

DIVERSIFICATION OF LIVELIHOOD IN COMMUNITIES AROUND TAM GIANG LAGOON

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1. Introduction

The Tam Giang (TG) lagoon, one of the biggest lagoon in Asia, is located in Thua Thien Hue province, Viet Nam, and covers about 22,000 ha with a length of 70 km along the coast. About 300,000 inhabitants have settled around the lagoon, in a total 236 villages from 31 communes, and mainly earn their livelihood by directly or indirectly exploiting natural resources in and around the lagoon. The natural resources of the lagoon are showing signs of stress mainly as a result of over-exploitation. In general, however, the geography is diverse as a natural system among the mountain, field, lagoon and sea which are close together. Therefore, livelihood in the location are various. For example, villagers who fish and do aquaculture can be farmers and fishers can fish in both the lagoon and sea. Several fishing gear are operated in the lagoon. In nice weather, some fishing gear such as gillnet and hook and line are also used to catch fish at sea. On the other hand, the communities living around TG lagoon can be categorized into two groups (1) the communities who are very poor and rely on a diversity of livelihoods (Quang Thai, Quang Loi, Phu Da, Vinh Ha) (2) The communities which are developing aquaculture as the main livelihood (Phu Tan, Vinh An, Vinh Hien). This report is focus on poor communities of which Quang Thai as an example

Box 1. Activities of the project Management of biological resources in Tam Giang Lagoon, Thua Thien Hue province, Viet Nam started phase I from 1994 -1996.

The phase II of this project continued in the period 1997- 2000 with general objective was helping improve livelihood opportunities for local communities through crop diversification and sustainable aquaculture development. Interdisciplinary and participatory methods were applied to natural resources management. The institutions directly involved in project implementation were: Hue University of Science (HUS), Hue University of Agriculture and Forestry (HUAF), Department of fisheries of Hue province (DoF) and local people in Phu Tan and Quang Thai communes.

Quang Thai (QT) commune is one of the two research sites of this project. It is in the northern section of Tam Giang lagoon. This commune is one of the poorest of 31 communes on the coastal lagoon in Hue province. The total population in Quang Thai is about 5100 people in 1100 households, of which 1024 engage in farming. The origin of the villagers is from Quang Tho and Quang Vinh communes. Seven family clans, whose names are VAN, Pham, Tran, Hoang, Ho, Le and Nguyen, settled there nearly 200 years ago. Formerly, the area was called *Cau ke, ke lac* by villagers living along Tam Giang lagoon, because this area was once deserted and abundant in Lac plant with little potential for rice production. With patience and industriousness, the first cultivators made great efforts to turn the primary area into fields and established the present farming and fishing-farming villages. Those first cultivators are worshipped by Quang Thai villagers. During the war period of 1954 to 1975, Quang Thai was abandoned and villagers only

returned after the liberation in 1975. After the war, they had to make great efforts to re-cultivate abandoned fields and repair the damages of war.

The Quang Thai, the geography is diverse, including: upper sandy lands for reforestation and agroforestry activities. Dryland and wetland for agricultural and aquaculture activities. Water areas of lagoon for aquaculture and aquatic exploitation. However, the land is not favourable for agriculture production: the soil is poor in humus and nitrites, sandy and alum contaminated with a poorly developed irrigation system.

The severe climate of Hue province in general and Coastal area in particular causes many difficulties for local villagers: In the rainy season, floods, submersion and strong tidal currents impact on rice fields and cause intrusion; and, in the dry season, water is insufficient for farming production and household needs. The water table is mostly alum contaminated affecting villagers health and life. In general, Quang Thai condition was favourable for livelihood diversification.

Box 2. Phu Tan commune is one of two research site of Tam Giang project in phase II. In this commune an aquaculture boom developed since 1994 and their livelihoods have affected by urbanization of Hue city. The ecological system has undergone many changes due to the economic development and the aquaculture production system compared to Quang Thai commune.

History of Trung Lang (TL) village. There are 6 villages in QT, of which 5 villages are mainly agricultural and one village, Trung Lang village, practices both agriculture and fishing in Tam Giang lagoon. This report focuses on understanding the livelihood diversification within TL village as a very poor community.

In 1905, Mr. Hoang Dinh Suong bought 1.1 ha of land, a low-lying field close to the lagoon, from the village of Lai Ha. This became a settlement area for 8 sampan and 4 farming households who did not own land. It become small hamlet though it was rather isolated from the neighbouring agricultural village. Over time, the hamlet grew with a purchase of 2.5 additional ha. Because this piece of land is located between the 2 villages, it called Trung Lang (middle Village). Initially there were 12 hhs of sampan group. Later on, agricultural people also came to Trung Lang, adding to the diversity of livelihoods practiced in the village. The population has grown, for example, in 1985 there were 105 households (hhs), 124 hhs in 1997, and 140 hhs in 2000 in Trung Lang with more than 680 people. After the typhoon of 1985, the Vietnamese government encouraged the settlement of sampan people in Trung Lang village. Between 1985 and 1989 many sampan people settled in the village under the settlement policy of the local government. There is 16 hhs to be living in boats on lagoon.

