHs)							
agriculture co-operatives receive 94000 d/ha or 100kg/ha	0	0	0	0	19	10	6
contrbuting to pay for stopping water	0	0	0	0	4	2	1
contributing 1 labour days/ labour	0	0	0	27	0	13	7
contributing labour days together	54	58	56	5	23	15	32
Farmers contribute to repair damage	0	0	0	0	4	2	1
irrigation costs	0	0	0	9	4	6	4
labour day asistance 45000 dong	4	0	3	0	0	0	1
labour day asistance for irrigation	4	0	3	0	0	0	1
mobilizing farmers' self-awareness	0	0	0	5	0	2	1
money contribution	0	0	0	0	4	2	1
participation together	0	0	0	14	0	6	4
paying labour days from source of irrigation costs	0	0	0	18	0	8	5
paying money for co-operative expenses	0	0	0	0	12	6	4
self-control, co-operative assist materials	4	0	3	0	0	0	1
voluntary participation	0	0	0	5	0	2	1
% of HHs reporting assistance is provided by gov't	92	20	60	60	15	37	
Government assistance provided (% of HHs)							
assistance for dike and labour days to stop water from going into field against flooding	0	0	0	0	25	5	2
cost extra assistance for labour days	0	25	4	0	0	0	2
do irrigation against waterlogging	9	0	7	0	0	0	4

encouraging water opening	0	25	4	0	0	0	2
expecting for government assistance	0	0	0	20	0	16	7
flooding forecast, crop pests and diseases	0	0	0	7	0	5	2
Government expect the participation of farmers	0	0	0	7	0	5	2
labor-day assistance for irrigation 45000 dong/days	57	0	48	0	0	0	28
minimal support	0	50	7	0	0	0	4
reducing irrigation costs	9	0	7	13	0	11	9
support prices to buy seeds, cooperatives lend seed money	0	0	0	0	25	5	2
% of HHs reporting availability of flood insurance programs	0	0	0	12	0	6	3
% of HHs willing to participate in insurance programs	0	20	9	60	42	51	31
Benefit expected from insurance program (% of HHs)							
as a program, so it is better to participate		0	0	7	0	4	3
expecting to have programs for farmers		0	0	0	9	4	3
have no money		0	125	0	0	0	17
poor children, so having no money to buy insurance		0	0	0	9	4	3
ready to buy insurance		0	25	0	0	0	3
real interests		0	25	0	0	0	3
reducing stress due to calamity		0	0	7	0	4	3
risk share		0	0	13	18	15	13
stable crop season		0	0	7	0	4	3
the voluntary participation of farmers but having no agriculture insurance		0	0	0	9	4	3

Table 39. Access to information (% of HHs)

	Tuy Phuoc			An Nhon			All
	Nhan An	Quang Van	Both	Duong Xuan	Hoa tay	Both	
Rice cultivation							
Own experience	56	85	69	32	73	53	60
Extension workers	48	70	58	96	23	59	58
Other family members	40	20	31	12	12	12	21
Neighbors/Other farmers	20	0	11	84	38	61	38
Newspaper/Magazines/Other print media	12	25	18	72	0	35	27
NGO	12	0	7	0	4	2	4
Farmer organization	24	25	24	4	35	20	22
TV/Radio	24	35	29	96	12	53	42
Soil nutrient management							
Own experience	32	75	51	28	69	49	50
Extension workers	80	65	73	76	19	47	59
Other family members	20	30	24	8	12	10	17
Neighbors/Other farmers	16	0	9	60	38	49	30
Newspaper/Magazines/Other print media	4	10	7	60	0	29	19
NGO	16	0	9	0	4	2	5
Farmer organization	12	25	18	4	35	20	19
TV/Radio	8	25	16	84	8	45	31
Animal husbandry							
Own experience	0	0	0	20	42	31	17
Extension workers	8	0	4	68	23	45	26
Other family members	0	0	0	16	12	14	7
Neighbors/Other farmers	0	10	4	80	46	63	35
Newspaper/Magazines/Other print media	0	0	0	48	0	24	13
Farmer organization	0	5	2	12	8	10	6
TV/Radio	0	0	0	68	0	33	18
Cultivation of other crops							
Own experience	0	5	2	8	35	22	13
Extension workers	0	5	2	84	15	49	27
Other family members	0	0	0	12	8	10	5
Neighbors/Other farmers	0	0	0	80	46	63	33
Newspaper/Magazines/Other print media	4	0	2	52	0	25	15
Farmer organization	0	15	7	8	19	14	10
TV/Radio	4	5	4	88	0	43	25
New rice varieties							

Own experience	0	0	0	0	42	22	11
Extension workers	64	65	64	84	4	43	53
Other family members	0	0	0	4	0	2	1
Neighbors/Other farmers	4	0	2	88	42	65	35
Newspaper/Magazines/Other print media	0	10	4	60	0	29	18
NGO	20	0	11	4	8	6	8
Farmer organization	40	40	40	4	46	25	32
TV/Radio	16	10	13	84	4	43	29
Rice pest control							
Own experience	8	10	9	72	50	61	36
Extension workers	72	55	64	60	0	29	46
Other family members	0	0	0	8	0	4	2
Neighbors/Other farmers	0	0	0	72	35	53	28
Newspaper/Magazines/Other print media	0	15	7	24	0	12	9
NGO	20	0	11	0	0	0	5
Farmer organization	28	35	31	0	31	16	23
TV/Radio	0	35	16	64	4	33	25
Aquaculture							
Own experience	0	0	0	8	0	4	2
Extension workers	0	0	0	44	0	22	11
Other family members	0	0	0	4	0	2	1
Neighbors/Other farmers	4	0	2	68	0	33	19
Newspaper/Magazines/Other print media	0	0	0	52	0	25	14
Farmer organization	4	5	4	0	0	0	2
TV/Radio	0	0	0	84	0	41	22
Weather forecast							
Extension workers	4	15	9	12	0	6	7
Other family members	4	0	2	8	0	4	3
Neighbors/Other farmers	4	0	2	28	0	14	8
Newspaper/Magazines/Other print media	8	5	7	76	0	37	23
Farmer organization	0	10	4	0	0	0	2
TV/Radio	84	120	100	96	8	51	74

Television, radio, extension workers, other family members, neighbors, other farmers, newpaper, magazines and own experiences were the most popular sources of information for rice cultivation, soil nutrient management, animal husbandry and cultivation of other crops. To know about new rice varieties, farmers got information from extension workers, neighbors/ other farmers, farmer organization, newpaper, magazines, TV/radio, own experience, NGO. There were various important sources of information for rice pest control obtained by extesion workers, own experience, neighbors, other farmers, television, radio, farmer organization, Farmers obtained the information for other crop cultivation (non-rice crops) were mainly from neighbors, other farmers flowed, extension workers, by television, radio, newpaper, magazines, their own experience, farmer organization. Farmers obtained the information for aquaculture from television, radio, neighbors, other farmers, newpaper, magazines, extension workers. The most important information source to know about weather forecast by farmers was television and radio (Table 39).

Table 40a shows yield and input use in rice production of winter-spring with wet seeding and modern varieties in low land. The average rice yield was 4.628 tons/ha. Seeds were purchased more than own production and the average seed rate was 239kg/ha. Farmers in Tuy Phuoc site used more N, P, K fertilizer amounts (84-47-13 Kg N – P – K per hectare) than those in An Nhon (72-52-21 Kg N – P – K per hectare). The hired labors occupied 68% of the total of 119 labordays need for rice production in winter-spring season.

