

Title: Economic and social benefits of flood-based livelihoods in Vietnam's Mekong Delta: a case study in An Giang Province

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Abstract

Floods are the consequence of climate change. Floods have most catastrophic impacts to social, environmental and economic conditions in the Mekong Delta. Nearly one-half of the Delta's total area (two million ha) is continuously inundated for between four and six months during the flood season. These floods have resulted in many tangible and intangible costs.

In contrast, a 'beautiful flood has contributed significantly to the improvement of local livelihoods. Dealing with costs of floods, recently the Government and farmers of Vietnam has adopted several strategies to exploit the natural flood benefits. A series of 'Living with the floods' policies has been released by An Giang provincial government to facilitate local people to exploit the natural benefits of flood and to mitigate the flood costs. First, the policy of building residential clusters and dykes to relocate vulnerable households locating in the flood-prone areas which subjected to high risks from floods was most significant. The second most important policy was applying the flood-based farming practices to improve farmer's livelihoods during the flood season. Finally, a low interested loan program which helped thousand of people raising their house foundations to avoid damage from annual floods.

This paper examined the economic and social benefits of several flood-based farming practices being employed by local people using content analysis from previous studies, in-depth interviews with key informants, and analyzing the secondary data from government reports for several years. The economic values of flood-based crops and aquaculture were measured using farm gate price for output and the wholesale market price for inputs.

The results showed that the flood-based farming and services have contributed significantly to the improvement of local livelihoods. Farmers can grow more than two rice crops in the flooded areas using flood-based farming approaches. Besides two main rice crops, prawn farmers could gain a net benefit from 22 to 44 VND million which was much three times higher than that of once rice crops. Small scale snake head fish and eel farmers gained a highly positive net benefit. The net return for eel and snake head fish were estimated from 2-4 million VND/12m² and 1 VND million/10 m² respectively. Instead of growing the third rice crop, water-caltrops, Neptunia and lotus were introduced which resulted in a higher net benefit than a main rice crop. The net benefit of lotus and water caltrops were ranged from 10 million to 12 VND million per ha which were twice higher than that of a rice crop. Neptunia showed a lower net return than water-caltrops and lotus, but its net benefit was quite close to a summer rice crop. Mushroom producing also provided a net return of 560,000 VND/100 m². In addition to economic benefits, those flood-based farming have been created many jobs for local people. Further more, many flood-based services were introduced at the same time which provided hundred thousand of jobs during the flood season in An Giang province. There were 406,937 jobs created during the flood 2005, of which 47,000 jobs are based on flood-based services. Floods have brought many social benefits as well as its economic one.

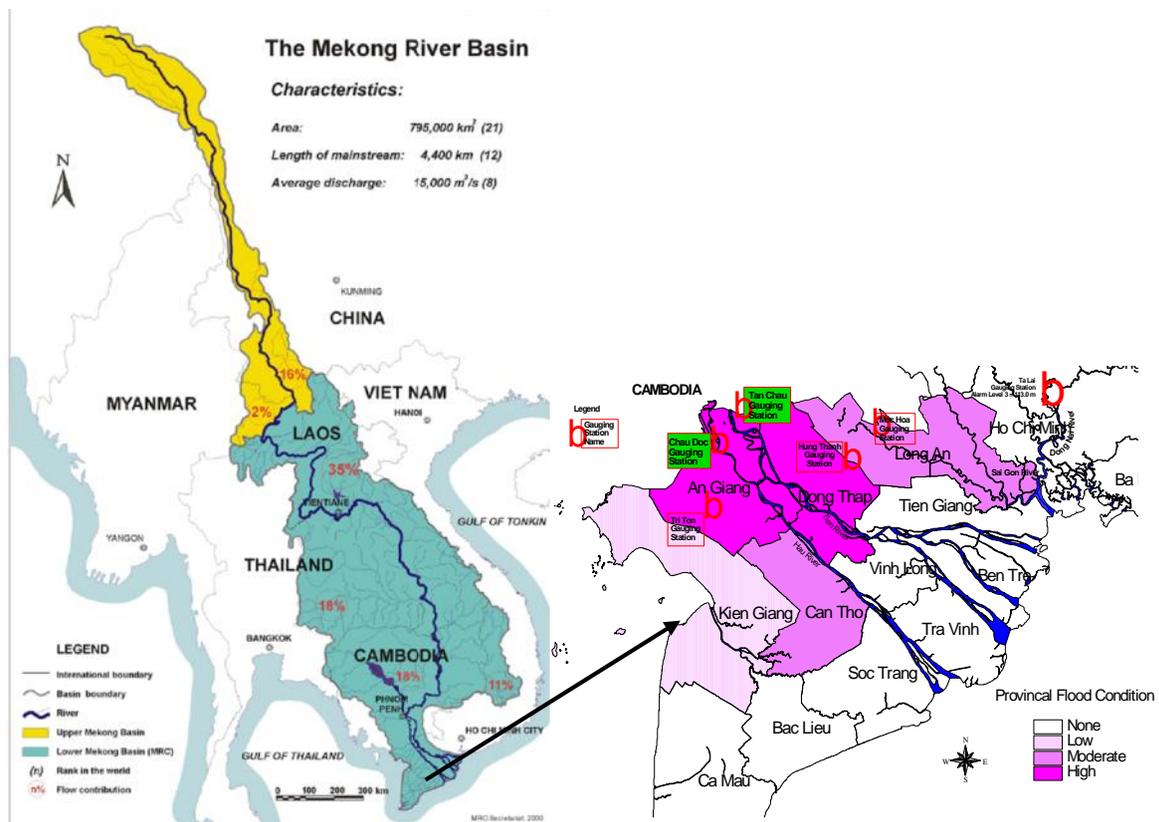
This paper suggested that governments should pay more attention on the research and development of those flood-based livelihoods for poverty reduction as well as sustainable use of floodplain resources. Because this study estimated the market benefit of the flood, a further in-depth study on non-market benefit of the flood should be taken into account to provide the full advantages of the Mekong delta's flood. At the same time, the non-market benefit of living with the flood policy would be recommended to assess the effectiveness of government policy on flood management. Climate change and a rise in sea level should be taken into policy formulating process of living with the flood policy in the Mekong Delta.