Community organization: There are 3 different production groups in Trung Lang village: Farming - fishing group; Mobile gear fishing group; and Fixed gear fishing group (Table 1). The farming-fishing group dominates the village with 78 hhs (62.9% total hhs). They mainly lived by agricultural production, but they fish the aquatic resources of the lagoon as they have free time after agricultural activities. Since 1995, under development strategies of Hue province this group developed aquaculture in Tam Giang lagoon.

Table 1. Basic situation of population of each groups in Trung Lang village.

Hh group	No. hhs	No. members	No. men	No. women	Total labour	No. female labour
Farming-fishing	78	411	182	309	207	109
Fixed gear fishers	20	123	61	62	72	45
Mobile gear fishers	26	153	57	96	66	33
Total:	124	687	300	467	345	187

Sources: Ha, 1997.

The Fixed gear fishing group, 20 hhs (16.1%), Fishing households who have inherited or can afford to buy a fish corral, pushnet, mussel rake, eel rake, or fish aggregating device (FAD) in Tam Giang lagoon. They have rights to fishing ground accorded by laws under the past feudal governments and local custom and still approved by the present government which has simply carried over the allocation. These fishers have generations of experience and their fishing ground are well situated where fish gather or pass through and where fish concentration are highest.

Finally, the Mobile gear fishing group is 26 hhs (20.9%). The poorest fishers who can only affords simple fishing gears such as gillnet, hook and line, pushnet, dragnet, pushnet, eel rake, and clam collecting. Mobile fishers have no fishing ground allocations and fish wherever they can. Livelihood of the mobile fishing group is difficult. Their education is the lowest. Their thoughts and awareness are limited, especially their awareness of natural resource protection. They have to earn living every day and think how to get many outputs. In addition, it is very difficult to gather them to inform/announce the threats of aquatic resources and local government's regulation on resource protection. They live separately; furthermore other groups look down on them. Through the initial statistics, the group had the most destructive fishing gears. However, after 1996 Tam Giang project and Fishing Department of Hue Province has support them to culture freshwater fish in fish cages in the lagoon.

Who controls resource management in poor communities around lagoon. In general, the Farming-fishing group's activities have greater impacts on the management of resources of the community because they occupied over 62% population of the village. They have owned the land or had land allocations for 20 years for agricultural production, but at the same time they still fished aquatic resources and undertook aquaculture in the lagoon areas. While the Fixed gear group and the Mobile gear groups main activities are to fish the aquatic resources and undertake aquaculture in the lagoon where the resources are of common ownership.

Because, in the integrated development of a coastal area, exploitation, protection and management of aquatic resources have a close relationship with agricultural production. Poor agricultural production has forced farmers to diversify income sources by fishing thus resulting in over-exploitation of lagoon resources. Increasingly more farmers engage in fishing activities such as freshwater macrophyte (plant) harvesting, electric fishing, pushnet and dragnet to improve their incomes. Therefore, changes in cropping patterns to improve the land productivity is important and critical to the management of the aquatic resources in Tam Giang lagoon. Moreover, regarding the social activities and the common ones of the community, the fixed gear group as well as mobile gear fishers are very limited. Only farming -fishing group participated in these activities.

2. Changing Livelihood in communities

Identifying the livelihood activities in the village and ranking each activity in terms of contribution to household income was carried out by the research team and local people in 2000 at Trung Lang village. The results of individual interviews and small group discussions in 15 households from three groups (Farming-fishing, Fixed gear and Mobile gear groups) is displayed in the Table 2.

Table 2: Livelihood activities and it rank in each group in the Trung Lang village

Livelihood activities	Farm-fish group		Fixed gear group		Mobil gear group	
	Before 1996	After 1996	Before 1996	After 1996	Before 1996	After 1996
1. Agriculture: Pig	x	xx	x	x		X
poultry		x		x		X
Rice	xxx	xxx		x		
Cash crops		xx		x		
2. Fishing: fish corral	x	x	xxx	xxx	xxx	xxx
Dragnet	x	x	x	x	xxx	xxx
Pushnet	xx	xx	xx	xx	xx	xxx
Gillnet	x	x	xx	x	xx	X
Collect clam	x	x	xx	x	xx	X
3. Macrophytes exploit	x	x	x	xx	x	xxx
4. Fish culture/fish cage		x	x	xxx		xxx
5. Other: Milling		x		x		
Small trading		x		x		X
Other (tailor, transportation)		x		x		X

Source: Field survey, 2000.

Notes: (xxx) Main income, (xx) contributing more income, (x) Contributing an extra income for households in this village.

The collected data in Table 2 shows that the activities providing subsistence needs for the family in the three groups are different. The important livelihood activities for the main income of Farming-fishing group is rice, peanut, pig, fish cage, poultry, pushnet and other activities as compared with only planting rice and sweet potato before 1996.