Table 40a. Yield and input use in rice production (winter-spring, wetseeding, MV)

	An Nhon			*Tuy Phuoc*			All
	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both	
Lowland							
Yeild (kg/ha)	5158	3900	4599	4595	4712	4651	4628
Seed (kg/ha)	192	205	197	270	274	272	239
Fertilzer (kg/ha)							
N	46	106	72	90	78	84	79
P	55	48	52	49	45	47	49
K	17	27	21	12	14	13	17
Labor (days/ha)	80	99	88	155	131	143	119
Highland							
Seed (kg/ha)		220	220				220
Fertilzer (kg/ha)							
N		140	140				140
P		47	47				47
K		29	29				29
Labor (days/ha)		117	117				117
Total							
All							
Seed (kg/ha)	192	207	199	270	274	272	239
Fertilzer (kg/ha)							
N	46	111	76	90	78	84	81
P	55	48	52	49	45	47	49
K	17	27	22	12	14	13	17
Labor (days/ha)	80	101	90	155	131	143	119

Table 40b. Percentage hired labor for rice production

	An Nhon			*Tuy Phuoc*			All
	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both	
Lowland							***68***
Land preparation	0	0	0	14	20	12	12
Crop establishment	0	0	0	18	26	17	17
Application of chemicals and org fert	0	0	0	10	4	4	4
Manual weeding	0	0	0	0	0	0	0
Irrigation		0	0	0	16	6	6
Harvest & Post harvest	16	38	30	30	29	29	29
Highland							***26***
Land preparation		0	0			0	0
Crop establishment		0	0			0	0
Application of chemicals and org fert		0	0			0	0
Manual weeding		0	0			0	0
Irrigation							
Harvest & Post harvest		26	26			26	26
All							***67***
Land preparation	0	0	0	14	20	11	11
Crop establishment	0	0	0	18	26	16	16
Application of chemicals and org fert	0	0	0	10	4	3	3
Manual weeding	0	0	0	0	0	0	0
Irrigation		0	0	0	16	6	6
Harvest & Post harvest	16	36	30	30	29	29	29

Table 40c. % Share in total labor for rice production

	An Nhon			*Tuy Phuoc*			All
	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both	
Lowland							
Land preparation	17	12	15	20	16	18	17
Crop establishment	14	12	13	22	22	22	19
Application of chemicals and org fert	35	22	29	13	16	14	19
Manual weeding	11	10	11	1	4	2	5
Irrigation	0	4	2	1	2	1	1
Harvest & Post harvest	23	40	31	45	40	42	39
Highland							
Land preparation		15	15				15
Crop establishment		10	10				10
Application of chemicals and org fert		25	25				25
Manual weeding		4	4				4
Irrigation		0	0				0
Harvest & Post harvest		47	47				47

All							
Land preparation	17	13	15	20	16	18	17
Crop establishment	14	11	12	22	22	22	19
Application of chemicals and org fert	35	23	29	13	16	14	19
Manual weeding	11	9	10	1	4	2	5
Irrigation	0	3	2	1	2	1	1
Harvest & Post harvest	23	41	32	45	40	42	39

The household income was shown in table 41. In the flood year the gross income from rice, vegatable was higher than those in normal year. The gross income in Hoa Tay site (An Nhon district) from rice, vegatable was lower than those in normal year. In the flood year the income from sale of farm implements, off-farm employment was lower than those in normal year. The income of non-farm activites in the flood year was same as in normal year. In Normal year, the most important source of income was from rice (contributed 64% to total household income) followed by from livestock (17%), and non-farm activitives (9%). In flood year, the most important source of income was from rice (contributed 65% to total household income) followed by from livestock (20%), and non-farm activitives (9%).

Table 42 presented the gender division of labor in the flood prone area. On own rice farms, the wives participated more than the husbands in drying, food preparation for labors, harvesting, manual weeding, pulling weeding, raising weeding, removing off-types, selling in the market rice products, transplanting. The husbands participated more than the wife in land preparation, application of fertilizer and chemicals, and seed selection. Husband and wife equally shared in keeper of cash, manual threshing, storing seeds.

On the other income generating activities, the wife get more than husband in bussinessman and the husband get more than wife in fisherman, livestock, tricycle driver.

Table 41. Income (local currency/household/year) from different sources

	Normal			Flood						Diff (Flood - Normal)			% Diff (Flood-Normal)/Normal		
	An Nhon			An Nhon			Tuy Phuoc				An Nhon			An Nhon		
	Duong Xuan	Hoa tay	Both	Duong Xuan	Hoa tay	Both	Nhan An	Quang Van	Both	All	Duong Xuan	Hoa tay	Both	Duong Xuan	Hoa tay	Both
Gross income (in '000 dong/HH/year)	35035	26633	30204	46278	23098	36065	17625	13627	15589	25147	11243	-3535	5861	32	-13	19
%Share in income																
Crop production	61	69	64	66	65	66	63	77	69	67	9279	-3527	4251	44	-19	22
Rice	61	69	64	66	63	65	63	77	69	66	9279	-3777	4140	44	-20	21
Vegetables	0	0	0	0	1	0	0	0	0	0	0	250	111			
Off-farm employment	1	5	3	1	6	2	6	0	4	3	-244	60	-109	-48	5	-13
Non-farm activitives	13	7	9	8	8	8	15	17	16	10	-937	0	2	-21	0	0
Livestock	21	11	17	23	12	20	0	0	0	13	3507	-68	1918	49	-2	36
Sale of farm implements	2	0	1	0	0	0	0	0	0	0	-800	0	-444	-100		-100
Borrowings	0	0	0	0	0	0	1	1	1	0	0	0	0			
Other sources	3	8	5	3	9	5	15	5	10	7	438	0	244	49	0	17
Net income (in 000 dong/HH/year)	27319	20752	23626	35189	18422	28084	13906	9978	11903	19474	7870	-2329	4458	29	-11	19
%Share in income																
Crop production	49	60	54	55	55	56	53	69	60	57	5906	-2321	2848	44	-19	22
Rice	49	60	54	55	54	55	53	69	60	57	5906	-2571	2737	44	-20	21
Vegetables	0	0	0	0	1	0	0	0	0	0	0	250	111			
Off-farm employment	2	6	4	1	7	3	8	0	5	3	-244	60	-109	-48	5	-13
Non-farm activitives	16	9	12	10	10	10	19	24	21	13	-937	0	2	-21	0	0
Livestock	26	14	22	30	15	26	0	0	0	17	3507	-68	1918	49	-2	36
Sale of farm implements	3	0	2	0	0	0	0	0	0	0	-800	0	-444	-100		-100
Borrowings	0	0	0	0	0	0	1	1	1	0	0	0	0			
Other sources	3	10	6	4	11	6	19	7	14	8	438	0	244	49	0	17
Cash income from sale (in '000 dong/HH/year)	24670	21909	22921	29701	19211	25039	10814	7305	9025	16532	5031	-2698	2118	20	-12	9
%Share in income																
Crop production	44	63	53	47	57	50	39	57	47	49	3067	-2690	508	28	-20	4
Rice	44	63	53	47	56	50	39	57	47	49	3067	-2940	397	28	-21	3
Vegetables	0	0	0	0	1	0	0	0	0	0	0	250	111			
Off-farm employment	2	6	4	1	7	3	10	0	6	4	-244	60	-109	-48	5	-13
Non-farm activitives	18	9	12	12	10	11	24	32	28	16	-937	0	2	-21	0	0
Livestock	29	13	23	36	15	29	0	0	0	20	3507	-68	1918	49	-2	36
Sale of farm implements	3	0	2	0	0	0	0	0	0	0	-800	0	-444	-100		-100
Borrowings	0	0	0	0	0	0	2	1	2	0	0	0	0			
Other sources	4	10	6	4	11	7	24	10	18	10	438	0	244	49	0	17

Table 42. Gender division of labor (% of Husbands/Wives)

	An Nhon						Tuy Phuoc						All	
	Duong Xuan		Hoa tay		Both		Nhan An		Quang Van		Both			
	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife
No. of Husbands/Wives	22	23	18	20	40	43	23	24	23	26	46	50	86	93
Who works on the farm?														
Application of chemicals	91	57	94	45	93	51	104	4	104	12	104	8	99	28
Application of FYM	91	83	83	15	88	51	65	17	39	4	52	10	69	29
Drying	68	91	78	80	73	86	61	83	61	88	61	86	66	86
Food preparation	0	87	11	80	5	84	9	96	9	100	9	98	7	91
Harvesting	95	91	94	85	95	88	74	100	91	81	83	90	88	89
Keeper of cash	5	83	22	95	13	88	4	92	9	100	7	96	9	92
Land preparation	95	83	106	70	100	77	109	21	96	27	102	24	101	48
Manual threshing	0	0	22	10	10	5	9	17	4	4	7	10	8	8
Manual weeding	9	78	44	50	25	65	0	21	4	23	2	22	13	42
Pulling seedlings	0	0	0	0	0	0	4	46	0	38	2	42	1	23
Raising seedlings	23	26	0	5	13	16	22	88	30	54	26	70	20	45
Removing off-types	14	91	6	0	10	49	30	25	35	15	33	20	22	33
Seed selection	27	91	6	0	18	49	74	17	87	23	80	20	51	33
Selling in the market	0	91	89	90	40	91	30	79	39	96	35	88	37	89
Storing seeds	9	87	6	5	8	49	39	17	87	35	63	26	37	37
Transplanting	0	0	0	5	0	2	9	25	4	38	7	32	3	18
Who works on other farmers' fields as hired labor or exchanged labor?														
Application of chemicals	0	0	0	0	0	0	4	0	9	0	7	0	3	0
Application of FYM	0	0	0	0	0	0	0	0	9	0	4	0	2	0
Drying	0	0	0	0	0	0	0	0	9	12	4	6	2	3
Food preparation	0	0	0	0	0	0	0	0	4	4	2	2	1	1
Harvesting	0	4	0	0	0	2	4	4	61	54	33	30	17	17
Keeper of cash	0	0	0	0	0	0	0	0	4	8	2	4	1	2
Land preparation	0	0	0	0	0	0	9	0	17	15	13	8	7	4
Manual threshing	0	0	0	0	0	0	0	0	9	8	4	4	2	2
Manual weeding	0	0	0	0	0	0	0	0	4	4	2	2	1	1
Pulling seedlings	0	0	0	0	0	0	0	4	0	15	0	10	0	5
Raising seedlings	0	0	0	0	0	0	0	8	4	42	2	26	1	14
Removing off-types	0	0	0	0	0	0	0	0	4	4	2	2	1	1
Seed selection	0	0	0	0	0	0	0	0	4	4	2	2	1	1
Selling in the market	0	0	0	0	0	0	0	0	4	8	2	4	1	2
Storing seeds	0	0	0	0	0	0	0	0	4	4	2	2	1	1
Transplanting	0	0	0	0	0	0	0	0	0	4	0	2	0	1
Other income generating activities														
businessman	0	0	0	0	0	0	0	0	0	4	0	2	0	1