Key words: living with the floods, flood-based livelihoods, climate change, sea level rise, flood-based farming, flood-based services, net benefit, social benefit, economic benefit, the Mekong delta.

Introduction

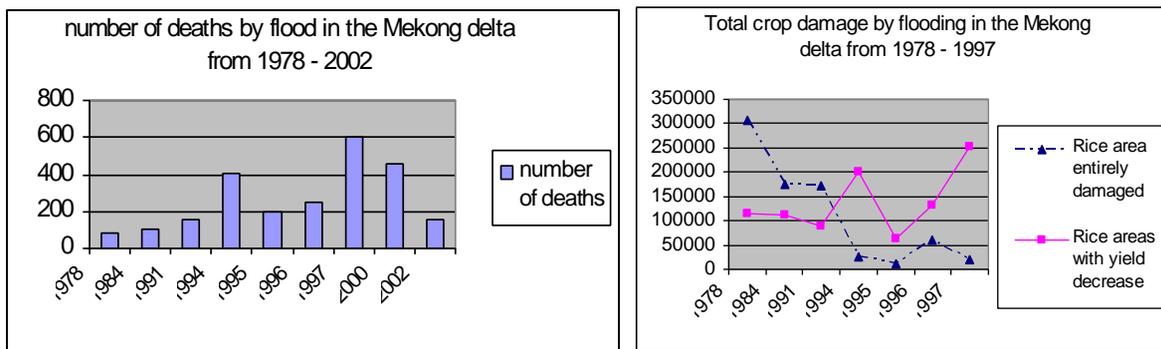
The Mekong River Delta (MRD) is a key fishery and agricultural production zone located on the southern coast of Vietnam (Figure 1). The Delta supports 17 million people and accounts for 20.8 per cent of the country's population (GSOV 2004). Most people live in rural areas (80 per cent) and work in the agricultural sector (GSOV 2004). The Delta includes 3.9 million hectares (ha) currently under cultivation (GSOV 2004), of which irrigated paddy fields comprise 2 million ha (Hori 2000), that are extremely important to the Vietnamese agricultural economy. Between 2001 and 2005, the Delta's annual economic growth was 13.9 per cent (VEN 2006). In particular, the export value rose from US \$1.46 million in 2001 to US \$2.89 million in 2005, of which 80 per cent came from agricultural production and seafood (VEN 2006). Since the Delta's economic growth has been increasing rapidly, it has become a major contributor to the country's economy. At the current time, Mekong River delta produces 50% of the nation's rice and contributes to Vietnam's position as the second largest rice exporter in the world (Tien *et al.*, 2001). 60% fishery and fruit products of the country also come from the delta (Sub Institute of Water Resources Planning and Vietnam National Mekong Committee 2003:1).

Figure 1: Map of the Mekong Delta



However, the annual flooding of the Delta is an obstacle to continued agricultural and rural development and poverty reduction. Nearly one-half of the Delta's total area is continuously inundated for between four and six months during the flood season and more than 11 million people are residing in these seven flooded provinces (Hori 2000, Gupta *et al.* nd). The number of flooded communes is 610, of which 77 are deeply submerged (over 3 meters in depth), 112 are submerged to an average level (from 2 to 3 m deep), 329 are shallowly submerged (under 2 m) and 82 communes are in eroded estuaries or coastal areas (Huan *et al.* 2003). These floods result in many tangible and intangible costs. The tangible costs include direct damage to infrastructure and disruption to commercial, residential and agricultural activity while the intangible costs consist of indirect damages such as human loss, ill health, inconvenience and loss of cultural significance (Gupta *et al.* nd). There were 407 deaths, and property loss of around VND 2,284 billion (USD 147 million) in the 1994 flood, 217 deaths and property loss of VND 2,182 billion (USD 141 million) in the 1996 flood, and 453 deaths and property loss of VND 4,000 billion (USD 258 million) in the 2000 flood (Tien *et al.* 2001: 28-29 and MRC 1999). Significantly, the 1997 flood took the lives of many children, with the overall death toll reaching 607 (MRC 1999, Figure 2). In addition to the human loss, 173,606 houses were destroyed by the flood in 1997 (MRC 1999). The flood also caused the loss of 19,785 ha of rice, while 251,341 ha of rice were affected by decreased yields (MRC 1999). It is estimated that the 1997 flood damage amounted to 6,996 VND billion (MRC 1999 and Figure 2). These costs are a burden for both the government and the local people of the Mekong Delta region.

Figure2: Number of deaths and areas of crop damage by flood in the Mekong Delta through the year



Source: MRC, 2002. Freshwater Aquaculture in the Lower Mekong Basin, Technical Paper No. 7, Phnom Penh, Cambodia

Additionally, with 700 km of coastline, the MRD will be most vulnerable to sea level rise due to climate change. Wassmann *et al.* (2004) estimated that 2.3 million ha (60 % of the MRD) was high vulnerable while 0.6 million ha (15%) and 1 million ha (25%) was medium and low vulnerable due to sea level rise. The ADB (1994) concluded that 1.5 to 2 million ha in the MRD would be at higher risk of high tidal threat. Wassamann *et al.* (2004) concluded that these adverse impacts could affect all three rice cropping seasons in the delta. It is predicted that in the next century, with a sea level rise of one meter, about 10.5 per cent of Vietnam's population or about 20 million people will be displaced (Dasgupta *et*

al. 2006). The majority of the affected population is in the MRD and the Red River Delta. Livelihood of the local people will be negatively impacted. About 35 per cent of the GDP will be disappeared by sea level rise. As a result, the nation's economy will be under threat.