The main livelihood of Fixed-gear group is fish corral, fish cage, harvesting Macrophytes, and pushnet as compare with only fish corral before 1996. Some of them are renting agricultural land to plant rice, peanut, poultry, and other activities. Fixed gear fisher's life is relatively more stable because they have used fish corral traditionally for a long time, but also participated in agricultural production, they bid 5% of rice field from commune or hired farmer's rice field after 1996.

While, the main livelihood activities of Mobile gear group are fish corral, dragnet, fish cage, harvesting macrophytes, and pushnet as compare with only fish corral before 1996. They have

new activities for livelihood (fish cage, pig, poultry, and other jobs) following integrated production, through they have limited knowledge, after 1996.

On the other hand, after 1996 effects of economic development in general, and Tam Giang project in particular, the local people have had increased opportunities for livelihoods such as crop production(peanut, sugarcane), livestock, aquaculture (fish cage, fish pond), and other activities (mill, trade, and transportation) as integrated production in order to decrease risks for their livelihoods. Culture of fish in TG lagoon is a new livelihood option for all groups, including livelihood opportunities for poor groups as well. Changing options for livelihood relate to changing activities of hhs in different group as show in Table 3.

Table 3. Changing No. Households of difference group on production activity
(No. Households)

Production group	Total HHs		Agriculture		Aquaculture		Aquatic exploit		Other activities	
year	1998	2000	1998	2000	1998	2000	1998	2000	1998	2000
Total hhs	124	140	78	84	14	58	124	124	6	18
Farming-fishing	78	78	78	78	4	16	72	62	4	12
Fixed gear fishing	24	30	0	6	10	10	24	30	2	6
Mobile gear fishing	22	32	0	0	0	32	22	32	0	0

Source: Key informants, 2000.

It is very interesting in this community, the local people have had a diversification of production processes (creating new activities) in order to decrease risk of production and increase sustainable livelihoods. This is different in other communities which have completely changed from agriculture activities to aquaculture development as the main means to generate income like Phu Tan and Vinh Ha communes.

Box 3. In 1953, the Thuan An dike was broken by a storm. From a total of 200.5 ha in Dien Truong, Tan My, and Tan An, 99.1 ha of rice fields in the South of Thuan An road were submerged, damaged by salt water and abandoned. This increased the total water area surface for aquaculture from 610.3 to 709.4 ha in Phu Tan. Other way, the households engaging in farming has not increased much (from 98 to 115 hhs). The number of fishing hhs has increased almost 5 times from 1953-1994 and Phu Tan has changed a great deal: from 4 villages with a subsistence agriculture system to 6 villages with fishing system (Phap and Mien, 1996)

3. Changes in agriculture land use in communities around lagoon

During period from 1976-2000, policy changes of the government and technology development have had impacts on the communities. There was change of land use during three periods (table 4), which have effected sustainable livelihoods of this community as following:

- 1976- 1982: During this period resources were managed by cooperatives. The land areas and production plan belonged to cooperative. Most of agricultural land (dryland and wetland) was planted to local rice and sweet potato with low yield of crops and low efficiency of land use relate to rice species and lack of technology. Because production was most important there was poor management of natural resources. Livelihood of local people was based on exploitation of aquatic species in the lagoon.
- 1983-1987: During this period land was allocated to households and institutions. The land areas were allocated to households with the goal of attaining self-sufficiency in local consumption. The Dry land area was for improved rice, peanut, sugarcane, and other crop and was allocated to households for long term use, 20 years since 1983, following Decision No. 64 of government. However, most of land areas was still planted one or two rice/year, sweet potato. In both seasons of rice (spring rice and summer rice) farmers faced problems concerned with water shortage, pest infestation leading to low yield. The income of communities was still low in poor communities like Quang Thai, Quang Loi communes.

Table 4. Changes in land use from 1976 to 2000 in Trung Lang village (ha)

Land Use	1976	1986	1998	2000
DRY LAND	18.50	18.50	18.50	18.50
• Two rice	13.00	13.00	9.50	9.50
• Peanut	0.00	0.00	3.70	5.00
• Sugarcane	0.00	0.00	2.30	0.00
• Sweet potato	4.80	4.80	2.50	2.50
• Other crops	0.70	0.70	0.70	0.70
WETLAND	18.50	18.50	18.50	18.50
• One rice	16.00	16.00	14.00	14.00
• Abandon land	2.5 0	2.50	3.70	3.70
SETTLE LAND	2.75	3.72	4.15	4.15
LAGOON AREAS	3000.00	1000.00	995.00	995.00

Source: field survey, 2000

- 1988-1997 and 1998-2000: The period Doi moi of Viet Nam government. The local people and outsiders diversified production in poor communities with such changes as the introduction of new crops for dry lands where the land area of rice resulted in low yields and sweet potato decreased. Peanut and sugarcane was planted since 1995. A fish pond was introduced in what was abandoned wet land before 1986 and fish cages were introduced to lagoon. There was support for diversification of crop production from projects (TG project), The Sugarcane Program, and other projects of NGOs and GOs in Hue province since 1995. The diversification of crop production was adopted well by local people through cropping patterns: 1) summer rice (local rice). 2) Spring rice - summer rice (rice-rice). 3) Spring peanut - summer rice. 4) Spring peanut-sweet potato. 5) Spring rice-summer-peanut. 6) vegetable. The diversification of production systems

was also displayed in wetlands and the lagoon by fish ponds and fish cages of communities around TG lagoon.