fisherman	0	0	0	0	0	0	17	0	17	0	17	0	9	0
livestock	55	52	0	0	30	28	4	4	0	0	2	2	15	14
non-rice crop farming	0	0	6	5	3	2	0	0	0	0	0	0	1	1
tricycle driver	0	0	0	0	0	0	0	0	4	0	2	0	1	0

6. Conclusions and recommendations

6.1. Summary of results

The irrigated rice villages with 2 rice crops per year in Phuoc Thuan and Nhon Hanh representative for flood prone area in the central Vietnam. The flash flood occurred in short period resulted the harder afford in rice production. The flash flood occurred mostly in wet season during December to January. This flash flood last for 7-15 days at the early stage of the rice plant. The factors caused flash flood included the relative low level of the rice field, heavy rains, typhoon affects, high tidal. These factors were not able to be predicted by farmers. Thus they had suffering with the problem because this caused dead of the rice plants, usually at the early stage (around one - two weeks after seed sowing). Farmers had to do replanting and filling the gaps with seedlings or seed broadcasting 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 experienced flash flood, farmers tried to build the boundary carefully and higher, pump water out, repaired irrigation system either by farmer community themselves or with the guidance of the government, agricuture co-operative. However, the negative impacts from this flash flood were faced by farmers as low rice production, animal, vegatable loss,… leading to low household income 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. Farmers' knowledge about submergence tolerance rice varieties was negligible though farmers accessed to various sources of information for crop and animal production.

6.2. Recommendations

- Research: In the flood prone area in the central Vietnam, there is the need of rice varieties that are tolerant to flash flood. Thus the breeding goal in rice research should target to the varieties which are tolerant to flash flood.

- Policy: Government should support financially and materially farmer community in the areas where are vulnerable to sudden flash flood to consolidate the dikes/ boundaries to protect the rice plants in 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.

- 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 varieties and their associated technologies.

References

1. Anh Linh 2007. High Tidal, Severe Submergence in the Mekong Delta (in Vietnamese). Vietnam Net. Website: http://vietnamnet.vn/xahoi/2007/10/752176/

2. Binh Dinh People Committee 2008. Report of the Agricultural result productton in 2008

3. Cao Viet Sinh 2002. Major Contents Of The Comprehensive Poverty Reduction And Growth Strategy (CPRGS). Workshop on poverty Alleviation Research in Rural areas: The micro approaches. Da Nang 9-10 May 2002. Agricultural Publishing house, Ha Noi. P. 18

4. Construction Center, 2007. Active Prevention of Damage caused by Typhoon. Ministry Of Construction Of Socialist Republic Of Vietnam. (in Vietnamese) http://www.moc.gov.vn/site/moc/cms?cmd=5&articleId=19765

5. Earth Observary (no year). Monsoon Rains Flood Vietnam. Website: http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=17228

6. Fumihito, I. Dang Van To, 1997, Flood and Typhoon disasters in Vietnam in the half century since 1950. Natural Hazards 15 (1)

7. FAO, 2001. Report of the FAO Asia-Pacific conference on early warning, prevention, preparedness and management of disasters in food and agriculture**.** Series title: RAP Publication - 2001/14 . 417 pg. Website: http://www.fao.org/docrep/005/ac120e/AC120e15.htm#TopOfPage

8. Ha Yen 2004. Recover the damaged rice area before 15 August. Viet Bao (Vietnam Net) (in Vietnamese). Website: http://www.vnn.vn/xahoi/nongthon/2004/07/220578/

9. Ha Yen and Ng. Tam 2006. Flood in Central: 7 persons died, loss of hundreds of billions dong (in Vietnamese). VietNamNet. Website: http://www.vietnamnet.com.vn/xahoi/doisong/2006/08/602509/

10. Hanh Chi 2008. Nho Quan overcomes the submergence on rice area. Ninh Binh electronic news (in Vietnamese). Website: http://www.baoninhbinh.org.vn/news/21/2DAA5C/Nho-Quan-khac-phuc-dien-tich-lua-ngap-ung

11. Hau Giang An People Committee 2007. Status of Socio-Economic in 2007 (in Vietnamse). Website:http://www.haugiang.gov.vn/Portal/OtherNewsView.aspx?pageid=13&ItemID=80&mid=75&pageindex=5&siteid=1

12. HMDC 2004. Summary of hydrometeorology situation, agri- hydrometeorology in July 2004. Journal of Hydrometeorology *26 October 2004.* HydroMeteorological Data Center- HMDC. Website: http://www.hymetdata.gov.vn/index2.asp?file=info132.htm&fld=m_repo

13. Hong Duc 2005. Hai Hau after typhoon (in Vietnamese). Website: http://www.dddn.com.vn/Desktop.aspx/TinTuc/VanHoa-XaHoi/Hai_Hau_sau_bao/

14. IRIN, 2009. VIETNAM: Dozens killed by flooding. Humanitarian news and analysis**.** UN Office for the Coordination of Humanitarian Affairs. IRIN (Jan, 2009). Website:http://irinnews.org/Report.aspx?ReportId=81253

15. Khanh Lan, 2007. Weather changes: strong affects on coastal provinces in Vietnam (in Vietnamese). Website: http://www.cpv.org.vn/print_preview.asp?id=BT10120722752

16. Kim Chau 2006. AH as “wonderful redemy’ to save submerged rice (in Vietnamese). Agricultural journal No. 192 (2517) dated 26 Sept. 2006. Website: http://www.thanhhajsc.com/Web/ContentDetail.aspx?distid=122

17. Le Ha 2005. Central: Falling houses, landslide, sinking road, submerged rice (in Vietnamese). Vietnam Net. http://www.vnn.vn/xahoi/doisong/2005/12/523655/

18. Long An People Committee 2008. Results of Implimenting Job Solution and Poverty Alleviation for the period 2001-2005 and Orientation of Commitments for the period 2006-2010 (in Vietnamese). Website: http://www.longan.gov.vn/chinhquyen/Pages/Ket-qua-thuc-hien-chuong-trinh-giai-quyet-viec-lam-va-xoa-doi-giam-ngheo-giai-doan-2001-2005-va-phuong-huong,-nhiem-vu-giai.aspx

19. Mekong River Commission, 2007, Annual Mekong Flood Report 2006, ISSN: 1728-3248, 3/2008, P. 48.

20. Minh Hang 2007. Flood at the center of flood area. Binh Thuan Today (in Vietnamese). Website:http://www.binhthuantoday.com/modules.php?name=News&file=article&sid=5965

21. Steve Morin, Truong Thi Ngoc Chi, Tran Quang Tuyen, and Flor Palis, 2004. Combining farmers’ and scientists’ views of nutrient management in intensive irrigated rice production systems in the Mekong Delta of Vietnam. *In* Proceedings The Mekong Rice Conference To commemorate The International Year of Rice, 2004 held at Ho Chi Minh city, Vietnam from 15-17 October, 2004 edited by D.W. Puckridge, Bui Chi Buu, K. L. Heong, To Phuc Tuong and Nguyen Van Bo. Published by Ministry of Agriculture and Rural Development, Hanoi, Vietnam. P. 294-302

22. ND 2008. Reducing Damages Caused by Floods: Need of Practical Actions. Electronic Vietnam News. (in Vietnamese) http://www.dangcongsan.vn/print_preview.asp?id=BT2250864784

23. Nguyen Viet Thi (no year). Rainfall, Flood And Flash Flood Forecasting System And Activities In Vietnam. The National Center for Hydro-Meteorological Forecasting. Website: http://www.imh.ac.vn/b_tintuc_sukien/bc_hoinghi_hoithao/l888-thumucuoi/rainfall-nguyen%20viet%20thi.doc