Despite these inevitable costs, existing floods in the Mekong Delta have also traditionally been known to bring benefits which contribute significantly to sustainable agriculture development in the region. Firstly, the 'beautiful' floods provide natural freshwater fish, other aquatic animals and aquatic vegetables for improving local food security and livelihoods. It is estimated that the average fish capture in the Delta is about 500 kg per household per year, which provides significant protein source for local people (Trong and Binh 2004, MRC 2002: 9). Secondly, floods deposit 150 million tones of sediment on paddy fields every flood season which are natural fertilizer (Tien *et al.* 2001). This helps to replenish the soil and maintain soil fertility for rice cultivation. Evidence shows that after every flood season, local rice farmers not only gain higher yields but also use less fertilizer because of the nutrient sediment (Nga 1999, Anh *et al.* 2002, Tien *et al.* 2001). In addition to these direct benefits, floods have important biological functions; for example, floods help to recharge groundwater, clean farm residuals, and maintain biodiversity improve the navigation transport, flush contaminated water caused by sulphate soils, transport salted water towards the South China Sea (Gren *et al.* 1995: 335, WWF 2004: 3 and Cuny 1991: 333 and Ninh 2007).

Experiencing with the severe flood in 1996 and 2000, government have been released a series of important policies to adapt flooding. Those policies are called "Living with the flood". At central government level, the Disaster Management Action Plan includes two main programs. Firstly, the irrigation and transportation development and construction of residential clusters in the Mekong Delta (Decision No. 99/TTg) which built residential clusters along dykes or roads aimed that no more evacuation is needed. In fact, by the end of 2002, nearly VND500 billion was spent to build 230 residential clusters in seven flooded provinces, which are planned to be home of about 39,000 households (Tinh and Hang 2003). Moreover, 142 clusters have been completed with more than 31,000 households having registered to move in (Tinh and Hang 2003). Secondly, loan program for poor households to heighten housing foundations and build houses on stilts to mitigate the impact of floods (Decision No. 256/TTg). In addition to this, enhancing flood release capacity of river systems and shifting crop calendar were contributed significantly to the reduction of flood costs. As a result, 29 large canals have been built in An Giang and Kien Giang provinces in the 1990s which were effective for flood release during the big flood in 2000, 2001 and 2002. Shifting of cropping calendar allows rice farmers to harvest the summer-autumn crop completely before the floods coming in August which can avoid the rice damage due to flooding.

More importantly, Local governments have been used several approaches to exploit the potentially natural benefits of flood for improving local livelihoods. By facilitating local people carrying out both non-farm and farm activities in the flooded areas, their flood-based incomes have increased significantly during the flood season. By investigating the government policy reports, reviewing previous studies and carrying out several in-depth

interviews with local officials and dwellers using a case study in An Giang province, this paper argues that there are significant social and economic benefits from flood-based livelihoods. In the following paragraphs, the background information on study site, research methods, results and discussions and conclusions will be presented.

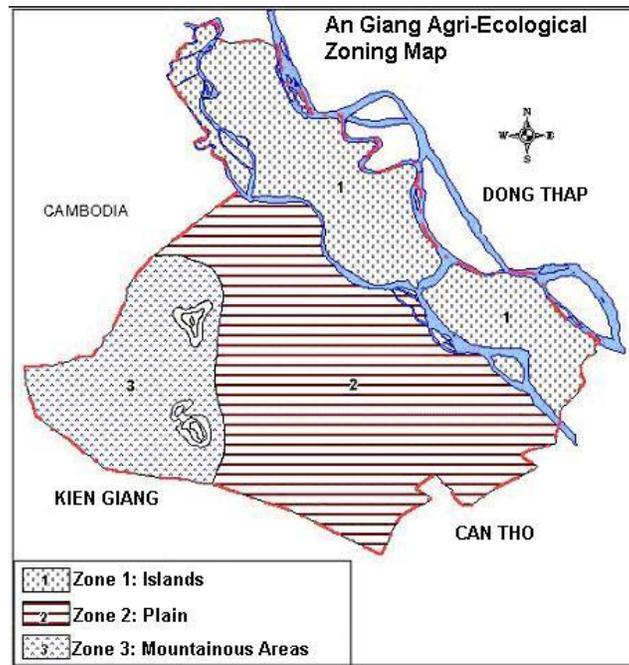
2. A case study in An Giang Province

An Giang province was selected as a case study because it is located in a flood-prone area of the Mekong Delta and represents a variety of living with the flood approaches: building residential clusters/dykes, raising house foundation and exploiting the natural benefits of flood using flood-based livelihoods. The province has total 340,623 ha of natural land, of which agricultural land accounts for 262,986 ha, forest land comprises 18,165 ha and the remainders are residential and public lands. The province's population reaches to 2 million people including 454 thousand households (An Giang Department of Statistics 2005). Of those, there were 53,700 poor households which accounted for 12.15 per cent of the province's total households.

An Giang province has a total of eleven districts and towns, divided into three agro-ecological zones: Island districts (Zone 1), Plains (Zone 2) and Mountainous areas (Zone 3) (Figure 2). Of these, the first two Zones are often inundated for four to six months of the year, while the mountainous zone is unaffected by floods. Within flood-prone areas of the province, Zone 2 comprises a high proportion of land areas (five out of eleven districts) and represents the most flood-prone areas of the Delta. However, flooding in zone 1 has been being controlled by high dyke systems which can regulate floodwater levels.

Since 2002, the government of An Giang province has released several policies to encourage local people to exploit the natural benefits of floods as well as to adapt to live with the floods. Significantly, the 31st project was initiative to assist local people to exploit flood-based livelihoods in 2002. There are three main flood-based approaches. In agriculture, five farming practices were implemented in the flood 2002-2003 consisting of growing the third rice and vegetables in the high dyke system area, cultivating rice in upland areas, and floating rice in deepest flood areas. Moreover, five flood-based aquaculture activities were cultured by local people including raising fish in small net cages for supplying domestic market, culturing freshwater prawn in paddy fields along the Mekong River using net fences, growing black fish in the net blankets along the small ditches and canals as well as raising catfish in ponds (An Giang Department of Agriculture and Rural Development-AGDARD 2005). More importantly, several flood-based services were employed an enormous local labour. Those activities include processing dried and fermented fish, embroidery, making fish-hook, making boats, weaving, and golden snail collections for selling to prawn and fish farmers, transport land for raising house foundation, collecting water hyacinth for making handicraft, fishery capture, grass collection for cow and beef farmers (AGDARD 2005).

