Lessons from the Lagoon

Research towards Community Based Coastal Resources Management in Tam Giang Lagoon Viet Nam

Edited by
Veronika J. Brzeski
Gary F. Newkirk

Lessons from the Lagoon

Research towards Community Based Coastal Resources Management in Tam Giang Lagoon, Viet Nam

Edited by

Veronika J. Brzeski and Gary F. Newkirk

Published by

Coastal Resources Research Network (CoRR)
Dalhousie University
Halifax, Nova Scotia, Canada

In association with

Canadian International Development Agency (CIDA)
Ottawa, Ontario, Canada

International Development Research Centre (IDRC)
Ottawa, Ontario, Canada

Coastal Resources Research Network (CoRR)
Lester Pearson International Institute
Dalhousie University
Halifax, Nova Scotia
B3H 3H5 Canada (http://www.dal.ca/corr)

In association with

Canadian International Development Agency (CIDA)
Ottawa, Ontario, Canada

International Development Research Centre (IDRC)
Ottawa, Ontario, Canada

First Published 2000

Canadian Cataloguing in Publication Data

Main entry under title:

Lessons from the Lagoon: Research towards Community Based Coastal Resources Management in Tam Giang Lagoon, Viet Nam

ISBN 0-7703-9494-9

1. Coastal zone management -- Vietnam -- Tam Giang Lagoon.
2. Fishery management -- Vietnam -- Tam Giang Lagoon.
3. Aquaculture -- Vietnam -- Tam Giang Lagoon.
I. Brzeski, Veronika J. (Veronika Julia), 1964-
II. Newkirk, G. F. (Gary Francis), 1946-
III. Coastal Resources Research Network.

SH307.V5L4 2000 333.95'6'09597 C00-950235-1

The research that led to the publication of this book was carried out by a grant from Viet Nam Sustainable Economic Development Programme (VISED) which was funded by CIDA and IDRC.

Table of Contents

Preface

Veronika Brzeski

This book is as much about a lagoon and the people that live on it or on its shore as it is about a group of researchers trying a new way of doing research. The chapters in this book describe the lagoon, its resources and environment and the people that rely on them for their livelihoods - farmers, fishers, aquaculturists, buyers and sellers, women and men. I will let the chapters tell their own stories and spend a few words introducing the "research team", the people who researched and wrote those chapters.

This book summarizes the information collected over 2 years by 19 researchers (see **Appendix C**) working on an internationally funded project "**Management of Biological Resources in Tam Giang Lagoon**". The project idea was originally conceived by Gary Newkirk and Stephen Tyler, working under the auspices of the International Development Research Centre (IDRC, Canada), and Vietnamese scientists from several national and provincial institutions and universities (see **Management of Biological Resources in Tam Giang Lagoon**). Funded by the Canadian International Development Agency (CIDA) and the IDRC, through a joint national project called VISED (Vietnam Sustainable Economic Development), it had as one of its objectives: "*To develop institutional capacity in interdisciplinary and participatory research methods applied to natural resources management.*"

In the past, IDRC projects focused on increasing the scientific capacity of researchers in developing countries with great success - training and facilitating training of scientists to international levels. However, such projects did little to alleviate the poverty that is so rampant in those countries. In an effort to maintain its objective of building research capacity and, at the same time, to tackle some of the issues underlying poverty, participatory research was introduced. Such was the idealism behind the conception of this project: to train researchers in Participatory Research and, especially, to give them the opportunity to practice and apply it in their own setting, with the participation of their own people.

Since 1975, when Viet Nam was re-united and became a Socialist Republic, Vietnamese people have had limited contact with the international community - particularly true for the scientific and academic community. In addition, after many years of war, the Vietnamese government focused its energy on rebuilding the nation and on feeding its weakened population - not on scientific research. Thus research and university curricula have not followed those of the western world.

What may appear to be a disadvantage was, in many aspects, an advantage in conducting research for this project. The little research that was conducted in Vietnamese institutions was based on very simple objectives to resolve real immediate needs. And that research was conducted by people with a much closer association to natural resources and rural areas - sons and daughters of farmers and fishers. Thus when project work required that they sleep in farmers' homes, play cards with them to pass the evenings away, share their meals with fishers and go off fishing in their boats, it quickly became a natural task - to work and socialize with the lagoon people. This may not seem very unusual but it is exceedingly rare in Canada for a university professor or an official from the Deparment of Fisheries and Oceans to spend a few days in a fishing village, eating, sleeping, talking, listening and socializing. A Canadian fisherman visiting Viet Nam was astonished to watch an official from the Department of Fisheries bailing, with an battered American army helmet, a fisherman's boat - not because she was concerned about her safety but simply because it was a task that had to be done. "If only Canadian DFO personnel were like that, the

management of the fishery in Canada would be different."

In my experience, development projects should not be evaluated by their results: by how many objectives they have completed, by the increase in yield of rice, nor by the number of rare species conserved; but by the changes that projects evoke within people affected by them. And this project, one based on the principle that researchers must collaborate with resource users to tackle management issues, was and continues to be successful. It has produced changes in people with a certain influence in their country - university professors and lecturers who teach the next generation, civil servants who supply the data and information on which policy and laws are based, and the resourse users, farmers and fishers who shape the face of the country.

And these changes are visible to those lucky ones, such as myself, who witnessed them. These changes can not be measured but only described and so, allow me the opportunity to describe some of them:

- A university lecturer in agronomy's first response to my questions about a mysterious lunar calendar responded with "nobody uses it anymore, it is only used in religious rituals". Two years later, he insisted that we refer to the lunar calendar in the final reports because it is what people use to plant crops and raise fish.
- An historian and an aquaculture extension agent collaborated with a marginalized group of fishers in the research for **Settlement of Sampan People**; a fishery biologist worked with women to research **Gender Roles in Farming and Fishing Activities**; an agronomist facilitated the **Community Banning of Electric Fishing**; a fishery biologist, a plankton expert, and an animal husbandry researcher specializing in swine, with lagoon users, studied the advantages and disadvantages of aquaculture development and the social implications in **Aquaculture - its Introduction and Development**.
- People who knew 'resource management' as management of resources, came to understand that it really meant managing people and that, if resource users managed themselves, resources could be conserved.
- People who were accustomed to speaking, either lecturing or training or advising, started listening and people who were accustomed to listening gained the confidence to speak.
- Researchers who spoke of wanting to reach the 'truth' and 'reality', realized that perceptions, opinions, views and attitude, though often resulting in conflicting information, were even more important in management issues.
- People who thought that aquaculture development, which brought great economic advantages to coastal communities, in reality only brought those economic advantages to a few while the rest became even more marginalised.
- People who relied on government management to ensure sustainability of resources came to realize that they had to take an active role in managing their resources to secure their livelihoods.

In short, over the course of the project, some researchers came to be convinced that Community based Coastal Resources Management (CBCRM) was indeed an attainable goal; and some resource users realized they had to take a more active role in reversing the trend of resource depletion. In both groups awareness was raised. This project did not change the status of Tam Giang Lagoon's resources, but it raised an awareness which will likely grow until it **will** make a positive impact on the lagoon resources and thus on people's livelihoods.

Acknowledgements

This book is dedicated to the local research partners, farmers and fishers around the lagoon who themselves were very dedicated to the project. They always ensured that we were comfortable, well fed and at ease in their villages. Special thanks go to the People's Committees of Quang Thai, Phu Tan and Vinh Ha and the families that hosted us during our field work.

This book is a result of great efforts on the part of the authors and they all deserve to be acknowledged for their work. Trương Văn Tuyển, the Project Coordinator, not only contributed many chapters to this book, but as well endless hours of advice, editing and guidance to all the researchers and advisors. His skill in participatory research with the local participants, with the research team and with local and international advisors is particularly inspiring. Ms. Lai Thi Qúy Thu fulfilled her duties as office manager, oral and written translator, typist, secretary and data recorder. She worked nights and during floods to translate all the reports which comprise these chapters. Without her assistance we could not have accomplished anything. We also thank Doan Ngoc Ha who contributed many hours of work on the maps.

Acknowledgement would not be complete without mentioning the institutional support that was essential in carrying out the project: Hue University of Agriculture and Forestry, and its Rector of the time, Prof. Dr. Võ Hùng who also acted as Project Leader; Hue University of Science and its Rector of the time, Prof. Dr. Nguyễn Thanh; the Department of Fisheries of Thua Thien-Hue and its Director, Mr. Nguyễn Lương Hiền; the Department of Science Technology and Environment of Thua Thien-Hue as well as its national counterpart, the Ministry of Science Technology and Environment.

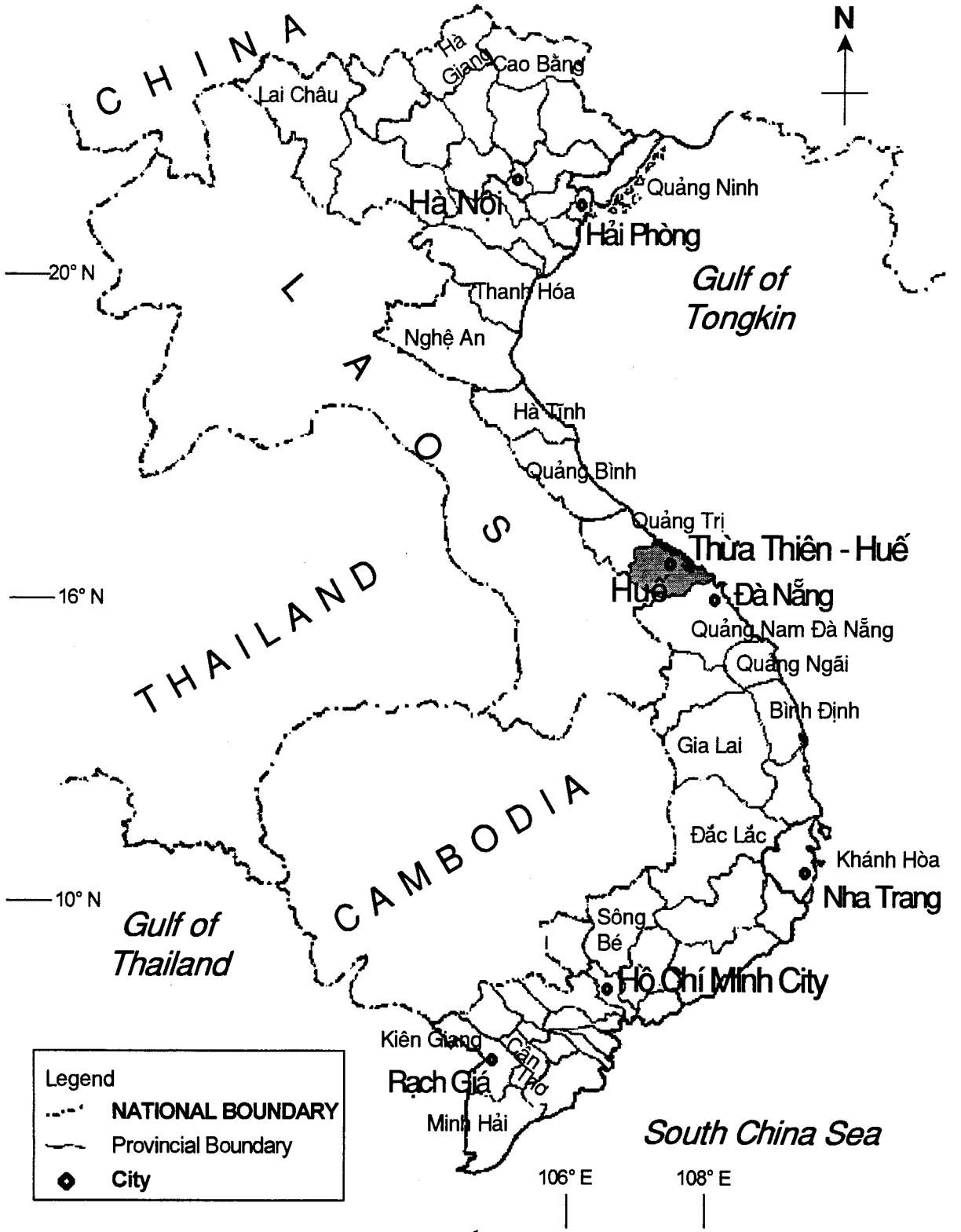
The Canadian International Development Agency (CIDA) and the Canadian International Development Research Centre (IDRC) funded this project through a joint programme, Viet Nam Sustainable Economic Development (VISED). These institutions also lent their support in the form of people, dedicated to the project - Jingjai Hanchanlash, Raymond Gauthier and Stephen Tyler. IDRC also funded the Coastal Resources Research Network (CoRR) which worked as advisors to this project and linked it to other IDRC-funded coastal projects. Jennifer Graham, CoRR Research Associate, assisted with very useful editorial comments and Becky Field, CoRR Administrator, was always available for long distance help throughout the field work and in publication advice.

List of Maps

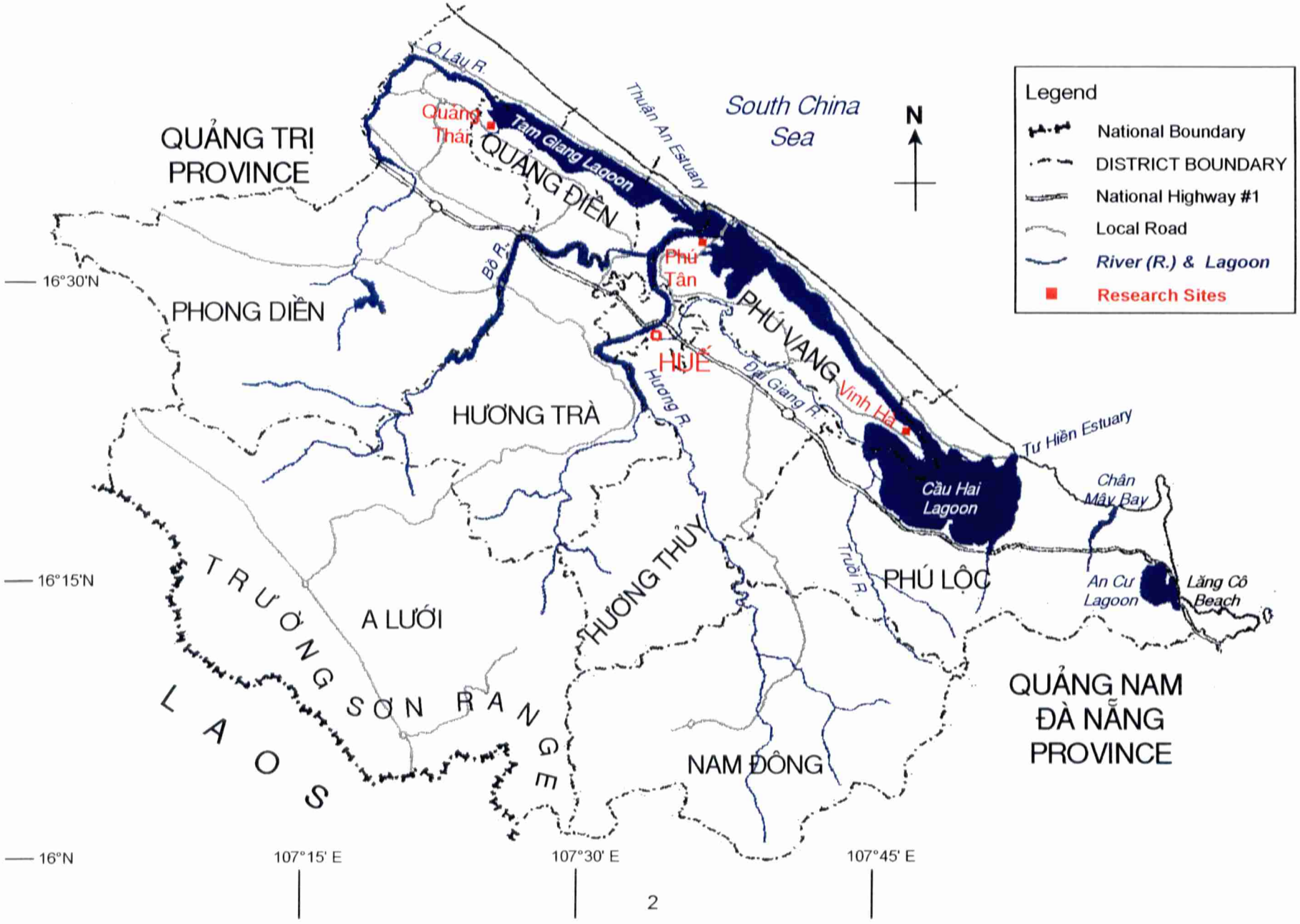
List of Abbreviations

CBCRM	Community Based Coastal Resources Management
CIDA	Canadian International Development Agency
DoF	Department of Fisheries (Provincial Level)
DoSTE	Department of Science, Technology and Environment (Provincial Level)
FAD	Fish Aggregating Device
FW	Freshwater
Hh	household
HUAF	Hue University of Agriculture and Forestry
HUS	Hue University of Science
IDRC	International Development Research Centre, Canada
NEZ	New Economic Zone
NGO	Non-government organization
PC	People's Committee
PR	Participatory Research
PRA	Participatory Rural Appraisal
RRA	Rapid Rural Appraisal
s.d.	Standard Deviation
VISED	Vietnam Sustainable Economic Development
VND	Vietnamese Đồng (local currency)