24. Nhat Ho (2004). Reparing the damage due to submergence in Bac Lieu province: Some people worried, some people were happy!. (in Vietnamese). BTC 18 Aug. 2006. Website:http://vietlinh.netfirms.com/docbao/2004/8/040818bct.htm

25. NNOL 2008. Central and Central High Land: Challenges in wet season. Economy news. Website:http://daklak24h.com/index.php?mod=article&cat=KINHT%E1%BA%BE&article=7081

26. Phu Yen News 2008. Thousands of hectare of dry rice crop and upland crop were submerged. Phu Yen: Homeland and People (in Vietnamese). Website: www.phuyen.info.vn/Tintuc/tintuc_detail.asp?NID=12151 - 57k

27. Phuong, H. 2005. Typhoon no. 7 caused loss of 0.5% GDP this year (in Vietnamese). Vietnam Net. Website: http://www.vnn.vn/kinhte/congnongngunghiep/2005/10/496185/

28. Tin Que Huong, 2007. Natural disasters kill 117 people in Vietnam in November. Website: http://tinquehuong.wordpress.com/2007/12/05/natural-disasters-kill-117-people-in-vietnam-in-november/

29. TN,TP 2003. Thai Binh: Damage due to flood rains upto 1000 billions dong (in Vietnamese). Website:http://vietnamnet.vn/xahoi/2003/9/29360/

30. Tran Nga 2008. Vietnam is vulnerable in loss of 5 million tons of rice (in Vietnamese). VietnamNet. Website: http://www.trongtrotchannuoi.com/apm/modules.php?name=News&file=article&sid=5750

31. Tran Van Sap 2007. How is the strong wind force in typhoons understood? National Hydrometeorology Center. (in Vietnamese) http://thoitietnguyhiem.net/default.aspx?ItemID=460&Category=21

32. Tung, V. 2007. Historical flood in Northern Central and North Vietnam (in Vietnamese). Website: http://www.sonla.gov.vn/sonla/Vietnam/Diem_bao/Trong_nuoc/16252007101114222230/

33. Tuoi tre newpaper online, TTXVN, 31/12/2008.

34. V. H 2007. More than 3,285 ha of dry rice crop 2006-2007 had to be re-sown due to submergence. Quang Ngai province: Integration and development. Economy news (in Vietnamese). Website: http://www.quangngai.gov.vn/quangngai/tiengviet/bangtin/2007/16191/

35. Vietnam Statistics Office, 2007. Website:http://www.gso.gov.vn/default.aspx?tabid=390&idmid=3&ItemID=7463

36. Vietnam Net, 2007. Phu Yen: Big flooding rain, evacuating hundreds of households (in Vietnamese). Website: http://www. Vietnamnet.vn-xahoi-2007-10-751744

37. Vietnam Newspaper 2009. In 2009 Increasing National Poverty Lines (in Vietnamese). http://www.baovietnam.vn/xa-hoi/92972/11/Nam-2009-nang-muc-chuan-ngheo-quoc-gia

38. VOV NEWS 2006. Rains, floods caused severe damage in many locations. Electronic News of Voice of Vietnam (in Vietnamese). Website: http://www.vovnews.vn/?page=109&nid=17774

39. VOV News 2007. Provinces in Central are ready to deal with the typhoon No. 2. Electronic News of Voice of Vietnam (in Vietnamese). Website: http://www.vovnews.vn/?page=109&nid=45878

40. VTV 1, Feb. 1, 2009. Overall Pictures of Vietnam in 2008 (in Vietnamese). Spoken by Vietnam Television 1 (Ha Noi) on morning Feb, 1, 2009

41. Weather forecast station of Da Nang, 2006. The average data of the period 1979-2005,

PART II. DEVELOPING A RESPONSE PLAN BASED ON PARTICIPATORY VARIETAL SELECTION, TARGETING AND UPSCALING STRATEGIES IN CENTRAL VIETNAM

1. INTRODUCTION

Annually, southern coastal zone of Vietnam is greatly damaged to production from typhoons, especially in winter-spring crop and wet crop. The survey results for the period 1998-2005 indicated that the total rice production areas damaged by flooding were about 144,956 hectares equaling to 14,495 hectares yearly.

The IRRI-Japan Project has developed submergence-tolerant rice varieties (rice varieties with the sub1 gene), and now afford to disseminate such varieties and their associated new production practices to South East Asia, including Vietnam. In the country, Binh Dinh provinces in the central Vietnam were chosen as target sites for the dissemination. Aside from the aspects related to these varieties created and tested by agricultural scientists, plant breeders, social scientists were afforded to assess farmers' preferences and their criteria by addressing farmers' response to the sub1 technology. With this information, implementation plans to disseminate the technology would be appropriate to the specific needs of the target clientele. In addition, farmers, especially rural women are keys to concerns of food security and poverty alleviation. Thus there is the need to recognize and incorporate the knowledge and experience on the part of women in development (Borjas, 1997). Moreover, the research found that men and women had different criteria in rice varietal selection (Chi, Thelma and Joyce Luis, 1999; Thelma and et al., 2008). Recognizing such important criteria by both men and women in selection of rice variety can help the breeding goals reaching more farmers' need and more success in seed dissemination.

Researching and selecting submergence tolerant rice variety will contribute to reduce the damage for farmers and develop the more sustainable rice production.

2. OBJECTIVES OF THE STUDY

- General objectives: The study aims to understand farmers' preferences on rice varieties and associated agronomic traits as their response to the sub1 technology in the submergence rice villages in Central Vietnam
- Specific objectives: To know farmers' preference of agronomic traits associated in submergence tolerance rice varieties and women's perspectives related to rice cultivation in the submergence area
- Expected outcomes: Documentation of the information on farmers' preference of agronomic traits associated in submergence tolerance rice varieties and women's perspectives related to rice cultivation in the submergence area

3. METHODOLOGY

Data collection: Farmers' preferences analysis was done in Tuy Phuoc and An Nhon districts, Binh Dinh province. The farmer's fields with research managed trial with different rice varieties tested in the villages were used to conduct farmers' preference analysis. The target farmers involved in this analysis were 30 farmers in each site with both male and female manged-farms. These farmers are the ones who were included in based line survey from Part I. However, the number of female managed managed farms in the villages selected was not sufficient, thus a complete emuneration of female managed farms were chosen. In this situation, 16 female and 15 male farmers in surveyed list in Thai Xuan village, Nhon Hanh commune (An Nhon district) and 7 researchers ; and 10 female and 10 male farmers from Luc Lam village, Phuoc Hiep commune (Tuy Phuoc district) and 6 researchers participated in preferences analysis for dry rice season 2008, (Summer-Autumn).

Preference data were gathered using preferential analysis (IRRI protocol). A group of farmers were allowed to "vote" for their preferred varieties during a field day by depositing paper ballots in a bag or envelope in front of the plot. Ballots with signal √ and ballots with X signal were prepared with three colors: blue, pink, and yellow. Ballots with signal √ are for varieties they prefer; ballots with X signal for varieties they dislike. Blue ballots were given to male farmer-participants; pink ballots to female participants and yellow for breeders/ researchers. Each participant was given two ballots with √ signal and two ballots with X signal. Both male and female farmers voted 2 rice varieties that they like best (designed positive votes) and 2 rice varieties that they most dislike (designed as negative votes). These were the raw data collected to know total positive and negative votes for a rice variety.

After votes are tallied, the farmers are asked to discuss why they preferred the varieties receiving the most votes. Preference analysis (PA) generates two kinds of data: (a) quantitative preference score for each variety, expressed as the number of votes it received divided by the total number of votes cast, and (b) list of characteristics farmers like about the preferred varieties.

Problem tree analysis was used to know information on the main and sub-problems and their affecting chains on rice production and farmer life at the studied sites. The focus group discussion with farmers was used with elicit method to trace the information from farmers' answers.

The qualitative data from the problem tree analysis was summarized.

Descriptive statistic was used to present summary table showing which among the varieties are the "most preferred or best" and the "least preferred or disliked" varieties by the farmers. For this, the preference score (PS) for each variety is calculated as follows:

$$PS = \frac{\text{Number of positive votes – negative votes}}{\text{Total number of positive and negative cast}}$$

The preference scores for males and females were presented. However, identification of the "most" and "least" preferred varieties or selection was based on the combined male and female farmers' preference scores.

Pearson Correlation was used to investigate the relationships between two variables (*x* and *y*). This answers the question: “is the change in one variable, associated with the change in the other variable?” We use the correlation to test the statistical significance of the association. The interpretation is that a significant correlation only shows that the two factors or variables vary in a related way (positively or negatively). This technique was used to test whether preference scores between male and female farmers as well as between researchers and farmers were significant correlation or not

If Pearson’s correlation coefficient (r) is positive, there is a direct correlation on preference score between male and female as well as between researchers and farmers.