Figure 2: **The agro-ecological zoning map of An Giang Province**



Source: **An Giang Department of Land Management (2000)**

3. Research Methods

This paper examined the economic and social benefits of flood-based non farm and farm livelihoods being employed by local people using content analysis of previous surveys of flood-based farming, in-depth interviews with local people about their flood-based livelihood strategies and analyzing the secondary data from government reports for several years after the 31st Project was implemented by the province. The economic values of flood-based crops and aquaculture were measured using farm gate price for outputs and the wholesale market price for inputs in the year 2005 while economic and social benefits of flood-based services were measured by number of jobs created and its financial gains using market price approach from those activities.

Several in-depth interviews were carried out in the project area to obtain the information about local livelihood strategies in the flooded areas. Using 'how', 'when', 'why' and 'who' questions to identify the way that local farmers adapt to live with the floods and to adopt new farming and non-farming practices. The respondents are key informants whose livelihoods based on both non-farm and farm practice during the flood season. Using the triangles approach was to check the validity of information by integrating different stockholder's opinions. Those included communal, district and provincial officials who are responsible for running the flood-based livelihood program in the province. Several case studies were selected consisting of typical farmers (fresh water prawn, eels, snake head fish, Neptunia farmers, golden snail and water hyacinth collectors, project managers in the province, districts and communes).

Besides the above information sources, several government reports were used support the evidence that the flood-based livelihoods have contributed significantly to the agricultural economy and poverty reduction in province. Secondary information about types, amount, and labour involvement in flood based farming and services were obtained from communal, district and provincial reports from the flood 2002 to the flood 2006.

4. Results and discussions

4.1. The benefits of living with flood program

An Giang province has implemented four main programs to assist the poor people in the flood prone areas to lived with flood since 1996. These policies have contributed significantly to local poor people in the flood prone areas. In particular, they became more safety to live with the flood (Box 1, 2 and 3).

Box 1: Building residential clusters/dykes in An Giang province

During 1996 and 2000, An Giang Province has built 89 concentrated residential clusters with a total area of 234 ha, sufficient for 14,234 housing foundations. It provided stable accommodation for 8,256 households that were relocated, equivalent to 56 per cent of the constructed housing foundations of the province.

As for the concentrated residential dykes, from 1996 to 2000, 54 dykes were constructed along 132 km, with an area of 132 hectares sufficient for housing foundations for 12,510 households. There were 8,631 households settled, accounting for 69 per cent of foundations (RD No. 64).

Box 2: Raising housing foundation program in An Giang province

In order to assist poor farmers in coping with floods, on 24 April, 1996 the Prime Minister issued Decision No. 256/TTg, facilitating loans to poor households for raising housing foundations or building houses on stilts. The Bank for Agricultural and Rural Development was responsible for the disbursement of this fund. In An Giang Province alone, 97,085 households received a loan to build housing foundations (approximately 67.6 per cent of total households in need). The total disbursed amount was VND 464,832 billion (USD 30 billion). On average, each household borrowed around VND 4.79 million (USD 316). The loan was subject to preferential interest rate applied for hunger eradication and poverty alleviation (the rate varied depending on the timing of loan disbursement) (Huan et al. 2003)

Box 3: Provincial policies for living with flood and poverty reduction

During the last three years from 2002 to 2004, An Giang province has released several policies to assist poor people to do farming activities during the flood season. In particular, 5,535 small boats were given to 5,323 poor households which cost about 4.9 VND billion. This helped them to improve their income by fishing during the flood season. Moreover, the social policy bank of Vietnam has provided a low interest loan to 5,399 poor households with 20.6 VND billion to facilitate them doing farming activities. Interestingly, during 2002 and 2004, the provincial Department of Agriculture, Labour and Local Associations provided 410 technical training classes for 11,627 trainees from poor households. (AGDARD 2005)

4.2. Flood-based farming activities and services and its gross output in An Giang province

The amount of flood-based farming has increased significantly during 2002 and 2005 (Box 4 and 5). Starting at the flood 2002 with 10 flood-based activities, there were 18 in 2005 (Box 4). In agriculture, the area of the third crop has increased gradually since 2002. There were 94,000 ha of the third crop in 2005 which increased by 2.3 times compared to that of 2002. Of those, area of the third rice crop accounted for 83,400 ha which increased by more than two times since 2002. The third vegetable crop comprised 9,400 ha which was more than twice compared to that of in 2002. In aquaculture, the area and number of flood-based aquaculture farming have increased significantly. The gross output has increased from 35,000 tones to 62,000 tones in 2002 and 2005 respectively.

Box 4: Flood-based agriculture in An Giang province in 2005

- Growing 83,411 ha of a third rice crop in the flood season
- Growing 7,024 ha of a rainfed rice crop in Tinh Bien and Tri Ton districts
- Growing 194 ha of floating rice crop in deepest floodwater areas of Tri Ton and Chau Phu districts
- Growing 9,358 ha of the third vegetables crop
- Growing 67 ha of water spinach, with 299 households participated, created 639 jobs, and gained net benefit of 6-10 VND million /ha
- Growing 121 ha of Neptunia, with 299 households participated, created 955 jobs, and gained a net benefit of 10-12 VND million/ha
- Growing 79 ha of lotus, with 299 households participated, created 456 jobs, and gained a net benefit of 18-20 VND million/ha
- Growing *Dien dien* (*Sesbania aculata*), 56 ha, 1,700 poor people, 15,000 – 20,000/person/day
- Growing 35 ha mushrooms, with 256 households participated, created 1,060 jobs

Source: An Giang Department of Agriculture and Rural Development (ADARD), 2002 - 2005. *Một số mô hình canh tác trong mùa lũ trên địa bàn tỉnh An Giang (Some farming activities during flooding season in An Giang province)*, Annual Report, An Giang province, Vietnam.