However, changing from the old farming system to a new farming system and land use has resulted in some crop adoptions but some failures in crop adoption as follows:

Adoption of peanut in farming system: The farmers adopted a new technology which was introduced by the Tam Giang team as crop diversification project in Quang Thai commune. For example households planting peanuts increased from 10hhs in Spring 1997 to 60 hhs in spring 2000 and peanut area was increased from 0.5 ha in 1997 to 5 ha in 2000.

According to Tuyen's report, (1997) evaluations of the 19 households on benefit and efficiency of using peanut showed that peanut production met villagers expectations and local socio-economic development strategies, peanut yield is equal to average peanut yield in neighboring sandy area which was planted for a long time, peanut production brings higher economic benefits than rice production, and peanut green material is used as a green manure for crops. On the other hand, growing peanuts in this poor soil area helps alleviate poverty, improves land productivity, and diversifies crops. Labour requirement and the production process of peanut are simpler than those of rice, and develops the farming systems around the lagoon. This is expected to decrease exploitation pressure on the Tam Giang lagoon aquatic resources.

Diversification of crops helped Trung Kieu villagers assist Trung Lang villagers to grow peanuts as part of a farmer to farmer extension program or participatory technical development (PTD). Mr. Loc, a farmer from Trung Kieu, came to Trung Lang to discuss techniques of peanut growing with local farmers and the TG lagoon project staff were facilitators in this process.

In contrast, there was not adoption with the sugarcane program: Participatory evaluation identified that most of the farmers did not adopt planting of sugarcane on sandy soil, because of lack of water causing low yield in summer season. In addition, there was damage by rats in the rainy season. Poor soil required high investment in chemical fertilizer and organic fertilizer for sugarcane. There are other reasons such as the farmer do not like to plant sugarcane because of the hard work in harvesting sugarcane; low price of sugarcane and transportation was very difficult from sugarcane field to sugar factory. As a result sugarcane production was not adopted (change from 2.3 ha/1998 to 0 ha/2000) in Trung Lang village since 2000. One factor was the lack of participatory technical development with local people (See PE of local people on peanut and sugarcane in Tinh report).

Diversification in wetland

The wetland areas were used for local rice production, which was land allocation to households from 1983 to long term use 20 years. Another area of wetland (about 10%) belongs to commune and is fallow land to be used for aquaculture development. Before 1976, the wetland area where the farmer only planted one rice season/year with low yield of rice (rice yield is 2.0-2.5 ton/ha) or abandon for harvesting natural fishes. Therefore, some farmers practiced aquaculture using locally available food sources since 1996 and they suggest making a plan for aquaculture development in wetland with natural food in order to decrease the natural exploitation in lagoon and improve their livelihood. However, the change from agricultural land to aquaculture was still

slow (only 2-8ha in period 1996 - 2000). There was a meeting with farming- fishing group and fixed fishing gear group to identify the current situation of aquaculture development in wetland as well as lagoon and to make a design plan for aquaculture development. They identified that they can not develop aquaculture in wetlands where rice was planted because there are negative interactions between rice production and aquaculture in term of water control, fertilizer, and pesticide. Another reason is that the wetland was allocated in a of 20 year term for farmers of two villages (Trung Kieu and Trung Lang), so the farmers of the other village do not agree with aquaculture develop in this area. They agree only to develop aquaculture in 14 ha of 26 field (O field) in order to increase income of households (To see participatory map for aquaculture development in appendix).

In contrast to this community, other communities like Phu Tan commune have converted more than 100 ha of agricultural land to aquaculture for Agar company, Vatec shrimp Co., police Department, Shrimp hatchery company, Fishery extension center, and villagers since 1994 - up to now as aquaculture boom (Phap, 1997).

4. Diversification of livelihood in lagoon

The existing lagoon area is more than 1000 ha where there are favorable fishing grounds and is frequently exploited by fishing community (fixed gear group and mobile gear group) to support their livelihoods. Generally, the lagoon bottom is sloping near the edge and even in the central and has the shape of a river bed. The depth is approximately 1m with maximum depth of 1.8m at low tide. In the dry season marine water enters the lagoon through Thuan An estuary fluctuates in time and depth. In the rainy season (from Lunar IX to XII) a large amount of water from the rivers flows through the lagoon before flowing out Thuan An estuary. At this time lagoon salinity is very low and some time fresh. In the dry season (from Lunar I to VIII), salinity fluctuates and in some cases rises to over 1%. The water in Quang Thai is always moving in the North it exchanged with waters from the O Lau river and in the South with water from Huong river and Thuan An estuary.