The level of correlation was classified based on r as following:

0 - no correlation

0.01-0.20 - very weak correlation

0.21-0.40 – weak correlation

0.41-0.60 – moderate correlation

0.61-0.80 – strong correlation

0.81-0.99 – very strong correlation

1 – Perfect correlation

4. RESULTS AND DISCUSSIONS

4.1. Participatory varietal selection (PVS) for enhanced varietal development

4.1.1. Mother trial and the preference analysis: Farmers preferences for varieties and their selection criteria

(1) Famers’ varietal selection in 2008:

The target rice stage at conducting preference analysis was 80% of rice grain ripen. However, the variety set used for mother trial comprised of various duration rice variety. The short duration rice was ripen, the long duration one was still green. Thus, choosing the stage for preference analysis was only relative. The first round of mother trial was conducted in dry season 2008 in both An Nhon and Tuy Phuoc. The dry season started from June, thus water level in the later stage of the rice plants and kept raising up and passed over the rice life cycle until the peak period of flash flood in November. We chose the time for preference analysis when all plants were still standing in the field with more than 80% of rice ripen of the short duration rice. If the time chosen was later, some of short plant height varieties would have been under water and the short duration varieties would have been over ripen and even dry up which would be difficult for farmers to evaluate.

- Differences in the farmers’ choices for varietal traits: Preference analysis in Thai Xuan village (An Nhon district) was presented in Table 1 and in Luc Lam village (Tuy Phuoc district) in Table 2.

Table 1. Preference analysis by farmers in Nhon Hanh commune, An Nhon district (2008)

Code of variety	IRRI Code of variety	Preference Scores				Grain yeild (T/ha)
		Male Farmer	Female Farmer	Combined Farmers	Researcher	
V1	IR 05F101	0,000	-0,031	-0,016	-0,214	4.5
V2	IR 07F102	0,000	0,156	0,081	0,000	4.0
V3	IR 07F286	0,000	0,000	0,000	0,000	3.9
V4	IR05F102	0,000	0,000	0,000	0,000	4.2
V5	IR 07F101	0,033	0,063	0,048	0,000	4.3
V6	IR 07F287	-0,167	-0,063	-0,113	0,000	4.2
V7	IR 07F289	0,200	0,125	0,161	0,214	4.4
V8	IR 07F291	-0,067	0,000	-0,032	0,000	4.4
V9	IR 07F290	0,000	0,000	0,000	0,000	4.2
V10	IR66876-11-NDR-1-1-1-1	-0,033	-0,094	-0,065	0,000	3.7
V11	IR57514-PMI-5-B-1-2	0,200	0,094	0,145	0,143	4.3
V12	IR49830-7-1-2-3	0,067	-0,063	0,000	-0,071	3.5
V13	IR 05A199	-0,067	-0,063	-0,065	0,000	4.2
V14	IR 05A193	-0,033	-0,031	-0,032	-0,071	4.3
V15	IR119	-0,133	-0,094	-0,113	0,000	4.2
V16	DV 108 (Local variety)	0,000	0,000	0,000	0,000	4.3

Note:

No.	Entries	IRRI Code of variety
1	Swarna Sub1	IR 05F101
2	IR64 Sub1	IR 07F102
3	IR64-2 Sub1	IR 07F286
4	Swarna Sub1	IR05F102
5	Samba Mahsuri Sub1	IR 07F101
6	Samba Mahsuri-2 Sub1	IR 07F287
7	TDK1 Sub1	IR 07F289
8	CR1009 Sub1	IR 07F291
9	BR11 Sub1	IR 07F290
10	IR66876-11-NDR-1-1-1-1	IR66876-11-NDR-1-1-1-1
11	IR57514-PMI-5-B-1-2	IR57514-PMI-5-B-1-2
12	IR49830-7-1-2-3	IR49830-7-1-2-3
13	IR 05A199	IR 05A199
14	IR 05A193	IR 05A193
15	IR119	IR119
16	DV 108 (Local variety)	DV 108 (Local variety)

Table 2. Preference analysis by farmers in Phuoc Hiep commune, Tuy Phuoc district (2008)

Code of variety	IRRI Code of variety	Preference Scores			
		Male Farmer	Female Farmer	Combined Farmers	Researcher
V1	IR07F102	0,250	0,200	0,225	0,250
V2	IR05F102	-0,150	-0,100	-0,125	-0,167
V3	IR07F287	0,200	0,100	0,150	0,083
V4	IRF07289	0,000	-0,050	-0,025	0,000
V5	IRF07291	0,000	-0,050	-0,025	0,000
V6	IRF07290	-0,100	-0,150	-0,125	-0,083
V7	IR64	0,000	0,000	0,000	0,000
V8	Swarna	0,000	0,000	0,000	0,000
V9	Samba Mahsuri	-0,050	0,000	-0,025	0,000
V10	IR 07F289	0,000	0,000	0,000	0,000
V11	IR 07F291	-0,050	0,000	-0,025	0,000
V12	IR 07F290	0,000	0,000	0,000	0,000
V13	IR66876-11-NDR-1-1-1-1	0,000	0,000	0,000	0,000
V14	IR57514-PMI-5-B-1-2	0,000	0,000	0,000	0,000
V15	IR49830-7-1-2-3	-0,150	0,000	-0,075	0,000
V16	IR 82355-5-2-3	0,000	0,000	0,000	-0,083
V17	IR 82355-5-1-3	0,000	0,000	0,000	0,000
V18	PSB Rc68	0,050	0,050	0,050	0,000
V19	DV 108 (Local variety)	0,000	0,000	0,000	0,000

Note:

No.	Entries	IRRI Code of variety
1	IR64 Sub1	IR07F102
2	Swarna Sub1	IR05F102
3	Samba Mahsuri Sub1	IR07F287
4	TDK1 Sub1	IRF07289
5	CR1009 Sub1	IRF07291
6	BR11 Sub1	IRF07290
7	IR 64	IR64
8	Swarna	
9	Samba Mahsuri	
10	TDK1 Sub1	IR 07F289
11	CR1009 Sub1	IR 07F291
12	BR11 Sub1	IR 07F290
13	IR66876-11-NDR-1-1-1-1	IR66876-11-NDR-1-1-1-1
14	IR57514-PMI-5-B-1-2	IR57514-PMI-5-B-1-2
15	IR49830-7-1-2-3	IR49830-7-1-2-3
16	IR 82355-5-2-3	IR 82355-5-2-3
17	IR 82355-5-1-3	IR 82355-5-1-3
18	PSB Rc68	PSB Rc68
19	DV 108 (Local variety)	

Table 3. Correlation analysis for relation between farmer and researcher scores in Thai Xuan Village, An Nhon (Summer-Autumn, 2008).

Correlations

		Male	Female	Farmer	Breeder	Yield
Male	Pearson Correlation	1	.667**	.929**	.523*	.042
	Sig. (2-tailed)		.005	.000	.038	.878
	N	16	16	16	16	16
Female	Pearson Correlation	.667**	1	.895**	.527*	.295
	Sig. (2-tailed)	.005		.000	.036	.267
	N	16	16	16	16	16
Farmer	Pearson Correlation	.929**	.895**	1	.574*	.171
	Sig. (2-tailed)	.000	.000		.020	.527
	N	16	16	16	16	16
Breeder	Pearson Correlation	.523*	.527*	.574*	1	.099
	Sig. (2-tailed)	.038	.036	.020		.716
	N	16	16	16	16	16
Yield	Pearson Correlation	.042	.295	.171	.099	1
	Sig. (2-tailed)	.878	.267	.527	.716	
	N	16	16	16	16	16

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4. Summary table of relation scores between male and female farmers and researcher and farmers in Thai Xuan Village, An Nhon (Summer-Autumn, 2008).

	n	r	Probability
Male vs Female	16	0.667**	0.003
Farmer vs Researcher	16	0.574*	0.016

Table 5. Correlation analysis for relation between farmer and researcher scores in Luc Lam Village, Tuy Phuoc (Summer-Autumn, 2008).