Box 5: Flood-based aquaculture in An Giang Province in 2005

- Fish culturing in small cages: 894 cages, 565 households, created 1,445 jobs
- Fish culturing in the blankets: 1,173 blankets, 1,162 households, created 2,100 jobs
- Fresh water prawn culturing in net fences on paddy fields, 675 ha, 793 households, created 1350 jobs
- Fresh water prawn culturing in net fences along the Mekong delta, 23 ha, 66 households, created 102 jobs
- Fish culturing in ponds: 1,198 ha, 6,476 households, 9,961 jobs
- Eel farming in plastic boxes: 23,437 m², 1,578 households, 4,278
- Thailand frog rearing: 1,054 m², 62 households, 123 jobs

The economic benefit of flood-based farming has contributed significantly to agriculture's economy. The gross output (GO) of flood-based farming was 1,070 VND billion which accounted for 14.8 per cent of total agriculture's output in the flood 2002. The development of flood-based farming has increased gradually since then and reached to 1,683 VND million which comprised 18.2 per cent of total agriculture output in 2005. Compared to the GO of two main agricultural crops in the non-flooded season, the economic value of flood-based farming made up about 20 per cent from 2002 to 2005 which were extremely important for local livelihoods. The GO value of agriculture for the whole year, two main crops and of flood season was presented in Table 1.

Table 1: The gross output and added value of agriculture during flood season and the whole year

No	Indicators	Unit	Years			
			2002	2003	2004	2005
1	GO (gross output), at constant 1994 price –whole year	VND Bil.	7,392	7,982	8,699	9,216
2	GO at constant 1994 price – two main crops	VND Bil.	6,314	6,625	7,041	
3	GO-flood season	VND Bil.	1,070	1,384	1,561	1,683
4	Percentage of GO of flood season compared to whole year	%	14.48	17.35	17.95	18.27

Sources: An Giang Department of Agriculture and Rural Development (2005)

4.3. Economic and social benefits of each flood-based farming practice

Seven flood-based farming were investigated its social and economic benefit. Those farming practices consist of fresh water prawn culturing in the net fences on paddy field and along the Mekong delta, snake head fish, eel culturing, water-caltrop, neptunia and lotus growing. The economic and social benefits of those will be presented in the following sections.

4.3.1. Flood-based freshwater prawn (*macrobrachium rosenbergii*) farming in net fences on paddy fields

Freshwater prawn farming is a new farm activity that was first introduced by local farmers in 2001 following Decision 170/2001/QD.UB of the An Giang People's Committee which proposed a range of incentives for farmers wishing to invest in freshwater prawn farming during the flood season. The main issue of the policy was to provide loan with a low interest rate for prawn farmers. This policy resulted in local farmers in Thoai Son and Chau Phu districts changing their production from three rice crops per year to two rice crops supplemented by freshwater prawn farming during the six month flood season. Interestingly, the land area used for prawn farming has increased rapidly reaching to 675 ha in 2005 as it has generated significant additional incomes for local farmers and created jobs for many poor people. It was reported that the area of water surface for culturing prawn was increased from 235 ha to 587 ha in 2001 and 2002 respectively.

According to Ha et al. (2005) prawn farming earned 22 million VND per ha with the market price of prawn in November 2005, more than twice the income earned from rice farming per ha, and created four full-time jobs per ha for the six month duration. However, the B/C of this module is still low because of its high input cost (28-44 VND million per ha) (Table 2).

Table 2: The economic value of freshwater prawn farming in Phu Thuan commune, Thoai Son district, An Giang Province

Parameters	Unit	Values	SD
- Total costs	(1000 VND/ha)	44,330	28,193
- Total benefits	(1000 VND/ha)	66,325	40,192
- Net benefits	(1000 VND/ha)	22,022	36,106
- B/C		0.5	1.84

Source: Ha, V. V., Tuan, V. V., Son, L. R., Thanh, V. D. and Thanh, D. N., 2004. Fresh water prawn culturing in Thoai Son district, An Giang province, research report, Cantho University.

Interestingly, poor local farmers who did not engage in prawn farming can benefit from a variety of support activities. The collection of golden snails for prawn feed generates additional jobs for the farming community. As can be seen that one collector can earn 25,000 VND per day in an activity that not only generates income but protects rice from crop damage. In 2003, golden snail collection employed 170 people and supplied feed for 322 ha of prawn farms (AGDAR 2003).

4.3.2. Combination of freshwater prawn farming and *Neptunia-oleraceae* cultivation in net fences along the Mekong River

In addition to the significant benefits of paddy field prawn farming, local farmers also farm prawns in net cages along the Mekong River. Upstream floodwaters from Cambodia and Lao provide farmers with a good water source for the freshwater prawns. Farmers in Chau Thanh district began farming prawns in the flood 2001, and the area used for prawn farming has rapidly increased in recent years. In 2003, 46 ha were being used by 97 households to farm prawns (AGDARD 2003), generating incomes of around six million VND per ha. This was complemented by *Neptunia-oleraceae* cultivation, which earned around eight million VND per ha. The economic value of both freshwater prawn and *Neptunia-oleraceae* farming is detailed in Table 3.

Table 3: The Economic benefits of both prawn farming and *neptunia-oleraceae* cultivation in Chau Thanh district, An Giang Province, 2004

Parameters	Prawn farming (1000 VND per ha)	<i>Neptunia-oleraceae</i> growing (1000 VND per ha)
- Total costs		56,550
- Total benefits	54,690	8,070
- Net benefits		6,210
- B/C		1,14

Source: Xuan, N. T. T., Lenh, L. V., Quang, N. N. and Thanh, V. N., 2004. Fresh water prawn culturing in the net fences along the Mekong River in An Giang province, research report, An Giang university, Vietnam

4.3.3. Snake-head fish farming

Caged fish farming can be another source of income for poor households during the flood season. This activity requires little capital but generates many benefits for poor and landless households. Fish farming was conducted along internal canals and fish ponds (pers. comm. Trung 2006). Farmers used the natural products captured from the inundated paddy fields such as golden snail, small prawn and fish for feeding the snake head fish. A household can earn net benefit around 2-4 million VND by raising fish in a 10 m²-cage. With the market price in 2005, the net benefits from this type of fish farming are shown in Table 4.