Interestingly, fishers said that before 1975 the lagoon areas of QT were more than 3000 ha from Van Trinh's bridge to the bamboo bush of Son Cong village (before QT included what is now three commune areas). After 1975 the provincial government cut 1000 ha for Dien Hoa commune and after 1983, 1000 ha were cut for Quang Loi commune. However, now the lagoon area of Quang Thai is only 1000 ha - the water area is in the open access category. This shows that the population growth rate and innovation of management policy of land and lagoon areas has effects on resources of local people. The traditional activities of local people for their livelihood in Tam Giang lagoon was as follows:

Aquaculture development in lagoon: At present, economic activities related to lagoon resources are increasing rapidly. Exploitation of aquatic species in the lagoon is developing strongly and has negative impacts on lagoon resources. Fishers are sustaining their lives on fewer resources. It can be seen as one way to develop the fishery sector and ease the pressure of overexploitation on lagoon resources. Fishing and aquaculture are becoming 2 production activities contributing significantly to the income of many communities around the lagoon. Aquaculture is one of the main strategies in economic development in Thua Thien Hue. Moreover, geographic and

environmental conditions are favorable for enclosing lagoon areas and for constructing aquaculture ponds.

Since 1996, in Quang Thai the local people not only exploited resources by traditional activities as mention above but also developed aquaculture. Viet (2000) showed that before 1996, there were no families raising fish, then there are 21hhs, 45hhs, and 58 hhs were raising fish in 1998, 1999, and 2000 respectively in Table 5 and Table 6.

Table 5: The situation of aquaculture in Quang Thai commune

Year	Group Number of hhs	Farming-fishing		Fixed gear		Mobile gear	
		<i>Number</i>	Percentage %	Number	Percentage %	Number	Percentage %
1998	21	13	62	8	38	0	0
1999	45	13	29	8	18	24	53
2000	58	16	27,5	10	17,5	32	55

Source: Viet, 2000.

Up to now there are 98 fish cages with 11,760 m² in lagoon. According to Viet (2000) the local people have been benefited from 2.1- 3.5 million DVN /season and only 3 hhs out of 58 hhs lost money because of the flood in 1999.

Table 6. The situation of aquaculture at Trung Lang village 1997 -2000

Indicators	1997	1998	1999	2000
Area (m ²)	1100	1736	3424	11760
Productivities (kg)	3400	7200	7190	-
Yield of Aq (kg/m ²)	3,0909	4,1475	2,1072	-
No. case / No. hhs	13/6	20/14	42/30	98/56

Source: Cháu, 2000.

The number of hhs raising fish has been increasing because of the following reasons: (1) The fish raising/fish culture in lagoon is a job/activity suitable to their living condition. (2) The fish culture is of benefit for the mobile gear fisher. (3) They have favorable condition to manage fish and care for fish because of having much free time. (4) There was the support of the project, especially transferring the technology by participatory approach.

On the other hand, economic effect is one of the important effects of the development of fish raising in Quang Thai with some reasons as following: (1) One new job has been created for the

community to contribute to the increase in income for villagers. (2) Employment is created to solve the situation of local labour surplus. (3) Supply of available, easy-to-use and cheap sources of food. (4) Making good use of the availability of natural feed in the area and other residues and by-product from agricultural production. (5) Making good use of land and water area of the commune and reducing the pressure of the over-exploitation on the lagoon area.

In addition, in Quang Thai fish raising also has major social impacts such as the enhancement of awareness in the protection and appropriate use of natural resource by the community, the enhancement in technology of fish raising particularly and in farming system generally, the enhancement in management capacity of land and water area to make good supportive links between various components in the production

However, aquaculture development of the mobile gear group in lagoon is not sustainable because of fish diseases. So they participated in making a plan for aquaculture development in the lagoon area with three groups of Trung Lang and researcher team. It was identified that there will be distance with from 1- 10 m width from FAM dam to center of lagoon and with 3 km length from Ha Dao gate to Quang Loi commune, where it is not allowed to place cages at the mouth of canals, and new cages must be placed at least 5m far away from old ones.

Interestingly, in Quang Thai aquaculture developed small size of fish cage (about volume 36 - 45 m³ for a fish cage) which was adoption with economic level and technical knowledge of poor community. Aquaculture development has been transferred from fixed fishing gear group and farming- fishing group to mobile fishing gear group as participatory technical development of fish cage (it means transferring from people with higher level to people with lower level of production), it brings better incomes and better water area ownership/rights for poor producers.

Box.4. Aquaculture development was different in Phu Tan commune. It has developed quickly with over 100ha of submerged and saline-intruded rice fields converted to aquaculture area. It also a conversion of lagoon area rights from large population to fewer members with 5-10 ha/of water area/net enclose. This is related to the reduction of fishing grounds for mobile gear group, it has results in a process of increasing the gap between the powerful rich and powerless poor (Mien and Phap, 1997).

Tam Giang lagoon has great potential for aquaculture development which brings better incomes for producers. However, the lagoon natural resources have benefited a large community over many generations. If a reasonable balance between aquaculture and fishing can not be maintained, and encroachment of lagoon water for aquaculture development continues, degradation or even destruction of fishing grounds for mobile fishers is unavoidable.