Correlations[a]

		Farmers	Researcher	Female	Male
Farmers	Pearson Correlation	1	.884**	.946**	.971**
	Sig. (2-tailed)		.000	.000	.000
	N	19	19	19	19
Researcher	Pearson Correlation	.884**	1	.875**	.831**
	Sig. (2-tailed)	.000		.000	.000
	N	19	19	19	19
Female	Pearson Correlation	.946**	.875**	1	.841**
	Sig. (2-tailed)	.000	.000		.000
	N	19	19	19	19
Male	Pearson Correlation	.971**	.831**	.841**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	19	19	19	19

**. Correlation is significant at the 0.01 level (2-tailed).

a. Village = Phuoc Hiep

Table 6. Summary table of relation scores between male and female farmers and researcher and farmers in Luc Lam Village, Tuy Phuoc (Summer-Autumn, 2008)

	n	r	Probability
Male vs Female	19	0.841**	0.000
Farmer vs Researcher	19	0.884**	0.000

- Assessing the difference between male and female farmers' preference scores, Table 3 and Table 5 show that there was significant and strong correlation between the male and female farmers' preference scores in Thai Xuan village (An Nhon district). This means that with r= 0.667 (at 1% level of significance), male and female farmers somewhat agree on their preferences for the best performing varieties tested in the researcher-managed trials in Thai Xuan village.

Similarly, in Luc Lam village (Tuy Phuoc provinve), Table 4 and Table 6 show that there was significant and strong correlation between the male and female farmers' preference scores. This means that with r= 0.841 (at 1% level of significance), male and female farmers somewhat agree on their preferences for the best performing varieties tested in the researcher-managed trials in Luc Lam village.

- Assessing the difference between farmers and researchers' preference scores, Table 3 and Table 5 show that in Thai Xuan village (An Nhon district) when farmers' preferences (male and female preferences combined) are compared to the breeders' preferences, the correlation analysis shows moderate correlation at r= 0.574 and 5% level of significance). The

results show that there is also moderate agreement between the farmers' preferences, given their own reasons and set of criteria for selection, and the researchers' own criteria in selecting good performing varieties.

In Luc Lam village (Tuy Phuoc district) Table 4 and Table 6 show that when farmers' preferences (male and female preferences combined) are compared to the breeders' preferences, the correlation analysis shows strong correlation at r= 0.884 and 1% level of significance). The results show that there is strong agreement between the farmers' preferences, given their own reasons and set of criteria for selection, and the researchers' own criteria in selecting good performing varieties.

- Based on preference analysis in Thai Xuan village, An Nhon dictrist (Samba Mahsuri-Sub1 and IR05F102 rice varieties were most preferred by farmers).

Samba Mahsuri-Sub1 was preferred for its stiff stem; duration is suitable for the weather; short time to harvest before heavy rains; this is usually about less than 100 days; big and long panicle; less unfilled grains; more spikelets; medium plant height (not so short, not so high) – advantage is easier to thresh and harvest

IR05F102 (IR64-Sub1) had same good characteristics that were preferred by farmers. stiff stem; erect flag leaf; duration is suitable – short time; plant is healthy – no disease observed; thick seed density; compacted seeds – more seeds in panicle; more panicles; bright color seeds – good indication of good quality seeds inside the husk; Compacted seeds

Farmers in An Nhon does not like IR07F291 variety (CR1009-Sub1) because of signs of long duration, high plant height. They also did not like IR57514-PMI-5-B-1-2: because it was high plant height, can easily lodge; long duration

In Tuy Phuoc district, IR07F102 (IR64-Sub1) and Samba Mahsuri-Sub1 were most preferred by farmers in Luc Lam village. IR07F102 (IR64-Sub1): with stiff, hard, sturdy stem; big panicle – with long and more spikelets; less unfilled grains; duration is suitable for the weather; short time to harvest before heavy rains occur; short plant height

IR07F287 (Samba Mahsuri-Sub1) was observed with good characteristics as plant looks healthy, with stiff, hard stem; big panicle – long and with more spikelets; erect flag leaf; short duration which is suitable to the weather; short time to harvest before heavy rains occur; thick seed density; compacted seeds – more seeds in panicle

Luc Lam village did not like IR05F102 (Swarna-Sub1). More signs of rice compare to other varieties, very long duration and not suitable for cropping season; high plant height which makes it susceptible to lodging; thin seed density; more unfilled grains

They did not like IR07F290 (BR11-Sub1): because of its too long duration – not suitable; more unfilled grains; high plant easily lodged; thin seed density; long duration (Table 7)

Table 7. Lines/ varieties preferred and disliked by farmers from mother trial (Summer-Autumn, 2008, central Vietnam)

Country/ Province / Village	Most/ Preferred Lines/ Varieities		Least Preferred Lines/ Varieties	
	Designation/ Common Name	Criteria	Designation / Common Name	Criteria
Binh Dinh Province/ Phuoc Hiep village	IR64-Sub1	with stiff, hard, sturdy stem; big panicle – with long and more spikelets; less unfilled grains; duration is suitable for the weather; short time to harvest before heavy rains occur; short plant height	Swarna-Sub1	very long duration and not suitable for cropping season; high plant height which makes it susceptible to lodging; thin seed density; more unfilled grains
	Samba Mahsuri-Sub1	plant looks healthy, with stiff, hard stem; big panicle – long and with more spikelets; erect flag leaf; short duration which is suitable to the weather; short time to harvest before heavy rains occur; thick seed density; compacted seeds – more seeds in panicle	BR11-Sub1	long duration – not suitable; more unfilled grains; high plant easily lodged; thin seed density; long duration
Binh Dinh Province/ Nhon Hanh village	Samba Mahsuri-Sub1	stiff stem; duration is suitable for the weather; short time to harvest before heavy rains; this is usually about less than 100 days; big and long panicle; less unfilled grains; more spikelets; medium plant height (not so short, not so high) – advantage is easier to thresh and harvest	CR1009-Sub1	long duration, high plant height
	IR64-Sub1	stiff stem; erect flag leaf; duration is suitable – short time; plant is healthy – no disease observed; thick seed density; compacted seeds – more seeds in panicle; more panicles; bright color seeds – good indication of good quality seeds inside the husk; Compacted seeds	IR57514-PMI-5-B-1-2	High plant height, can easily lodge; long duration

(2) Famers' varietal selection in 2009:

*** In Nhon Hanh site:**

In Nhon Hanh site, farmers' evaluation at ripening stage indicated that DB6, IR70213-10-CP14-2-5-2, IR 07F102 (IR64-sub1) were preferred by farmers.

DB6 was preferred for thickness paddy, big panicle – with long and more spikelets, heavy particles; less unfilled grains; stiff, hard, sturdy stem; heavy particles; more branch; good heat resistance; good submergen tolerant variety.

IR70213-10-CP14-2-5-2 was preferred for erect flag leaf disabled later; plant is healthy

– no disease observed; heavy particles; stiff, hard, sturdy stem difficultly lodged and suitable for cropping season in local; big panicle – with long and more spikelets; bright color seeds, long grain, easy to sell; less unfilled grains; good submergen tolerant variety

IR 07F102 (IR64-sub1) was preferred for stiff, hard, sturdy stem difficultly lodged and high plant; long grain, compacted seeds, less unfilled grains; good submergen tolerant variety; more branch;

Farmers in Nhon Hanh does not like IR70181-32-PMI-1-1-5-2, IR07F289, Swarna-sub1 because of signs of long duration; thin seed density; erect flag leaf disabled soon; high plant height which makes it susceptible to lodging; more unfilled grains; more insects and diseases

IR07F291 variety (CR1009-Sub1) because of signs of long duration, high plant height. They also did not like IR57514-PMI-5-B-1-2: because it was high plant height, can easily lodge; long duration

Table 8. Preference analysis by farmers in Nhon Hanh commune, An Nhon district (2009)

IRRI Code of variety	Name	Preference Scores			
		Male Farmer	Female Farmer	Combined Farmers	Researcher
IR 07F 287	**Samba Mahsuri Sub1**	-0,067	-0,133	-0,100	-0,167
CR 1009	CR 1009	-0,067	-0,067	-0,067	-0,167
THADOKKHAM 1	THADOKKHAM 1	-0,067	0,000	-0,033	0,333
IR 07F 291	CR1009 Sub1	0,000	-0,133	-0,067	0,000
SWARNA	SWARNA	-0,067	-0,267	-0,167	0,000
DB 6	**DB 6**	**0,067**	**0,467**	**0,267**	**0,000**
IR 70181-32-PMI 1-1-5-1	IR 70181-32-PMI 1-1-5-1	-0,267	-0,067	-0,167	0,000
IR 05F 102	Swarna Sub1	0,133	-0,067	0,033	0,167
IR 07F 289	TDK1 Sub1	-0,067	-0,267	-0,167	-0,500
IR 07F290	BR 11 sub1	0,000	0,200	0,100	0,000
IR 70213-10-CPA 4-2-3-2	**IR 70213-10-CPA 4-2-3-2**	**0,000**	**0,267**	**0,133**	**0,167**
DV 108	DV 108	0,133	0,000	0,067	0,000
SAMBHA MAHSURI	SAMBHA MAHSURI	0,000	0,000	0,000	0,000
IR07F102	**IR64 Sub1**	0,267	0,067	0,167	0,167