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Table 4: Snake-head fish farming in Tan Chau district – An Giang province, 2004

Parameters	Unit (thousand VND per m ²)
- Total costs	564.3
- Total benefits	593.5
- Net benefits	29.2

Source: Nam, C. Q., Thuy, N. T., Thu, T. P., Phat, T., Hai, P. T. and Thanh, D. N., 2004. Snake head fish culturing in the flood season in An Giang province, research report, Cantho university, Vietnam.

4.3.4. Eel culturing

Eel farming is another profitable farming activity for the flood season which is growing in popularity. Wild eel breeds are trapped in the paddy fields and are then raised in back yards. The sale of the matured eels generates income and creates home-based employment. It is estimated that a 12 m² cage earns a household a net income of one VND million. A case study of social and economic benefits of eel farming is presented in Box 6.

Box 6: Social and economic benefits of eel farming in Chau Thanh district, An Giang Province

Mr Huynh Van Phuc, a 60-year old farmer, living in Vinh Binh Commune of Chau Thanh district, who has been farming eels for 5 years, concluded that culturing eels help him to improve income during the flood season as well as escape poverty. Mr Phuc raises eels in the plastic boxes of 40 m² using the local natural eel breeds and feed from the floodplains. The main feeds for eels are golden snails and small fish which can be collected from floodplains using home-based labour. He said that with 40 m² of a plastic box, he can gain a net benefit of 7 VND million in a five-month farming time after subtracting the total cost of 3 VND million. This is a suitable flood-based farming practice for the poor, which requires little capital investment. According to Mr Phuc, this module provides him job opportunities and additional income during the flood season. Additionally, this farming practice generates job opportunities for his neighbors, for example, other poor people can collect golden snails for selling to him. Since growing eels, his family is no longer in debt. More importantly, he can hire more lands for farming rice. Mr Phuc reported that more than 30 households are culturing eels in this hamlet now.

Source: Pers. comm. Mr Phuc in Vinh Binh Village (August, 2005)

4.3.5. Flooding water-caltrops cultivation (*Cu au*)

Flooding water caltrops, is suitable for medium flood prone areas, and is grown after summer rice season for six months during the flood season. This model can generate twice the net income of the summer rice season, returning about 10-12 VND million per ha with the market price of rice in 2004 (ADARD 2004). It has become increasingly popular since its introduction in 2002. In this activity, farmers can grow the *water-caltrops* in their spare time of flooding and then create jobs for local labour during three months - harvest season. The product is then sold in both the domestic and export markets. The caltrops are grown primarily in and Chau Thanh district, and is a profitable and sustainable farm product for local people.

4.3.6. Lotus growing

Lotus is another profitable crop for farmers, returning about 10 million VND per ha, twice the return to rice farming. Lotus is suitable for low flood prone areas in An Giang province such as Thoai Son, Chau Phu and Chau Thanh. This may also be applicable to medium flood prone areas. The area of lotus growing is increased significantly. The net benefit of each ha was 10 VND million which was more than that of one ha of rice in 2004. The economic value of lotus is illustrated in Table 5.

Table 5: The economic value of lotus in Thoai Son district, An Giang province, 2004

Parameters	Unit (1000 VND per ha)
- Total costs	6,886
- Total benefits	17,100
- Net benefits	10,214
- B/C	1.48

Source: Ha, V. V., Thanh, D. N., Duyen, T. T. M., Cuong, H. T. K., Tuyen, T. T. N. and Huy, Q. N., 2004. Growing lotus and neptunia in the flood season in An Giang province, research report, Cantho University, Vietnam

4.3.7. Naptunia Oleraceae cultivation (*rau nhut*)

Farmers grow this fresh vegetable which is then sold in the local market. This species is suitable for medium flood prone areas and can be cultivated by small households with limited land area. A farmer can earn around four 450,000 VND per 100 m² during the flood season. The economic valuation of Naptunia oleraceae is shown in Table 6.

Table 6: The economic valuation of *Naptunia oleraceae* cultivation in Chau Phu and Phu Tan districts, An Giang province, 2004

Parameters	Chau Phu district (1000 VND per ha)	Phu Tan district (1000 VND per ha)
- Total costs	6,041	4,853
- Total benefits	9,475	9,338
- Net benefits	3,434	4,485
- B/C	0.57	0.92

Source: Ha, V. V., Thanh, D. N., Duyen, T. T. M., Cuong, H. T. K., Tuyen, T. T. N. and Huy, Q. N., 2004. Growing lotus and neptunia in the flood season in An Giang province, research report, Cantho University, Vietnam

4.3.8. Mushroom growing

Utilising the spare lands, local farmers have grown mushrooms during the flood season. Poor farmers collected rice straws from the summer-rice crop for producing mushroom. One mushroom crop took around three weeks which provided many jobs for poor jobless people. This task required little capital investment which is highly suitable to small scale farmers. The economic benefit of mushroom producing was estimated that if one farmer grows 100 m in lengths of rice straws, they may earn about 685,000 VND which is as much as the net benefit of a 1000 m² rice crop in the summer season. Therefore, mushroom growing not only generates many jobs but also provide additional income for local people which there were not been in the previous floods.

4.4. Social benefits of flood-based services

During 2002 and 2005, there have been hundred thousand of jobs crested by the 31th project or ‘living with flood’ policy (Table 7). Starting at 95,692 jobs created by the flood 2002, this figure has increased significantly since then. Interestingly, the flood in 2005 generated 406, 937 jobs to local people that was four times higher than that of the flood in 2002. It can be concluded that floods are the livelihoods of the poor. In the following paragraphs, the social benefits of each service will be presented.