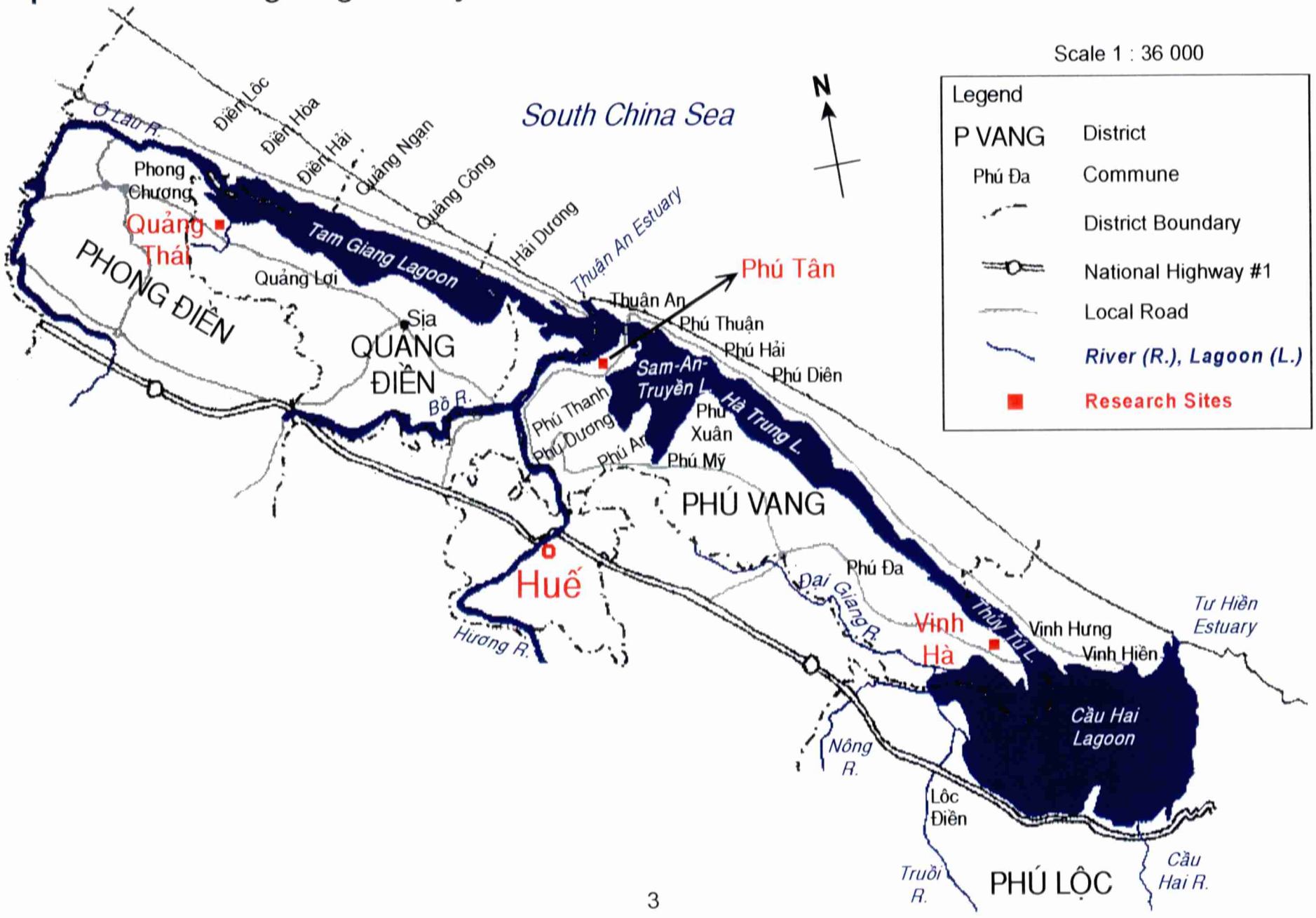
Map 1. People 's Republic of Việt Nam



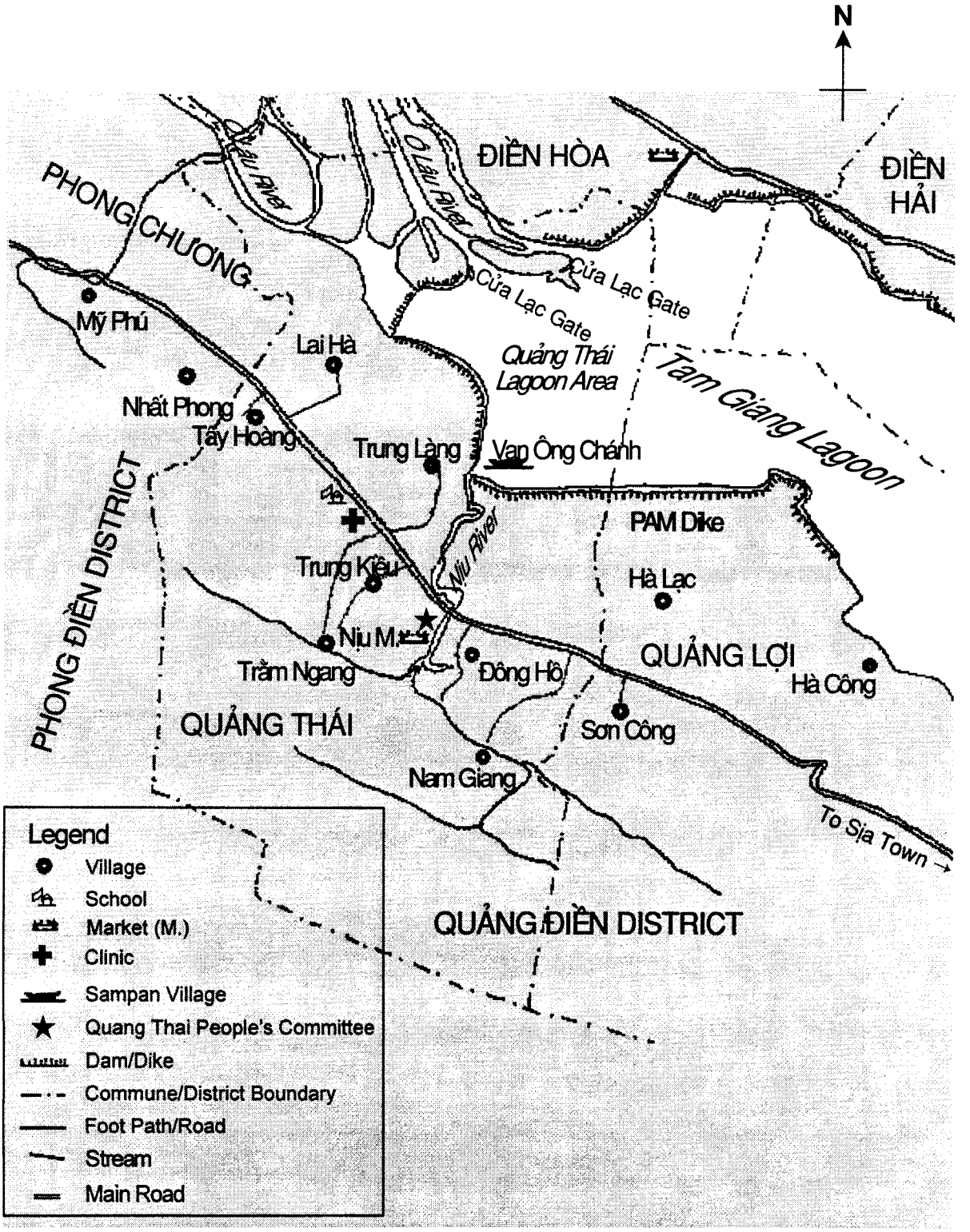
Map 2. Thừa Thiên - Huế Province



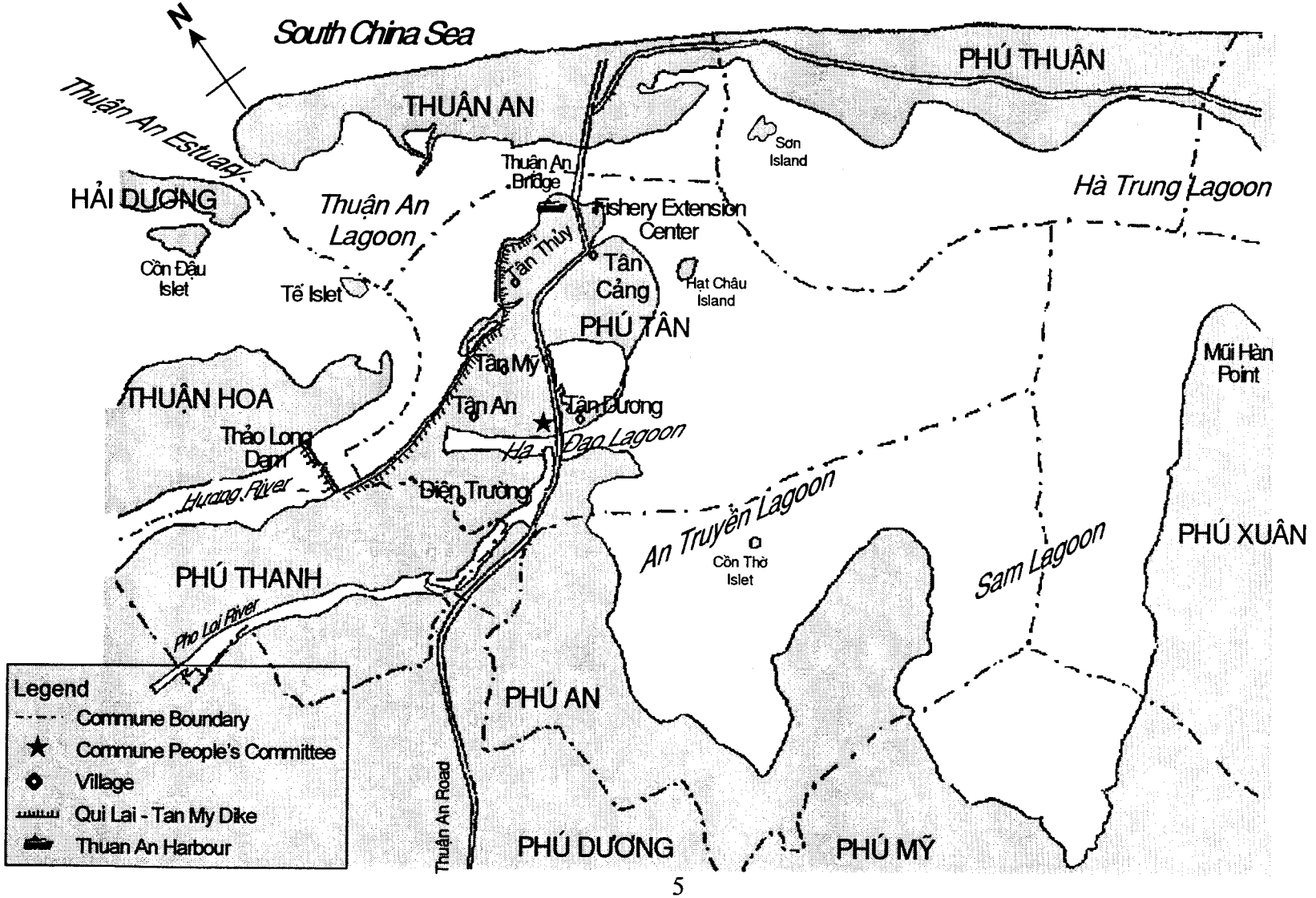
Map 3. Tam Giang Lagoon System



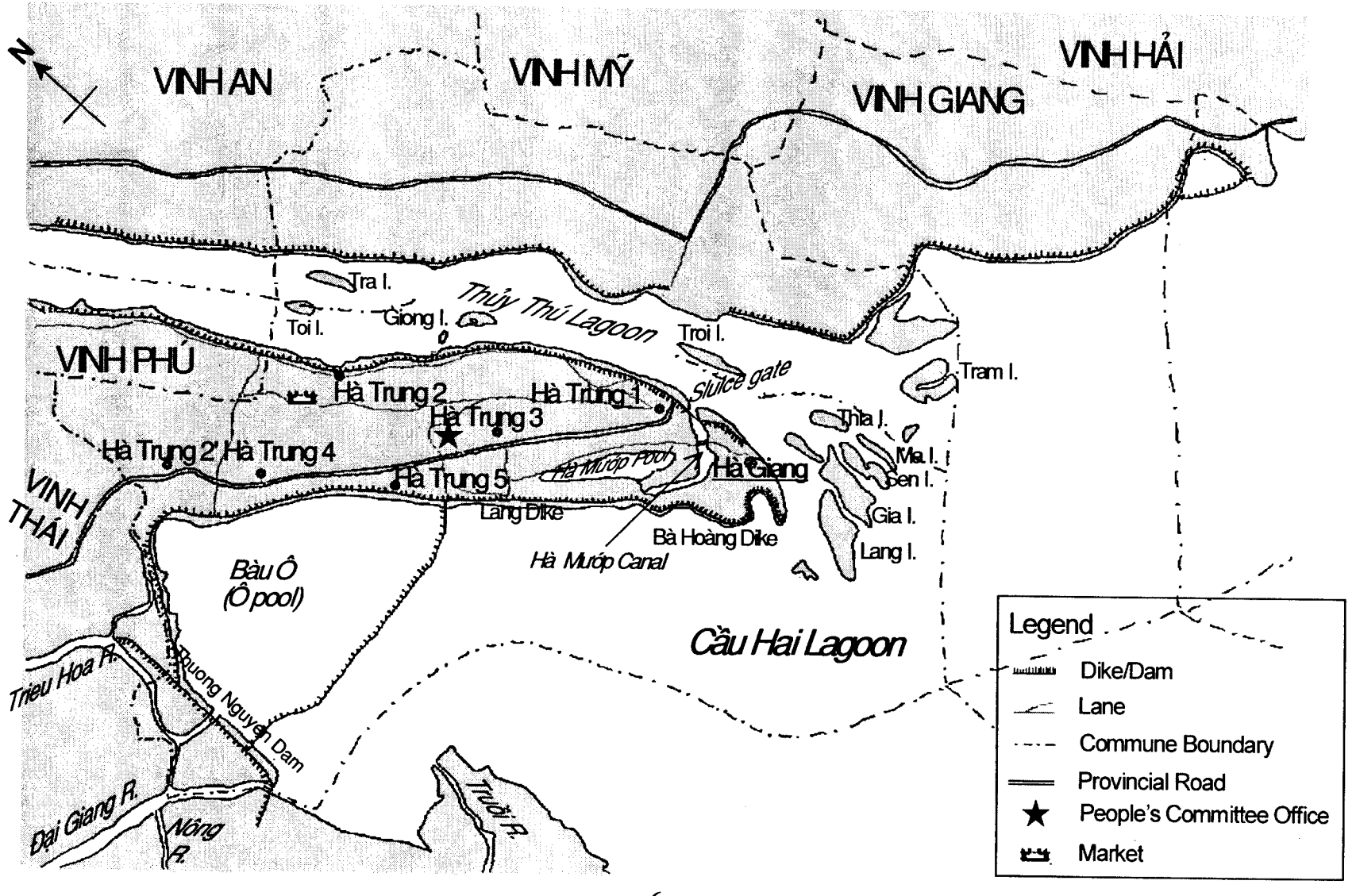
Map 4. Quảng Thái Commune



Map 5. Phú Tân and surrounding communes



Map 6. Vinh Hà Commune



Management of Biological Resources in Tam Giang Lagoon

Trương Văn Tuyển and Veronika J. Brzeski

BACKGROUND

The Tam Giang lagoon, one of the biggest lagoons 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 (Map 2, p. 2). About 300,000 inhabitants have settled around the lagoon, in a total 236 villages from 31 communes, and 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. Community based coastal resources management (CBCRM), whereby resource users take charge in the management of their resources, is one of many possible approaches to solving those problems. CBCRM has been proven effective in areas with small-scale artisanal activities which are difficult to control by government. The experience of the International Development Research Centre (IDRC, Canada) in CBCRM has prompted design of a project that would begin the process of community involvement and evaluate the potential of such an approach in Thua Thien-Hue Province.

The project was designed in 1994 by a group of Canadian and Vietnamese researchers from Hue University of Science (HUS), Hue University of Agriculture and Forestry (HUAF), Department of Fisheries of Thua Thien-Hue Province (DoF), Department of Science, Technology and Environment of Thua Thien-Hue Province (DoSTE), Nha Trang Oceanography Institute, Southeast Asian Research Institute and Hai Phong Institute of Oceanography. The project outline was developed and approved by IDRC and VISED (a joint programme of the Canadian International Development Agency, CIDA and IDRC) in 1995. The project started in July 1995 with a Participatory Rural Appraisal (PRA) training course and exercise in Phu Tan commune. In October, 1995, three interdisciplinary research teams were formed to conduct research in three separate research sites.

The institutions directly involved in project implementation were: HUAF, HUS and DoF. Among a total of 19 researchers (HUAF: 7, HUS: 9 and DoF: 3), there were 4 PhDs, 5 Masters and 11 Bachelors or engineers belonging to the following disciplines: Biology (5), Agronomy (2), Rural development studies (1), Animal production (2), Sociology and Ethnography (3), Fisheries (4), Agricultural Economics (1) and Environmental Chemistry (1) (see **Appendix A**). The project was managed by a Management Committee of 6 members. The chairman and the coordinator were both from HUAF. The Management Committee made final decision on all activities, monitored the budget and held monthly meetings.

The project's general objectives were:

- To understand the utilization and management by local communities of the biological resources of the Tam Giang Lagoon.
- To help improve livelihood opportunities for local communities which do not threaten the natural resource base.
- To develop institutional capacity in interdisciplinary and participatory research methods applied to natural resources management.

The project had 9 specific research objectives:

Objective 1. To identify the structure and social organization of representative communities whose members are active fishers and farmers, including social and gender roles of fisher groups.

Objective 2. To identify the groups harvesting lagoon resources, the species harvested, the sites and technologies used, and the amount of harvest by gear, season and location.

Objective 3. To estimate stock and understand crucial ecological parameters of important species in the lagoon, including distribution, migration, spawning, nursery habitats and growth.

Objective 4. To identify local resources management and production, decision-making at the community level, including fishers' gear selection and the allocation and enforcement of use rights to fishing grounds as well as the roles of village leaders, commune People's Committee (PC, see **Appendix A**) and formal and informal regulations and policies.

Objective 5. To identify the share of aquatic production destined for household consumption and use, household-based processing, direct local marketing, export and the significance of aquatic products to people's livelihoods.

Objective 6. To understand why previous settlement attempts sampan people (see **Appendix A**) have been unsuccessful and to involve sampan people in determining preferences for livelihood alternatives.

Objective 7. To improve farm incomes and the productivity of poor soils; especially for selected villages where households engage in both farming and fishing.

Objective 8. To identify the socio-economic and environmental impacts of aquaculture development in the lagoon including an analysis of conflicts between aquaculture and other economic activities (e.g.: agriculture, tourism, fishing, transport, etc.)

Objective 9. To initiate research to develop methods of sustainable aquaculture production, addressing technological, organizational and regulatory issues.

TRAINING ACTIVITIES

PRA Training was organized at HUAF and Phu Tan commune for 28 participants consisting of 19 project members and other interested local researchers (3 members of the Upland Resources Management Project (IDRC funded); 4 from Bạch Mã National Park and 2 from the Japanese International Volunteer Centre, JIVC, a Japanese non-governmental organization (NGO). The training course provided the researchers with new methodologies to conduct research and to improve local people's participation in the research activities.

In November 1995, 2 project members attended "Festival Workshop on Community-based Coastal Resources Management (CBCRM)" organized by the University of Philippines in Dilliman.

In December 1995, 2 project members attended a 2-week training course on 'Coastal Zone and Marine Resources Management' organized by Southeast Asian Regional Centre for Tropical Biology (SEAMEO/BIOTROP) and hosted by the University of Can Tho.

In January 1995, 1 project member attended a Regional Ecotone Seminar (Ecotone V) on "Community

participation in conservation, sustainable use and rehabilitation of mangroves in Southeast Asia" held in Ho Chi Minh City.

There was one on-site Project Advisor provided by IDRC for the first year who provided informal training as research activities were designed and implemented.

PRELIMINARY RESEARCH FINDINGS

Three of the most important findings in the project are (1) the diversity of income sources of all local villagers, (2) conflicts between management strategies and user groups, and (3) the importance of local government support and involvement in CBCRM activities.

Production groups

In the last century, to adapt to changing circumstances, villagers specialized in specific income generating activities and participated in different production activities. As resources became scarcer, households diversified their income sources and therefore, classifications of production groups which were once distinct, are now quite vague and overlap. Generally, there are two types of communities: (1) farming communities whose members have access to land allocated as rights of land use; and (2) fishing communities, including new settlements and sampan people, whose members only have limited rights to public water areas. However, occupations for all these user groups are diverse by season and by household member.

Fishers

Most of the fishers in Phu Tan are descendants of Sampan people (see **Appendix A**) who originally lived on boats and had no access to land. Before 1953, some sampan people, who had ability and desire, settled on land. They bought land and built houses and gradually established villages. That is the case of Tan Duong villagers in Phu Tan commune. This community relies mainly on income from fishing.

There are 2 types of fishers in the lagoon:

Fixed gear fishers - Fishing households who have inherited or can afford to buy a fish corral, fixed lift net, mullet trap, or fish aggregating devices (FAD) (see **Appendix A**). They have rights to fishing grounds 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 grounds are well situated where fish and shrimp gather or pass through and where fish and shrimp concentrations are highest.

Mobile gear fishers - The poorest fishers who can only afford simple gear such as gillnets, hook and line, traps, aerial traps, pushnets and dragnets (see **Appendix A**). Mobile fishers have no fishing grounds allocations and fish wherever they can. "They follow the fish's tail" is a popular Vietnamese explanation for their fishing methods.

Farmer - Fishers

In the 16-17th centuries, food and animals were abundant. Local people produced agricultural products

only but these were sufficient for their livelihoods. This peaceful life prolonged until the 19th century. When French invaded Indochina, the local people suffered many difficulties. Nature was overexploited and destroyed heavily (many railways built by the French to exploit wood are still visible in Song Thủy, Phu Loc District). Life was not as easy as before and farmers had to diversify their sources of income. Farmers made local simple gear such as FAD, bamboo fish trap, fish corral, lift net, gillnet, hook and line (see **Appendix A**) to exploit the lagoon, improving their life thus becoming farmers-fishers.

Farmers

Agricultural productivity on the edge of the lagoon is very low. This is attributed to poor, sandy, alum and often saline-intruded soils. There are very few irrigated fields and therefore most rice fields produce only 1 crop per year. Around 1993-1994, according to Decree 64 (for the long term allocation of land to farmers), cooperative lands were subdivided and distributed among the members of the communes. Land allocations (as well as exact date of allocation) vary from commune to commune depending on available land and population, but in general, are small (see **Appendix A**). Most farming households must diversify their income sources. Some, as in Phu Tan, have converted their rice fields into aquaculture ponds, others fish in their spare time or engage in other economic activities.

Occupations and Seasonality

These production classifications, though quite fitting a number of years ago, are no longer relevant - though still used and still dictate membership in a cooperative (cooperatives still exist though they don't have the power they used to - see **Appendix A**). As fishing and farming production decreases and new opportunities emerge (emigration, tourism, marketing, aquaculture, etc.), households are forced to diversify their activities. Many better off farmers can have access to both fish corrals and aquaculture pond, fixed gear fishers also operate pushnet and dragnet. In different seasons, occupations differ and can be described in a very general and simple way:

- During the rainy periods (November to January), when soil moisture is high, farmers seed and prepare fields for crop growing, fishers fish and aquaculturists raise shrimp and fish.
- The main crop growing season (December to April), which overlaps the rainy and dry season, is a slack period for many poor farmers and a time when they are lacking in food. Some go fishing, do off-farm activities or work as labourers.
- Later in the dry season, after the harvest (June to August), farmers lack work. They become active in off-farm activities such as fishing, working as hired labour or in construction and collecting firewood and grass. Some fishers also farm as additional job: they grow rice in the submerged fields at the edge of the lagoon (rights to such poor land, if available, is contracted out by auction). Aquaculture, done by both farmers and fishers, is operated mainly in the dry season.
- During the flood season, from late September to early November, storms, heavy rains and strong winds and floods stop people from earning a living. People struggle and suffer with high risks and calamities. It is a slack time for fishers because of the dangers in fishing.

Within household diversity of occupation results in following conditions:

- Extremely low levels of income makes people find additional source by diversifying the economic

activities. Fishers and sampan people keep pigs. Some fishers win contracts for the rights of land use for growing rice. Some farmers practice fishing by buying fixed gear complete with the rights to fishing grounds. Many farmers use mobile fishing gear seasonally.

- The transitional process from farming communities and fishing communities to mixed farming-fishing communities has occurred because of a decrease in natural aquatic resources and changes in management strategies. Originally, Trung Lang village of Quang Thai commune (Map 4, p. 4) was a fishing community. It is now becoming a farming-fishing village consisting of a mobile-gear fishing group, a fixed-gear fishing group, and a farming-fishing group, the latter of which occupies half of total households. Dien Truong village of Phu Tan commune (Map 5, p. 5) was a farming village but it has become a farming-aquaculture community since it converted agriculture land into aquaculture area. Ha Giang village of Vinh Ha commune (Map 6, p. 6) was a new settlement of fishers which became a farming-fishing to make better use of local resources. Some land is used for crop production and pigs are raised by most households.

Different types of work are generally the responsibility of different people within the household. Migrating workers are mainly the unemployed youth. They work in construction, trade, and clothes manufacturing, etc., outside the community. Men and women are responsible for different activities. In fishing households, the men produce rice as alternative work and in farming households, the men fish as an alternative. Women are responsible for domestic animal production and the trade of fishing and farming products.

Conflicts

Problems are now emerging as the number of fishers increases; as fishing gear are modified to increase catch efficiency; and as aquaculture develops in the lagoon. Conflicts between fixed gear fishers (mainly fish corral owners) and mobile gear fishers (gillnet, pushnet, dragnet) have emerged since 1990. At that time, the number of fishers and fishing gear, especially in Phu Vang District (Map 3, p.3), were increasing annually at rate of 0.79 unit of gear/ha compared to the present average rate of 0.34 unit/ha. It was also at that period that the enclosure of water area for aquaculture began. Referred to as net enclosures, they were first introduced in 1987.

Briefly, conflicts have been observed as follows:

Agriculture vs. Aquaculture

The conversion of agricultural land into aquaculture area and the construction of ponds in Phu Tan required the destruction of the primary dike preventing saline intrusion. Though adjacent rice fields were thought to be protected by the highway, acting as a dike, saline intrusion has affected these fields.

Agriculture vs. Fishery

The availability of many aquatic species is closely related to salinity fluctuations. In the northern part of the lagoon (in Quang Thai), Cua Lac dike was built to increase rice productivity by preventing salt water from leeching into the rice fields (Map 4, p. 4). The villagers claim that before Cua Lac dike was recently rebuilt, salinity in the lagoon area was higher and, therefore, fish catches were higher and some valuable species such as crab and tiger prawn were available. At present these species are not caught.

Aquaculture vs. Fishery

The privatization of water area for aquaculture (ponds and net enclosures) has reduced the public area available for fishing. This has caused some serious conflicts some of which have led to the damage of aquaculture structures.

Mobile fishers vs. Fixed fishers

In general, water area is considered public access for all fishers. However, fixed gear fishers have rights (though limited) to their own fishing grounds. Mobile gear fishers have very limited rights to fish (limited by time and specific location) in those grounds. As a result of resource depletion, fixed gear fishers are expanding or enclosing their fishing grounds and the overall numbers of fishers and gear are increasing, causing stress to resources and to fishers. Unequal access to fishing grounds leads to unequal benefits between fishing groups which results in conflicts. Other conflicts occur among fishers because of the use of destructive fishing gear by certain groups. Small conflicts result in quarrels or fighting. Serious conflicts must be solved by the authorities. However, traditional mobile fishers, though poor, have been fishing for many generations and understand the informal rules in fishing. They try to preserve good relations with fixed gear fishers to get help when it is needed.

Farming groups vs. fishing groups

Different groups living around the lagoon have access to different natural resources. The farmers want to fish but in return, refuse to share their land with the fishers who want to practice farming. The fishers want to have access to land and, as well, compete to gain a higher share of fishing grounds. Farmers are reputed to use destructive fishing gear such as lamps at night, dynamite and poison oblivious to the destruction of aquatic environment. They are accused of stealing fish from the cod end of fish corrals.

Settled groups vs. Sampan groups

The sampan people are encouraged to settle on land by the government but they are not provided appropriate land and assistance because already settled farmers and fishers do not want to lose land nor increase their crowded population.

Social conflicts occur as a result of a lack of respect among groups with different customs, traditions and life styles.

Government involvement

The villagers around the lagoon are accustomed to leaving all responsibility of management to the government, although it does not enforce the majority of its laws and policies. Such is the case for the National Article 8 signed by President Võ Chí Công in 1989 which bans electric fishing in Viet Nam. In a case study in Quang Thai, the villagers organized themselves and successfully involved the commune government in a community-initiated ban of electric fishing. The commitment and involvement of the commune government in the enforcement activity increased. Initially, when the self-management committee of the villagers was established, the commune People's Committee (PC) assisted simply by keeping its security force on stand-by in case of serious conflict or emergency. Due to some difficulties as well as opportunities, the commune security force became more involved. The commune leadership

took over more of the enforcement activity because it could not ignore the specific requests from the villagers and, of course, enforcement of laws and regulations is its responsibility. Formerly the commune government did not know how to act in the face of violators and was not aware of the extent of destruction made by electric fishing on aquatic resources. The villagers' activities raised government awareness and resulted in the enforcement of a law for the protection of aquatic species. The fishers solicited the commune government's involvement in fisheries resource management activity which was originally identified, planned, organized and implemented by the fishers themselves. The support of the commune government was very much appreciated (see **Community Banning of Electric Fishing**).

COMMUNITY BASED COASTAL RESOURCES MANAGEMENT

In the short period of the project's implementation, one management intervention was made in Quang Thai: the banning of electric fishing, which was initiated by the fishing community of Trung Lang. Electric fishing was declared illegal by national government decree but was not enforced by the local authorities.

CBCRM research was initiated using different approaches in planning and implementation and therefore, success varied among sites. Based on the level and duration of people's participation and on the extent of changes made to management, a higher level of success was associated with a small scale (village rather than commune or district level), with topics that produced direct benefits and in areas more isolated from large city centres and markets.

The project has tried to involve the local government at three levels: the provincial, the district and the commune (3 project members are from a provincial department). Involvement of commune government has made important contributions to the CBCRM research, especially for the topics providing direct benefits for local people. In most projects, involvement of local government is solicited by the interveners or outsiders (researchers in this case) however, in this participatory project, local people were instrumental in soliciting involvement of the commune government which increased its support considerably, especially in the case of the banning of electric fishing.

In the case of electric fishing, the project cooperated with government agencies and other donor agencies for specific activities and other community needs:

- The division of aquatic resources protection of the DoF cooperated in the community-based ban of electric fishing;
- The commune security force was involved initially in supporting the effort, helping the villagers to organize patrols, apprehending electric fishers, applying fines and often joining the patrols. As the situation became more volatile (threats were made to key fishers involved in the ban), they took more responsibility over the patrols and arrests.
- World Vision (an international NGO with an office in Hue) provided a credit scheme 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 neighbouring communities.

These activities provided direct benefits for local needs and therefore, enhanced local participation and also improved commitment of the local government towards research activities. Cooperation and linkage with other agencies should be well planned at the beginning CBCRM research. It is most important that the community is provided with necessary resources to be able to apply the CBCRM research results and improve critical community needs.

Challenges in expanding CBCRM

One of the most challenging tasks for the research team has been the planning of specific CBCRM research activities. In general the researchers are not skilful at research planning, a result of the education system. Moreover, CBCRM and participatory approaches are new concepts. Poor planning resulted in considerable unexpected problems in implementation.

Making the CBCRM activities sustainable was also one of the most difficult tasks of research team. A CBCRM activity required not only local resources but also external support, such as capital for investment and technical support. The research team struggled to gain access to such support and funding as the project budget was limited and strictly for research activities.

The most difficult challenge for all involved (villagers, researchers and government) was to deal with the existing conflicts. It is difficult to plan well and implement the research activities aimed at solving conflict in the system. The researchers are aware of the conflicts however, they lack the knowledge, skill and experience required to plan and implement activities on building awareness of the conflicts and changing people's attitudes and behaviours. The people may understand the conflicts but they may not implement any changes because these would result in losses to their livelihoods.

The ban of electric fishing was initiated under conditions which made the activity easier to implement. The ban was supported by government law and, especially, the provincial government was beginning its efforts to enforce the ban in the province. Therefore the commune government increasingly supported the activity in both dealing with the violators and in protecting the local guards when threats were made against them. As almost all the electric fishers were from outside the fishing community, the ban was mainly against outsiders which meant that all local fishers benefited equally and few local fishers suffered losses as a result of the ban. Therefore it was easier for the villagers to organize themselves and contribute to the activity.

Further expansion of CBCRM activities may encounter the following difficulties:

- The local government support will likely be weaker should an intervention be based on a local role and not a government law. In such cases, the community's sense of responsibility and confidence is crucial and must increase.
- Some possible future activities may result in losses, not only to outsiders, but also to some inside the community. The direct and immediate benefits resulting from the activities may not be shared equally among all villagers - some might gain while others might lose. Disagreements among villagers may emerge and their support would likely decrease. It is very important to identify people responsible and capable of running an activity and to select strategies.
- In conditions where there is less responsibility assumed by the local government and less support from part of a community, effective solutions to deal with threats made by uncooperative fishers (locals and outsiders) should be identified as a prerequisite to any further expansion of activities.

Research Process

Trương Văn Tuyển and Tôn Thất Pháp

INTRODUCTION INTO THE COMMUNITY USING PARTICIPATORY RURAL APPRAISAL

Participatory rural appraisal (PRA) was very important in providing basic survey data and information for the management and sustainable protection of the lagoon's resources. The data and information were surveyed, collected and combined by the community - people who directly use, manage and protect the resources - and project researchers. Research results were presented back to the community. The information collected gives an overview on issues concerning the exploitation, use, management and protection of the resources to local authorities, policy-makers, researchers, funding agencies and communities.

When first applying PRA, we were really confused between the simplicity of its theory and the complexity of its application. During the implementation, through the help of colleagues, advisors, and the project's coordinator and through individual efforts, we learned to apply the theory and to base scientific theory on the knowledge of community. Together with conventional natural and social science research methods, participatory research is a powerful tool to apply in research for development.

In participatory research, the first important thing is to identify key participants or informants who serve as an entry point into the community. In Viet Nam, this step requires the assistance of governments at all levels, especially at commune and village levels. Key informants are commune officials, heads of production groups, and experienced and respected elders in the community. They are the link between researchers and the community, between local government and researchers, and also represent the community in presenting villagers' expectations and difficulties, and in leading and monitoring the implementation of specific socio-economic development plans in the locality. Initially, together with the researchers, key informants conveyed the project's objectives which helped villagers understand and agree to participate in designing and implementing research plans. In conducting the research, key informants closely collaborated with the research team and were instrumental in identifying research topics, implementing and evaluating the research, and determining future activities. The research results obtained were thanks to effective local key informants.

To understand local socio-economic situations, as well as the use, exploitation and management of resources, interviews, discussions and exchanges with many villagers of different ages, sex and wealth status were conducted. Data and information were collected at many locations: homes, fields, lagoon, boat landing shores, markets, etc., so that interviewed villagers would feel at ease and ready to share, and suggest information and issues of concern. Questions on all topics were discussed and exchanged among researchers and villagers as friends, frankly and openly, because they have few opportunities to present their views. The information obtained from such interviews, combined with commune reports and observations helped the researchers gain knowledge on the status of local resources and socio-economic conditions, and served as a basis for planning appropriate research activities.

IDENTIFICATION OF PROBLEMS AND RESEARCH QUESTIONS

Aspects which were considered in identifying of research topics are summarized as follows:

Magnitude: The magnitude of the problem as perceived by the community was estimated by: (1) the percent of the community affected; (2) the time scale of the impact (seasonal, occasional, continuous); and (3) those most affected (rich, poor, children, women).

Feasibility: In reality, many plans can not be carried out in the local conditions and sometimes can only be carried out by higher-level management agencies. Researchers and local community must anticipate the solution's complexity, its technical and resource requirements and the available conditions and flexibility to determine feasibility.

Previously attempted research: If the identified problem was or is being solved but requires more attention, it is prioritized. Chance of success is higher and investment will usually be lower when there is previous experience and/or data on which to base follow-up research.

Community's concern: Local people are willing to participate in the solution only when they fully perceive the problem. Researchers can not solve a problem on their own though they may consider it as significant.

Applicability of research results: What proportion of the community can apply the results or experiences? Evaluation of the applicability of results is based on existing individual conditions and circumstance in the community in terms of access to natural resources, amount of labour, equipment, skills and other requirements.

In Quang Thai, the research team and local people identified problems of lack of capital, poor infrastructure, unfavourable natural conditions, poor farming techniques, and poor distribution of farming land. The table on the following page lists problems and issues identified and solutions suggested.

PROBLEMS/ISSUES	SOLUTIONS SUGGESTED
Upper Sandy Area	
Lack of water, small green area, environmental degradation	Planting of seapine trees
Previously failed efforts at planting trees - low survival rates of trees	Improve tree planting approach
Unexploited peat resource	Effective management and use
Agricultural land	
Lack of water in dry season	Provide irrigation, develop cropping patterns that retain moisture
Low soil fertility	Diversify crops, introduce nitrogen-fixing crops such as peanuts
Salt intrusion in low-lying rice fields	Improve rice variety, develop aquaculture
Home gardens are large but provide small income	Diversify home garden plants and improve gardening skills
Pig production popular but provides low income - low investment and poor quality breeds	Improve pig breeds, find capital
Low education and production skills	Organize training courses and agricultural extension
Aquaculture and fishing	
Use of illegal destructive fishing gear such as electric fishing	Encourage community-based management of fishery resources
Conflicts in fishing grounds between farmers and fishers and among fishers	Find solutions, propose policies on allocation of fishing grounds
Freshwater macrophytes is important for crop and animal production but its harvest is unstable	Evaluate the stock, identify sustainable exploitation rates
Large area of rice fields are saline	Shift production to aquaculture of freshwater and brackish water species
Under-developed aquaculture: lack of capital and techniques	Develop appropriate aquaculture patterns, techniques and find financial support
Social issues	
Frequent migration of workers	Propose appropriate policy
Failure in settling sampan people	Find causes and improve settlement organization
Overpopulation and low awareness of health care and education for women and children	Find effective measures to apply population control especially in fishing village

APPLICATION OF PARTICIPATORY METHODS

Participation of local villagers in the research activities is key to developing and strengthening community groups. CBCRM programming in the Philippines is successful through a combination of community organizing, environmental education, alternative income generation (livelihood development) and participatory research into resource use, extraction and management (management research). At the early stage in Viet Nam, the researchers focussed on participatory research (PR) hoping, at the same time, to touch on the other components such as livelihood development, and community organizing. PRA was applied at the 3 selected commune sites (Quang Thai, Phu Tan and Vinh Ha) at the beginning of the research period to learn more about the community groups, get them to analyse their situation, and to involve them at the start in project development.

Different community groups were involved in the research though the groups are not distinct and members can belong to more than one group:

- Government officials at district, commune and village levels
- Fishers: Fixed gear and mobile gear fishers
- Farmers
- Farmers-fishers
- Women
- Aquaculturists
- Sampan people
- Traders and merchants (middlewomen and men)

The support of local government officials was enhanced by fitting the research activities to local socio-economic development. Establishing a good rapport with local leaders improved participation from the other groups as well.