During the first years in Quang Thai, fish cages aquaculture was well developed. However, recently there has been an increase in the number of diseases that affects the fish. Unfortunately, the relationship between animal health and aquaculture practice is not well understood, especially by the local people who have no experience in undertaking aquaculture. It is suspected that bad management that has greatly affected animal health. This research aims at further exploring this link (Chat, 2000).

Conversion of agricultural land into aquaculture area in one area in Trung Lang village (around PAM dike) and the destruction a dike which was preventing salinity intrusion from the lagoon to rice field need to be monitored. Though aquaculture might be an appropriate direction for the development of saline-intruded sandy lands, its impacts on society, environment, agriculture and lagoon resources should not be ignored.

Aquaculture brings high initial economic return, the local government set up policies prioritizing and supporting the aquaculture as a key strategy for socio-economic development of the province. Under this policy, the lagoon areas with aquaculture potential are fragmented and allocated to the individual households. This means that they have expanded quickly before anyone understood its full impact of poor village (Trung Lang), which is a critical issue in lagoon management.

5. Diversification of livelihood by fishing gears

With an area of over 1000 ha, Quang Thai lagoon is a favourable fishing ground and is frequently exploited by communities for their livelihoods. The fishing ground is a busy place with a variety of methods used to exploit its biological resources. Fishing capacity depends on the type of fishing gear and available labour.

At present, the Quang Thai lagoon has more than 330 fishing gear (Table 7) operated by Quang Thai villagers and many other gear from neighbouring communes. The main species exploited in Quang Thai are snakehead, goby, common carp, walking catfish, freshwater macrobrachium, greasybacked shrimp, swamp eel, mullet, local carp, grassfish, *Caridina*, and clams.

The most common gear are pushnet, dragnet (both mobile gear) and fish corral (fixed gear). The latter requires rights to a fixed area of water and more capacity for investment. The fishing gear providing the main income for Trung Lang villagers are fixed gear and pushnet with eel rakes and clam collection providing supplemental income.

Table 7. No. fishing gear are activities in Trung Lang village as compare to 1006 and 2000

Nhoĩ m	F-corall	FAD	Gillnet	Pushnet	Clam	Eel rake	Cầu
M-F	4		18	9	18	12	4
Fix-F	40	10	4	50	16	30	
F-F	15	5	8	10	65	9	
Total	59	15	30	69	99	51	4

Source: Field survey, 1997 and 2000.

Most of gear are operated in shallow water areas near the shore of the lagoon and are simple and low-cost but use nets with very small mesh size of 5x5 mm referred to as A5. Small mesh size, poor fishing methods and many other socio-economic reasons are seriously decreasing lagoon aquatic resources. According to villagers, catches in Quang Thai lagoon were highest in the

period from 1990 to 1992 and, since then, have steadily decreased. Daily production of a fish corral was 10 kg per day at its peak while in 1997 average catches were less than 2kg.

Fish corral: The water is very shallow, the bottom is nearly flat - average water is 1,5m deep. O Lau river estuary is divided many branches and provides an abundant food source. Fish corral is the traditional one of Trung Lang fishers, formerly the fish corral was made of bamboo. After the storm of 1985, and the entire bamboo fish corral was destroyed completely, bamboo fish corrals were changed into net ones (polyethylene material) in the whole Tam Giang lagoon.

At present, in Trung Lang there are 42 fish corrals which are put into 3 lines from shallow bank to the deep one and the boundary between Quang Thai and Dien Hai communes. The distance between lines is 50m - 65m. The materials for making side of fish corral are polyethylene net (a₃ - a₅) and the poles made of bamboo. According local people, 1998, the outputs from fish corrals are decreasing more and more, two or three years ago (before 1995) fishers could get the profit from 30.000-50.000 VND a night. But during this period (1996-1998), the maximum of profits has been 8000-15000 VND/ fish coral, with an average of 7000-10000 VND/ fish coral. It is such a cause that fishers refused to pay tax and the illegal fishing gears are increasingly used.

FAD: In Quang Thai there are 52 FADs, which are distributed between fish corral. FAD is made of the top bamboo, the branch of bamboo is stuck at the bottom and made up the habitats with 5-7m in diameter to attract fish. We will harvest once a month. This kind of work does not cause the pollution or harm for ecology. However, some places/sites in Tam Giang lagoon system, FADs are often used with dynamite to fish. It is necessary to ban immediately.

Push net: this fishing gear is used widely in Trung lang. Most of families of 3 groups practice the gear. The main species caught is *caridina*, especially by woman fishers who participate in the activity. Sometimes they stay overnight in the lagoon and the next morning (4AM) they fish. They come back until 2 PM to dry *caridina* or sell them to the wholesalers.

Mussel rake: the fishing gear and the activity are the same as pushnet for *Caridina*, but different in size (smaller and shorter). The activity is practiced in 2 periods: in February - March and June-August.