Table 7: Social benefits of flood-based farming and services

No	Flood-based activities	2002	2003	2004	2005
1	Agriculture	79.117	136.770	327.057	340.578
2	Aquaculture	5.909	8.627	17.287	19.359
3	Flood-based services	10.666	33.832	18.597	47.000
Total		95.692	179.229	362.941	406.937

Source: An Giang Department of Agriculture and Rural Development (ADARD), 2002 - 2005. *Một số mô hình canh tác trong mùa lũ trên địa bàn tỉnh An Giang (Some farming activities during flooding season in An Giang province)*, Annual Report, An Giang province, Vietnam

4.4.1. Flooding water hyacinth harvesting for handicrafts (*Lucbinh*)

One of the most interesting activities of the flood season is harvesting *lucbinh* (*flooding water hyacinth*) for use in handicrafts. Each year, flooding brings an enormous amount of *lucbinh* and it collects in the fields. Local farmers, especially women, spend their free time picking *lucbinh* stems for use in handicrafts such as woven bags and vases which are sold domestically and exported to Japan. Harvesters can earn about 15,000 – 25,000 VND per day picking *lucbinh* and the harvest creates 1,200 jobs in the flood 2005 (AGDARD 2005).

4.4.2. Golden snail collection

Poor farmers collect golden snails in the flooded fields for supply to prawn farmers. It is estimated that one person may earn 25,000 VND per day collecting snails (ADARD 2004). This source of income not only helps the poor to improve their livelihoods but also reduces the crop damage by the snails in the next rice season. Interestingly, this activity may result in a reduction in water pollution due to pesticide killing golden snails in current farming practice. In the flood 2005, there were 4,025 poor people involving this activity.

4.4.3. Fishery capture

When the flood comes local people prepare nets, fish traps for capturing wild fish from the Mekong River as well as in the floodplains. This activity often lasts for six months of flooding. Each fisherman can earn from 20,000 to 40,000 VND per day which help them to live friendly with the flood (AGDARD 2005). This is an important income source for the poor. In the flood 2005, there were 12,000 fishermen engaging fishery capture in An Giang province. Farmers believe that they will lose their livelihood if there were no floods as well as small floods.

4.4.4. Wild grass collection for cattle growers and soil transportation service during

the flood

Besides the above services, poor and landless farmers can take the full advantages of flood by collecting wild grass and selling them to cattle growers in the village. This activity also provides an average of 300 jobs during the flood season. Each collector can gain 20,000 – 25,000 VND/day which help them to buy rice and other necessity. In addition to this significant benefit, each person can earn from 30,000 to 50,000 VND per day by transporting soil for raising house foundation. This service created 1,424 jobs for the poor people in the whole province.

4.4.5. Other flood-based services

In addition to the direct benefits of flooding, those indirect benefits are considerable too. These supported services include processing of dried and fermented fish, weaving and embroidery, hook, broom and boat making, plait and carpet weaving. Each person can earn from 300,000 to 600,000 VND per month during six months of flooding (Table 8).

Table 8: **The social and economic benefits of flood-based services**

No	Flood-based services	Jobs	Average income
1	Processing dried and fermented fish	460	450,000 – 600,000 VND/month
2	Weaving and embroidery	3,370	300,000 – 600,000 VND/month
3	Hook making	2,057	300,000 – 450,000 VND/month
4	Boat making	2,243	600,000 – 1,200,000 VND/month
5	Plait, weaving	5,572	300,000 – 450,000 VND/month
6	Broom making	385	300,000 – 450,000 VND/month
7	Carpet weaving	996	300,000 – 450,000 VND/month

Source: An Giang Department of Agriculture and Rural Development (ADARD), 2002 - 2005. *Một số mô hình canh tác trong mùa lũ trên địa bàn tỉnh An Giang (Some farming activities during flooding season in An Giang province)*, Annual Report, An Giang province, Vietnam

Conclusions

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Flood-based farming and services have contributed significantly to rural agricultural economy of the province. In particular, there were a variety of flood-based farming approaches which can be exploited the natural benefits of the Mekong Delta's floods. Those farming practices are likely to be new to local people, but they are so important to local livelihood. Farmers can earn much more than rice growing if they culture fresh water prawn and snake head fish, grow lotus, Neptunia and water-caltrops using flood-based approaches. However, prawn farming required a higher capital investment than that of snake head fish and eel farming. More importantly, several flood-based farming practices are suitable to the poor such as growing aquatic vegetables during the flood season. Landless and poor farmers otherwise can benefit for several flood-based services for their livelihoods from the flood season. They may become poorer if there is no flood. Those farming and services generate an enormous number of jobs to solve the jobless problems and to escape poverty in the rural flooded areas of the Mekong delta.

It is recommended that the government should pay more attention to sustainable flood-based livelihoods if the floods will be eventually due to climate change and a rise in sea level. Their flood-based farming and services may be under the threat; if there will be more big floods. Therefore, an in-depth study about the nature of Mekong delta's floods, and flood-based livelihood approaches should be carried out to put this issue into policy making process for the future living with flood policy under different climate change scenarios.

Although a part of financial and economic benefits of floods can be measured in this study, a further study to calculate the full benefit of natural Mekong delta's floods should be implemented urgently. Those are non-market benefits of floods as it presents functions of soil replenishment, water purification, biodiversity and flood-based cultural values of the region. At the same time, a study about non-market benefits of dyke and residential cluster policies would be conducted to assess the impact of living with the flood policy in the Mekong River Delta.