Table 9. Lines/ varieties preferred and disliked by farmers from mother trial (Summer - Autumn, 2009, in Nhon Hanh commune, central Vietnam)

No	Most/ Preferred Lines/ Varieities		Least Preferred Lines/ Varieties	
	Designation/ Common Name	Criteria	Designation / Common Name	Criteria
1	**DB6**	Thickness paddy, big panicle – with long and more spikelets, heavy particles; less unfilled grains; stiff, hard, sturdy stem; heavy particles; more branch; Good heat resistance; good	V7 (IR70181-32-PMI-1-1-5-2)	Long duration; thin seed density; erect flag leaf disabled soon; high plant height which makes it susceptible to lodging; more unfilled grains

		submergen tolerant variety		
2	**V11 (IR70213-10-CP14-2-5-2)**	Erect flag leaf disabled later; plant is healthy – no disease observed; heavy particles; stiff, hard, sturdy stem difficultly lodged and suitable for cropping season in local; big panicle – with long and more spikelets; bright color seeds, long grain, easy to sell; less unfilled grains; good submergen tolerant variety	IR07F289 (TDK1 Sub1)	Long duration - not suitable: insects and rat damaged the crop; erect flag leaf is tilted; a lot of white panicle (worm in the stem);
3	**IR07F102** (IR64-sub1)	Stiff, hard, sturdy stem difficultly lodged and high plant; long grain, compacted seeds, less unfilled grains; good submergen tolerant variety; more branch.	IR 07F 287 (Swarna-sub1)	Too long duration – not suitable

Table 10. Correlation analysis for relation between male and female famers scores at maximum tillering stage in Nhon Hanh (2009).

		Male	**Female**	**Remarks**
Male	Pearson Correlation	1,000	0,327	weak correlations
	Sig. (2-tailed)		0,254	not significant
	N	14,000	14,000	
Female	Pearson Correlation	0,327	1,000	
	Sig. (2-tailed)	0,254		
	N	14,000	14,000	

Table 11. Correlation analysis for relation between researcher and famer scores at maximum tillering stage in Nhon Hanh (2009).

		Researcher	**Farmer**	**Remarks**
Researcher	Pearson Correlation	1,000	0,454	moderate correlations
	Sig. (2-tailed)		0,103	not significant
	N	14,000	14,000	
Farmer	Pearson Correlation	0,454	1,000	
	Sig. (2-tailed)	0,103		
	N	14,000	14,000	

4.2. Evaluation of new lines under farmers' management

4.2.1. Sensory evaluation of the cooking and eating quality of the submergence tolerant rice and farmer's local variety

In Phuoc Thuan site: The varietie IR 05F102 (IR64 Sub1) that were selected by farmers from PVS- research managed trial was used in baby trials. There were 20 farmers had seeds of TBR1 and DV108, thus they did baby trial with 3 varieties: IR 05F102, TBR1 and DV108. The other planted 3 rice varieties as IR 05F102, TBR1 and DV108.

Regarding to sensory test, in Phuoc Thuan, the local rice variety TBR1 and DV108 are the most preference variety as compared with submergence tolerant rice varieties because its cooked rice is softer, sweeter, gloss, white transparent. TBR1 is 1st preference by farmers. IR64 sub1 is least preference because it is not transparent, the farmers cannot sell their harvest. In addition, local people have not a habit of eating cohesiveness cooking rice and the trader of rice buy the rice of IR64-sub1 lower than the normal cost. The rice harvest is also glutinous and the farmers and consumers in the area prefer white and non-glutinous rice. The crop is difficult to harvest because rice stems were troubled (straw usualy is untidy/ confused). There were also a lot of broken grains.

Table 12. Sensory Evaluation Summary Report for farmers in Phuoc Thuan commune, Central Vietnam in 2009

Code/ Variety		COUNT		Relative Weight		Combined Weight	Rank
		Acceptable	Not Acceptable	Ranking	Rating		
568	IR64 Sub1	9	26	25,00	24,71	24,86	**3**
345	TBR1	30	5	42,92	44,68	43,80	**1**
934	DV108	19	16	32,08	30,60	31,34	**2**
TOTAL		**58**	**47**	**100**	**100**	**100**	

Analysis of rice preference of male and female farmers also showed that male and female farmers preferred TBR1 than other selected rice variety. Thus the breeder should consider farmers' criteria in cooked rice of local rice into the submergence tolerant rice varieties.

Table 13. Sensory Evaluation Summary Report for male and female farmers in Phuoc Thuan commune, Central Vietnam in 2009

Code/Variety		COUNT				Relative Weight				Combined Weight		RANK	
		Acceptable		Not Acceptable		Ranking		Rating					
		Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
568	IR64 Sub1	6	3	10	16	30,61	20,18	31,56	18,88	31,09	19,53	**2**	**3**
345	TBR1	14	16	2	3	41,84	43,86	44,38	44,95	43,11	44,40	**1**	**1**
934	DV108	6	13	10	6	27,55	35,96	24,06	36,17	25,81	36,07	**3**	**2**
TOTAL		**26**	**32**	**22**	**25**	**100**	**100**	**100**	**100**	**100**	**100**		

4.2.2. Integrating farmers criteria for enhanced breeding works:

About farming practices in Nhan An and Quang Van villages of Tuy Phuoc site, farmers used variety DV108, DB06, TBR1 and the seed rate of 120-150 kg/ha for high yielding rice and 50 kg/ha for hybrid rice (Nhi uu 838). The source of seeds was from self production 70% and bought 30% with HYV. The hybrid seed bought 100%. The manual direct seeding was applied for high yielding rice and hybrid rice. The rice straw of high yielding rice was burnt after harvesting dry season, feed to animals selling for the person doing something. The rice straw of hybrid rice was all burnt after harvesting dry season. In high yielding rice, the important insects were Leaf folder, caseworm, green leafhopper, brown planthopper, stemborer, rice bug

controlled by chemicals, IPM, water management. The important disease on high yielding rice were blast, bacterial leaf blight and they were controlled mainly by chemicals and IPM. The destructive weed in the high yielding rice field included Water grass, Molasses grass controlled by hand and they were controlled by hand weeding. In hybrid rice variety, the important insects were leaf folder, brown planthopper and were controlled by chemicals. The important disease of hybrid rice was blast and was controlled by chemicals. The destructive weed in the high yielding rice field included Water grass, Molasses grass controlled by hand and they were controlled by hand weeding.

In Duong Xuan, Hoa Tay village of Nhon Hanh site, similar farming as Phuoc Thuan site was found, however farmers didn't use hybrid rice. They used higher seed rate of 150-170kg/ha for high yielding rice. The source of seeds was from self production (75%) and buying (25%). The manual direct seeding was applied for high yielding rice. The rice straw management was feeding to animal and cash. In high yielding rice, the important insects were leaf folder, caseworm, green leafhopper, brown planthopper, stemborer, rice bug controlled by chemicals. The important disease on high yielding rice were blast, sheathbligh, bacterial leaf blight controlled by chemicals, IPMs. The destructive weed in the high yielding rice field was mainly water grass, molasses grass controlled by chemical and hand weeding.

4.3. Farmers' varieties: historical perspective and current needs

In Tuy Phuoc site, Phuoc Thuan commune, before the year 2008, most of farmers in the selected villages adopted high yielding rice varieties (100%). The popular high yielding rice varieties in Tuy Phuoc site were DV 108, DB 06, TBR 1 with the average yield in Winter Spring crop from 5.5-6.0 t/ha and 5.0- 5.5 t/ha in Summer Autumn crop. Hybrid rice varieties was Nhi uu 838 with the average yield from 6.5-7.0 t/ha. In Tuy Phuoc, 63% farmers planted Ma lam 48 and DV108 rice variety. Farmers planted TBR1 because of various reasons as hard stem, high yeild, test new variety, recommended by extension agent. Farmers plant 2 rice crops per year.

In An nhon site, Nhon Hanh commune, before the year 2008, the common high yielding rice varieties were DV 108, Ma Lam 48, Ma Lam 49, TBR 1, U ai 32 with the average yield in WS (Winter Spring) crop of 5.0-6.0 t/ha and in DS (Summer Autumn) crop from 5.0-5.5 t/ha, the average yeild in third crop of 3.5-4.0 tons/ha. All rice varieties planted by farmers are not tolerant to submergence. 45% farmers in An Nhon site planted TBR1 rice variety. Farmers planted TBR1 because of various reasons as hard stem, high yeild, test new variety, recommended by extension agent. Farmers planted Malam 48 because of reason as suitable soil condition and planted DV108 because of many reasons as high yield, suitable soil condition, good quality, vegetative vigour, short duration, rice grain do not shatte, hard stem, do not lodge, flooding tolerant... Farmers plant 2 - 3 rice crops per year.