Participation was improved by involving villagers in appropriate research activities. The farmers were involved in the improvement of agricultural productivity. The fishers participated in research into fishery resources, freshwater macrophytes, aquaculture and aquatic resource protection. However, the level of local participation in each research topic varied. Participation was weak for those research topics focussed on basic studies, ie. aquatic resources assessment, social issues, effects and impact of development strategies. However, participation was higher for those research topics or activities which were oriented towards interventions, such as the banning of electric fishing, improving land productivity through appropriate cropping patterns, and finding alternative income for women.

The process followed varied a great deal among research activities, depending on the nature of the topic, the experience of the researchers involved and the level of interest of the participants. Despite the variations, the process can be idealized as follows:

- Local people identified their problems, assessed local potential regarding natural and human resources, proposed research topics and the groups to be involved. This process was facilitated by the project researchers.
- Researchers and local participants planned the specific research topics. The local people made decisions on the selection of participating households, overall content and implementation procedure to be followed. The researchers facilitated the work by providing various options for

the participants, thus building their awareness and developing their insight into various alternatives. In fact, the level of the researchers' influence on local people's decision-making varied among topics and research sites.

- The implementation of research activities was mainly done by fishers and farmers with the following assistance from the project:
  - Training and instruction on research design, data collection and recording, and evaluation were provided to the participants regarding specific activities.
  - Materials and tools that were not locally available for data collection and recording were provided to the participants.
  - Supervision of data collection was the responsibility of the researchers, field staff and/or local research collaborators.
  - Materials and resources necessary for implementing research activities in combination with livelihood activities were made available to the households. In some cases, money and gifts were given as compensation for extra time that the households took to collect and record the data.
- There was continuous evaluation and improvement in the implementation of research. In most research activities, continuous evaluation was done by the researchers. The evaluations identified difficulties encountered and positive results. Proposed improvements and changes to contents and procedures were discussed and agreed to with the participants and then put into effect. A lot of improvements were made in research content, type of data collected, and the process in order to adapt the research to local people's knowledge and skills. To improve the reliability of data, other appropriate villagers were involved.
- The final evaluation was done by the local people and the researchers. The level of participation from local people in evaluating the results was different among research topics. The local people were interested mostly in the results from direct interventions and topics focussing on direct and immediate benefits. The researchers also evaluated using their own skill and experience, based on project objectives and on feedback from the local people.

The participatory process described above was the ideal which project researchers aimed to attain. It was effective in some cases while less so in others depending, as mentioned earlier, on the nature of the research, the level of participant interest, and the experience and attitude of researchers in using participatory methods. An activity which was not participatory from the design phase could not, in most cases, sustain participation throughout. Basic biological research which researchers felt had to be conducted in order to evaluate the status of resources, was more difficult to conduct in a participatory way from planning to evaluation. Activities which were designed, planned, implemented and evaluated with the participation of local resource users, more effectively attained the ideal. Those were mainly activities from which the local people benefited either through improved production or empowerment.

OVERCOMING LOW PARTICIPATION

Because of the participatory nature of the project, the collaboration of local people was key to project results. Each research site had some development projects funded by national and international organizations which provided immediate results and benefits with little or no effort required from the

communities. Compared to those projects, our project activities, which did not provide benefits such as those which focussed on basic studies (eg. assessment of fishery resources) experienced difficulties in maintaining interest among villagers. In monthly meetings with fishers in the Phu Tan area, the main objectives were to interview, discuss and collect data and information aimed at long-term-benefit for fishers. But some participating fishers became bored and indifferent when they could not see any practical benefits from the project. When this situation prolonged, some fishers also began to believe that the cooperation was simply for the benefit of scientists. Overcoming these problems was not easy. Reflecting on both positive and less successful experiences, the following factors were considered important by the researchers:

Frequent explanation of project objectives

Introduction of project objectives is important however, explanation and reiteration are very important and useful. The villagers can better understand the project which encourages them to voluntarily participate for the long-term benefit of their community.

Good rapport with local people

A good rapport with local people is always enhanced by faith, respect and trust in their ideas, and serious attitude in collaboration and identification of each research activity.

Relationship among villagers - researchers - local government officials

In the political system in Viet Nam, activities in local communities can not proceed without local government support. Therefore, in addition to nurturing a relationship between villagers and researchers, local government should be involved in the research process. In this 3-sided relationship, local government acts as both collaborator and foundation - supporting research activities carried out by villagers and researchers.

Avoid interview burn-out

Optimum ignorance (or "knowing what you don't need to know") is an important principle in PRA, which must be applied to avoid abusing villagers in over-interviewing and gathering unnecessary information. One meeting with an individual or a group is easy to arrange but repeated meetings are difficult - it is hard to maintain interest if interviews are boring. Repeated meetings with the same participants must be brief, have a focussed agenda, and provide some incentive or attraction to maintain their interest and not to make them feel they are wasting their time.

Collaboration among researchers

In conducting participatory research, the researchers' working attitude is key to achieving the research results and collaboration with local people. Researchers must be enthusiastic, good at listening to villagers, creative in applying research to a specific situation, and aware of their objectives - to address community's problems and to improve livelihoods. In a multidisciplinary research team, solidarity and assistance among researchers is important to obtain good research results. To solve a problem or a research topic, ideas from both natural and social scientists are important. Researchers must collaborate with one another, through discussions and field trips, to complete each activity or research topic.

Semi-annual and final meetings

Occasional large meetings which bring together various stakeholders as well as government officials can improve the effectiveness of participatory research. If a meeting deals with subjects of delicate nature or brings together groups which rarely meet or communicate, a meal or party at the close of the meeting can build comradery and enhance communication. In Phu Tan, large festive meetings increased the attention of local government officials, their awareness of the research activities and their understanding of problems concerning lagoon resources and environment. It provided them with an opportunity to learn about problems which highly concerned fishers such as those emerging from government policy inappropriate to the local situation.

SUPPORT

In all sites, support for the research was essential to project activities. Support originated from the local people, local government officials, colleagues and national and international institutions. Described in this section is the support which the Quang Thai team received.

Local support

Participatory research activities should be in harmony with local socio-economic development plans. Ideas must also be appropriate with the local situation, locally available resources and the community's expectations or desires.

In Quang Thai, the research team was supported by villagers, commune and village government and production groups in identifying, and implementing research topics which brought efficiency in terms of scientific knowledge and practical benefits to villagers. During the participatory research, a good rapport between researchers and community and commune government was achieved. Local villagers' expectation of a monetary support was limited and there was a strong commitment on the part of both researchers and the community to bring practical benefits for people and to protect environment and resources for future generations.

Regular meetings of the lagoon project researchers from the 3 sites (Quang Thai, Phu Tan and Vinh Ha) created conditions for all research members to share experiences, research results and exchange information. The project's researchers are working towards understanding issues, assessing biological resources, studying gender issues in each research site specifically and in the whole Tam Giang lagoon in general. University students were also involved in the research.

Outside support

Quang Thai was one of the 4 communes selected by the Department of Crop Production, HUAF, for research on on-farm conservation of rice diversity supported by the International Rice Research Institute (IRRI). This study is assessing the biodiversity of rice varieties in saline and alum contaminated sandy areas around the lagoon and its role in food security. It will make contribution to management of lagoon resources.

The research team approached World Vision (an international NGO) for support in the activity of banning electric fishing. World Vision has set up a credit program in the area to help villagers in Phong

Chuong and Quang Thai develop alternative livelihoods. It responded by extending credit to electric fishers who voluntarily gave up the practice.

The research team supported the villagers of Trung Lang, Quang Thai commune, in their effort to improve communication and transportation. The villagers submitted a proposal for the construction of a bridge and 2 culverts to connect them to markets and schools and the research team solicited funds from the British High Commission to Viet Nam.

EVALUATION OF RESEARCH PROCESS

Participatory methods and multidisciplinary research were new to this research team at the start of this project. Researchers from different disciplines and institutions had a chance to become familiar with working as a team in solving problems. As a result, process of understanding lagoon communities through the research activities was effective.

Research

Multidisciplinary research was used and developed in the Vietnamese context. Knowledge and experience of researchers were improved and exchanges among the researchers in fields such as environment, agronomy, fishery, biology, aquaculture, history, sociology, economics, health, rural development, and farming systems were fruitful.

However, multidisciplinary research is very time consuming and it was difficult for the researchers to find enough time for field work and discussions. Collaboration and exchange of experiences and research results were not as frequent as anticipated between research teams.

Conventional research methodologies and participatory methodologies were applied as flexibly and creatively as experience enabled. The implementation of research was a learning process for each researcher on how to design, modify and complete research project

Participation

Project members want to continue working together and with the key-informants who have been collaborating in the research sites. The number of community participants however, needs to increase to implement trials of crop and animal patterns, and management changes in fishing and aquaculture.

During the research, many villagers in the community were very enthusiastic and voluntarily participated. However, research efficiency is different in different communities: the efficiency of participatory research in farming community was higher than that in fishing and fishing-farming communities. Some reasons may be that the education level in farming community is higher, and the village structure and family relationships are more stable and longer established. Low educational levels limit the awareness and the gathering and recording of data. Training for villagers was planned, but not carried out because of budget constraints. The research efficiency was affected, though the researchers patiently and regularly explained, instructed and exchanged with participants. In our opinion, training and cross-visits are necessary for participatory research, because they contribute to reducing the disparity of education levels of individuals in and between communities, and to improving the quality of data and information provided by community.

Participatory research methods, when applied successfully, established a good rapport between researchers and villagers through cooperation, equality, respect and benefit to both groups. Researchers acted as facilitators for villagers in their determination of problems and priorities. In most cases, the collaboration between local collaborators and researchers was fruitful although it did take time to nurture. Local villagers made great contributions to the research through their valuable time for discussions, data collection and evaluation of results, in contributing their boats, gear and materials for experiments, and the most important - their trust and faith in the researchers and their work. Researchers and local community shared ideas, knowledge and valuable social time together.

Research activities that were proposed, initiated and controlled by community were carried out voluntarily by the community, with suggestions, instructions and support from the researchers in the form of seedlings, materials, techniques, etc. In Quang Thai for instance, this was the case for the following activities: trial of planting peanuts in 1-crop rice fields (see **Participatory Development of Peanut Crops**), reforestation of sandy lands, and community's banning of electric fishing (see **Community Banning of Electric Fishing**). Activities initiated and controlled by researchers were to gather specific information to complete their understanding of the lagoon resources and their uses: resource assessments of freshwater macrophytes (see **Freshwater Macrophytes - their Ecology and Exploitation**), aquatic species and fishing catch (see **Fishing in Quang Thai Commune**). Participation in such research topics was not as high nor as enthusiastic and problems were encountered especially in collecting catch data.

In spite of each group having specific roles - key or subordinate - the researchers and community collaborated closely during the implementation of the research topics and the researchers regularly monitored and reminded the villagers to ensure the efficiency of implemented research.

The researchers also tried their best to find funding to help local community solve economic difficulties and improve local infrastructure. Short-term research was conducted in parallel with long-term research to meet urgent needs in economic production, improve local economy and reduce pressure of exploitation on the lagoon. This enhanced long-term and effective collaboration of local participants.

Results

Research results obtained are not completely reliable because of problems with the application of participatory methods. Some of the problems associated with catch data collection by fishers are:

Accuracy of data: Catches from fishers had to be measured quickly and efficiently, otherwise the price of aquatic products would decrease due to spoilage. Especially for large catches, measurement errors were high.

Fishers' ability to record data: Not every fisher knows how to read and write. Therefore, locating enthusiastic fishers who knew how to write was not easy.

Lack of trust: Many fishers didn't record true data because they were afraid that these data would be used to raise taxes on their fishing activities. In addition, fishers, who operate gear considered destructive or exploit resources that are or should be protected, seemed unenthusiastic in collaborating fearful that their data would be used against them. For example, fishers operating bottom nets in Thuan An estuary participated for only 2 months because they realized that their data might be used to support banning of

their gear.

In Phu Tan, these constraints resulted in decreasing participation of the fishers in the research (see **Fishing in Sam - An Truyen - Thuan An Area**). The number of participating fishers was reduced from 30 to 16, and the accuracy of data recorded by fishers was low as revealed by discrepancies in data, spot checks by researchers and comments made by certain fishers in confidence. Though the data should still be validated, through the research process, significant and practical questions arose which address the sustainable management of local biological resources.

CONCLUSION

Participatory research helped the local government and resource users involved become aware of the decrease of lagoon resources and inspired ideas and actions for the protection of resources. It also helped them become aware of the importance and long-term benefits of sustainable development of resources. The research activities also served to create a bond between different community groups within the same commune and among different communes, and facilitated collaboration, expression of individual ideas, and the development of common ideas focussed on protecting aquatic resources and on managing fishing activities in the lagoon. The research activities also gave an opportunity for resource users, local leaders and functioning bodies to discuss solutions for the protection of the resources managed by them. The results obtained from this cooperation raised awareness on issues of decreasing resources, impacts of overexploitation, and the waste which results from poorly planned or unplanned development. This awareness encouraged resource users to become more active in protecting the resources on which they depend.

Research Overview

Tam Giang Lagoon Research Team

As mentioned in the 2 previous papers, 3 communes were selected as research sites for the project. A brief overview of the research as well as some comparative information on the 3 sites are presented here to situate the research.

The province of Thua Thien-Hue is located in central Viet Nam (Map 1, p. 1) and its capital Hue was, between 1744 to 1945, the nation's capital and home to its emperors even throughout French colonial rule (1883-1945). It was traditionally the country's main cultural, religious and educational centre. Between 1954 to 1975, Thua Thien-Hue belonged to the Republic of Viet Nam (South Viet Nam) with the Demilitarized Zone (DMZ) (separating North from South Viet Nam) located in present-day Quang Tri province. During the Viet Nam war, Thua Thien-Hue was the scene of the bloodiest battles and intensive Agent Orange spraying by the American Army. The upland area, once a lush tropical forest, is now covered with grass despite reforestation efforts. Thua Thien-Hue has a very narrow land area, very poor agricultural land and extreme weather. The North East Monsoon crosses the South China sea and is blocked by the Truong Son Range (on the Laos border) and the Bạch Mã Range (on the border with Quang Nam Da Nang province) and unleashes an enormous amount of rain resulting in floods throughout the province. With an annual average rainfall of almost 3 metres (most of which falls between September and December), flooding is a regular occurrence and limits the activities of the province's 900,000 inhabitants.

Quang Thai commune is located on the northern basin of the Tam Giang Lagoon System (Map 3, p. 3; Map 4, p. 4). It is relatively isolated from the main transportation route. The district road leading to Quang Thai is a sandy poorly-maintained road and traffic to and fro is primarily by bicycle with occasional motorcycles. It is mainly an agricultural commune with one fishing village.

Phu Tan commune is located in the centre of the lagoon system near the Thuan An estuary (Map 3, p. 3; Map 5, p. 5). It is a bustling commune with a paved road running through the centre, the province's main harbour and a variety of markets both wholesale and retail. It is also is a major thoroughfare from Hue to Thuan An and beyond - the only bridge that crosses the lagoon leads from Phu Tan to Thuan An which boasts a popular beach and the main wholesale seafood market. Phu Tan is the centre of aquaculture development and home to many sea-going fishers. Most of it's original agricultural land has been converted to more lucrative uses (aquaculture, settlement land, factories, markets, etc.).

Vinh Ha commune is located on the southern most basin, the Cau Hai lagoon (Map 3, p. 3; Map 6, p. 6). This area is under the influence of the 2nd opening to the sea - the Tu Hien estuary - which was closed for most of the research period due to sediment deposits. It is also the most flood prone area as it is surrounded by mountains which receive the highest rainfall in the province. The commune's main economic activity is agriculture and, as in Quang Thai, there is only one fishing village, a recent settlement. Aquaculture has developed in this area though it was severely limited by the closing of the Tu Hien estuary causing a drop in salinity.

Table 1 presents a brief comparison of the 3 communes.

Table 1. Comparative statistics from 1996 of the 3 communes selected as the research sites (see Maps 3, 4, 5, and 6, pp. 3 to 6).

Characteristic	Quang Thai	Phu Tan	Vinh Ha
Distance from Hue (km)	50	9	38
# of Villages	7	6	5
Population	5100	5576	8134
# of Households	1100	1007	1290
# of Fishing Households	76	478	94[a]
# of Farming Households	1024	115	1196
Land area (ha)	2155	1018	1745
Water Area (ha)	1000	709.4	1500
Residential Land (ha)	66	30	166
Total Agricultural land (ha)	520	101.4	445
Rice fields (ha)	246	101.4	334
Aquaculture area (ha)	0	273	78
Main crops			
Rice	*	*	*
Sweet Potato, Cassava	*		*
Peanut, beans, maize, Chili, Tobacco	*		
Fishing gear			
Fish Corral, Mullet Trap, FAD	*	*	*
Bottom net, Fixed Lift Net, crab trap		*	*
Dragnet, Pushnet, gillnet, hook&line, eel & Macrophyte rakes	*	*	*
Electric fishing	*	*	*
Main aquatic species			
Siganus, mullet, greasybacked shrimp, eel[b], grouper, FW macrophytes	*	*	*
Prawns (tiger/banana), Crab		*	*
Carp, grassfish, goby, clam	*		*
Caridina, gruntfish	*		

[a] 94 households - estimated from 31 sampan households and 63 Ha Giang households. There may be other fishing households in the commune's 4 other villages but they are few in numbers.

[b] Eel - FW eels are mainly in Quang Thai; brackishwater eels in Vinh Ha and Phu Tan; and marine eels in Phu Tan only. Swamp eel (*Monopterus albus*) is found everywhere.

QUANG THAI

The Quang Thai research team consisted of 6 members belonging to the following disciplines: biology (Trần Thanh Bình and Lê Thị Nam Thuận), agronomy (Trần Văn Minh and Trương Văn Tuyển), fisheries (Nguyễn Hồng Việt) and sociology (Nguyễn Hữu Thông) (see **Appendix C**). In February 1996, Mr. Trần Thanh Bình was killed in a traffic accident.

Quang Thai is a commune in the North of Quang Dien district, Thua Thien-Hue province (Map 2, p. 2). The area was established by 7 main family clans nearly 200 years ago. Formerly, the area was called "Câu Kê, Kẻ Lác" by villagers living along Tam Giang lagoon, because this area was once uninhabited, abundant in *Lác*[1] plant and had little potential for rice production. With patience and industriousness, the first cultivators made great efforts to turn the primary area into fields and these ancestors have been worshipped since by subsequent generations. 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.

Natural conditions in Quang Thai are diverse, including: upper sandy lands, gardens and agricultural land. However, the land is not favourable for agricultural production: the soil is poor, sandy and alum-contaminated with a poorly developed irrigation system. The severe climate of Central Viet Nam causes many difficulties for economic production and local villagers' life: in the rainy season, floods, submersion and strong tidal currents impact on rice fields and cause saline 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.

The villagers' lives are very difficult: 15% households are better-off; 45% households are medium (lacking in food supply[2] for 1-2 months of the year) and 40% are poor households (lacking in food supply for 3 - 6 months). In households whose men died fighting in the war, labour is lacking. These households (10% of the population) receive a very small pension from the government (insufficient at 60-72,000 VND/month) and are starving (see note 2).

Health care and education in Quang Thai are very limited as a result of poor economic development. The commune clinic consists of 4 beds with 1 doctor and 2 nurses. Only simple cases can be treated and medicine is lacking. In fact, the clinic staff's main responsibilities are primary healthcare, vaccinations and family planning programmes. Illiteracy is still common among adults - some have never learned and some have forgotten how to read and write. In the commune, 97% of children go to school although the

---

[1] *Lác* plant (also called *Cói*) is cypress grass (*Cyperus malacensis* Lamk.). It is used to make sedge mats and to bind crabs' legs to prepare for shipping and market.

[2] Households which lack in food supply for any period of the year are poorer than the normal poor households. They lack in staple food (rice) for certain periods. In Hue this occurs usually towards the end of the rainy season, before the main rice crop is harvested. Having no savings, they must find work to get their daily food. These people are categorized as 'starving' by the government. Generally the poorest households among the poor are starving and most of them are ill, elderly or have no labour force to earn for food during shortages. In Vietnamese, starving households are *thiếu đói*, the poor are *nghèo*, medium are *trung bình*, above average are *khá*; and rich are *giàu*.

number of children who quit school without finishing the secondary curriculum is high, mainly because children are an important labour force in the family. There are 2 schools in the commune - one elementary and one elementary-secondary. The elementary-secondary school consists of 23 classrooms, 31 teachers and 769 pupils. There are no English teachers. There is a high school located in Sia Town (14 - 15 km away) and, despite the difficult travel, Quang Thai attendance has increased from 1-2% in 1975-1980, to nearly 5% in 1980-1985, and, since 1995, 10% per year. There is one kindergarten with 8 classrooms but it is very simple, insufficient and the number of children attending is not stable.

Quang Thai borders on the northern part of Tam Giang lagoon basin (Map 4, p. 4). The lagoon area allocated to the commune measures more than 1000 ha. It receives freshwater inputs from O Lau river and rain water. It is an estuarine ecosystem abundant in aquatic species: fish, shrimp, freshwater macrophytes, clams, and birds. There are also inland sources of freshwater including Niu river (3.5 km long and 10 ha area), Nam Giang lake (40 ha), and Tram Ngang pond (20 ha).

Poverty and difficult farming production are some of the reasons for the increase in exploitation in the lagoon. The lagoon area is fishing ground for more than 100 fishing and farming-fishing households in Quang Thai and many other fishers from neighbouring communes (Phong Chuong, Dien Hai, and Dien Loc). In addition, non-fishing households exploit the lagoon resources as a last resort to supplement meagre incomes. As a result, the biological resources in the lagoon are decreasing, and ecological balance and the environment are being seriously affected.

Overview on research activities and results

Agriculture

In Quang Thai, access to agricultural land was awarded for 20 years to households in 1993 according to national government Decree # 64 (see **Appendix A**). Land allocation consists of 6 types:

- Settlement land (10.5 ha): allocated for an indefinite time to each household by the government.
- Rice nursery and cash crop land: 200 m^2 per person
- Rice fields (1 crop/year): 250 m^2 per person
- Rice fields (2 crops/year): 200 m^2 per person
- Forest land (nearly 30 ha): 20 ha is cemetery land and 10 ha is used for cash crops and reforestation.
- Upper sandy land (25 ha): barren land located higher and farther from the settlement area than the forest land. It has been allocated to villagers for reforestation in the PAM program (for the greening of hilly and barren lands) - 15 ha is reforested and 5 ha is sparsely reforested.

Agriculture plays a critical role in the locality. It is the main source of income for most of the population although many households still rely on fishing to supplement their incomes. Thus improving farming production in the area around the lagoon can potentially reduce exploitation of lagoon aquatic resources. The main problems in farm productivity were identified as lack of capital, lack of water, use of local low-yielding varieties, and poor, saline and alum contaminated soils. On this basis, a change in cropping patterns using peanut was proposed by the researchers.

Various cropping patterns, using cash crops such as corn, mung bean and red bean intercropped with peanut, were tested in 1-crop rice and cash crop fields by 19 households from Trung Kieu village. The results show that peanut is an appropriate crop which improves income, diversifies crops, and improves productivity of poor soils. Income from peanut is twice that from rice. In addition to improving soil fertility, peanuts produce high quantities of green material which is used as green manure for crops and as feed for pigs or chickens. (See **Participatory Development of Peanut Crops**).

A second activity aimed at improving land productivity was tree planting on the upper sandy area. Five thousand (5000) seapine saplings were grown locally by 76 households who participated as individual households or in groups. Awareness of the importance of tree planting was considerably improved. Sapling mortality was high (40%) due to flooding in the lower sandy areas where nurseries were located so they could be closely monitored by villagers. The experience has taught farmers that the lower sandy area is not appropriate as nursery areas early in the rainy season since floods cause water logging. (This research is not documented in this book).

Fisheries

Quang Thai lagoon has been officially allocated to the commune but there is a lack of effective enforcement to exclude other fishers. Fishers follow the old rule that "land is private, water area is public" and, as a result, not only Quang Thai villagers but also villagers from other neighbouring communes exploit its aquatic resources. Some laws and regulations regarding management and protection of aquatic resources (such as the ban on electric fishing and the use of lamps) have been promulgated but not effectively implemented or enforced. Electric fishing was no longer practised after a ban was imposed by the fishing community in Quang Thai encouraged by the researchers. The activity not only stopped the operation of those destructive gear but also strengthened the community's capacity in solving local issues. The activity also mobilized the fishing community and commune leaders around the issue of protection and management of local resources. (See **Community Banning of Electric Fishing**).

Groups of fishers exploiting Quang Thai lagoon resources were identified as coming from fishing households, fishing-farming households and, even farming households. It was estimated that 327 fishing gear of 7 different types were operating in Quang Thai lagoon in 1996. The highest in number are mobile gear[3]: pushnet (30.27%); dragnet (21.10%); eel rake (15.62%). Fixed gear[4] are fewer: fish corral (18.04%) and fish aggregating device (FAD - 4.59%). Both mobile and fixed gear operate in the lagoon day and night with an average density of 2 boats and 2 mobile gear in 10 ha water area (excluding freshwater macrophyte harvesters, gillnets and drum or noise fishers).

Fishing and fishing-farming households who are better-off have inherited or acquired fixed fishing gear and the rights to the associated fishing ground. The income of these households is higher and more stable and taxes are levied for access to fixed fishing grounds - mainly to fish corrals at 40,000 VND/fish corral unit/year. Poor households who do not have exclusive access to water area fish on common grounds

---

[3] Mobile fishing gear must be actively operated by a person (push net, dragnet, eel rake) or are temporarily set but never left unattended (gillnet) (see **Appendix A**).

[4] Fixed fishing gear are fixed (permanently or for the season) to the bottom of the lagoon and rely on currents (fish corral, bottom net) or attraction (FAD) for fishing (see **Appendix A**).

using mobile gear such as dragnet, pushnet, motorized dragnet and eel rake and collect clams by hand. Harvesting freshwater macrophytes and collecting clams are main fishing activities by many poor and medium households in the communities. The main catch of mobile gear are species of low commercial value such as *Caridina*, freshwater macrobrachium and small fish.

Aquatic species in the lagoon were identified as belonging to 3 ecological groups: freshwater, brackish water and marine water. Seasonal presence of species depends on salinity of lagoon water, especially marine species. 41 aquatic species of 22 families, 10 orders were identified, of which main exploited species are goby, gruntfish, grassfish and mullet caught by fixed gear; and *Caridina*, freshwater macrobrachium, swamp eel and featherback caught by mobile gear. *Caridina* and clams are critical to the livelihood of poor fishers, especially women and children. Catch frequency of valuable species, such as crab and true eel, is low. (See **Fishing in Quang Thai Commune** and **Appendix B**).

Another important aquatic resource is freshwater macrophyte which is harvested for its use in agriculture as a green manure and mulch and for animal feed. The peak harvest is in November to January when 6,000 tons are used for Spring crop seedlings. In February to March, 2,880 tons are harvested to use as a mulch for cash crops. In Summer (April and May), only 960 tons are harvested for the Summer crop. Most of macrophyte harvested is used as green manure, and sold on request to farming households and delivered to the local market, boat landings or directly in the fields. The price varies with season: 20,000 VND/cart in November to January and 50,000 VND/cart in February to May. (See **Freshwater Macrophytes - their Ecology and Exploitation**).

Aquaculture was not practised in Quang Thai in 1995-96. The capacity and feasibility for aquaculture development was investigated by the research team through research on environment, ecology, and lagoon resources, as well as productivity in the low-productivity rice fields of the O Lau estuary (named O fields) which are submerged during most of the year. The cultivation of freshwater fish in the O fields was recommended as a way to reduce pressure on the lagoon resources, create jobs and improve livelihoods. Fishing households agree with and support this development, and are eager to participate in experiments. The lagoon and the rice fields on its shores have a great potential in fishing and aquaculture although it is exploited unsustainably and without planning.

Socio-economic factors

In Viet Nam, the commune is governed by the People's Committee (PC) under the leadership of commune Communist Party (see **Appendix A**). Functional organizations, such as cooperatives and production groups[5], assist the commune's PC to manage, govern and lead local villagers in socio-economic activities and in implementing government regulations and policies. The leaders of cooperatives and production groups are men esteemed in their communities and experienced in production activities. Their role is instrumental in the management and allocation of resources. Traditional cultural activities are still preserved and passed on from generation to generation. The village head has an important role in village ceremonies or rituals which have features of "village rules".