References

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- ADB (Asian Development Bank): 1994, *Climate Change in Asia: Vietnam Country Report*, Regional Study on Global Environmental Issues, Manila.
- An Giang Department of Agriculture and Rural Development (ADARD), 2002 - 2005. Một số mô hình canh tác trong mùa nước lũ trên địa bàn tỉnh An Giang (Some farming activities during flooding season in An Giang province), Annual Report, An Giang province, Vietnam.
- An Giang Department of Land Management (AGDLM), 2000. An Giang flooded and agricultural zoning maps, An Giang province, Vietnam.
- An Giang Department of Statistics, 2005. Statistical Year Book 2005, An Giang province, Vietnam.
- Anh, V. T., Kien, V. N., Nha, D. V., Son, T. N., Duyen, N. P., Phu, X. P. and Duc, N. H., 2002. Nghiên cứu sự tương quan giữa phù sa, dinh dưỡng đất và năng suất lúa khu vực Bắc Vàm Nao tỉnh An Giang (Study on the correlation between sedimentation, soil nutrients and rice yields, North Vam Nao of An Giang province), An Giang University, An Giang province, Vietnam.
- Cuny, F. C., 1991. 'Living with Floods: alternatives for riverine flood mitigation', *Land Use Policy* (8): 331 – 337.
- Dasgupta, S., Laplante, B., Meisner, C., Wheeler, D. and Yan, J., 2006. 'The impact of sea level rise on developing countries : a comparative analysis', World Bank, <http://econ.worldbank.org>.
- General Statistics Office of Vietnam (GSOV), 2003-2004. 'Administrative units, land and climate' http://www.gso.gov.vn/default_en.aspx?tabid=465&idmid=2&ItemID=1927 (15/4/2006).
- Gren, I. M, Groth, K. H. and Sylven, M., 1995. 'Economic Value of Danube Floodplains', *Journal of Environmental Management* (45): 333-345.
- Ha, V. V., Thanh, D. N., Duyen, T. T. M., Cuong, H. T. K., Tuyen, T. T. N. and Huy, Q. N., 2004. Growing lotus and neptunia in the flood season in An Giang province, research report, Cantho University, Vietnam
- Ha, V. V., Tuan, V. V., Son, L. R., Thanh, V. D. and Thanh, D. N., 2004. Fresh water prawn culturing in Thoai Son district, An Giang province, research report, Cantho University.
- Hori, H., 2000. *The Mekong: environmental and development*, The United Nations University, Tokyo, Japan.
- Huan, D. N., Robson, R. and George, E. T., 2003. Residential clusters in An Giang, Dong Thap and Long An provinces of the Mekong Delta, Adam Fforde and Associate Pty Ltd.
- Mekong River Commission (MRC), 1999. 'Flood management and mitigation measure in the Mekong River basin', <http://www.fao.org/docrep/004/ac146e/AC146E00.htm> (20/10/2005).
- MRC, 2002. *Freshwater Aquaculture in the Lower Mekong Basin*, Technical Paper No. 7, Phnom Penh, Cambodia.
- Nam, C. Q., Thuy, N. T., Thu, T. P., Phat, T., Hai, P. T. and Thanh, D. N., 2004. Snake head fish culturing in the flood season in An Giang province, research report, Cantho university, Vietnam.

- Nga, T. T., 1999. Ảnh hưởng của phù sa lên năng suất lúa và sinh vật thủy sinh trên bãi bồi An Giang, vùng sông Cửu Long, Việt Nam (The effect of soil sedimentation on rice yields and aquatic fauna and flora in An Giang province, Mekong Delta, Vietnam), Cantho University, Cantho Province, Vietnam.
- Ninh, N. H., 2007. *Flooding in the Mekong delta, Vietnam*. Occasional paper in fighting climate change, Human Development Report Office.
- Sub-Institute of Water Resources Research 2003. *Proposal on Scientific Solutions to Development of Dykes for the Sake of Sustainable Development in the Mekong River Delta (Nghiên cứu đề xuất các Giải pháp Khoa học Công nghệ xây dựng hệ thống đê bao, bảo vệ và phát triển bền vững đồng bằng sông Cửu Long)*, Ministry of Science and Technology, 2003.
- Thanh, D. N., Nam, Q. C., Thuy, T. N., Thu, T. P., Phat, T. and Hai, P. T., 2005. Nghiên cứu các mô hình canh tác trong mùa lũ ở An Giang (Survey on some flood-based farming activities in An Giang province), An Giang and Can Tho universities, Vietnam.
- Tien, C. D., 2001. Vùng ngập lụt vùng sông Cửu Long: thực trạng và giải pháp (The prone-flood areas in the Mekong Delta of Vietnam: the situation and solution), HCM National University, HCM City, Vietnam.
- Ting, D. Q. and Hang, P. T., 2003. Living with floods in the Mekong River Delta of Vietnam, 3rd Water Forum: Poverty and Flood Theme, Ministry of Agriculture, UNDP, Vietnam.
- Trong, N.V. and Binh, L. T., 2004. Current Information on Inland Capture Fisheries in Vietnam, Country Status Report, Vietnam Ministry of Fisheries, Hanoi.
- Vietnam Economic News (VEN), 2006. 'How to boost Mekong Delta industrial development' http://www.ven.org.vn/view_news.php?id=6693 (22/3/2006).
- Vietnam Economic News (VEN), 2006. 'How to boost Mekong Delta industrial development' http://www.ven.org.vn/view_news.php?id=6693 (22/3/2006).
- Vietnamese Government (VNG), 2001. Decision No. 1548/QĐ-TTg on residential and dyke construction in flood-prone areas of the Mekong Delta, Hanoi, Vietnam.
- Wassmann, R., Hien, X. N., Hoanh, T. C. and Tuong, T. P., 2004. 'Sea level rise affecting the Vietnamese Mekong Delta: Water elevation in the flood season and implications for rice production', *Climate Change* (66): 89-107.
- World Wildlife Fund (WWF), 2004. 'Living with floods: achieving ecologically sustainable flood management in Europe' <http://assets.panda.org/downloads/livingwithfloodswwfpolicybriefingfinal.pdf> (15/2/2006).
- Xuan, N. T. T., Lenh, L. V., Quang, N. N. and Thanh, V. N., 2004. Fresh water prawn culturing in the net fences along the Mekong river in An Giang province, research report, An Giang university, Vietnam.