4.4. Relating farmers' selection criteria to agro-ecological and socioeconomic environment

4.4.1. Preferred traits by male and female farmers

According to Chi, et al (1999), the most important criteria for both men and women to select a variety is the grain yield follow by the price at harvest. men were more concerned with the trait of resistance to insect pest meanwhile women were more concerned with the trait of taste and milling recovery. Women were also more concerned to storage quality of traditional rice than men.

In this study, farmers expected the rice varieties with various traits as tolerance to submergence, acid sulphate soil, resistance to insect and diseases, resistance to lodging, high yield, less percentage of losses, transparen, good grain quality in terms of number of broken grains, smell, good aroma and cooking qualities; they also would like to adopt rice that is

requiring low inputs, low investment and are easy to manage. And male and female farmers preferred traits following table 43.

Table 14. Preferred traits by male and female farmers in central Vietnam

Female	Male
- High yeild grain; - Suitable duration (2-3 crops season per year depend pronze); - Good growth and development of rice; - Good tolerant (submergence, heat, pest disease, logding, acid sulphate soil, salinity soil…); - Good quality rice; - Easy to harvest and thresh	- High yeild grain; - Suitable duration (2-3 crops season per year depend pronze); - Good growth and development of rice; - Good tolerant (submergence, heat, pest disease, logding, acid sulphate soil, salinity soil…); - Good quality rice;

4.4.2. Positive and negative traits of varieties grown over the years

Table 15. Positive and negative traits of varieties grown over the years in central Vietnam

Positive	Negative
- High yeild grain - Stiff stem, not susceptible to lodging - No insect pest; no sign of diseases - Easy to harvest and thresh - Good aroma, transparen, color, no broken grains, not glutinous - Low inputs, low investment, easy to manage, high benefit	- Low yeild gran; - Long duration vatiety in 3 rice crops per year and short duration variety in 2 rice crops per year; - Inflected brown plant hopper, rice grassy stunt virus and rice ragged stunt virus diseases of rice varieties; - High plant, easy lodging; - No aroma, no transparen, broken grains; - Less tolerance to submergence, acid sulphate soil, salinity soil…; - High inputs, high investment, difficult to manage, low benefit

4.5. Farmers' adaptation strategies to avert the impact of flooding on rice farming system

Farmers' adaptation strategies to avert the impact of flooding on rice farming system included planting the sub-1 gene varieties in their own fields for few season to observe the performance of the plant. They also need to visit the demonstration field in their village as well as understand well about cultural practices and technologies related to varieties through participation in the training by technical staff or extension workers. Farmers tried to build dikes to pump out. They also apply fertilizer after water recede for plant to grow faster.

Farmers build themselves the temporary bunds to prevent the impact of water from flooding. But this is not that strong and can easily give way when strong flooding occurs. They will develop model production: Paddy/ Rice – Fish

Improvement of field condition by government providing physical barriers to flood waters and establishing canal system for proper drainage. Another suggestion is to have rice varieties that can tolerate lodging and submergence conditions; rice vatieties can anti diseases, anti pests. Farmers agree to contribute some funds to the government for building the structures like boundaries, canal interior field, solidified the internal canals, dredging ditches to control

floodwater inflows. Government should find market of production and support technology.

4.6. Target sites for variety dissemination – for expansion

At the moment, the submergence rice varieties are not yet ready for dissemination because they lack of farmer's expected criteria as compared to local rice varieties without Sub-1 gene. In the central Vietnam should recommend farmers to plant Sub-1 rice varieties in wet season which is affected by flash flood (growing in December annual). Binh Dinh and the provinces in the central Vietnam are affected by later flood, high tide and can be the target sites for dissemination. When the later flood, high tide occur at the same time with tropical low pressure or typhoon, the affect of flash flood is more severe.

If IR64-Sub1 would be found to be good varieties, this will be further validated and disseminated to the farmers. They hope to include this in the development of the 60 hectares of new varieties; to be disseminated to other nearby Phuoc Thuan commune like Phuoc Hoa commune (Tuy Phuoc district) with rice-rice system that is also severely affected by flash flooding annually. The CBA - UNDP - GEF SGP's project is hoped to include the submergence - prone rice areas. Leader of Scientific Association of Binh Dinh province is director this project.

4.7. Dissemination strategies at the national and community level

4.7.1. Networking and national seed distribution system

Regarding to networking and national seed distribution system, the technologies are transferred to farmers through the formal system from state level to regional level or to provincial level first. After that the provinces direct the districts, and the districts direct the communes. From the commune the technologies are disseminated to farmers through Farmers' Association, and public associations as extension clubs, women's association, leaders of villages, extension leaders, key farmers of the villages.

However, in some cases, the technologies can disseminate through informal system as oral transmission among farmers, exchange or giving materials as seeds and other material inputs.

The network includes the connection among research institutes, university, department of agricultures of the provinces (DARDs), extension centers of provinces, seed centers of provinces in transferring the new technologies to farmers. The activities of the network comprises of collaboration in technology development and transfer to farmers.

(1) Quantity of seeds required for multiplication:

The quantity of seeds required for multiplication is not fix how much. However, the more foundation seed availability the more better is. The seeds from breeders are used to produce foundation seed, thus the amount of foundation seed are usually small. Thus, there is the need of seed multiplication system.

(2) Seed multiplication system:

Seed multiplication system in Vietnam is following as:

*** Seed system:** Breeder (V_0) → Super puration (V_1) → Comfirmed variety (Variety for growing)

*** Seed production system:** Breeder (V_0) → Institute/ research centre → Seed company/ Agricultural Cooperation/ Farmer → Growing

(3) Identification of partners and beneficiaries:

At first the partners can be identified as the staffs of DARD, staffs of extension centers and seed centers. The staff of extension centers of provinces received seeds for multiplication.

However, the seed dissemination in this way was not successful due to, firstly, not yet ready seeds for dissemination, secondly, not care and monitoring of seed after giving to the followers including farmers. At the moment the final beneficiaries limited at a small numbers of farmers as farmer cooperators in varietal evaluation during mother trials, self managed from baby trial and sensory test. The in – depth research related farmers' expected criteria about seeds has not yet reached.

4.7.2. Insights into community-based/village-level technology dissemination strategies.

To reach farmers, all advance technologies including the new rice varieties can reach farmers through the community-based/ village-level. The training of new technologies at community-based/ village-level can be organized by extension centers of the provinces, and/ or by the research staffs of the research institution and university. The farmers' association communicate with its members about new agricultural technologies. The farmers' association plays the main role in technology dissemination. Aside from meeting and training, demonstration fields, communication system are important

4.8. Assessment of benefits of PVS, both by researchers and farmer cooperators

The method of transplanting 1 seedling per hill when the seed amount is scare. They learn how to vote to select the most preferred and least preferred rice variety. They participated in focus group discussion and sensory test. This method helps them to know more about information related to submergence rice varieties. Focus group discussion and doing survey by staffs help farmer to communicate and learn knowledge from other farmers and staffs. This also increased the good relationship among farmers in the villages. The farmers conduct trials, and get better yield, becomes happy because of own contribution

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusion:

Farmers selection criteria for enhanced breeding work included short duration, more panicles, more sub – panicles, long panicles, more hidden panicles, compact or dense seeds, stiff stem, resistant to planthopper and other insects, resistant to rice diseases, thin rice husk, erect and long flag leaf with relatively acceptable light green to be indicative of potential higher yield, long grains, and less signs of grain spots or any grain disease based on grain discoloration.

Varieties selected for dissemination comprised of IR64-Sub1.

5.2. Recommendation:

- Policy support system
- Institutional linkages and networking
- Farmers/ community adaption strategies
- Dissemination strategies at national level
- Research areas on participatory varietal selection

REFERENCES

1. Borjas, Partricia Howard, 1997. Gender Studies in Agriculture and Rural Development. Wageningen Agricultural University. Home Center for Rural Development. Sociology. Homepage. Internet

2. Truong Thi Ngoc Chi, Thelma R. Paris and Joyce Luis 1999. Male and female farmers' participatory in rice varieties selection in Long An province, Vietnam. Presented and Printed in "Results of Science Research for 1999" of Cuu Long Rice Research Institute (in Vietnamese).

3. Thelma R. Paris, Abha Singh, Amelia D. Cueno and V.N. Singh 2008. Assessing the Impact of Participatory Research in Rice Breeding on Women Farmers: A Case Study in Eastern Utta Pradesh, India. Expl. Agric. (2008), vol. 44. Cambridge University Press, p. 97-112