Included in Trung Lang fishing village is a sampan community called "Van Ong Chanh", which consists of 18 households and 29 boats. Settlement of these sampan people has not been carried out because land

[5] There are 2 agricultural cooperatives and 2 fishing groups in Quang Thai. The agricultural cooperatives are divided into production groups (each group consists of about 60 - 90 households).

is not available. In addition, they hesitate to settle because they worry about how they will supplement their low incomes to support a land-based lifestyle since living expenses are much higher on land than on boats. In all aspects of life, they are isolated and isolate themselves from communities on land. Integration and exchange are difficult because of limited infrastructure - transportation, education and health. These are some of the reasons why there are still people living on boats in the province. (See **Settlement of Sampan People**).

Gender

Women in Viet Nam have multiple responsibilities which include productive and reproductive work as well as community work. In the farming and fishing villages of Quang Thai, it was obvious that women have a great work load. Some of this was documented through a study on resource access of men and women and gender roles in farming and fishing families. Women's work was illustrated through biological clocks (bioclock which indicated a women's work over a 24-hour period) and a seasonal calendar summarizing their annual pattern of work. (See **Gender Roles in Farming and Fishing Activities**).

PHU TAN

The Phu Tan research team consisted of 6 members: 2 biologists (Tôn Thất Pháp and Lê Văn Miên) and an ethnologist (Nguyễn Xuân Hồng) from Hue University of Science; a researcher on animal husbandry (Hoàng Nghĩa Duyệt) from Hue University of Agriculture and Forestry; a fisheries and aquaculture researcher (Võ Thị Hồng) from Hue Department of Fisheries; and an economist (Bùi Thị Tám) from Faculty of Economics Hue University (see **Appendix C**). Six (6) undergraduate students from Hue University of Science wrote their theses on topics related to the lagoon.

Phu Tan commune was selected as a research site because of its proximity to Thuan An estuary which connects the lagoon to the sea (Map 3, p. 3). A high diversity of fishing gear operate the lagoon area from the estuary to Sam-An Truyen lagoon. This small area of central lagoon has the following particular characteristics:

- It is strongly affected by the sea through Thuan An estuary and the salinity ranges from 20 - 30‰ in dry season to 0 - 5‰ in rainy season.
- All types of fishing gear seem to operate in this area.
- The density of fish corrals, bottom nets and fixed lift nets is highest of the whole lagoon
- There are many bottom nets set near the lagoon opening to the sea which catch fry of fish species migrating into the lagoon for shelter and food.
- It is the centre of aquaculture development in the lagoon

Overview on research activities and results

Fisheries

For fisheries' research, the research site was expanded to 5 additional communes - Hai Duong, Thuan

An, Phu Thuan, Phu Xuan and Phu An - to cover the range of fishing and aquaculture activities which affect the area (Map 5, p. 5).

At present, there are 13 types of gear operating in Tam Giang lagoon. Fixed gear (fish corral, bottom net and fixed lift net) take up large fishing grounds and bring higher catches compared to mobile gear. The density of fish corrals is highest in Sam - An Truyen lagoon while the density of bottom nets and fixed lift nets is highest in Thuan An area (Map 8, p. 133).

A year of catch data collection with fishers using 8 types of gear in the research site came up with a list of 80 exploited aquatic species from 3 groups: fish, shrimp and crab (in the same order of abundance) (see **Appendix B**). Of these, 34 species are considered main exploited species and are distributed all over the research area. Peak fishing season is during the dry season with highest catches in May, June and July, when most gear are in operation, and a minor peak occurs at the start of the rainy season (September and October). This corresponds to the diversity of species exploited which is highest in the dry season (more than 50 species) and lowest in the middle of the rainy season (December and January at about 30 species). The diversity of species exploited by fish corral is highest at 69 spp. The diversity caught by gillnet is lowest at 6 spp. (See **Fishing in Sam - An Truyen - Tuan An Area**).

Bottom nets, set near Thuan An estuary, specifically target fry of marine fishes migrating into the lagoon. Five (5) main species were identified with a high proportion of catch made up of *rò* (fry of *Siganus oramine*). The catch of *ro* is estimated at over 10,000,000 individuals per bottom net per month. The high catch of in-migrating fry suggests over-exploitation of fry sources. (See **Migration of Marine Species into the Lagoon**).

Although aware of the decrease in resources as well as the destruction of certain fishing gear, fishers are forced to violate fishing rules to earn a living. As a result, conflicts between fishers operating different gear frequently occur between mobile and fixed fishers. Fishing grounds have reached their capacity in gear density and labour intensity, and their resources can no longer produce plentiful catches. This is a consequence of fishing production under inappropriate management system in the face of decreasing resources, poverty and over-population. Throughout the history of fishing in the lagoon, fishers who owned fixed gear were wealthier and had more power. Mobile fishers had to comply with regulations set by fixed fishers and any change in the operation of fixed gear often brought losses to mobile fishers. Moreover, past and present management systems focussed their attention on fixed gear which were easier to control and tax. In time, the rights of fixed gear owners prevailed over those of mobile gear owners.

Aquaculture

The research site is a key area for aquaculture development in the lagoon. Rapid development of aquaculture has resulted, in part, from the conviction that an improvement of livelihood based on the harvest of aquatic natural resources is impossible. Aquaculture in ponds is most common however the area under net enclosures is increasing in Phu Tan (Map 8, p. 133).

Net enclosures have developed from fish corrals as a combination of fishing and aquaculture. One or more fish corrals, and the fishing grounds around them, are surrounded by a small mesh net fixed to the lagoon bottom with bamboo stakes thus excluding other fishers from the area. Inside the net enclosure, aquatic species are harvested by fish corral when they reach a suitable size and smaller plots are surrounded by a double layer of net for stocking of valuable species. Net enclosures first emerged in

1994, and quickly spread over most of lagoon area of Phu Tan. It is an alternative production system to fishing in areas that are overexploited and no longer favourable. The conversion from fish corral to net enclosure is the conversion from an open fishing ground with benefits shared between mobile and fixed fishers, to a closed fishing ground, exploited only by a group of fixed fishers. Therefore, conflicts between mobile and net enclosure fishers is a warning to planners of aquaculture as well as local government.

Main species cultured in ponds are tiger prawn, crab, seaweed, red grouper and rabbitfish. Aquaculturists have been experimenting with different methods to determine those appropriate to economic and environmental conditions while at the same time maximizing profits. Polyculture has become popular as a result of experience. Problems still encountered are lack of fry, lack of capital, and disease. However, aquaculture is still developing so well that it equals fishing in terms of production in some areas of the lagoon.

Some low-lying and low-yielding rice fields bordering on the lagoon have been converted to aquaculture areas. At present, 30 ha have been converted for aquaculture in Phu Tan. This conversion can be seen as an appropriate change of cropping and animal production which can improve income of producers. In interviews, local villagers indicated that they supported the conversion of low-yield rice fields to aquaculture. One reason is that the economic benefits from freshwater aquaculture are at least twice that from rice production while economic benefits from the culture of marine species is twice that of freshwater species. However, the culture of marine species has resulted in saline-intrusion of agricultural lands adjacent to aquaculture areas.

Research results on fishing exploitation and aquaculture indicates that the development of aquaculture is dominant. However, rapid development and lack of planning are causing negative impacts on biodiversity as well as environment and ecology. This information is valuable and timely for local government and policy makers who should support the planning of suitable and sustainable aquaculture in the lagoon, and should help fishers understand the advantages and disadvantages of aquaculture.

The communities living around the lagoon have depended on its resources for generations. If a balance between aquaculture and fishing is not maintained, changes in aquatic resources and impacts on fishers' livelihoods are unavoidable. (See **Aquaculture - its Introduction and Development**).

Management system of aquatic resources in the lagoon

Throughout the history of Viet Nam, the relationship between central government and local villages was key to the management system. Although villages had to comply with and were subject to central government rules, in fact, they often acted independently of government to enhance the livelihood of villagers. And, in the end, the government and villages had to compromise and reach agreement in applying policy and laws. A government who manages successfully its rural area is one that knows how to take advantage of its relationship with villages. Thus, in a sense, Vietnamese villages surrounding the lagoon were self-managing but in coordination with the government.

Tam Giang lagoon fishers have 2 types of settlements: villages on land and *Vạn* - clusters of families living on boats (sampan people). *Van* are formed on the basis of geography (families sharing a fishing ground) or by gear (*van* of gear types). Officially recognized by government, *van* were self-management units under the administration of villages on land.

Though it is difficult to evaluate the management system during feudalism, it did emphasize self-management of fishing communities through *Van*, and there was close collaboration between heads of *Van* and their managing villages, creating a stable, orderly and secure management system. The present management system is centralized with no real involvement of fishers which is not appropriate for the Tam Giang lagoon ecosystem.

Our results indicate that the appropriate management unit of a rural lagoon area is the village and effective management tools are informal rules. If village rules can be formalized into government laws and government laws can be popularized as village rules, with a good balance, the efficiency of implementation will be increased while cultural identity of localities preserved. (See **An Historical Perspective on the Management of Lagoon Resources**).

Study on aquatic resources marketing

Phu Tan is not far from Hue city, and transportation is easily accessible, thus a wider range of middlewomen/men and markets is possible and active compared to other communes around the lagoon. Fishers are primary producers but also serve a role in the marketing of their produce. Women are primarily involved in fish marketing. Due to the small scale of fishing and aquaculture production, the volume of daily products sold in markets is low and depends on the species, fishing gear and season.

Middlewomen/men can be classified into 2 groups: one from city and inland villages who buy and take products to city or other adjacent markets; and the other from local fishing villages - small traders or fishers. The latter buy products from fishers to sell to local consumers but they don't have enough capital to take part in central markets. There is significant difference between the 2 groups in terms of capital but not education level. There are no personal relationships between producers and middlewomen/men, however there are relationships based on debt which is especially common in aquaculture. A third group of middlewomen/men, referred to as collectors, buy high quality products for the Song Huong Freezing Factory which processes products for export.

For low value products sold to local consumers, the market is in perfect competition with price determined by the relationship of demand and supply, bargaining, and paying cash. Many fishers (mainly fisherwomen or women from fishing households) participate in aquatic markets with a limited volume of products but of various kinds of species. However, for products sold to middlewomen/men or collectors for export, price determination depends much on fishing season and credit relationship. Since most local traders have low income, capital and knowledge of marketing, fishers experience disadvantages in marketing competition. The Song Huong Freezing Factory has a monopoly in buying aquatic products in the area and so the price is determined by collectors. (See **Aquatic Resources Marketing**).

VINH HA

The Vinh Ha research team consisted of 7 members of the following disciplines: Aquatic biology (Võ Văn Phú); Animal production (Lê Đức Ngoan); Environmental chemistry (Nguyễn Xuân Khoa); Crop Science (Nguyễn Thị Thanh); Aquaculture (Tôn Thất Chất); Fishery (Nguyễn Quang Vinh Bình) and Ethnology (Trần Văn Tuấn) (see **Appendix C**). In 1996, Lê Đức Ngoan and Nguyễn Thị Thanh went abroad to further their studies.

Vinh Ha is located in the southern portion of the lagoon - on the Cau Hai basin (Map 3, p. 3). This ecosystem is affected by the southern opening to the sea - the Tu Hien estuary - which is smaller and shallower than Thuan An and has weaker tidal currents. The water is less saline than near Thuan An especially since the Tu Hien estuary was closed by sediment deposits in 1994. The closure impeded the in-migration of marine fish, which had previously contributed to the catch of fishers in Cau Hai. Aquaculture of marine and brackishwater species was also affected. The government has made great efforts at dredging the estuary with limited success - wave action, wind and water currents move sediments back into Tu Hien.

Vinh Ha commune has 5 villages whose members belong to 2 cooperatives with 22 production groups. Most of the production groups are farming groups, however 4 are fishing/farming groups whose members engage in fishing and aquaculture to supplement their farming incomes. Ha Giang village, a new settlement, is the exception as most of its population is engaged full time in fishing using 7 types of traditional gear and, recently, in aquaculture. It was established in 1967 by sampan people but most of its population has settled since 1975 (Map 12, p. 208) when the Viet Nam war ended. This village was selected for research because of its involvement in the fishery and because it is a new settlement. The population of Ha Giang village consists of 427 people in 63 households, with 77 male and 70 female labourers. There are, in addition, 31 sampan households (150 people) living on the lagoon near the village.

Ha Giang's lagoon shore extends for more than 5 km. The total land area is more than 107.5 ha with a settlement area of 14.5 ha, seapine reforestation area of 13.5 ha, aquaculture ponds of 13.5 ha and agricultural land of 66 ha, some of which is abandoned. Most of the land is saline-intruded therefore the area of abandoned land is increasing. The area of aquaculture can be potentially expanded by 250 ha by repairing a dike built during the French colonial period (Ba Hoang Dike). Water canals for exchange of water and irrigation could be made available.

On average, fishing provides 90% of household income while the remainder is derived from other activities, mainly animal and crop production. The villagers are very poor (92% are starving - see Footnote 2, p. 27) and their houses have bamboo walls and thatched roofs which can not withstand the storms, floods and strong winds that affect the area. Concrete and tile-roofed houses are few (15 %). The commune leaders are very concerned about the welfare of this fishing settlement and have brought in, so far, 6 development projects. The 2 biggest projects - # 327 and HCR - brought in more than half billion VND in support for building dikes for aquaculture ponds and roads.

Overview on research activities and results

Fisheries

Data collection with Ha Giang fishers identified 48 species caught by fishers of which 42 are fishes (see **Appendix B**). The order of *Perciformes* has the highest number of species (21 spp.) followed by *Cypriniformes* (4 spp.), *Clupeiformes* (3 spp.), and *Mugiliformes* (3 spp.). Three species are on the list of rare fish in Viet Nam: *Leiocasis hainamensis, Clupanodon punctatus* and *Syngnathus pelaricus*.

In Ha Giang, there are 153 units of 7 types of traditional fishing gear. Included in that number are 37 units of fish corrals and 57 units of bottom nets. The total catch by all units of the 7 traditional gear was estimated at 105 tons per year. Fish amount to 85% of the catch. Fish corrals and bottom nets bring highest catches. The most valuable exploited fish are gizzardshad, local carp, stripped mullet, mullet

(*Mugil kelaarti*), trumpeter (*Pelates quadrilineatus*), goby, and rabbitfish; and invertebrates are greasybacked shrimp and clam. (See **Fishing in Vinh Ha Commune**).

Fish corral and bottom net have operated for long time. In Ha Giang, the community manages the locations of these 2 gear. Individual bottom net sites are rotated among the fishers within a line and between lines at different locations to ensure equal access to the more productive sites. Fish corral are located in 2 locations of different water depths. The deeper ones require more investment but produce more than the shallower ones. Catch by fish corral doesn't depend on location of fish corral, but on investment input which doesn't appear to cause conflicts among fishers.

The project worked to convince fishers to replace the nets of cod ends with a larger mesh size - from A5 (5mm x 5mm) to A7 (7mm x 7mm). At first, only 2 fish corral households and 3 bottom net households participated in the research and replaced their cod ends through project funding. Though inconclusive, results suggest that using a larger mesh size did not decrease daily catch. It may have made the water run through the gear faster, and moss and other plankton did not foul the larger mesh sizes as much as they did smaller mesh sizes. These results convinced many fishers and 25 households (50 %) operating these 2 gear indicated their interest in replacing their cod end nets with larger mesh sizes in the following summer of 1997. (This research is not documented in this book).

Aquaculture

Research results show that salinity in Ha Giang lagoon changes from 0‰ - 17‰. The appropriate period for shrimp cultivation was identified as from months IV to IX (the 4th to 9th months of the Lunar Calendar or from May/June to October, see **Appendix A**). The main species cultivated are mullet, rabbitfish and freshwater species such as grass carp, tilapia and walking catfish. The preferred species are greasybacked and tiger prawns but salinity has been too low in recent years for production. Sources of fry are both hatcheries and the lagoon.

Animal production

In Ha Giang village, there are few opportunities for women to earn for their livelihoods. Few of them go fishing and agriculture is very limited. Animal production provides an opportunity to increase income and is convenient as it does not require travel and time away from home. When the project began its activities, more than 100 fattening pigs were kept by women in the village. Pigs were mainly fed rice bran, cassava root meal and some vegetables bought in the local market. Because of high costs of feed, the benefits were low. Waste fish are readily available in the region in high amounts and at low prices during the fishing season but the villagers did not use them efficiently. Ensilage was deemed as a promising preservation method for waste fish, particularly over the rainy season. This method was introduced to some Ha Giang fisher women. Freshwater macrophyte and waste fish available in Spring were fermented and used as feed for pigs in Winter. Twelve (12) women were involved in this experiment. Weight gain was significantly higher among experimental pigs (fed fermented feed) in the 3rd and 4th months of raising compared to control pigs (fed the traditional local diet). After 4 months, average weight of experimental pigs was 61 kg compared to 52 kg of control pigs and after 6 months, the weight of experimental pigs was, on average, 15.5 kg higher than that of normal pigs. Income from pig production was improved from 150,000 to 170,000 VND/animal/month over 6 months of fattening. The cost of feed, bought during peak fishing season, was not significantly higher than the cost of the traditional diet. (This research is not documented in this book).

Social and cultural aspects

Cultural rituals reflect a good sense of community, a close relationship and friendship among households, families, and clans in the area. Some rituals are held regularly at certain times in a year by each household, such the ritual *Cầu Ngư* which asks for good fishing season. Other rituals are irregular and only offered certain times, for instance after many consecutive years of poor harvests.

Informal rules were applied strictly under *van* management. People gathered and worked in *van* and had a custom of helping each other in fishing. Such customs brought high economic benefits to the entire fishing community. Fishing grounds were allocated for different *van* (*van* of fish corral, *van* of bottom net, *van* of gillnet for goby, etc.). Even within a gear type, different *van* were formed according to special features of the gear used, for instance the *van* of shallow water fish corral and *van* of deep water fish corral. Each *van* complied with informal lagoon rules which were agreed to by all *van*, and also had their own rules for managing their own specific fishery and fishing grounds. (See **An Historical Perspective on the Management of Lagoon Resources**).

CONCLUSION

Although each site has different characteristics of environment, community, resources, developments and project activities, there are common threads which link the 3 sites together and ensures that all research activities complemented each other.

Poverty is apparent in all 3 communes. Phu Tan is distinct in that it has a much wider range of standard of living but that only makes the poor seem more destitute and more marginalised. Health care and education are just as unaccessible to the poor in Phu Tan as they are unavailable to the more isolated communes of Vinh Ha and Quang Thai. Throughout the lagoon are scattered sampan communities either still living on their boats or recently settled on low-lying available land on the edge of the lagoon with government assistance. In both cases, they are quite isolated and have limited access to land, resources, education and infrastructure.

Overexploitation of resources is both a result and a cause of poverty. In all 3 sites, population density is high, land availability is low, soils are poor and opportunities for alternatives in income generation are few. In Phu Tan, opportunities are much higher, but so is the population density. Thus, in all 3 sites, lagoon resources are not only a major source of income for many families, but also a last resort to supplement incomes for non-fishing households. Many people, in desperate need of food and income, resort to illegal fishing methods, such as electric fishing, which require low investment and little skill. Even families who have fished for generations using traditional gear are forced to follow the trend in decreasing mesh sizes of their nets and, as a result, catch juvenile and fry of aquatic species. One fishery, the bottom nets at the Thuan An estuary, targets fish fry which migrate into the lagoon.

Low agricultural production plagues all 3 areas. Soils are sandy, saline and alum-contaminated and irrigation is poorly developed. Fields are flooded in the rainy season and parched during the dry season. Much of the land has been abandoned or used inefficiently. With low incomes and food production for farmers, they are increasingly dependent on fishing in the lagoon. Farming-fishing households are increasingly common. In Quang Thai, farmers are diversifying with crops which are more suitable to poor soils and increase return. With project assistance, they planted peanuts. In the Phu Tan area, farmers are increasing incomes from low-productivity rice fields by converting them into fish ponds. And in Ha

Giang village, Vinh Ha, pig fattening using local resources from the lagoon, has increased returns, while at the same time, adding value to those lagoon resources. All these efforts are attempts at increasing the livelihood of local people with the intent of decreasing the pressure on lagoon resources.

Conflict between different groups of resource users is increasing on the Tam Giang lagoon. As resources dwindle and development occurs with little or no management, access to resources, land, infrastructure and investment assistance is increasingly inequitable. This is especially apparent in the development of aquaculture, a new technology which has recently boomed in Phu Tan. Fishers with access to fixed fishing grounds are enclosing those grounds with nets to exclude all fishers. More privileged fishers and farmers are allocated pieces of the shore to build shrimp ponds. Mobile fishers are forced to find other fishing grounds travelling further and further from home. More discussion on conflict is presented in the introductory paper **Management of Biological Resources in Tam Giang Lagoon**.

Traditional management systems have slowly eroded away replaced by a succession of government imposed rules. At present, the government is in a weak position to enforce its rules which has resulted in very weak management of lagoon resources. The traditional rules are forgotten and fishers now rely on the government, as ineffective as it is, to take charge of management. In Quang Thai, the fishers did attempt to take control and enforce the national law of banning electric fishing, however it was difficult to sustain when threats were made by neighbouring fishers.

Gender issues were included in most, if not all, of the project's activities. The research confirmed that women are equal to men in productive activities (fishing, farming, etc.) and far more active in activities relating to reproduction (including household responsibilities). Although management issues and politics are dominated by men, marketing of farming and fishery products is mainly the responsibility of women.

At each site the researchers focussed on different issues depending on the need, situation and opportunity. However, due to the project's focus, an assessment of fishery resources was attempted at all 3 sites as was research on fisheries management. The following papers have been selected from the final reports of the Phase I of the project submitted to IDRC in 1997. Some of the reports were abridged while others merged to simplify and lighten reading.

An Historical Perspective on the Management of Lagoon Resources

Nguyễn Xuân Hồng, Trần Văn Tuấn and Tôn Thất Pháp

Along the coast of Central Viet Nam, there are many important lagoons such as Tam Giang - Cau Hai Lagoon System in Thua Thien-Hue province (referred to in the project as Tam Giang Lagoon), Sơn Khê and Trà Ô in Quang Ngai province, Thị Nại in Binh Dinh province, and Cù Mông and Ô Loan in Khanh Hoa province (Map 1, p. 1). The total combined area of these lagoons is about 28,000 hectares of which Tam Giang Lagoon occupies nearly 22,000 ha.

The Tam Giang Lagoon is actually a system of lagoons stretching along the coast for a length of 68 km from O Lau river mouth at the Tam Giang lagoon (the northern most lagoon basin after which the whole lagoon system is named), through some smaller transitional lagoons, Sam, An Truyen, Ha Trung and Thuy Tu, and to the Cau Hai lagoon in the South (Map 3, p. 3). In addition, there is an isolated lagoon in the southern end of the province - Lang Co lagoon (also called An Cu lagoon) (Map 2, p. 2). Tam Giang lagoon occupies 4.3% of the province's total area or 17.2% of the province's delta area. At present, the Tam Giang lagoon system is bordered by 32 communes belonging to 5 coastal districts and plays an important role in the socio-economic development of the districts and the province.

Livelihoods in the locality are various. There is no clear distinction among production activities since villagers are often engaged in several activities. For example, villagers who fish and do aquaculture can farm and fishers can fish in both the lagoon and at sea. The geography is diverse - the mountain, fields, sea and lagoon are close together. Therefore, households are active in different production activities in different places on the same days as expressed by the words in a folk song:

> *In the morning, going to the mountain to burn wood and make charcoal*
> *In the afternoon, going to the lagoon or the seashore to catch sand crab*

Several fishing gear are operated in the lagoon. In nice weather, some gear such as gillnet and hook and line are also used to fish at sea.

SETTLEMENT OF THE LAGOON

People settled the lagoon area a long time ago. The first settlers were Chàm people whose relics are found in the legend of "Mọi Biển" (Sea barbarians), in Cham cultural heritage (in Quang Thai, Túy Vân, etc.) and in books on the history of this area (Duong Van An, 1961; and Le Quy Don, 1977). The Cham people moved away during the immigrations of Viet people from the North and the South[1]. That is why we mention only the present Vietnamese villagers in the lagoon area when we address the lagoon villagers.

---

[1] According to most historians, Tam Giang lagoon villagers originate from Thanh Nghệ Tĩnh people migrating at different historic times corresponding to the southward migration of the Viet people. However, based on facts and old historic documents, there was also another wave of migration from the South during the Tây Sơn and Gia Long Dynasties.

Table 1. Places settled around the lagoon by lagoon area or water area.

Lagoon Name[a]	Other names	Commune	District
An Giá	Vũng Sỹ, Vụng Sịa	Quảng Phước	Quảng Điền
An Xuân	Cuốc	Quảng An	Quảng Điền
Hà Lạc	Vũng Nẻo, Niểu		Quảng Điền, Hương Trà
Bác Vọng	Vũng Dồng		Quảng Điền, Hương Trà
Vĩnh Xưởng[a]		Hải Dương	Hương Trà
Lạc Thiếu[a]		Hải Dương	Hương Trà
Thôn Hai[a]		Hải Dương	Hương Trà
Hạ Đạo		Phú Tân	Phú Vang
Giang Sâm		Phú Tân	Phú Vang
Thủy Tú			Phú Vang
Mậu Tài		Phú Mậu	Phú Vang
An Truyền	Vụng Chuồng	Phú An	Phú Vang
Vông			Phú Vang
Thanh Lam	Vụng Lam, Vũng Chàm, Sam	Phú An	Phú Vang
Tô Đà			Hương Thủy
Hòa Đa			Hương Thủy
Hà Trung	Đầm Đả, Đả Đả	Phú Vang	Phú Lộc
Hưng Bình[a]			Phú Lộc
Hòa Lâm			Phú Lộc
Nghi Ngang		Vinh Giang	Phú Lộc
Mỹ Án	Ông Chủ	Vinh Hải	Phú Lộc
Ô Tê			Phú Lộc
Vụng Chinh			Phú Lộc
Ô Trai			Phú Lộc
Lương	Minh Lương		Phú Lộc
La Bích	La Hồng		Phú Lộc
Bạc	Hà Bạc	Cảnh Dương	Phú Lộc
An Cư	Lăng Cô, Hậu, Sam		Phú Lộc

Source: Duong Van An (1961), Le Quy Don (1977) and interviews with villagers.
[a] Denotes an area of water not geographically designated a lagoon.

Immigrations of Viet people from the north started at the beginning of Lý dynasty (1010-1225) and increased in the Trần (1225-1400), Lê (1428-1788), Mạc (1527-1600) and Nguyễn (1788-1945) dynasties[2]. Immigration from the South occurred during the Nguyễn Huệ dynasty (1788-1792) when Nguyen Hue took over Phú Xuân citadel (present-day Hue), and appealed to Viet people from Quy Nhơn migrating to Thuận Hóa (present day Hue) to lend their support. Then, when Gia Long defeated the Tay Son dynasty (1792), he moved Minh Huong people (Vietnamese of Chinese origin) from Sài Gòn - Gia Định to Hue. Whatever their route, settlers spent a lot of their energy and even their lives to establish villages in upland, delta, coastal or lagoon areas. Over a long period, Vietnamese villagers settled in many places around the lagoon and cultivated land or fished. There were 2 kinds of settlers: those who settled on land to farm and those who made boats their home and fished (referred to in the project as sampan people - see **Appendix A**). Lagoon water areas were named according to their characteristics similarly to rice fields on land (Table 1).

The origin of fishery exploitation in the lagoon is related to the origin of the sampan people. Legends claim that, in each area of the lagoon, one sampan family established and fished exclusively in that area (the original areas are listed in Table 1). As the families grew over generations, they formed organizations called *vạn* which regulated fishing in a claimed area. Although originally *van* was a clan of related fishers, it eventually became a division based on geographic area though still loosely related by blood or close friendship. These households also began to form groupings according to the type of fishing gear they operated. Generally, 2 to 7 families operating the same gear joined together to form a subgroup of a *van*. Over time, the bond which joined fishers in a *van* developed into a combination of blood relation, marriage, fishing activity and gear and sharing a fishing area.