Clam collection: Consisting of 2 ways: collecting by hand and collecting by motor boat with rake. The rake blade is the iron frame with the trapezium and fixed the net at the back to contain clam. Because this type of fishing with motor changed the bottom ecology, a ban on this fishing method was considered. This activity was done in the shallow area along the bank from March to August

Eel rake: In Trung Lang there are many tributaries where the alluvium is deposited by yearly flooding, so the bottom is rich in organic matter; at the same time, the water plants develop well, making it suitable for eels to develop and grow rapidly. The blade of the eel rake is an iron hook like fishhook and the bamboo stick fixed with the motor boat. Hhs who have the motor boat do this fishing. They can practice every year and everywhere, except the area where there is much macrophyte.

Hook and line: this type of fishing is decreasing due to low products, furthermore, the development of other fishing types has separated this activity from other activities in the lagoon

gradually. This type of fishing is done during the period from August to January. There is 4 set of fishing line in the village but they are used seldom.

In general, traditional fishing gear (bamboo and rattan) in Tam Giang lagoon have developed over a long period of time and have not had a serious impact on the lagoon environment and resources. Over time, increases in population and poverty have forced increases in terms of distribution, fishing effort and efficiency of gear so has become destructive to lagoon resources and the environment by polyethylene materials used and mechanization.

6. Diversification seasons for livelihood activities

Natural condition in Trung Lang village provide opportunities for diversification of agriculture, aquaculture, and fishing. Therefore, the local people are very busy throughout the year with production activities. For example the seasonal calendar for farming-fishing group, as showed in Figure 2, compares before 1995 and after 1995 with the new cropping pattern and crop diversification.

Figure 2: Seasonal calendar for livelihood activities of Farming -fishing group

Cropping patterns			10	11	12	1	2	3	4	5	6	7	8	9
1. Wetland (O field)														
Before 1995	Summer Rice													
After 1995	Rice-rice													
	Fish-rice													
	Aquaculture													
2. Dryland														
Before 1995	Spring rice													
	Sweet potato													
After 1995	Rice-rice													
	Peanut -rice													
	Rice - peanut													
	Sugarcane													
	Peanut-sweet potato													
	vegetable													

Resource: Field survey, 1999.

Changing farming systems through crop diversity has a positive effect on agricultural production and aquatic resources in the lagoon. In the old system, farmers planted one rice or sweet potato field per year, only tending to the crop three months per year. At other times, the farmer accessed lagoon resources, using gillnets, dragnets, pushnet, eel rakes and clam collection. Under the new farming system, farmers plant rice-rice, peanut-rice, peanut-sweet potato, sugarcane, and other crops per year. This means that farmers are busy farming for five to six months per year - consequently, aquatic resources are less exploited by the farmers.

Other groups (Mobile fishing gear group and Fixed fishing gear group) have activities in wetlands and the lagoon for natural aquatic exploitation and aquaculture development. In Trung

Lang village, there was an increase in the season for aquaculture. Villagers raise two crops of fish within one year which is relate to increasing time harvesting of FWM. Beside they are also increasing time working for other activities such as transportation of construction material, rice and trade of fish, other aquatic as presentation in Figure 3.

The data in Figure 3 showed that both of the groups have many activities in the lagoon and they have activities year-round, with a concentration of activities from January to September. The local people are very busy for both farming and fishing from February to September. The intense activities for women are clam collecting, eel rake, pushnet, and hook-line and both women and men work on fish cages, fish ponds and FWM harvesting. Slack time in farming and fishing communities in Quang Thai occurs during flood season (from months VIII -X). However, the local people have activities year round for animal care, trade, FWM harvesting, and transportation. Diversification of production is not only increasing income generation but also decreasing risk in livelihood of local people.

Figure 3. Season Calendar for livelihood of Fixed gear and Mobile gear group (Lunar Month).

Livelihood activities	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Fish corral												
Dragnet (da)												
Pushnet (dui)												
Gillnet (luoi)												
Ell rake/Mussel rake												
Clam collection												
FAD												
Hook and line												
FWM harvesting*												
Fish case/fish pond*												
Transportation/trade*												

Sources: key Informants, 2000

Freshwater Macrophytes (FWM): The lagoon of Quang Thai is a very unique ecosystem and complicated but rich in both plant and animal creatures. The thick mass of aquatic plants is the main food source for grass-eating fishes and also the major revenue for many local households. There are 7 kinds of FWM in Quang Thai found in and around of water surface in TG lagoon. There are 3 periods in the development of FWM: the first period, from August to October the standing crop of macrophytes varies. Floods also reduce the macrophytes standing crop production. The second period, from November to March, highest standing crop and depending on the salinity, harvesting for agriculture and aquatic exploitation. The third period, from April to July, is a regeneration phase. Fresh waster macrophytes are a valuable resource to local villagers of Quang Thai commune.

Before 1995, the FWM is the main income sources for many households and thousands of tons (9840 tons/year with 60-150 million VND) were harvested annually to serve for farming production as a green manure and mulch for crops, FWM make contribution to improving crop production in the poor soils around the Tam Giang lagoon.