Over the years (still in Feudal times) a number of sampan people, who had enough money, access to land and desire, settled on land. Many of them acquired agriculture land and grew rice but never abandoned their fishing life. They began acquiring rights to their own fishing grounds to operate fixed gear (or 'big gear') such as fish corral, bottom net, fixed lift net and fish aggregating device (FAD). These rights were acquired in feudal times through annual auctions. This system gave fishers who won the previous year's auction priority for the same ground in the new year's bid. In this way rights to an area were maintained in the same family through many generations. Eventually the auctions ceased and the rights were held for life and acquired through inheritance. Instead of an auction price, fixed taxes were paid annually. The present government in Viet Nam still honours these rights and charges a tax relative to potential production.

When fixed fishing grounds emerged, fish corrals quickly became the most common gear located throughout the lagoon as in the present. Although, in the use of lagoon area, the concept "land is private, water is public" was considered law very early in the history of the lagoon fishery, possession of water area was gradually accepted. Thus the location of fixed fishing gear became rather stable and a tax was levied based on type of gear and location.

Today a large number of sampan people still live on boats and operate mobile gear such as gillnet, hook and line, dragnet and pushnet (sometimes referred to as 'small gear'). Their fishing grounds are not fixed - they fish "following the fish's tail".

---

[2] Some of the dates overlap because different families had control over different regions of Viet Nam.

TWO LEVELS OF MANAGEMENT IN VIETNAMESE HISTORY

Since the settlement in Tam Giang lagoon, the villagers have had their own management rules in addition to those imposed by the government (common to other rural areas). So, the management includes the 2 systems in Vietnamese rural areas:

- Management by rules (Community-based or traditional management) and
- Management by policies and law (government management).

Local management based on informal rules (documented - "Hương Ước", or oral statements) originated when rural communities had no class discrimination. When class distinctions emerged, local management was still present in communities which relied on subsistence production, a closed economy and community solidarity. In contrast, government management is enforced by documented laws and rules. Depending on different circumstances, one or another of these two levels of rural management may be predominant, while the other may be fading. Alternatively, the two systems may be combined at different levels.

From Feudal times to 1975

Under Feudalism, the lagoon area was considered similar to land and was managed by farming villages (referred to as managing villages) located close to or far from the lagoon. One notable village, often mentioned in historical documents regarding the lagoon, is Thuy Tu village located 10 km away from the lagoon. The managing villages organised fishery production and collected taxes from the fishers exploiting the area allocated to the village. *Van* facilitated the management of lagoon areas allocated to these distant managing villages. *Van* also improved the management and protection of aquatic resources and prevented exploitation by fishers from other areas or *van*. The leader of a *van* collected taxes for the managing villages and had the authority and responsibility to solve conflicts among fishers within his *van* or with other *van* or villages. Fishers of a *van* complied with both government regulations and *van* rules which were established to manage their own resources and approved by the managing villages and higher government levels. In the management system under feudalism, *van* played an important role in administrating fishing production in the lagoon and preventing violations of rules. Therefore, conflicts were solved quickly and effectively at the *van* level and the number of conflicts sent to upper government for resolution were few.

Under French colonial rule, though the lagoon was considered as France's property, management by *van* was considered effective and still applied. The French government set the level of taxation and managing villages were assigned to collect them.

Under Ngô Đình Diệm's rule (1959 - 1963), the relationship between *van* and managing villages was severed. The lagoon was managed by communes and taxes were collected by commune government. Fishers were organized into groups whose representatives struggled for fishers' rights, especially for the reduction of heavy taxes levied by communes. However, the groups did not work effectively and the commune government played a decisive role in determining and collecting taxes. *Van* were only effective as social groups and production groups. This management mechanism existed until 1975.

From 1975 to the present

After 1975, in Tam Giang lagoon, *van* were disbanded and merged into administration units on the

mainland. Fishing activities are now under the management of communes. Fishing communities were divided into production groups and *van* had no longer any function. Self-management by the fishing community was no longer tolerated. From 1975 to 1985, management by the government was not really appropriate, effective nor were the rules and regulations enforced. The local government's only activity was to collect taxes on fixed gear.

According to the Regulation on Protection of Aquatic Resources, dated April 25 1989 by the Socialist Republic of Viet Nam, the national government is the highest management body that administers the protection and development of aquatic resources through a "system of policies, strategies, plans, socio-technical applications and documents". The national government issues decrees, resolutions, articles and decisions regarding the protection and development of resources. Province and district governments issue decisions and announcements appropriate to the local situation for enforcement based on national government documents (Ha Ky, 1994).

At present, Tam Giang aquatic resources are managed by a system of administrative and functioning bodies, with key roles played by provincial People's Committee (PC), district PC, commune PC, Department of Fisheries, Division of Protection of Aquatic Resources (DoF), and District Bureaus of Agriculture and Fisheries. In general, regulations issued by local administration are few compared to those by the national government. Local enforcement of national policies is not given much attention by local governments. Coordination among the above mentioned government institutions in the management and protection of aquatic resources of the lagoon is lacking. Therefore, violations and conflicts in fishing activities are not resolved satisfactorily, thoroughly and promptly.

THE STRUCTURE OF *VAN* TOWARDS THE END OF THE FEUDAL PERIOD

As population increased and *van* developed, there emerged 2 categories of *van*: *van* of big gear (fixed gear) and *van* of small gear (mobile gear). *Van* of big gear consisted of fishers operating fixed gear such as fish corral, bottom net and fixed lift net, which required high investment and were located on important fishing grounds. These fishers gained access to fishing grounds through auction. *Van* of small gear consisted of fishers operating mobile gear requiring low investment. Their fishing grounds were areas outside the fishing grounds of fixed gear. At that time, these areas were under open access with no auction. The location of fish corral, particularly, was respected and there was no invasion of those grounds. A mullet trap (a small fixed gear) was never set in the fishing ground of a fish corral and, although gillnets of banana prawn or goby were free to fish anywhere, they could not invade the fishing grounds of fixed gear. To this day, mobile sampan fishers are somewhat restricted in their activities by the settled fixed gear fishers - mobile fishers have to avoid fixed gear fishing grounds or must share their catch with the owners of the fixed gear at an agreed to ratio.

In each category, there were organized *van*, for instance:

- *Van* of fish corral fishers, divided into owners of deep water fish corrals (in more than 2m depth) and shallow water fish corrals (about 1.5m).
- *Van* of gillnet fishers separated according to type of gillnets targeting goby, gizzardshad, banana shrimp, mullet, halfbeak, etc.
- *Van* of hook and line fishers
- *Van* of lift net fishers

- *Van* of fishers using FAD - those made of bamboo and those made of stone.
- *Van* of traders

Depending on its fishing gear and social structure, each *van* had particular rules, communities activities and taxes stipulations.

The family unit

The family (nuclear or extended) was the basic production unit of *van*. Labour assignments were, and still are, pursuant to gender and age. The husband (or head of family) was the key person in production activities while the wife and young children traded, cooked, made nets and helped with fishing. The economic production unit of a fishing community was, and still is, the family.

***Van* structure**

Each *van* consisted of 3 administrators - a head of *van* (*Trầm*), in charge of general affairs, and 2 assistants: *Biện*, in charge of finance, and *Xâu*, in charge of communication. The roles of *Trầm*, *Biện* and *Xâu* were particularly important and visible in ceremonies, tax collection, punishment of violators and diplomatic affairs. The 3 administrators had no special privileges attached to their position - they worked equally with other members.

The head of a *van*, highly esteemed by the community, was elected by the members to manage and represent the *van*. He presided over ceremonies or rituals of the *van*, such as rituals for the beginning of a new fishing season and rituals for wishing for good catches. He also participated, as *van* representative, in ceremonies held by villages on the main land. Heads of *van* were descendants of those families who first established the community. A group of guards, elected by fishers, assisted the head. The guards were assigned on rotation to patrol the *van*'s fishing area and apprehend violators of the fishing rules, for instance those using dynamite or poisonous vegetation.

Presently the members of *van* are only loosely managed by *van* leaders. *Van* leaders often don't know the exact membership of their *van* and only recognize the head of the household. Except for *van* of fish corrals, members of other *van* can separate or join together for a short time such as one fishing season.

Van was a self-management unit. However, *van* were not isolated and were usually attached to villages on land. This is still the case - for example, Tan My village (Phu Tan commune) includes *Van* Lê Bình as well as the households living on land. The administrative structure in villages on land was more complete consisting of: *Lý Trưởng* (village leader), *Thủ Bộ* (in charge of land certificates), *Hương Bộ* (in charge of birth and marriage certificates), *Hương Bảng* (in charge of ceremonies), *Kiểm Nã* (in charge of security), *Ông Đề* (in charge of infrastructure) and *Đầu Xâu* (in charge of communication). Thus *van* depended on villages in terms of administration and past and present governments managed *van* through agricultural villages.

***Van* rules**

Fishers' lives were very much affected by rules - there were rules on social, cultural and economic life of fishers. These rules were not documented, only transmitted orally, but were strictly complied with by

fishers.

Van of fishing gear had common features and rules:

- They covered a certain area
- They were managed by a leader - head of *van*
- They held regular rituals during the lunar year. Common rituals were held at shores where boats were landed at the beginning or closing of a fishing season
- They included offerings as part of rituals. Common offerings were: paper clothes, rice soup, rice, salt, paper bow and arrow.
- Their members were supposed to make contributions for offering rituals of communities.

Each *van* had a set of rules which dictated how its members worked, socialized or conducted rituals. The rules stipulated:

- The method of using each gear
- The relationship and collaboration of members in their fishing activity
- The details for the ritual offering of paper objects - burned, dropped on the water surface, hung on bamboo stick in a temple built out on the lagoon, etc.
- The taboos in fishing and daily life such as not calling the name of target animal when fishing; not revealing fishing grounds and catch; using slang (for example: one, ten, hundred, thousand are referred to as *Rơm, Bó, Lằm, Thiên* respectively); leaving bamboo baskets, used for storing catch, upside down when empty; not calling back someone who is leaving for fishing, etc.

The location of fish corrals was stipulated based on the results of an auction and fishers had to comply with the rule and set their fish corrals in places assigned to them. Fish corral weirs could not be so long as to invade a neighbouring fisher's grounds however, within their own ground, they could set as many weirs and cod ends as they wanted.

Van of gillnet for banana shrimp and for gizzardshad also stipulated the maximum length of a gillnet and, if it was longer, the owner was told to cut it. The reason for this maximum was related to the operation of these gillnets. Gillnets fished cooperatively at high tide when the water level does not fluctuate. At this time, the whole *van* cast their nets for 15 to 20 minutes. There were usually 2 fishing grounds located at each end of the tidal influence. If a gillnet was too long, it interfered with the operation of the others and the fish were scared away. In addition, if the gear was too long and there was no room for a fisher, he didn't have enough time to move to the other end of the tidal range.

Since in each *van* the gear type was the same, fishing gear were marked by the owners. Fish corrals were marked on one bamboo stick of the weir by crosses and straight lines (for example IXI, IIXI, IXXI, etc.). Gillnets were marked on the float or lead. Fishers knew the owner of each symbol and could recognize stolen property. In such instances, the head of *van* settled the problem - the highest punishment being expulsion from the community.

Fishers of a *van* helped each other. They called each other to go fishing at the right time, watched over others' property, helped each other in marketing, and looked for each other's property lost in storms.

Present *van* system

Presently, a *van* is no longer considered a community of the same blood but a community of neighbours. Relationship by blood is considered by some sampan people to have some negative characteristics in that those fishers related to the leaders of the *van* are favoured and those with no powerful relations are disadvantaged. Some sampan people who have settled on land a few generations ago retain their original ties to *van*.

MONETARY RELATIONS

Monetary relations are very important in any type of fishing in a community. Since fishing is seasonal, uncertain and risky, fishers depend on each other and others to help them in time of need. The following examples and scenarios were common in the past and continue into the present.

Among fishers

When fishers are in a needy situation due to, for instance, illness, wedding, funeral, establishment of a new household, poor fishing season, or slack season, they borrow money or food from richer fishers. As a result, they are both in a bond. Borrowing fishers can either stay with their own families and go fishing with lending fishers, or stay with the lending fishers for an agreed duration. Although this relationship appears flexible, the final agreement is strictly carried out. Even during the flood season when not fishing, borrowing fishers work odd jobs for the lender - mending nets, burning fouling organisms on the bottom of the boat, etc.

To invest in their fishing operations, fishers often need to borrow either money or fishing gear. In return, instead of money with interest, the lender is reimbursed by the use of the fishing gear of the borrower by agreement of both parties. This relation is commonly applied in the operation of fish corrals and is described in the example in Box 1. One lender can loan to many fishers, so he could operate several fish corrals, and even fish full time using other people's gear. In the case of a natural disaster, the 2 sides must reach an agreement on the payment for damage.

Box 1. A debt relation between 2 fishers

Fisher Trần Câu had a fish corral of 1000 pieces of weirs. This was not enough and he borrowed money for another 300 pieces of weirs from Mr Lý Hòa. The following agreement was made: the fish corral was operated by Mr Tran Cau (borrower) for 5 days and by Mr. Ly Hoa (lender) for 1 day each week for a period of a 2 years. Even if over 3 nights of fishing, Mr. Ly Hoa had earned a sum equivalent to the loan, he still continued to fish with Mr. Tran Cau's fish corral until the end of the second year. The converse also applied: if over the 2-year period Mr. Ly Hoa did not earn enough to repay the loan, he had to stop operating the fish corral as agreed.

Between fishers and traders

Traders also give loans to fishers in the form of money for making boats, gear or baskets for storing their catch. Fishers repay the money by installments by selling their catch to the trader. From each catch, 5 to 10% goes towards paying the debt. Informal interviews with fishers and traders revealed that fishers

in the lagoon and in the coastal area of Thua Thien-Hue have relations, to some degree, with 8 big traders in Đông Ba market, Hue city[3]. In each local market there are traders, but they deal with much smaller quantities and have less lending capital. The relationship between fishers and traders does not have a deadline. When the fisher decides to stop selling his catch to one trader, he repays the borrowed money and stops the relationship. He can even borrow money from a new trader in order to pay the old trader, and thus come into a bond with the new trader. Alternatively, when he has enough money, he repays money to his lending traders. He can continue to sell his catch to traders, but the commission is lower.

Between crew and owner

The distribution of catch shares, as method of paying crew, has been the rule for a long time and fishers are satisfied with it. An example of share distribution in gillnet fishing is described in Box 2. A share is calculated based on net return after subtracting inputs for food, gasoline and other expenses.

The rule for catch share for some fishing gear were fixed. Since boats have been motorized, the share distribution was changed to compensate for the cost.

Box 2. Example of shares in gillnet fishing

Boat	1 share
Engine	2 shares
Gillnet	2 to 4 shares [1]
Each fisher	average 1 share (½ to 1½) [2]

[1] If investment for net is low, it gets 2 shares

[2] Depending on labour contributions. Each fisher received 1 share of the catch although the boat driver, who was experienced and had knowledge of the terrain, was awarded 1½ shares, and an apprentice, doing minor work such as bating, detaching fish from net, and washing net, was awarded ½ share or a small payment.

GOVERNMENT MANAGEMENT OF TAM GIANG LAGOON

Tam Giang lagoon has played an important role in the development of local communities. Though the role of the lagoon was viewed differently throughout Viet Nam's history, every government wanted to have control over the lagoon and its people. From the establishment of lagoon communities to 1975, governments only paid attention to the exploitation of the lagoon in terms of military strategy, communication (as a water way), a source of food and a source of revenue (through taxes). In Feudal times, the governments relied on villages and on informal rules of local communities for control. Villagers paid taxes and fulfilled all their obligations to the governments. Resource exploitation was not restricted or controlled by previous governments since there was no pressing need:

- Pollution was low and aquatic resources were abundant;
- Governments couldn't manage villages directly - there were too many levels in between; and
- Wars happened endlessly.

Since the feudal times, population has increased and the role of *van* eroded during successive administrations by the ruling governments. When the present Vietnamese administration took power in 1975, management of the lagoon was taken over by government. Because of rapid increases in

[3] The 8 traders are 7 women: Lê Thị Lê, Đặng Thị Dung, Phạm Thị Dương, Hồ Thị Đê, Lương Thị Mai, Nguyễn Thị Cạy and Trần Thị Tôn; and one man: Hồ Đe.

population, exhaustion of natural aquatic resources and social changes, the government's view of the lagoon changed. From 1975 to 1988, government management of the lagoon was lax, pollution increased and natural resources decreased. Since 1988, the Vietnamese government has changed its approach by issuing and implementing policies on social assistance and on protection of the lagoon. These policies had initially created changes in the social, cultural and economic livelihoods of communities. However, other issues emerged such as conflicts between fishers and aquaculturists, and between resource protection and greed. The present government is concerned with the exploitation of the lagoon by fishing and aquaculture, and the enhancement and protection of aquatic resources and degrading environments. It prioritizes the development of certain localities - poor areas with low education. Thus, the present government has tried to manage of exploitation of the lagoon resources.

Present government structure

Tam Giang - Cau Hai lagoon is under the management of the Vietnamese government. The government structure is a model of vertical management and is generalized in the following model:

National Government
↓
Province (*Tỉnh*)
↓
District (*Huyện*)
↓
Commune (*Xã*)
↓
Village (*Làng*)

There are also other transitional levels in certain circumstances: *Phủ* (between province and district); and *Tổng* (between district and commune). The government issues laws and policies and the provincial and district governments are to disseminate and implement them. Commune governments (in some cases villages) are to enforce the laws directly. The efficiency of the vertical management however depends on many factors.

Government laws in the lagoon area

Policies on management of water area

Prior to 1975, Tam Giang lagoon was considered, for management purposes, as an area which belonged to the government but was managed by agricultural villages. Those managing villages allocated rights to fishing grounds by auctions held annually for members of the local *van*. When fixed gear were developed, individual fishers (generally sampan people who had settled on land) who won bids had the right to exploit the area themselves, hire others to exploit it, or rent it out for a fee. One auction rule prioritized rights to the previous winner of the bid so that when a fisher once won bid on a water area in Tam Giang lagoon, he could exploit this area all his life and pass it on to his offsprings. Inheritance

of the rights to a fishing area still exists in lagoon villages today.

The lagoon still belongs to the government of Viet Nam however, from 1975 to 1988, the government abandoned the old administrative structure, integrated *van* of fishers into land-based villages and allocated the management of lagoon to communes. Though the rights to using water areas has not changed much, this system caused many difficulties to fishers because of lax management resulting in increased exploitation. Therefore, after 1988, the government issued some changes: Decree 64 allocates water area or aquaculture area to fishing households. Households who want to do aquaculture must apply to the commune to be granted an area of water and get approval from the district. The water area allocated is not more than 5 ha (its exact size depends on a few factors). Households can join together to establish production groups thereby increasing the size of area granted. So, after the decree 64, use of water area and aquaculture area was officially recognized and regulated. However, this caused conflicts between fishers and aquaculturists which is not effectively handled by the commune government.

For example, a group of aquaculturists from Phu Tan with leader Mr. Đặng Thẹ sued a group of Phu An fishers who damaged and stole from their aquaculture area. Dang The's official suing statement was sent to 3 governing bodies and responses were slow as indicated in the following table:

Office	**Governing body**	**Date sent**	**Date replied**
Commune Police	Phu Tan Commune People's Committee	29 June, 1996	6 July, 1997
District Police	Phu Vang District People's Committee	10 July, 1996	25 July, 1997
Provincial Institution of Inspection	Thua Thien-Hue Province People's Committee	20 August, 1996	

Delays in response and resolution led to the case being forgotten.

Another conflict occurred in Quang Dien District which spurred the District People's Committee to draft a temporary regulation on fishing production and aquaculture and on the development of aquaculture on lagoon area managed by the district. The regulation is based on national government articles on the protection of aquatic resources but adapted to the Tam Giang lagoon environment. The People's Committee regulated:

- Minimum distance between 2 fish corrals and between fish corral and bottom net,
- Construction material (bamboo) of fish corral cod ends and the weir close to the cod end
- Mesh size between the 2 bamboo sticks.
- Banning of gear such as motorised dragnet, pushnet, dragnet, dynamite and electric fishing.

The regulations were drafted by the district bureau of Agriculture and sent to the Provincial Division of protection of aquatic resources for consideration. At the same time, ideas and comments from communes and villagers were also obtained. This document is said to be drafted with villagers' participation. Based

on the regulations, Quang Dien Bureau of Agriculture did resolve conflicts on the location of fishing gear however, the government was very slow to respond - the process caused many delays. The delays caused property losses and wasted time for fishers.

Taxation

Before 1975, setting or collecting taxes for the exploitation of aquatic resources was the responsibility of villages. The national government set the rate and the villages submitted to it the required amount. The level of taxation for aquatic resources exploitation in Tam Giang lagoon was set according to lagoon basin, type of fishing gear and type of boat. For example, in the Nguyễn dynasty, tax levels were as follows: the annual tax for An Xuân lagoon was 8 *hốt* of good silver; for Vũng Chuồng (An Truyen), 66 *quan* 6 *tiền* 40 *đồng*[4]; for Sia lagoon, 40 *quan*; and for Đầm Dã lagoon, 620 *quan* (Duong Van An, 1961). Annual tax on medium sized hook and line was 2 *quan* 6 *tiền*; for small hook and line, 3 *tiền* 30 *đồng*; for a small boat, 6 *tiền*; and for a bamboo trap, 6 *tiền* 40 *đồng* (Le Quy Don, 1977).

Annually, in early lunar month III, auctions were held. Villages were assigned to organize and monitor the auctions. For instance, Ha Trung Village organized an annual auction for the rights to fish in Đầm Dã lagoon[5]. People who registered for the auction had to deposit 30% of the previous year's auctioned price to prove that they could afford to bid. The person who won the auction, usually a powerful and wealthy individual, had to then submit 30% of the present auction price to the province and 70% to the village. The same individual subsequently held another auction to interested *van* that then held auctions for their members. The mandarin or the trader (a wealthy land owner) who won the original rights managed fishers through heads of *van* and controlled his power through tax collection and management of water area. This is expressed in a motto cited by fishers:

> *The highest person is the chairman of Thua Thien province*
> *The second is the mandarin managing Đầm Dã lagoon*

From 1975 to 1993, the collection of taxes was the responsibility of the commune government who received a collection fee of 20 to 30% of the taxes before they were deposited in the state bank for distribution to all levels of government (including commune). At present, in many instances, the collection of taxes is the responsibility of the district and therefore the commune does not receive the collection fee (Phu Tan Commune Chairman, pers. comm.). As a result, the commune government of Phu Tan has lost interest in tax collection and does not assist district officials in tax collection. District officials, working and living far from fishing villages, are not as knowledgeable on the use of resources as commune officials are. Because of the lax registration of fishing gear and boats, aquatic exploitation has recently increased. The concept that "land is private, water is public" is now destroying lagoon resources. Without efficient implementation of government laws and lack of policies regulating the number of fishing gear and boats, the exploitation capacity of the lagoon has been exceeded.

---

[4] 1 *Quan* = 10 *Tiền*; 1 *Tiền* = 60 *đồng*

[5] Before 1968, Đầm Đả lagoon (also referred to as Đả Đả) was a name given to a small lagoon area which contains a small southern section of Ha Trung lagoon and a small northern section of Cau Hai lagoon. It was obviously an important fishing ground as indicated by the high annual tax.

Other policies

Besides the above mentioned policies, the government has issued policies on resource protection and social policies. However at different periods, these polices have received different levels of attention. Before 1975, governments based their management of resources on fishers' rules. After 1975 and especially recently, the Vietnamese government has issued many policies on the protection of aquatic resources, and environment (Laws on land - 1993, laws on protection - 1994), on social assistance (settlement, granting of loans, elimination of starvation and poverty alleviation, health care, family planning, etc.). However, the implementation and efficacy of these policies is rarely ideal and is hampered by many factors.

The roles of villages and government in management

The relationship between government and village is not simple and one-way. It involves a balance of authority, power and responsibility shared by the village and the national government (Phan Dai Doan and Pham Quang Ngoc, 1994). In reality, a village has tendency to both comply with and be independent of the national government. The tendency of the government is to manage villages. However, for many reasons, this is not completely successful. As collaborators, the government and village try to compromise to reach agreement in enhancing the people's livelihoods. A government that manages successful its rural area is one that knows how to take advantage of its relationship with villages.

Paul Doumer, governor-general of Dong Duong remarked on the role of the Vietnamese village: "It is a small republic and independent nation limited in local rights. It is a community which is closely organized, disciplined, and responsible to upper governments for its members, who the upper government may not need to know. This is very advantageous to the government" (Doumer cited in Duong Kinh Quoc, 1988). In his opinion, one way in which the government managed villages was through taxes. Tax levels were based on general wealth of a village and the village authorities were responsible for collecting and submitting the stipulated taxes. Paul Doumer appreciated the role of the Vietnamese village in community management. However, this doesn't mean all the responsibility of management was given to villages.

Vietnamese villages are responsible for management in coordination with higher levels of government. All activities in the villages have to comply with activities of government. The government, through middle authority levels, makes policies and laws which local villages have to implement. Of courses, to be effective, the government should manage with caution and reason. Some incidences have shown the opposite:

- Development of policies that are not enforced (for example: a minimum mesh size for fishing gear and a maximum of 5 ha granted for aquaculture)
- Development which does not respect the ownership and livelihood of fishers. For example, in the implementation of aquaculture expansion policy, many fishers have their fishing grounds taken away by privatization.
- Inequitable implementation of laws that cause division or favouritism within a community (eg. conflicts which arose in Phu Tan in June 1996 over the illegal appropriation of fishing grounds for aquaculture resulted in the sabotage of nets and theft of shrimp in Tan An. No move has been made by the government to investigate though legal suits have been filed).

MODERN CHANGES

As a result of over-population and over-exploitation of resources, many social changes have occurred: some fishers have moved to new economic zones set up by the government to de-populate dense areas, some find alternative income sources, and still others have escaped to foreign countries.

Under the socialist government, many changes have occurred in fishers' lives. As a result, informal rules have also changed. Technological advances have also made changes to fishing gear - bamboo is no longer used and has been replaced by nylon netting. The location of fish corrals and fishing grounds of other gear has changed due to natural and anthropogenic changes occurring in the lagoon. Fishers view the old rules as appropriate in the past but that they should be adjusted to suit the present.

Due to environmental changes, some fish have disappeared from the lagoon (such as gizzardshad) while new ones have appeared (such as local carp). As a result fishers have had to change fishing gear. Some old rules such as the length of fish corral and gillnets are no longer followed. Fishers can set gear of any length provided that it does not interfere with other fishers. These changes are negative, destroying the good traditions of fishers.

Some fishers have settled and started fishing in the area after 1975. Although perhaps born around the lagoon, they moved to the north under the Socialist Regime as soldiers and only recently returned. They are not aware of the old rules or ignore them.

Formal rules by the national and local governments have not covered all aspects of fishers' lives as the rules are too general and are applied too flexibly. Informal rules of the past were close to the fishers and their lives. At present, fisher's lives, fishing gear and natural environment are no longer appropriate to the old rules. Some old rules have been abandoned and others have changed to be appropriate to the present natural and social environment.

CONCLUSION

Government management and community management combine to manage villagers effectively and appropriately. At different times in history, the level of each approach to management in their combination varied. Before 1975, community management was emphasized over government management. On the contrary, after 1975, government management was emphasized. At the village level, community management seems to be more effective. However this community management must be supervised by the government.

It is difficult to compare the present-day management system of the lagoon to that under feudalism. Population pressure, resource degradation and wars have had an effect on the success of management regardless of its appropriateness. However management under the feudal times enabled fishers to have some decision-making power through the *van*. Managing villages were in close collaboration with *van* leaders, which created a stable management system. The present management is a centralized system in which villagers are not involved. It is not really effective in ensuring the security and stability of fishers' production. This is one of the reasons why fishers pay little attention to implementing regulations on protection of the aquatic resources issued by the national and local governments.

Laws, rules, ethics and public pressure are factors which create a balance and stabilize the community.

As mentioned above, the appropriate management unit of a rural lagoon area is the village. Effective management tools are rules. Written or oral, village rules play an important role in community life. Management based on rules, ethics and public pressure is effective. If village rules can be formalized into laws and government laws popularized as village rules, with some adjustments, a relationship between laws and rules is created. Moreover, in studying village rules, we have not found any serious conflicts between local rules and government laws. Therefore, by subtly integrating government laws into village rules, the efficiency of implementation will be increased while the cultural identity of localities preserved.

REFERENCES

Doumer, Paul. *Đông Dương thuộc Pháp (Hồi ký)* (Indochine belonging to the French (an autobiography))" as cited in Dương Kinh Quốc. 1988. *Chính Quyền Thuộc địa ở Việt nam trước CM tháng 8/1945*. (Colonial government in Viet Nam before August, 1945). Ha Noi. pp. 198-199

Dương Kinh Quốc. 1988. *Chính Quyền Thuộc địa ở Việt nam trước CM tháng 8/1945*. (Colonial government in Viet Nam before August 1945). Ha Noi, 1988.

Dương Văn An. 1961. *Ô Châu Cận Lục*. Translated into Vietnamese by Bùi Lương. Á Châu Publication. Sài Gòn.

Hà Ký. 1994. *Một số chính sách bảo vệ và phát trriển nguồn lợi thủy sản Việt nam*. (Some policies on protection and development of Vietnamese aquatic resources). Collection of scientific reports. National conference on Environment and Development of Aquaculture. Pages 240 - 241.

Lê Quý Đôn. 1977. *Phủ Biên Tạp Lục*. Scientific and Social Publications. Hà Nội.

Nguyễn Quang Vinh Bình. 1996. *Quản lý nguồn lợi thủy sản hệ Đầm Phá Tam Giang*. (Management of aquatic resources in Tam Giang lagoon system). Thuận Hóa Publications. Huế. 49pp.

Phan Đại Doãn and Phạm Quang Ngọc (eds.). 1994. *Kinh nghiệm tổ chức quản lý nông thôn Việt Nam trong lịch sử*. (Experiences in management of Viet Nam rural areas in history). CTQG Publications. Hà Nội.

Settlement of Sampan People

Võ Thị Hồng and Nguyễn Hữu Thông

SAMPAN PEOPLE

During southward expansion of Viet people under dynasties of Lý, Trần, Lê and Nguyễn (from the XI to the XIX Centuries), many agriculture villages were established in the Hue region. In Vietnamese traditional society, land and fields are basic necessities and people's property and pride. The original cultivators were worshipped and their descendants continued to expand areas under agriculture. Newcomers to an area had to accept less desirable lands and suffer scorn by the older villagers.

During those times, certain groups of people, isolated from mainstream society, moved to boats which became their homes as well as their source of livelihood. Known as "sampan people" (see **Appendix A** and **An Historical Perspective on the Management of Lagoon Resources**), they didn't own land for many reasons: War, loss, starvation, migration, etc. They weren't accepted by farmers and were considered as people with "no land to live on and no land for graves". Since permanent burial grounds are essential to ensure a successful afterlife in Vietnamese society, certain dunes near rivers were donated by "farmers' mercy" to sampan people to bury their dead.

Not accepted as members of villages, sampan people live in groups of relatives or friends called a *vạn* which can be considered as a 'village' or community. *Van* is a traditional unit, consisting of about 30 - 50 boats (or households) living together. A leader and a representative board are elected to manage community activities, such as organizing rituals, ceremonies, protecting rights for *van* people, etc. During Tự Đức's reign (1847 - 1883), the *van* was admitted as an administrative unit under the administration and control of villages on land. Fishers in *van* on Tam Giang Lagoon were allocated fishing grounds by the feudal government of the time for which taxes were collected twice per year at 2 villages (Thủy Diện and Thủy Tú).Characteristics of habitation, knowledge and customs, as well as fishing production of *van* are generally similar.

Vietnamese language has some contemptuous words (*Nôốc, Kẻ Nôốc*)[1] for sampan people. The distinction between land and water people has existed for many centuries and until now, the distance between people on boats and on land hasn't been eliminated. This accounts for the suffering attitudes and thoughts of sampan people. They live very closely together, are isolated from land-based society and avoid making trouble with people on land. As a result, they have not kept pace with land-based society and their relationships with this society are limited to trade. Their cultural and economic life is also underdeveloped relative to land-based Vietnamese. This distance is maintained and as a consequence, they are always scorned by others. In reality, farmer's bad impressions of sampan people are so deep that though present social policies are made to bridge the gap, it remains.

---

[1] *Nôốc* is a old word, meaning boat which is also shelter of sampan people. *Kẻ Nôốc* is sampan people. This word bears a scornful meaning.

RESETTLEMENT PROGRAMME

After 1975, the new Vietnamese government established a policy of planning and relocation of people and stabilization and development of the national economy. Through this policy, the government tried to settle nomadic communities in Viet Nam. The aim of settlement or relocation of a nomadic community relates not only to the aspect of livelihood stability but also to the solution of environmental problems - ie. because of an unstable livelihood, people may have inappropriate behaviours with regards to the present environment. According to the Vietnamese government, communities which should be settled or relocated are diverse:

- Minority people who are nomadic, live in stilted houses and practice slash and burn farming.
- Farmers who live in delta areas where population density is high and resources are exhausted.
- People who live around canals or in slums, especially in and around urban areas.
- People who live on boats (Sampan People)

For this purpose, New Economic Zones (NEZ) were established in unpopulated areas where newly settled or re-settled people were assisted in establishing agricultural communes.

In reality, the livelihoods of each of these people have their own particular features. Therefore, planning of settlement should be different for each case - even the settlement of different groups of sampan people in Thua Thien-Hue Province. For example, sampan people who live on rivers (Bo, O Lau, Huong, etc.) have different characteristics depending on whether they live upstream, downstream, in the city centre or on the outskirts of the city. Differences also occur between sampan people living on the lagoon close to the estuary and sampan communities near villages on main land and between communities who live close to farming communities and those isolated from them.

Settling sampan people into agricultural areas presented many problems particularly socio-economic. Factors related to settlement are: soil, infrastructure, jobs, social welfare, habit and custom. Traditionally fisher people, many have had many difficulties in the NEZ where they had to learn agricultural practices. Thus, recently, many programs focussed on sampan people were carried out to research and implement settlement for sampan communities.

- Resolutions and implementation by government and mass organizations of settlement models for sampan people from the Huong River (flowing through Hue City) in urban areas such as Trường An, Kim Long and Phú Bình.
- Research topics and proposals by academic institutes (e.g. Department of Geography, 1987)
- Issues raised by press (Nguyen Phan, 1993; Phan Hoang Quy, 1992; Duong Thanh Vu, 1991)
- International research and financial programs[2]

[2] Reports of "Centre de Protection Maternelle de la Rivière des Parfums à Huê - Viet Nam" and activities by Nordic Assistance to Viet Nam (NAV), a Norwegian NGO.

Each program had its own objectives and activities and coordination among the programs or topics was lacking.

In 1985, a terrifying storm resulted in death and destruction to communities living in the whole province of Thua Thien-Hue and sampan people especially suffered the most serious losses to life, boats and property. After the storm, the provincial peoples committee and other functioning agencies made greater efforts to implement settlement for sampan people. In October of the same year (after the storm), a DoF census estimated the sampan population at 1405 households with 7754 people. The province of Thua Thien-Hue established 41 settlement areas, located in 30 communes of 5 districts (Table 1). The same storm brought fear into the minds of many sampan people which made them want to settle on land. However, several years later, most of these people returned to living on boats.

Sampan people or newly-settled sampan people must be assisted to overcome historical gaps and prejudice, so that they can be confident and integrate into the larger community. The study, analysis and interpretation of events in sampan people's life are critical to designing good resolutions, i.e. finding appropriate settlement area and helping them integrate into the community.

LIVELIHOOD STATUS OF SAMPAN PEOPLE

A 1995 survey carried out by the DoF in all of sampan locations on the lagoon edge indicates that sampan people are experiencing difficulties in production and livelihood activities. The property of a sampan household in general consists of some wooden or aluminum boats and some mobile fishing gear. Other possessions have little value.

Most sampan households have lived on boats for hundreds of years through many generations as validated by interviews with sampan people from 3 communes in 2 districts: 8 households in Phu Xuan (Sam lagoon) claim that their ancestors have lived on boats for more than 100 years; 6 out of 8 households in Loc Dien (Cau Hai lagoon) have lived on boats for over 200 years; and 7 out of 8 households in Vinh Hung (Thuy Tu lagoon) for over 100 years.

Birth rates

Though the national government has a programme of population control which is promoted in all agricultural communities through health clinics, the campaign is not effective in sampan communities who are isolated from mass media information and from clinics. In 3 lagoon communes closest to Hue city (ie. the least isolated), birth rates among sampan households is still very high. The average number of people per sampan household is 6 to 13 of which 70 to 80 % are children compared to agricultural villages where the average couple has 2 to 3 children. As an example of a sampan family in Quang Thai commune, Mr Nguyễn Kỉnh has 2 wives, 20 children and over 100 grandchildren.

Education

The education level of sampan people is low. Ninety percent (90%) of sampan people are illiterate. Presently, most children quit school after finishing elementary level. Classrooms are made of bamboo and thatch, are constantly damaged and thus few children go to school. Interviews with sampan children in 3 communes in Phu Vang district (closest to the city of Hue) provided the following information:

Table 1. Settlement areas for Sampan people, their location and household information.

District	Commune	Settlement area	No. of HH	# of people	# of Labourers
Phong Điền	Điền Hải	Thế Chí Đông	26	183	67
		Điểm Chợ Mới	41	287	96
		Minh Hương	19	91	26
	Điền Hòa		46	495	94
Quảng Điền	Quảng Ngạn	Group 8 hamlet 13	61		
	Quảng Thái	Quảng Thái	60		
	Quảng Lợi	Mỹ Thạnh	60		
	Quảng Phước	Phước Lập	110		
	Quảng Thành	Vạn Hòa Xuân	30		
	Quảng Phú	Quảng Phú	30		
	Quảng Công	Hamlet 14	32		
	Quảng An	Quảng An	330		
Hương Trà	Hương Phong	Thuận Hoà B	20	75	49
	Hải Dương	Cồn Dài	15	101	46
Phú Vang	Phú Tân	Cồn Mu Thiên			
		Lê Bình - Tân Thủy			
		Mẫu Bảy			
	Thuận An	Hải Tiến	203	1326	349
	Phú Xuân	Lê Bình	32		
		Thủy Diện	59		
	Phú An	Đồng Miếu	111	611	226
	Phú Đa	Viễn Trình	46		
		Làng Viện	51		
	Vinh Phú	Hà Bắc	14	87	21
	Vinh Hà	Hà Giang	233	494	309
	Phú Diên	Thanh Mỹ	105	783	217
	Vinh Thanh	Vinh Thanh	12	62	30
	Vinh Xuân	Vinh Xuân	15	104	43
	Phú Thuận	Cồn Sơn	45	280	138
	Phú Hải	Phú Hải	4	31	11
	Vinh An	Vinh An	11	58	22
	Phú Mỹ	Phú Mỹ	46	258	116
Phú Lộc	Lộc Điền	Group 30	196	1570	
		Bắc Sơn	7	36	
		Phú Thanh	23	244	
	Vinh Hưng	Đình Đôi	75	375	157
		Giếng Bôn	65	338	139
		Ba Cây	10	52	24
	Vinh Giang	Giang Xuân	74	419	162
	Lộc Bình	Mai Gia Phường	62	352	137
	Total		**2539**	**13,958**	**5532**

- In Phu Thuan, 46 out of 58 children (79.3%) are illiterate.
- In Phu Tan, 36 out of 45 children (80%) are illiterate.
- In Phu An, 34 out of 39 children (87.2%) are illiterate.

Similar interviews with heads of sampan households in 3 districts concluded that:

- In Phu Vang District, 30 out of 56 head of households are illiterate or can only read (not write). Only 26 finished elementary level.
- In Phu Loc District, 29 out of 32 heads of households are illiterate or can read only. Only 3 finished secondary school level.
- In Huong Tra District, out of 8 heads of households interviewed only 1 finished secondary level, 6 can read and 1 is illiterate.

Fishing activities

All sampan households operate fishing gear in the lagoon: fixed gear such as fish corrals and bottom nets and mobile gear such as gillnet, pushnet, and dragnet. Catches are low and, since the density of fishing boats and fishing gear are very high at present, catches are constantly decreasing. Incomes are very low, especially for the poorer sampan people who operate mobile gear.

Expectations

Of sampan households interviewed, all of them desired to settle on land. They need land, housing, and occupations with a stable income. They want their children to go to school, and their life not to be threatened by natural disasters (floods and storms).

METHODOLOGY

This paper has combined the research activities at 2 sites on the lagoon. Trung Lang, Quang Thai commune, is located on the northern tip of the lagoon system (Map 4, p. 4). This village contains both an old settlement area of sampan people from 1905 as well as a *van* of sampan people who are still living on their boats. Tan Thuy, Phu Tan commune, is located near the Thuan An estuary (Map 5, p. 5). This area contains an old settlement of sampan people, a very recent settlement funded by a government programme, and sampan people still living on boats.

Trung Lang study

Site selection

Trung Lang (Map. 4, p. 4) was selected as a research site for the following reasons:

- In Trung Lang most of the villagers are sampan people and sampan-originated people who have settled and both groups live close together.
- The settlement of the sampan people on land in Trung Lang was originally self-motivated by practical needs and favourable conditions under feudalism. Later settlements were organized by

government settlement programs.

- In Trung Lang, there are 3 production groups (fixed gear fishers, mobile gear fishers and farmer-fishers) whose members consist of a majority of land-based sampan people having settled from as early as 1905 to the present. The mobile fishing group also includes some sampan people who never settled as well as those who have returned to boats after attempting to settle on land.
- The sampan people in this area have typical features of sampan people on the lagoon: a long history of habitation in *van* units, particular livelihood system, tradition and customs.

Interviews

Many written documents on sampan people in Thua Thien-Hue are available however they contain descriptions, survey results or recommendations for settlement which are so general that they can not be applied to a specific area under specific conditions. Therefore, in the study on Trung Lang village, information was mainly obtained from observation and interviews with local villagers. The people involved in the interviews were:

- Sampan people who either never settled or returned to boats after trying to settle.
- Sampan-originated villagers settled in Trung Lang for several generations
- Farmers in Lai Ha and Trung Lang (neighbours of sampan people)
- Local government officials (primarily those concerned with the affairs of sampan people)

Because of their special living conditions and homes, local sampan people are shy and lack confidence in communicating and expressing their ideas within a larger community, and in participating in solving community's problems. They consider researchers as people from a land-based society which creates a gap difficult to overcome. They are not accustomed to filling out sociological checklists or questionnaires (most of them are illiterate). Thus the collection of information was done by the researchers - ie. counting and recording every boat.

Observation

Observations were made in:

- Trung Lang settlement area
- Tram Ngang - Quang Thai settlement area (a failed settlement area)
- A future settlement area for sampan people planned by the commune (near Trung Lang).

Policy analysis

Local government's policies and regulations were reviewed by researchers. Discussions among researchers and villagers, including confidential conversations, were focussed on the problems related to settlement. Through these discussions, researchers could act as a bridge, to disseminate the local government's view to villagers, and vice versa. The researchers collected information to exchange with local government on villagers' needs and desires.

Tan Thuy study

Interviews with sampan people and settled households were conducted in combination with a survey on "building a model for settlement of sampan people in Tam Giang lagoon" carried out by the DoF. Travelling on the lagoon by boat, the researchers interviewed sampan people in Phu Tan (Map 5, p. 5).

Checklists were used to get information from local households. The survey was implemented in 37 out of 41 settlement areas. In each area, 5 to 10 households were interviewed. In Le Binh - Tan Thuy, randomly-selected groups of poor and rich, settled and sampan households, and those who own land and those who don't, were involved in the interviews. Documents from the DoF and the Statistics Division of the Department of Science, Technology and Environment (DoSTE) were consulted.

The collected data was analysed and validated by going back and presenting the information to selected groups. The results were used to interpret the failure of settlement in some areas - the return of some households to sampans - and to understand sampan people's expectations of models of settlement, which would be appropriate with sampan people's expectations, customs and tradition, education and socio-economic life.

The results were presented to Tan Thuy management officials and villagers to get their comments.

TRUNG LANG, QUANG THAI COMMUNE

Quang Thai Commune lies in the Northern most part of Tam Giang lagoon. As with most areas around the lagoon, it was originally made up of farming villages among which are Lai Ha and Trung Kieu. Nearby on the lagoon lived a sampan community called Van Ong Chanh which was under the management system of Lai Ha village (Map 4, p. 4).

In 1905, Mr. Hoàng Dình Suông bought 2.2 *mẫu* (2 *mẫu* = 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 households and 4 farming households who didn't own land. It became a small hamlet though it was rather isolated from the neighbouring agricultural villages. Over time, the hamlet grew with a purchase of 5 additional *mau*. Because this piece of land is located between the 2 villages, it was called Trung Lang (Middle village). The initial 12 households has now grown into 102 families with more than 600 people. Most villagers originated from sampan families who settled over the years since 1905. There remain 124 people still living on boats and officially registered as members of Trung Lang village.

Most Trung Lang people fish for a living and belong to 3 production groups. The majority of members of Group 2 (Fixed Gear Group) own fish corrals and FADs. The majority of Group 1 members (Mobile Gear Group) operate trawl, gillnet and pushnet. Group 5 is fishing-farming group whose members farm and operate some mobile gear, such as pushnets and eel rakes. Households that own fish corrals get higher and more stable incomes than mobile gear owners. The majority of sampan people belong to Group 1 who, in general, meet a lot economic difficulties.

Talking with and listening to them, we came to realize that the poverty of sampan people results from a psychology established by a floating and unstable life on water and not owning any land. Based on the Vietnamese principle that "land is private and water is common property", they don't develop or invest in their fishing grounds. In addition, though the income is low, it is different to income earned from agriculture: there is no reason to save for the future as the day's catch pays for day's needs. They don't

feel they need to save money and invest it into their exploitation areas or in gear. Sometimes, especially, during the stormy season, they lack food - an experience shared by many generations.

Van Ong Chanh

As mentioned, before 1905, Trung Lang was a field on the edge of the lagoon and the lagoon area nearby belonged to Van Ong Chanh. Over time, the *van* should have disappeared, especially after the storm of 1985, when sampan people were encouraged to settle on land by the local government. However, for some reason, some households remained living on boats. After 10 years, according to an informal census carried out in this study, the population has actually increased to 119 people in 18 households with 29 boats (7 households with 1 boat each and 11 households with 2 boats each).

Of the 18 households only 2 own a fish corral each while the rest use mobile fishing gear. Though, in some cases, the income may be sufficient, the community is very poor. This can be explained by the isolation in terms of culture and society that has hindered their education and the development of an organized community.

Their relations with other communities are limited - even with the sampan-originated Trung Lang people. Three (3) children go to regular school but they stay near the school and since 1995, 10 children have been attending a special evening class in Trung Lang organized under a humanitarian aid program. However the children attend the class only if encouraged by their families and only when the weather is good. The sampan families organize a boat every night to gather all the children and bring them to Trung Lang.

All the sampan families want to settle on land, though there are many hesitations and worries:

- Low education level - fear of being cheated and not able to face and withstand new difficulties and challenges.
- Lack of close relatives and friends - fear of having no help when encountering difficulties.
- "Homesick" - missing life on water
- New livelihoods - since they only know how to fish, when far from water, they fear they will not be capable of earning a living.
- Isolation and competition: Fear that farmers won't sympathize with them.

Changes in population

Establishing a settlement requires a good environment - physical, social and psychological. However, first and foremost the number of people to be settled must be determined with certainty. The number of sampan people in Van Ong Chanh changes frequently for many reasons:

- Long term absence from their area to fish or temporarily live in other *van*
- Return of some previously settled people to a life on boats
- Permanent move (without registring) onto land or to another *van*
- Entry into the *van* of some boats from other *van*

- Entry of new couples who lived on land but with no access to land, they bought boats and joined the sampan people.

Lack of work causes many children to migrate such as in the case of Mr Phạm Kỷ who has 2 wives and 18 children. Of his children, 7 live in Vạn Cửa Rài (about 4 km south of Van Ong Chanh), 5 moved to NEZs in provinces of Rach Gia and Dac Lac and 6 have died. All the surviving children have children of their own.

Over the project period, changes in population occurred frequently. For example, in June 1996, a list of population of Van Ong Chanh was made for the present study. Making the list was simple because population was low. Two months later, Mr. Hồ Văn Phép, Vice chairman of Quang Thai Commune People's Committee provided an official list of sampan people. The two lists are quite different as indicated in Table 2.

In the 2 lists, only 6 households in 21-household list were identical (in name and number of household members). In 6 cases, the name of head of household is identical but the number of family members differs. This reflects on the system of registry - in many cases households do not register or do not have the right to register because their move is illegal. The People's Committee are reluctant to register new sampan people into their authority since they will be obligated to provide services and, eventually, land to all those registered.

Over the research time, some examples of moves were observed:

- Phan Thị Tình (a woman-headed household): Returned to the *van* after trying to settle.
- Phạm Kỷ: Settled with a land grant but later passed it on to other people and returned to the *van*.
- Nguyễn Quả: Fishes far away from Quang Thai and is often absent from the community
- Hà Lộc and Hà Quạt: Immigrated recently from other areas

Settlement attempts by local government

In 1986, a settlement was established in Tram Ngang village for 15 sampan households. As planned, each household was granted 100 m^2 land, materials for building a house and food for the first 6 months on land. Eventually all of them abandoned everything and returned to their boats.

Through interviews, we were made aware that local government authorities had their own plans for the settlement of sampan people. However, these plans have not been carried out yet because they are still seeking financial support - Quang Thai commune has sent a proposal for national government support. Their proposal mentions that the commune will use part of the 5% land allocated to the commune (according to decree 64) as a settlement area. This area is located between Trung Lang village and Niu River. It is low-lying and prone to flooding but settled people could be supported by the commune to build raised terraces. Its most advantageous point is that is located close to Niu river. Additional support for settlement will depend on financing by the central government or other organizations.

Table 2. Sampan people living in Quang Thai listed by household head and by number of family members. The Researcher's List was compiled by the researchers through interviews and observations and the PC List is from the official registry of Quang Thai People's Committee.

Researchers' List			PC List		
#	Name	# People	#	Name	# People
1	Hà Chiến	5	1	Hà Chiến	5
2	Hà Cường	3	2	Hà Cường	3
3	Hà Đức	10	3	Hà Đức	8
4	Hà Lộc	7	4	Hà Lộc	5
5	Hà Lụa	3	5	Hà Văn Lụa	3
6	Hà Quạt	10	6	Hà Quạt	7
7	Hà Tắc	10	7	Hà Tắc	10
8	Hà Tuấn	8	8	Hà Tuấn	8
9	Nguyễn Quả	6	9	Nguyễn Quả	6
10	Nguyễn Thiết	7	10	Nguyễn Thiết	8
11	Phạm Kỷ	9	11	Phạm Kỷ	7
12	Phạm Lơn	5	12	Phạm Lơn	6
13	Hà Khánh	4	13	Hà Hóp	9
14	Nguyễn Khánh	3	14	Nguyễn Nọ	3
15	Nguyễn Kỉnh	9	15	Phạm Vọng	4
16	Nguyễn Mốc	8	16	Phan Thị Tình*	5
17	Nguyễn Thị Nhớ	1	17	Trần Hùng	3
18	Trần Thương	11	18	Trần Khê	8
			19	Trần Lũy	4
			20	Trần Thị Vách	2
			21	Trần Tính	10
Number of Families		18	Number of Families		21
Number of People		119	Number of People		124
# hhs with > 6 people		10	# hhs with > 6 people		9

* Woman-headed household

TAN THUY, PHU TAN COMMUNE

To understand the reasons of the failure of settlements, Tan Thuy village, a large settlement area in Phu Tan commune, Phu Vang district, was chosen as a research site (Map 5, p. 5). Tan Thuy village is located on 12 ha of sandy loam, on the right bank of Huong River estuary, 2 km from Thuan An estuary, 12 km from Hue city and 100 m from Thuan An road (a provincial road). This area is advantageous for both water and road transportation. It is located near a market, where aquatic products are traded and carried to Hue City, and a boat landing shore. The area belongs to Tan An village and is the most appropriate for settlement. Fields in the area are saline-intruded and muddy and can not be used for rice production. Therefore, the villagers earn living only by fishing. Crop production was not observed, only bamboo is planted around houses. Though belonging to Phu Tan commune, a relatively rich commune in Phu Vang district, the lives of most Tan Thuy villagers are not stable.

Tan Thuy village was established as a settlement area for 42 sampan households (324 people) in October 1985 by the district and commune governments. Each household was granted materials for building a house and 10 kg of rice (equivalent to 1.2 million VND). Because of the fear caused by the storm, some households decided to settle permanently and invested their own or borrowed money to build stronger, more permanent houses.

Though they began living on the land, their lives were still attached to the water. Living on land, they felt, was not convenient. Fishing is a job of "following the fish's tail". Usually, adults fished at night leaving behind children and old people which made them vulnerable to being robbed of the little property they owned. At that time, a few households returned to living on boats. For 5 years, conflicts between sampan young men and young men of neighbouring villages grew to a point when the settled people wished to return to their boats. Thus in 1990, only 20 households remained in Tan Thuy.

In 1993, a new national government policy on settlement specifically for all sampan people was decreed and the Department of Labour implemented once again the settlement of the sampan people. In 1995, when we conducted research in Tan Thuy village, there were 2 settlement areas: Le Binh and Tan Thuy. In Tan Thuy, 51 households were registered in the population list. However, only 42 households had built houses or terraces, and 9 households were still living on boats. The land for housing was small with each plot measuring only 120 m^2 and located very close to each other with no drainage system or toilets. The market and the edge of the lagoon served as the community toilet.

Education and social life

Before settling on land, sampan people lived in a very close community and had very limited contact with land-based people - their lives were simple and honest. Now living in Tan Thuy, they are still naive about life on the land and very curious about their surroundings and neighbourhood.

When asked why they returned to boats after the first settlement periods, they gave the following reasons:

- Unable to adapt to life on the land
- Afraid of farming because of a lack of experience and skill.
- Afraid of officials and villagers who are land residents.
- Simple and ragged houses, small land holdings, constrained life

- Absence while fishing resulting in vulnerability to theft

For economic, educational and social reasons, settlement for sampan people has often failed and sampan people want to return to boats.

RECOMMENDATIONS

The following recommendations should be considered in planning new settlement areas:

- Sampan communities have existed for many generations as a life among friends and relatives. This should be considered when implementing settlement.
- Commune officials must recognize the fact that membership in a *van* is very flexible. If the basis for designing the settlement project is an outdated list of *van* members, households not on the list would emerge after the settlement has been implemented causing complications in land allocation. Sooner or later, another *van* would emerge, including people from other places.
- Appropriate land area for settlement: the settlement area must be located close to the lagoon so that sampan people can adapt more easily to their new life. They could still use their boats and continue fishing at least until they became accustomed to a new life. This would avoid big changes in their livelihoods and improve success of settlement.
- Land area granted should be large enough, so that they will not feel cramped.
- Education and training should provide sampan people the knowledge and skills to learn alternatives to fishing to help stabilize their livelihoods. A combination of fishing, farming and aquaculture could be introduced to create jobs and improve their standard of living. Job training (such as handicraft making), appropriate to their ability and available resources, should be held locally, or if in farther places, their participation should be made possible. Marketing for developed products must be developed.
- Infrastructure in the new settlement area, for living and development, should be considered: roads, schools, water, clinics, etc. Classrooms should be made available for children to improve their education. Newly settled people must have equal access to available infrastructures with land-based people.
- Cultural activities (social, sport, musical, etc.) should be developed for sampan and settled people to integrate them into the surrounding farming communities.
- Support for building houses and capital for economic ventures should be provided. Settlement for sampan people must be developed in parallel with the improvement of socio-economic life in the communities.
- Sampan people should be aided in developing appropriate livelihoods so that they can earn stable and sustainable incomes. Their income level should be high enough for their needs but diversified so that the lagoon is no more the only resource pool exploited and exhausted.

REFERENCES

Department of Geography. 1987. *"Những cơ sở khoa học và thực tiễn của việc định canh định cư ngư dân đầm phá Bình Trị Thiên"* (Scientific base and practice of settlement of sampan people in Binh - Tri - Thien lagoon). Department of Geography, Hue University of Pedagogy. Presented and defended before the Department of Science, Technology and Environment, Thua Thien-Hue Province. December 1987, unpublished report.

Dương Thanh Vũ. 1991. *Dân Vạn đò trên sông nước sông Hương* (Sampan people on Huong river). Sunday Labour newspaper. 1991.

Nguyễn Hữu Thông. 1993. *Cư dân thủy diện sông Hương: Thực trạng và những vấn đề cần quan tâm* (Sampan people on Huong river: real status and concerns). Thua Thien-Hue newspaper, No. 309, 1993.

Nguyễn Phan. 1993. Viet Nam les gitans de la riviere des Parfums. Visages de L'Aventure Solidaire No. 55.

Phan Hoàng Quý. 1992. *Những con đò trên sông Hương* (Boats on Huong river). Board of Science and Technology, Thua Thien-Hue. Magazine of Scientific and Technological Information No. 1, 1992.