However, aquaculture development in lagoon, the local people only harvested Freshwater Macrophytes about 180 harvesting days/year to apply for agricultural production. After aquaculture development in lagoon, however, they harvest FWM everyday for both agricultural and aquacultural production.

7. Effecting of GO and NGO projects on livelihood diversification.

Since 1995 up to now, there have been 14 NGO projects and GO projects in Quang Thai. World Vision (an international NGO with an office in Hue) provided credit for electric fishers who were committed to quitting that occupation; The British Council funded the building of a bridge and 3 culverts in an effort to improve communication with the outside and integrate the fishing village with the neighboring communities; Helvetas funded credit to develop reforestation on sandy dunes in order to improve water resources for community; CECI (Canada Centre for International Studies and Cooperative) funded the building of 40 houses with adaptations to the flood condition in this areas. Other projects funded aspects of improved livelihoods for this remote commune such as small scale infrastructure development and loans for poor women.

The projects relate to activities of agriculture, forestry and fishing in Quang Thai as following:

- *Aquaculture development with natural feed of Mobile gear group in lagoon areas.*
- *Crop diversification as peanut (new crop) replaced rice field with low yield*
- *Crop diversification as sugarcane (new crop) replaced rice field*
- *Aquaculture development of fish (grass fish) with natural food of fix gear group and farming-fishing group in near PAM dam.*
- *The fish - rice model in wet land (O field)*

In general, those projects funded money and some equipment for Quang Thai commune are more than 200.000 USD from 1995 to 2000. However, they have had different effects on livelihood of this community depending on methodology/approach between insiders and outsiders.

In process of livelihood diversification in Quang Thai, we think that having many elements to affect on:

- Strategies on agriculture and fishing of government and local government
- Affecting by project activities of NGO and GO
- Activities of agriculture and fishing extension
- The natural condition (geography and biological) and natural resources
- Communities bases management on natural resources of communities
- Management capacity of local government and production group
- Gender issues in production activities and social activities of communities

In fact in Quang Thai, there are two elements to be facilitate process livelihood diversification of communities:

- 1) Affecting of projects and activities of agriculture and fishing extension as participatory technical development (PTD) or farmer to farmer extension.
- 2) Self management of communities and self helping in production groups in communities
(To see in chart)

8. Learning up to now

1. In Trung Lang village, there are diverse natural resources such as dry land, wetland, and lagoon areas as well as production system of cropping, aquaculture, and natural exploitation related to diverse livelihood. If the local people know appropriate ways to exploit natural resource, it improves sustainable livelihoods for community.

2. Sustainable livelihood requires diverse strategies of production. However, options are constrained because poor quality of resources and limited knowledge of local people in Trung Lang village.

3. Livelihood is dynamic and changes in response to innovations from outside (like research team of project and extension of province). This means that the extension must respond to the diverse resource base.

4. Sustainable livelihood for lagoon communities, beside aquaculture and fish catching, should include appropriate cropping systems. A successful diversification project was peanut growing as a new crop in order to improve livelihood and decrease exploitation of the natural resources in TG lagoon. Unfortunately, other projects such as the sugarcane project were not adopted in the coastal area. This is because this project did not take a participatory approach. Had the sugarcane company had a discussion with farmers they would have learned about the issues in coastal communities i.e. lack of water, poor transportation, labour difficulties. The role of extension and researcher of project is very important to facilitate local people to identify production strategies.

5. Aquaculture development is necessary in this poor village around Tam Giang lagoon for improvement of livelihood, but it requires a plan for lagoon and land use.

6. Training on lagoon environment and multiple strategies are necessary for sustainable livelihood in Trung Lang village.

Challenges between livelihood with sustainable development

- It is difficult to plan and implement well an aquaculture plan in poor communities, while aquaculture is expanding as a strategy for economic development of the community.
- The conflict among different groups of resource user is difficult for improving their livelihood as limited knowledge of CBCRM

- Expanding research results of the project to other poor communities is also difficult as the project budget was limited.

9. Recommendation

1. To assist the local people to implement a plan for development aquaculture in lagoon in order to avoid problems of overcrowding and conflicts such as in Phu tan commune (environment, Macro physiology, fishing decease).
2. A further understanding of the rice-fishing patterns is essential, as rice-fishing is an example of a sustainable livelihood activity for farming-fishing group and fixed gear fishing group in wetland. Perhaps this activity can be enhanced.
3. Improving awareness/perception of the adoption of technical, environmental management of the lagoon and multiple strategies for production of local people through training by research team of project in Trung Lang village.
4. Expanding research results on diversification of livelihoods by the project from Quang Thai to other poor communities is necessary in Tam Giang lagoon.

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9. Appendix

Figure 1. Participatory mapping of natural resource management in Quang Thai commune.

Figure 2. Changing dry land use of agricultural production in Trung Lang village

Figure 3. Participatory mapping of a plan for aquaculture development on lagoon

Figure 4. Participatory evaluation on peanut production

Figure 5. Participatory evaluation on sugarcane production

Hue April, 16, 2001