Gender Roles in Farming and Fishing Activities

Lê Thị Nam Thuận

INTRODUCTION

Quang Thai is a commune located on the northern tip of the Quang Dien district. It is located 15 km from Sia town and 50 km from Hue City (Map 3, p. 3). The main economic activities in this commune are farming on poor soils and fishing in a lagoon area of nearly 1000 ha in the northern section of Tam Giang lagoon.

Natural conditions, however, are very severe. Floods in rainy season and drought in dry season cause difficulties for agricultural and fisheries production and for living activities. Infrastructure is poor; there is no electricity[1]; and education levels, production skills and knowledge are low. Natural and socio-economic conditions affect gender roles through labour division and other activities in the community.

The present research describes gender roles in fishing, farming and fishing farming communities in Quang Thai commune (Map 4, p. 4).

METHODOLOGY

Interviews, observation, mapping, plotting and other PRA tools, were applied to record data and information. Households participating in this research also contributed to other research on fishery and freshwater macrophyte exploitation in the lagoon.

Collaboration with commune PC and the local chapter of the Women's Union helped validate the information and identify advantages and problems facing women in their work.

ACCESS TO RESOURCES

Agriculture land

After 1975, cooperatives were organized in central Viet Nam and land management was under government control. In 1994, as stipulated by Decree 64, land was allocated to Quang Thai farmers for long term use and cooperatives were relieved of decision making in farming production. Though cooperatives still exist, their role is minor mainly assisting farmers in accessing agricultural supplies and sometimes in marketing (see **Appendix A**).

Through the land allocation, men, women and children received equal shares of land such that each household was allocated an area of land based on the number of family members at the time. The amount and location of the land also depended on soil type and potential crops produced on the land:

---

[1] Electricity was installed in Quang Thai in June 1997 however at that time only 50% of households had access to it. It was not affordable to the rest.

- Sweet potato and peanut fields: 200 m^2 per household member
- Rice and cash crops fields producing 1-crop/year: 250 m^2/person
- Rice fields producing 2-crops/year: 200m^2/person
- Sandy upper land (mostly only suitable for tobacco and chili): under open access. Its use depends on household capital and labour.

Lagoon water area

Fishing grounds were not granted to any household or person as was agricultural land. Mobile fishers follow the saying "land is private, water area is public". Fishers using fixed gear (mainly fish corrals) exploit fixed fishing grounds with rights passed on through inheritance or by winning bids or purchasing then from previous owners. All rights to fixed gear areas are held by males and inherited by sons. No woman-headed household owns the rights to an area. Despite this fact, fixed gear fishing areas are, in Viet Nam, considered as equally shared by the husband and wife.

Taxes

Taxes on agricultural land are applied in the farming community. Households pay taxes to the national government through the commune government based on potential crop production. Taxes on fishery production is applied only to fish corral owners at 40,000 VND/unit/year. Mobile gear fishers are not liable for taxation.

GENDER ROLES IN LABOUR AND LIVELIHOOD

A farming community (Trung Kieu)

Trung Kieu is a village of Quang Thai commune belonging to Tam Giang Cooperative. The main economic activity is crop production. Other activities include trade, animal production, and the production of wine, conical hats and construction material. Because of the severe climate and poor infrastructure (especially irrigation system), farmers encounter a lot difficulties. Local villagers, both men and women, struggle to maintain their livelihoods.

Observation and interviews in Trung Kieu show that men are key people and leaders in both society and in family. They participate in the local government, in production groups and in the cooperative. In the family clan, they are heads who are respected and esteemed. In economic activities, men are always responsible for hard labour: preparing the land and plowing. However, in women-headed households, women have to do these hard jobs themselves. Women are most active in education, health care, trade in local and district markets, making conical hats and brick making.

Both women and men harvest crops. Besides crop farming with men, women do other activities such as raising animals, making wine, making conical hats, collecting thatch and growing chili and tobacco seedlings. Producing chili and tobacco seedling creates jobs for many women in the flood season (lunar months VIII to X, see **Appendix A**), bringing in income for the family and meeting local demand for seedlings.

During the slack season, many men and women 13 to 35 years old leave their village to find work. Most of them migrate south to work on coffee bean plantations (months IX to XII). Some girls (10 to 15 years old) work as servants for families in cities. This indicates a lack of jobs for youth, a critical issue in the community. Children, mostly boys aged 7 to 15 years old, help their families by caring for buffalo after school. Most of children go to school (except for children of very poor families) however, they usually quit school after finishing secondary school (at about age 15) for economic reasons and because of difficult travelling conditions: the high school in Sia town is 15 km away (Map 3, p. 3). Most girls quit school earlier than boys to help their families with economic activities, care for their younger siblings and do housework.

Labour division in Trung Kieu village is determined by gender and tradition based on the difference in strength of the 2 genders: most of the hard labour is done by men. However, in the home, women are supposed to do all housework, care for the children and husband, and raise animals. Men sometimes do housework but, in reality, spend more time drinking with their male friends during free time.

Another problem in Trung Kieu is high population growth rate partly due to the fact that there are no evening activities and no electricity so people go to bed early, and also due to the desire for sons. Recently, they have become aware that poverty is also caused by having too many children, and are gradually applying family planning. This is especially the case for young couples.

A fishing and fishing-farming community (Trung Lang)

There are 3 production groups in Trung Lang: mobile gear owners (Group 1) and fixed gear owners (Group 2) and households involved in fishing and farming (Group 5). Gender roles in Trung Lang are different and more varied compared to the farming community in Trung Kieu. Labour division is also based on strength and gender roles. Migration for jobs is also common in Trung Lang - the lack of jobs for youth is an issue for the whole commune.

Access to education in this village is very limited even compared with Trung Kieu. Only 2 or 3 girls have finished secondary school. Most children participate in fishing and trade and help their parents with family work such as taking care of their sisters and brothers, cooking and washing. Males and females older than 6 years old (except for old people) all participate in fishing activities in the lagoon and in trading products in markets or at landing shores. However, for different types of fishing gear, participation level and type of work for males and females vary.

Mobile gear fishers

These households use gear such as pushnet, dragnet, eel rake and macrophyte rake, and collect clams by hand. Men repair boats and gear, drive the boats and operate macrophyte rakes and set the nets. Operating dragnets and eel rakes is done by both males and females, usually 6 - 8 hours per day. Women also join the men in macrophyte harvesting, and hook and line fishing while pushnet and clam collection are specifically women's work. The latter require patience and endurance - the fisherwoman must stand in water for many hours (even in cold weather and at night).

Fixed gear fishers

Setting fish corrals and emptying cod ends are jobs for men because this work requires much strength. Men also drive boats and set the nets. Women do the less physically demanding work such as repairing

nets and making fish corral weirs and cod ends. In households operating fish corrals, women also operate pushnet to supplement the family income.

Fishing-Farming

The combination of fishing and farming provides higher incomes than either activity alone. However, it increases the labour intensity for both women and men. Besides farming during the appropriate season, they fish to supplement their diet and their incomes and to provide inputs for other production activities: for instance freshwater macrophyte is harvested for crop and animal production. They do not need to purchase aquatic products like farming households do but exploit them directly from the lagoon. Labour division between men and women is similar to that in farming households and fishing households. However, the time devoted to fishing is different from other fishing households. Fish corral catches are mainly collected by men at night. Women operate pushnet and harvest freshwater macrophyte and clams during the slack periods or at any convenient time. These households try to make maximum use of available resources to improve income and life therefore, their living standard is better.

Besides fishing, women trade the daily catch from 7 to 7:30 am and from 1:30 to 2 pm. They have to work intensely and continuously all day long to earn a living, organize the family and care for children. In households operating fixed gear, the women's work is easier while the contrary is true in farming-fishing and mobile gear households since, in addition to farming or family care, they fish to supplement their income. In Trung Lang village, most of women work very intensely. Fishing can always occupy their free time.

GENDER ROLES IN RULES, CUSTOMS AND RELIGIONS

The farming community in Trung Kieu and fishing and fishing-farming communities in Trung Lang, like other Vietnamese villages, are affected by a Southeast Asian traditional idea that "men are respected and women are scorned". In the family, men are key labourers bringing in the main income. Taking care of and organizing family, educating children, doing housework and raising animals are women's responsibilities. Women consider the fulfilment of these jobs as heaven's mandate and therefore voluntarily make whatever sacrifice is needed. In these matters, the woman's role is equal to that of the man in the family, and sometimes the woman's role is more important. In many households, family expenditures are discussed and decisions are made by agreement of both husband and wife. In women-headed households, the women have to do all the work themselves and work harder than most.

Trade of agricultural and aquatic products in local markets is a very busy occupation and one done mainly by women. Many women try sell their products in Sia market using available transportation - either bicycles or *xe lam* (tiny 3-wheeled trucks). This creates an economic link with other communities and is one way to bridge the cultural gap between the village and the town.

In society, men's roles are more visible than that of women. Interviews with villagers show that men represent their family, the cooperative and local government, and participate in activities such as studying government policies and laws and attending religious ceremonies of village or clan. This was apparent in our interviews with households: those who received us and answered our questions were always men and household heads. During the inauguration ceremony of Phong Lai village temple in Quang Thai (located near Trung Kieu), only men participated at the main ceremony. Only later, 3

Vietnamese Heroic Mothers[2] were invited to join the feast. All the other women were in the background, responsible for cooking.

Due to tradition and difficult natural conditions, villagers, especially women, do not have the opportunity to improve their education and learn about family planning. In the research site, especially in the fishing community, the population growth rate is very high: each family has 6 to 7 children. One typical couple (30 years old) has 5 children ranging in age from 1 to 9 years old. Having many children increases poverty, causing malnutrition and poor care for children. To provide for such large families, women have to work with their husbands on the lagoon and in the fields. This is one of the critical issues which need to be addressed in the socio-economic and cultural development of the locality.

In the last two revolutionary wars against the French and Americans, women sacrificed a great deal - the whole village had to be abandoned for a long period during the last war. In Quang Thai, 90% of the households are honoured families who served the Revolution with honour and there are 19 Vietnamese Heroic Mothers in the commune. Through these people and their honourable efforts, Quang Thai was awarded the name "Heroic Army". This is in part due to the great contributions of the patriotic women of this area.

BIOCLOCK OF WOMEN

Based on collected information, bioclocks of women in the farming community in Trung Kieu and in the fishing and fishing-farming communities in Trung Lang are drawn in Figures 1 and 2:

Farming women (Figure 1)

0430: prepare breakfast, feed animals, water tobacco and chili (from months X to V)
0700: do farming or service work according to crop season
1100: Prepare lunch, feed pigs, prepare things for the market
1330: do farming, go to market to trade
1800: Prepare dinner, feed pigs, bathe children
2000: clean house, do washing, plan for tomorrow's work, chat or relax
2300: sleep

Fishing and fishing-farming women (Figure 2)

0430: prepare breakfast, trade aquatic products at the lagoon; water chili and tobacco (if farmer-fisher)
0700: farm or fish (macrophyte harvesting, clam collecting...)
1100: prepare lunch, feed animals, prepare things for the afternoon market
1300: farm, fish, trade aquatic products in the local commune market or at the shore, or prepare hook and line, make fish corral weirs and cod ends
1700: Prepare dinner, feed animals, bathe children

---

[2] Vietnamese Heroic Mothers - This title is awarded by the Vietnamese government to women who have lost 3 or more family members as a result of the war and have no one to look after them at the present time. The government thus takes on the responsibility to care for them by awarding them with a pension and other necessities.

Figure 1. Biological clock of women in a fishing community in Quang Thai

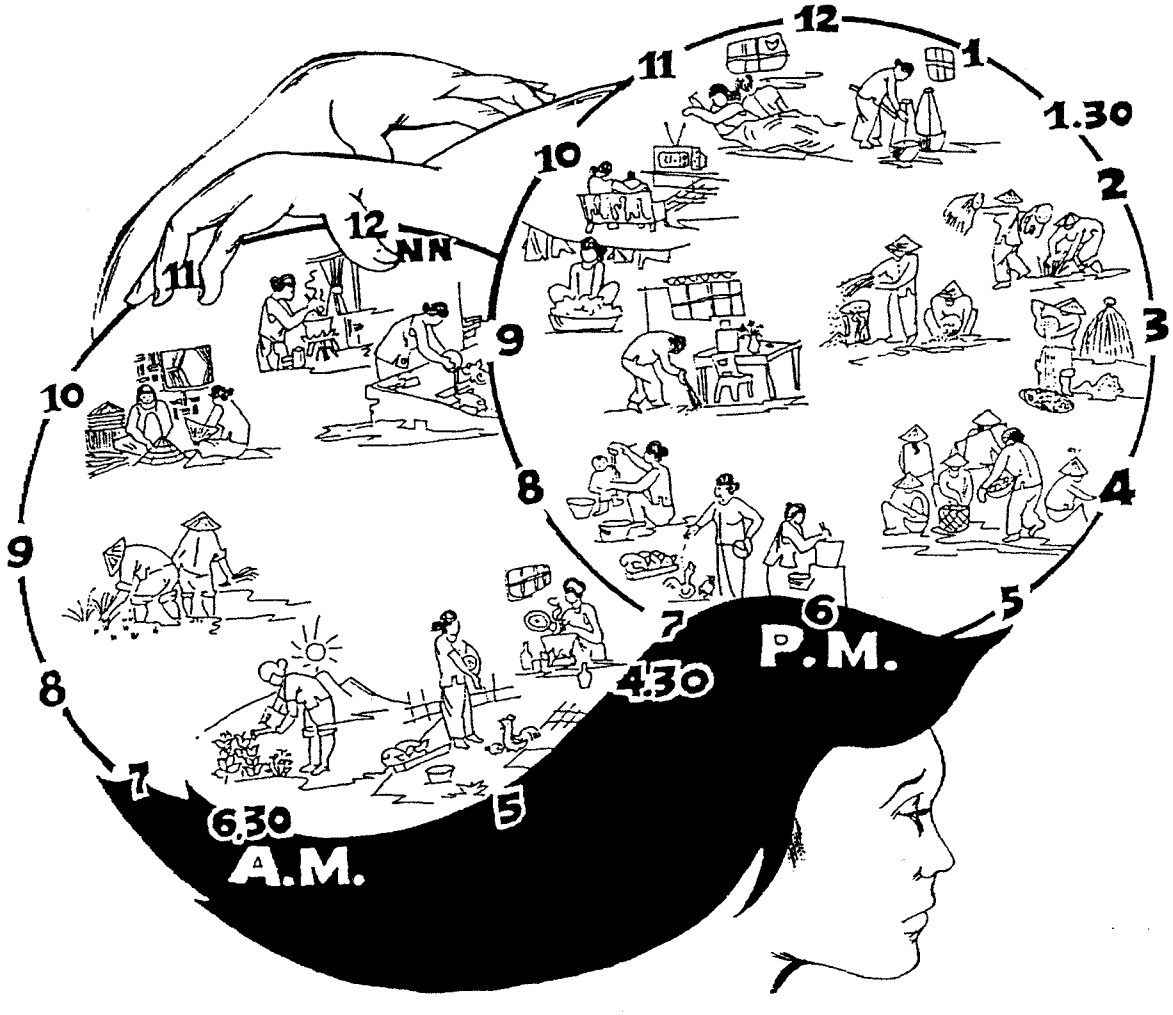
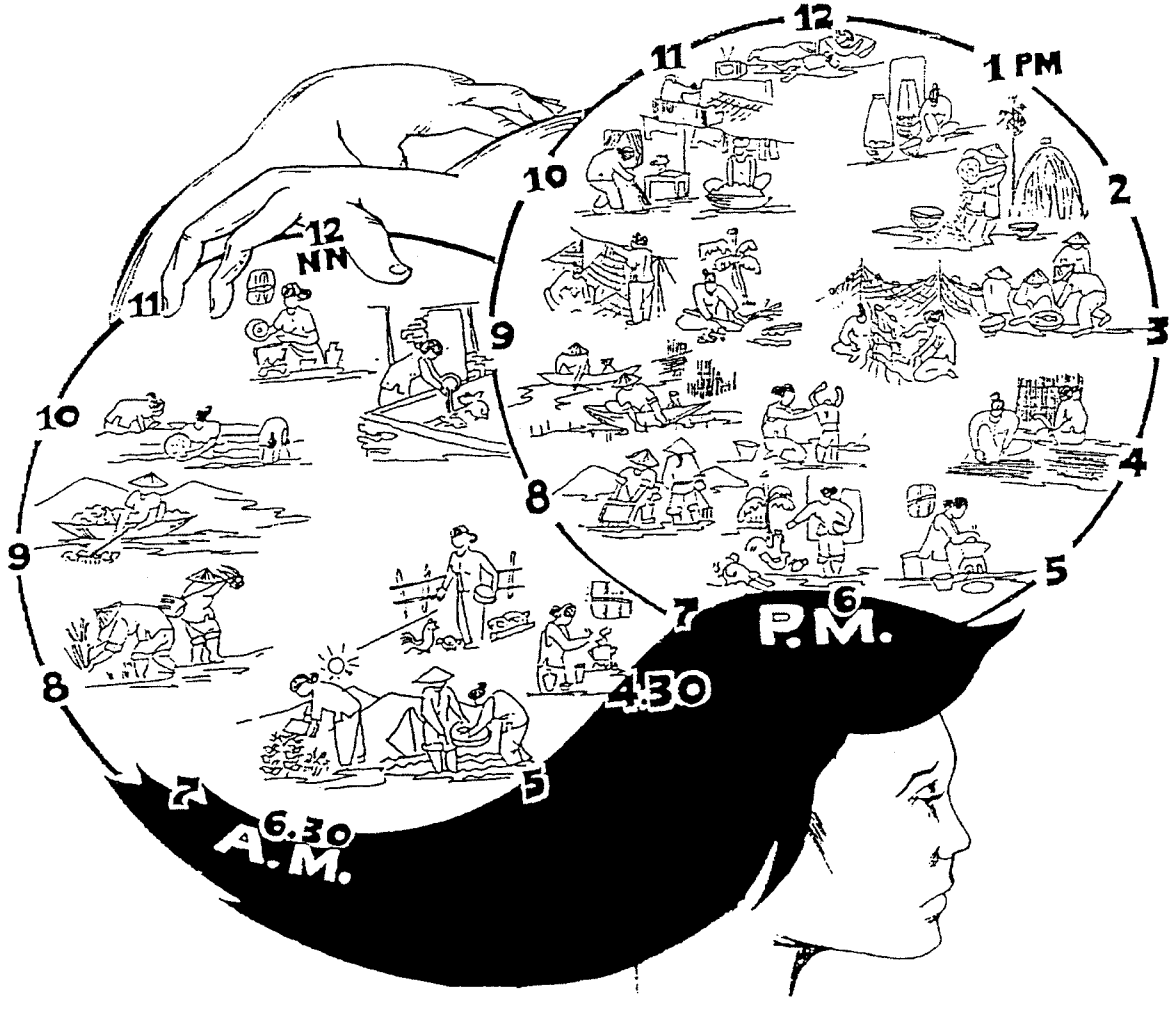


Figure 2. Biological clock of women in a fishing-farming community in Quang Thai



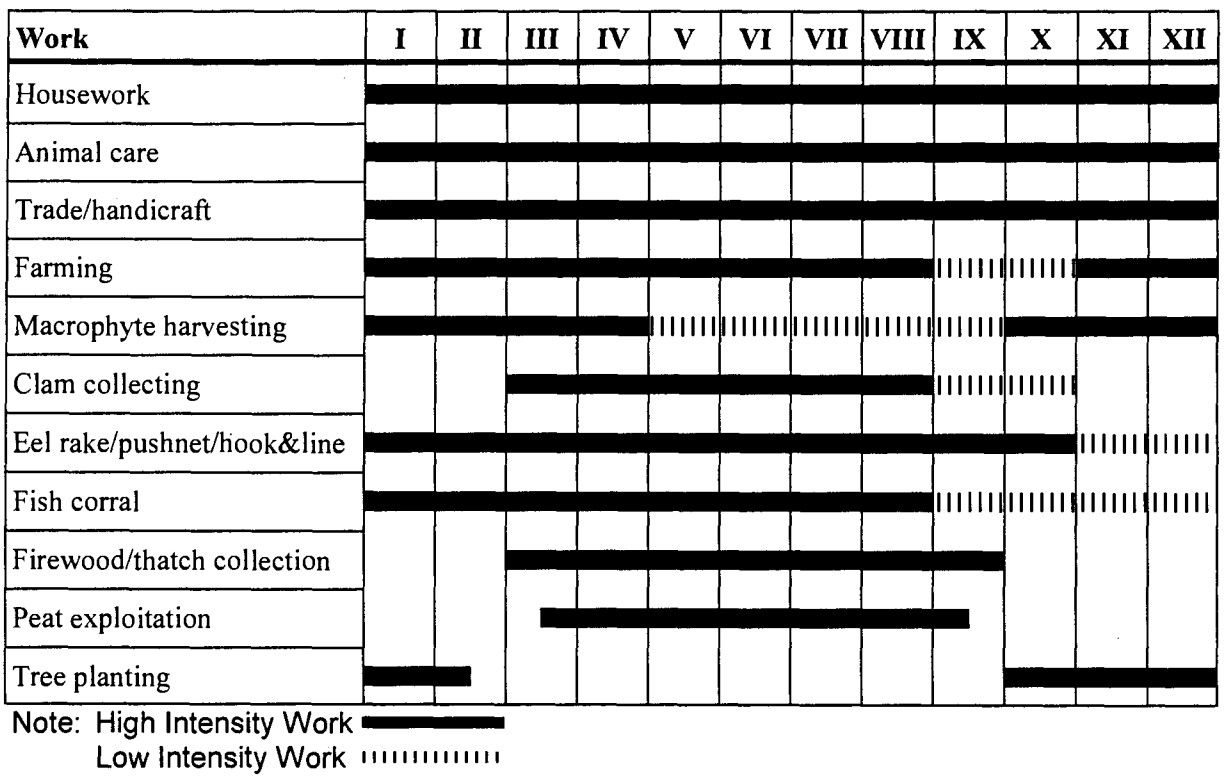
1900: fish using pushnet, hook and line, etc.
2200: clean house, bathe, prepare for tomorrow's work, preserve catch for tomorrow's market, perhaps relax.
2400: sleep

The 2 bioclocks show that intensity of work of women is high: about 19 hours per day. The working intensities of women in the farming community and in the fishing and farming-fishing communities are different: in general, women in fishing and fishing-farming communities work harder and production activities are more diverse. Therefore, time for entertainment and for improvement of knowledge is limited. Time for sleep for women in the research site is short: 4.5 to 5.5 hours. These 2 bioclocks are representative for the communities, though there are variations in each household.

SEASONAL CALENDAR

Based on the information collected on women's role in socio-economic activities and family, a seasonal calendar for women's work in the research site was drawn in Figure 3.

Figure 3. Seasonal Calendar for Quang Thai women in Lunar Months.



The seasonal calendar indicates that some women's activities are year-round, especially housework, animal production, trade and handicraft making. Farming and fishing are seasonal. Fishing depends on the weather and farming depends on the climate and the local irrigation system. Slack time in farming and fishing communities in Quang Thai occurs during flood season (from months VIII - X). This is also

the season when poverty and lack of food are predominant, because fishing and farming produce little.

CONCLUSION

- In family and community decision-making, men have the final word.
- Besides doing all housework, women take part in economic activities such as fishing and farming the same as men. Thus, women work harder and more hours than men.
- Social and natural conditions and traditions have a great effect on gender roles. Education of women is particularly low. They have little chance to expand their knowledge.
- Policies which prioritize socio-economic and cultural development in remote places such as Quang Thai should be promoted so that local villagers, especially women and children have more chance to improve their lives.
- Research on gender should be continued to obtain more detailed information on gender roles within communities living around the Tam Giang lagoon in socio-economic and cultural activities and in the management of resources.

Aquatic Resources Marketing

Bùi Thị Tám

INTRODUCTION

Second to food markets, aquatic markets are very active in Thua Thien-Hue and in Phu Tan particularly. Aquatic market are markets solely devoted to the trade of aquatic species (both marine and freshwater). They are often located at or near a boat landing shore, or in a convenient place for boats to stop and unload before heading back for home. Activity at such markets is greatest at or sometimes restricted to dawn. In the years before the *đổi mới* economic policy (or open market) while production and consumption of food, particularly rice, were strictly controlled by the government, aquatic markets were less controlled and were established early with the participation of many trading agents.

Prices in aquatic markets have an effect on the management and protection of lagoon resources. When there is a surplus of aquatic products of various sizes and quality relative to consumer demand, producers must sell their products at low prices sometimes even failing to sell some of their product. This affects the behaviour of producers: for instance, when prices are low, fishers need to exploit and sell more in order to earn a living which means more fish on the market (more supply) and a further lowering of price. Alternatively, when the price of aquatic products is high, producers can earn enough by selling less and do not necessarily over exploit the resources.

This research presents some general preliminary information on the operation of aquatic markets in the lagoon and social economic aspects in the marketing mechanism. The research was conducted from May to November1996 in Phu Tan Commune. The objectives of the research were to:

- Collect basic information on aquatic markets in the lagoon and problems in marketing activities.
- Analyse operation of marketing mechanisms and relationship among marketing agents at different market levels.
- Make recommendations to improve marketing activities and income and production efficiency of villagers.

Due to time constraints, our research focussed on marketing activities and market agents. Through this process, some comments and information on the structure and operation of local aquatic markets in the lagoon area are provided. Information on higher markets (city markets) is not presented in detail in this report.

METHODOLOGY

In perfect competition, price determination is based on the relationship of supply and demand. In imperfect competition, price is determined by the stronger competitors (who have larger markets, privileged rights from government policies, etc.). In a monopoly market, sellers have control over the price which they use to maximize profits. Information on marketing agents, number of participants and entry conditions is required to classify the competition of the market as perfect or imperfect. The

structure of markets stipulates behaviours and conducts of the marketing agents involved.

Some important things to note in aquatic market studies are the relationships and interactions of the above characteristics and the management and exploitation of aquatic products. A market in perfect competition with plenty of products easily sold will encourage resource exploitation and aquaculture development. High quality aquatic products which are sold at high price and therefore, bring higher income for producers can encourage fishing and aquaculture towards protection of the resources, instead of catching small fish and shrimp.

Income plays an important role in this matter. In general, if villagers' incomes are stable and sufficient for their needs, they also have clearer and more suitable production-management strategies than in cases of low and unstable income. Therefore, studies on marketing performance and problems in consumption are significant not only to improve consumptive markets and to recommend suitable and effective solutions for resources management and protection, but also improve income and livelihood of villagers.

Data collection

Interviews with fishing households, observation and Rapid Marketing Appraisals (RMA) were applied. More than 50 households in Phu Tan were randomly selected from groups of fishers operating different fishing gear falling into 2 categories: those involved in only fishing (31 households) and those involved in both fishing and aquaculture. Another 3 households and officials working in Song Huong freezing factory were also interviewed. Criteria for analysis and description of market structure and conduct were applied to generalise the local markets in Phu Tan.

BACKGROUND INFORMATION

Geography

Phu Tan Commune, Phu Vang District, Thua Thien-Hue Province, is located near the Thuan An estuary, a transitional zone between marine water and freshwater, 9 km away from the provincial capital Hue (Map 5, p. 5). This position creates conditions for Phu Tan to develop a diverse economy of farming, fishing, aquaculture and small industry. However, in Thua Thien-Hue, the climate creates difficulties in animal and aquaculture production. Heavy rainfall, storms and floods frequently occur in the fall and, in winter, temperatures are low. Saline-intruded soils around the lagoon are not favourable to farming production thus in recent years in Phu Tan, aquaculture has developed and expanded rapidly as an alternative.

According to studies by biologists, the exploitation of fry migrating into the lagoon from the sea is high. The total number of fishing households in the commune is also high - 214 households practice aquaculture, 264 households fish in the lagoon and 141 households fish both in the lagoon and at sea. This has resulted in resource overexploitation. In household interviews, most fishers made the same remark that day by day, large-sized fish and shrimp are disappearing. In recent years, they were forced to change mesh size from A9 (9x9 mm) to A7 (7x7 mm) or A5 (5x5 mm). Therefore, fry migrating into the lagoon are caught before reaching maturity.

Population and labour

The results of study in Phu Tan show that the birth rate in Phu Tan commune is rather high, about 2.5 - 2.8 % per year. This is one important source of labour supply for Phu Tan, but at the same time, it also raises many questions in economic and social development.

Table 1. Average number of people and labourers in Phu Tan Commune in 1996

Total Commune Population	5576
Number of households	1007
Average household size	5.97
Average labourers per household	2.35
Average female labourers per household	1.3
Highest educational level of female labourers (form)[1]	3.8

Data source: Household survey, September, 1996

The data in Table 1 show that the size of household in Phu Tan is rather large, but the number of labourers, ie. household members of working age, is about half. Female labourers are 50% of the total commune labourers and their educational level is low - many of them are illiterate. Household survey shows that the highest educational levels of female labourers is less than 4th form. This affects not only household economic production, but also other social matters such as education and taking care of children, application of birth control as well as positions of female labourers in family and in society.

Economic activities of households in Phu Tan

With traditional boats and fishing gear, such as fish corrals, pushnets, dragnets, liftnets and fishing rods, fishing has been the main livelihood for generations of people in Phu Tan. However, compared to fishing at sea, income from fishing in the lagoon is much lower and there are fewer markets for their products.

Aquaculture has recently played an important role in improving people's incomes. So far, there are 20 production groups (214 households) in Phu Tan. Production groups of aquaculturists must be approved by Commune and District People's Committees and they receive technical support from officials of Fisheries Extension Centre. According to the DoF, 636 ha of lagoon area have potential for aquaculture development. As of 1996, 176 ha have been developed for the culture of shrimp, crab, rabbitfish, seaweed and other species (see **Aquaculture - its Introduction and Development**).

With the development of aquaculture, there is an increased diversity of species and size of aquatic products which can meet increasing demand for aquatic products, especially for restaurants and export.

---

[1] Presently in Viet Nam, the primary school has 5 grades (Grade 1 to 5), secondary school has 4 grades (Grades 6 to 9) and high school has 3 grades (Grades 10 to 12). Previously, the education system was organized differently. Form 1 to Form 6 refer to the first 6 years of schooling. Children now start school at 6 years of age while, in the past, probably at 5 years of age.

This can improve producers' income, however, because aquaculture requires high investment and techniques, poor households (usually those operating mobile gear) can not participate. As aquaculture area expands, conflict between aquaculturists and mobile fishers is unavoidable.

Poor soils and extreme climatic conditions make agriculture difficult to develop. Only one village (Dien Truong) in Phu Tan is considered a farming village. Fishers raise pigs to supplement their incomes and make use of by-products from aquatic resources processing. However, because of lack of techniques and investment capital, production is low. Other households in Phu Tan are active in tailoring, making conical hats, making bricks, small-trade, etc. Among fishing households, these activities are limited. Fishing and aquaculture attracts most labourers.

Table 2. Income sources of fishers by household

Type of household	Income source (%)			Average Monthly income per capita (in 1000 VND)
	Fishery Resources	Agricultural Resources	Other	
Fishing	88.4	8.4[a]	3.2	312.5
Fishing/Aquaculture	80.58	15.3[a]	4.12	468.11
Aquaculture	95	5[a]		
Aquaculture/Agriculture	70	30[b]		

Data source: Household survey (September, 1996) and PRA in Dien Truong village, 1996
[a] Animal Production only
[b] Animal and Crop production

In fishing households, more than 88% of income is derived from fishing while income from animal production (chickens, ducks or pigs) is less important than in groups operating both fishing and aquaculture. Although income from aquaculture households was not obtained to complete the table, it is common knowledge that income of fishing households is much lower and usually less stable than that of aquaculture households. Observation indicates that compared to aquaculture households, fishing households don't have capital to invest in other activities to improve their income. The survey results show that these households mainly operate mobile gear and most of their catch is sold at local markets.

Households active in both aquaculture and fishing have more market options. Besides selling their products in local markets, they sell to their familiar customers - middlewomen/men or collectors for export. Therefore, their income is higher, more stable and not entirely dependent on the result of fishing.

Table 2 also indicates the differences in income structure of groups of households. In households who are also active in agriculture, about 30% of income is from crop and animal production, while, in other households, only 5-15% is from animal production, and none from crops.

In fishing households, average daily catches range from 1 to 5 kg of which shrimp of various species total about 0.5 - 2 kg. Economically important fish total almost an equivalent amount and the rest is waste fish[2]. In peak season, average daily catches are 10 to 15 kg. Household interviews indicated that

[2] Waste fish do not reach the main consumer market. They are either too small or a unpalatable species. Waste fish are either used as food for the fisher's family, are sold as feed for farm and aquaculture animals, or are discarded depending on the species and size.

most of the catch is sold while only 10 - 15% of daily catch (0.2 - 0.5kg) is for family consumption which is low for households of 4 to 6 people with no other sources of income. Their supply of staple foods (mainly rice) and other needs depends on fishing income which can vary from nothing (during the stormy season) to a few months of good income. Many families suffer food shortages for a large part of the year.

STRUCTURE, CONDUCT AND PERFORMANCE OF THE MARKET

Marketing

Because Phu Tan is not far from the Hue city and transportation is easy, a wider range of middlewomen/men and markets is possible and active compared to other communes in the lagoon area. In Phu Tan, there are more marketing agents dealing in larger quantities and over larger operating areas compared to more isolated communes such as Quang Cong and Quang Ngan (Map 3, p. 3) where difficulties in transportation are a hindrance to marketing performance.

Producers as marketing agents

Fishers are producers but can also serve a role in the marketing of their produce - though that role is most often performed by women who are either fishers themselves or are from fishing families (wives, daughters and sisters). These fisherwomen are very active in local markets (selling to middlewomen/men and local consumers) but rarely attain the level of middlewomen/men who trade larger volumes at higher prices in distant markets. Because family fishing and aquaculture production is small scale, the volume of daily products consumed in markets is low and depends on the availability of aquatic species, fishing gear and season.

Entry conditions: Fishers have been marketing agents since the fishing tradition began despite their limited knowledge of marketing. However, they are disadvantaged in bargaining with middlewomen/men from the city or other places by their experience, which is limited to the local market scene, and by the amount of capital they have for trading. These are some of the limitations to fishers' participation in larger and central markets. Their low educational levels, according to them, does not affect their trading capacity.

Market level: Since fishing in the lagoon area is limited and it is difficult to increase the level of participation of individual households in fishing and aquaculture, the participation of many small producers/sellers with a small volume of products in the market creates a local competitive market for selling. At the same time, there are fewer middlewomen/men and collectors and most of them have connections to larger markets (city and neighbouring areas). This is advantageous to collectors or middlewomen/men, as they are in a position to make local producers/sellers compete amongst each other for a sale. This situation will remain unless producers can cooperate amongst themselves.

Middlewomen/men

We can classify middlewomen/men into 2 groups based on product destination. The first are from city and other places and buy and bring the products to city or other adjacent markets as wholesalers or retailers. The second group are local middlewomen/men - small traders or fishers who buy products from producers to sell to local consumers. They only participate in local markets since they have little capital and experience to take part in central markets or to collect products for the Sông Hương Freezing Factory or for export. Thus the first group act as middlewomen/men or wholesalers while the latter, as retailers. In general, all middlewomen/men and collectors have a certain amount of capital and knowledge of trading.

Market level and entry conditions: There are differences between the 2 groups of middlewomen/men in terms of level and entry condition. Table 3 shows that there is significant difference in the amount of capital of the 2 groups, but there is no significant difference in years of experience and educational level between the 2 groups. Local groups have much smaller capital than middlewomen/men from other places. To many of them trading is a secondary job, i.e. they participate in trading during slack time or in peak fishing season to improve their incomes. Therefore, they have less experience than that of middlewomen/men from other places though it not reflected in the data of Table 3.

From household interviews, we concluded that there are no close relationships (by blood or friendship) between producers/sellers and middlewomen/men. They develop an acquaintance with each other during trading. However, there is a relationship based on debt: middlewomen/men often pay advances to producers (20-25%), so many producers, who lack capital and must borrow, are in bond with middlewomen/men. This situation is more common in aquaculture. As a result, fishers' options for selling aquatic products are, to some extent, limited.

Table 3. Characteristics, market levels and entry conditions.

	Local middle women/men	**Non-Local middle women/men**	**Difference [a]**
Average capital (1000 VND)	1,252.0	6,018.0	S
Average experience (yrs)	6.1	8.8	NS
Education level (form)	5.6	6.2	NS

Data source: Rapid Marketing Appraisal, 1996

[a] Significant at 5% level, S = significant; NS = non-significant

Collectors

Collectors are similar to middlewomen/men in terms of buying and selling fish but work within a smaller number of marketing channels (the products do not travel through many hands before final sale). As a result marketing costs are lower and profit margins are higher from those of middlewomen/men. Collectors mainly 'collect' the better quality and higher priced species and sell them to the exporting/ processing company. Collectors have pre-arranged agreements with both the fishers and the company. During the low fishing season, the fishers come to them when they have a higher value catch to sell (ie. of export value) and know they can get a better price. During peak fishing season, fishers are forced to sell wherever they can. Collectors are not included in the analysis of Table 3 because this group consists

of few households and differences are rather significant.

Marketing channels

Because of the diversity in size and species of aquatic products (cultivated and fished) it is not accurate nor significant for there to be a unique market channel for all of aquatic products. Moreover, there are big differences in consumers' preferences in aquatic products. This difference is more apparent in aquatic markets than in markets of other goods or agricultural products. Even preference of groups of consumers varies in terms of quality for the same aquatic product. For example, small-sized fish and shrimp are suitable for rural markets, where villagers' incomes are low. In contrast, high quality products are favourable to consumers with high incomes. Therefore, we classified aquatic products into 4 main groups:

- Shrimp (tiger prawn, green prawn, banana prawn, greasyback shrimp, etc.)
- Crab
- Economically valuable fish (rabbitfish, snapper, mullet, etc.)
- Less valuable fish

This classification is relative because consumptive mechanism is calculated by averaging total consumed volume, though sizes and quality are different. However, product quality in each channel is clearly deduced, therefore we can see a general pattern for the marketing of each specific aquatic product. Figures 1, 2, 3 and 4 show that the marketing channels from producers to consumers for shrimp, valuable fish, crab and other fish, respectively.

Figure 1. Marketing channels of shrimp in Phu Tan

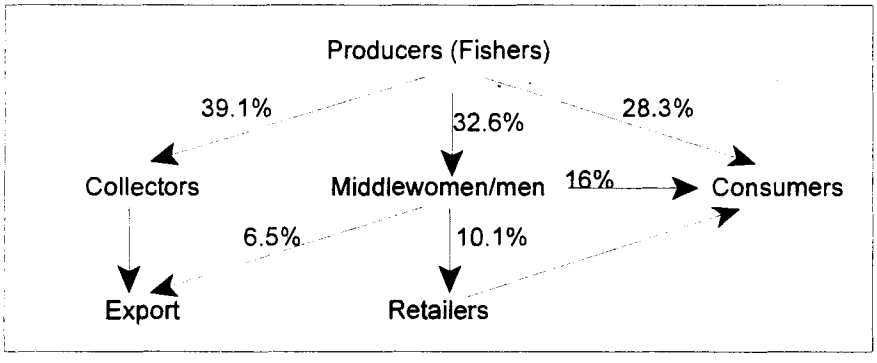
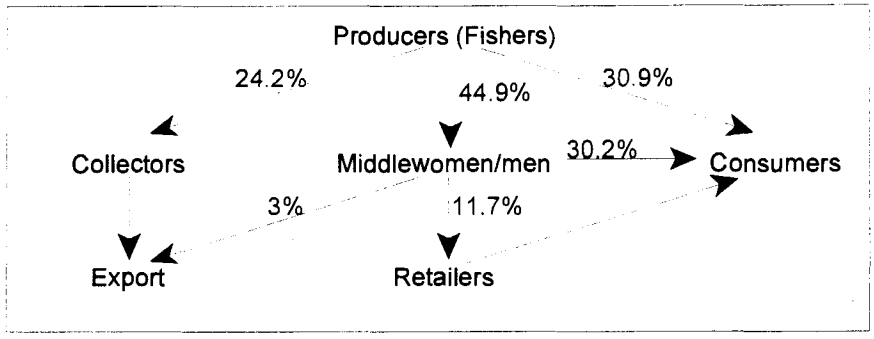


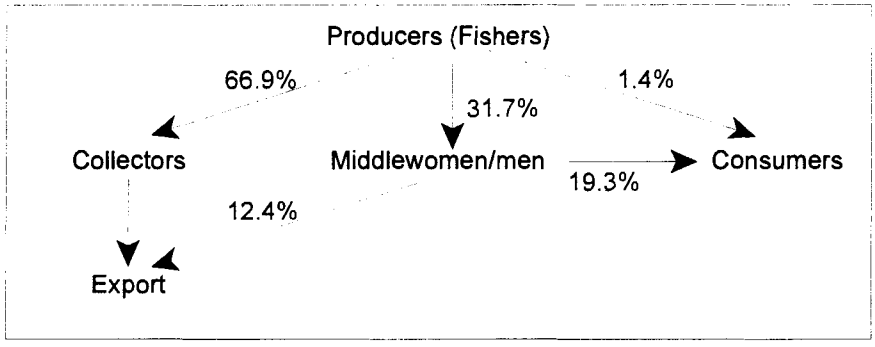
Figure 1 shows that almost 46% of shrimp produced is sold for export, 40% of which goes through collectors. 32.6% is sold to local middlewomen/men and middlewomen/men from other places who then sell for export or to retailers or consumers in city markets. As mentioned above, the quality of shrimp is different in different marketing channels: in the flow from producers to exporters, shrimp are mainly big, high quality and more expensive, while shrimp sold in local markets or even city markets are small and less expensive.

Figure 2. Marketing channels for valuable fish in Phu Tan



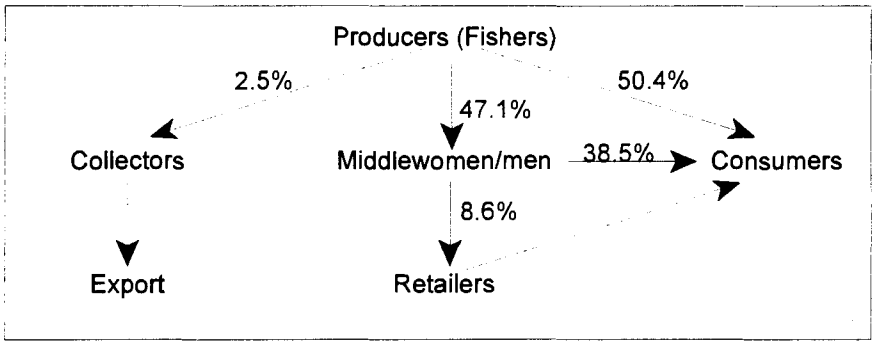
For economically valuable fish (such as rabbitfish, snapper and red grouper), marketing channels are similar to that of shrimp, but the relative amount in each channel is different (Figure 2). For example, nearly 45% of valuable fish are sold to middlewomen/men and then to retailers or consumers in the city and other neighbouring markets. The rate of export is less than for shrimp.

Figure 3. Marketing channels for crab in Phu Tan



For crab, the export market takes a higher proportion of production (almost 80%) and only about 20% is for local consumption (Figure 3).

Figure 4. Marketing channels of other fish in Phu Tan



Small fish such as tigerfish and rabbitfish are mainly consumed locally for food or processing (50.4%) and the rest (47%) is sold to middlewomen/men (Figure 4).

In summary, about 30 to 50% of the volume of aquatic products is sold to middlewomen/men, 25 to 40%

to collectors for processing and export, and the rest is for local consumption.

Price determination and price seasonality

During interviews, marketing agents indicated that there are differences in price determination according to season and type of aquatic products. In peak season (April to August), the price is usually low and determined mainly by middlewomen/men. In low season (December to March), price is higher and determined through agreement by both parties. Though price of shrimp is considered more stable all year, the difference in price in the 2 seasons is high: from 25,000 to 40,000 VND/kg. Fluctuations in the price of crab is high, because harvest of crab is highly seasonal.

Comparing market channels to each other, differences in price determination are clear. When products are sold to local consumers, price is determined based on the relationship of demand and supply, on bargaining, and on form of payment (cash or credit). However, the volume of products consumed in this way is not high. This means that in peak season, not all products can be consumed locally, because supply is higher that the demand.

When products are sold to middlewomen/men or collectors for export, price is determined by fishing season and credit relationship. It is important here to consider the role of Song Huong Freezing Factory which has a monopoly on buying aquatic products for processing and export. It is difficult for producers to sell their products directly to the factory, or even when they do, they often don't receive the price that middlewomen/men or collectors would because of the small volume and their lack of marketing experience. Therefore, though the presence of middle agents increases costs and decreases selling price for producers (ie., producers have to sell their products at lower prices), producers accept their role.

Of interviewed fishers, 58.8% claim that middlewomen/men and collectors control the price for export. Moreover, in low season, price of products sold to aquatic processing factories increases little, while in peak season, the price decreases considerably. Producers must however sell their products to collectors, because they don't have many options and their capital is limited. As for other small-sized aquatic products, their price is determined by bargaining in local markets which suggests a potential for improving marketing performance for producers. While larger volumes of aquatic products are sold to the Freezing Factory which contributes much to producers' incomes, an improvement of marketing activities in this channel by suitable measures would improve producers' income. For instance, if they were organized, they would be in a better position to negotiate higher prices. In such an instance, the higher price of larger exportable aquatic products would provide an incentive for fishers to manage and exploit the aquatic resources in positive way, by avoiding catches of smaller individuals and allowing aquatic species to grow and mature.

To understand fishers' marketing strategies and identify suitable solutions for the above mentioned situation, we surveyed fishers on their choice of market for their products (Table 4). Though preference does not necessarily reflect where products are actually sold (which depends on seasonality, location, size, species and opportunity), it does reflect fishers' perceptions at the time of the survey.

Table 4. Fishers' choice of marketing channel

Buyers	Preference (%)	Reasons for Preference
Local consumers	31.6	Small volume, near, convenient, reasonable price
Middlewomen/men	39.5	Quick, convenient, higher price, debt bondage
Collectors	28.9	Based on debt relationship

Data source: Survey, July 1996

Table 4 shows that selling to middlewomen/men is the favourite choice of fishers. Selling to local consumers is second. The reason is simple: they have a small volume of products daily and the price is more reasonable than selling to collectors. This agrees with some fishers' opinion that price is determined by the Song Huong Freezing Factory. Moreover, applying this way, fishers can sell their products quickly and conveniently, meeting daily needs.

CONCLUSIONS AND RECOMMENDATIONS

Aquatic resources markets in Phu Tan are in perfect competition in local markets dealing in low value products. Many producers participate in these markets with a limited volume of products but with a diversity of species. Most of them have low incomes and rely on fishing since they have little capital for and knowledge of marketing. These limitations cause certain disadvantages to fishers in marketing competition, especially when the volume of products for export from aquaculture increases.

For high quality products for export, because buying is nearly monopolised, the price is determined by collectors. More in-depth studies are required on higher market levels to analyse the structure and efficiency of those markets.

In reality, fishers expect sustainable management and exploitation of the resources to increase quality of aquatic products and their income. However, at present, many don't have access to capital or aquaculture areas. Because of lax management and protection of the lagoon resources, they still over exploit though they are aware of the consequences.

On the basis of fishers' recommendations and the research results, we make the following suggestions:

- Improve the protection of resources using community awareness and participation.
- Conduct training courses to improve fishers' basic knowledge of marketing (especially for women), and to help them understand and make decisions for appropriate strategies of management and protection as well as efficient strategies for production and marketing.
- Supply credit and technical support to establish groups of producers and consumers that will improve producers' competitive ability in the marketing of lagoon resources.

Community Banning of Electric Fishing

Trương Văn Tuyển

As soon as the Quang Thai research group met the fishing community in Trung Lang village, Quang Thai commune (Map 4, p. 4) in December 1995, they were informed by fishers that destructive fishing, specifically electric fishing, was a serious problem. Interviews with 20 fishing households (from a total of 115 households) and 2 general meetings in the community indicated that people supported the establishment of a self-management committee to implement a ban on electric fishing. An effective solution to enforce a restriction of a fishing gear is one component of resource management. This activity was feasible due to the eagerness of the fishing community and Quang Thai PC to participate.

Trung Lang is a recently established village, set off from the main villages of Quang Thai commune by its location - on the edge of the lagoon. It is a fishing village with 3 operating production groups (see **Appendix A**): Group 1 is composed of fishers operating mobile gear; Group 2 is composed of fishers operating fixed gear; and Group 5 is composed of fixed and mobile gear users who have access to agricultural land (thus known as the fishing/farming group). Fishing grounds and aquatic resources are common property with limited rights allocated to fixed gear fishers.

Electric Fishing

Electric fishing first appeared in the early 1990s and has increased dramatically. Electric fishers, working from small bamboo boats, use transformers to increase the voltage of a 9-volt battery to more than 200-volts. Two rods, transmitting the voltage into the water, are used to electrocute and stun the fish which float up and the larger ones are scooped up in a small basket at the end of one rod. The high voltage also kills most small aquatic species which have no commercial value and are not collected. Coinciding with the emergence of electric fishing, aquatic production has been rapidly reducing. Fish corral owners, who formerly earned high incomes from their fixed gear, now have to rent fields and farm to supplement their income.

Using electric fishing violates National Article 8, "The regulation on aquatic resource protection and development", signed by President Võ Chí Công on 25 April 1989. In the last several years, governments at different levels have launched campaigns to enforce the regulation and on January 9, 1996, the chairman of Thua Thien-Hue province signed and implemented a regulation specifically banning electric and blast fishing. However, the efforts to ban electric fishing were not successful because the communities were not involved in the implementation. Management of resources, as applied by the government since 1975, has made fishing communities very dependent on government rule. They are aware of the destruction of electric fishing, but they leave law enforcement to the government. In general, fisheries management in the lagoon is lax (see **An Historical Perspective on the Management of Lagoon Resources**).

It is obvious that communities must be involved in the management of fishing gear to enforce the regulations on the protection of aquatic resources in general and banning electric fishing in particular. A community-based approach to the management of fishery resources was proposed by the research group in Quang Thai. A focus on controlling electric fishing was a way to develop and gain experience in community based coastal resources management (CBCRM).

Collected information indicates that more than 50 small bamboo boats, each carrying 2 people, use electricity to fish in Quang Thai lagoon area daily. This is documented in a video made by the researchers. Hundreds of others also practice electric fishing on foot in the submersion land (shallower water) surrounding the lagoon of Quang Thai, Quang Loi, Phong Chuong, Dien Hai, Dien Loc communes (Map 4, p. 4; Map 3, p. 3) and other communes in the area. They also fish in the Spring in an area called O Fields - rice fields bordering on the lagoon which are only used for crops in the summer when the waters have receded. In 1992, one person using electric fishing died of electric shock but less serious electric shock accidents occur frequently.

PROCESS FOLLOWED IN IMPLEMENTING THE BAN

The goal of the community was to protect the Quang Thai lagoon area from damage by electric fishing. They wanted the ban to be run and financed by the community itself with only some support from the local government. However, in the first stage, while the economic and social difficulties of electric fishers were not yet solved, support was necessary from all parties to improve the operation. As the activity progressed, problems and difficulties were identified and solutions were applied in order to improve the implementation.

The process followed can be summarized as follows:

Meetings

Two meetings of members of the 2 full-time fishing groups (1and 2) were organized and chaired by officers from Quang Thai People's Committee (PC). In the first meeting, the fishers agreed to implement a ban on electric fishing. They appointed a self-management board consisting of 1 director and 2 members (the 2 leaders of fishing groups 1 and 2).

The self management committee and the researchers proposed a procedure to implement the ban. The procedure and organization were approved by Quang Thai PC. In the second general meeting, the self management committee presented their ideas on how to organize, implement and get community support for this activity. Community members discussed the presented ideas, contributed their own and reached an agreement on the final activities (including financial aspects) for self-management. The following guidelines were established:

- Appoint a self-management committee (already done)
- Request official commune approval for the committee as well as the banning activity
- Appoint a commune officer in charge of organizing a security force and of arresting violators
- Assign 2 local guards from Trung Lang village
- Request contributions from mobile fishers (1 million VND) and fixed gear fishers (1.5 million VND) would pay for the local guards (at 150 000 VND per month)
- Request the project and commune PC support for an awareness campaign and allowances for the commune security force and equipment (boat rental and fuel).
- Assign the fishing group leaders as responsible for collecting fishers' contributions every 6 months.

Cooperation

The committee appealed to neighbouring communes to cooperate and comply with the ban of electric fishing. The self management committee asked Quang Thai PC to send representatives to 5 neighbouring communes in which there are many people practising electric fishing. They encouraged people in those communes to give up electric fishing and to sign letters of agreement. In Quang Thai commune itself, 55 electric fishers were identified and the 52 farmers and 3 fishers voluntarily signed the letters.

Awareness building

A campaign to build public awareness against electric fishing was organized. Constant communication and education was extended so that fishers understood the consequences of environmental destruction. For 50 days[1] before arrests and fines were applied, the following activities were conducted:

- The villagers sailed around the lagoon for 4 days with banners, flags and a loudspeaker to announce and inform all fishers of the ban. They specifically approached electric fishers and engaged them in discussion.
- Communication was also addressed to electric fishers in the O fields.
- The commune broadcasting station (the village loudspeaker-system) announced the ban in the villages.
- The steering committee for the ban of electric fishing went to the neighbouring communes to announce the plan and procedure of the activity and to unify and synchronize other communes with Quang Thai for more effective results.

Implementation

Organization, control and protection of Quang Thai fishing grounds were continuously carried out by the self management and steering committees since the campaign was launched on March 5, 1996. During the first 4 days, the implementation was conducted in parallel with an awareness campaign.

The lagoon area was patrolled daily from 5am to 10pm. Initially, 2 fishers from the village (on a rotational basis organized by the self management committee) patrolled the area daily with members of the commune security force in case of arrests. Later, they were joined by 5 guards from 5 agricultural communities of 5 villages in the commune (Lai Ha, Dong Ho, Tram Ngang, Trung Kieu and Trung Lang - Map 4, p. 4) who extended their duties in protecting agriculture fields to stopping electric fishers on foot.

The implementation resulted in a decrease of 90-95% in the number of people practising electric fishing in daytime. Between 1 and 3 am, there were still some but the numbers were much reduced (as determined by occasional spot checks by the self-management committee).

---

[1] The warning period was originally set at 30 days but it was prolonged to give people more time to find alternative sources of income as this was during the slack farming season when work is scarce.

Arrests and fines of violators

The self-management committee and the guards anticipated revenge and conflicts when protecting the commune's fishing grounds. However, rigid measures had to be applied to warn people who still violated the regulation. After over 50 days of communication and awareness building, on 29 April 1996, the commune steering committee and the self management committee arrested violators for the first time. On that day, 6 boats and 12 violators were arrested and punished as follows:

- Transformers were confiscated
- Each person was fined 150,000 VND
- The boats were returned to the owners
- The batteries were held to ensure payment of the fine.

After this, the number of violators decreased considerably. Those still active were secretive for fear of arrest.

Alternative income activities

Along with the implementation of the ban, the research group addressed the social problems of the poor households who signed the letter of agreement to give up electric fishing. The group tried to help them find alternate sources of income to support their families by enlisting the aid of World Vision, an international NGO. This organization has a credit programme in Quang Thai and neighbouring communes and agreed to give preferential treatment to those identified as previous electric fishers for loans to develop animal production or other income generating activities. The organization provided loans for 20 of the 52 households in Dong Ho and Tram Ngang villages as a first step. Later they granted loans to the remainder and to some electric fishers in Phong Chuong commune.

Electric fishing was practised in most localities around the Tam Giang lagoon (total 31 communes) but no commune except Quang Thai enforced the ban in 1996 even though the PC did not get any direct grant, budget or equipment to support the activity. From May, 1996 to December, 1996, 35 violators were arrested and fined 12 of which were witnessed by the researchers. This indicates a very important improvement in local government's commitment and effectiveness in protecting aquatic resources and it was initiated by the villagers in the local community. In February, 1997, the district government implemented the enforcement of the banning of electric fishing by assigning police and army forces to patrol and arrest violators in all communes. This created a favourable environment and good support for on-going activities in Quang Thai.

DIFFICULTIES ENCOUNTERED

- Threats were made to the local volunteer guards and members of the self-management committee by violators outside the community. Some fish traps and nets of fish corral belonging to the volunteers were damaged but, even worse, the violators threatened to bodily harm the volunteer guards. The guards lacked the power and equipment to fight with violators. They only patrolled the lagoon and communicated with the security force of commune.
- Prior to the locally implemented ban, no efforts were made to synchronize and implement

government laws and regulations (especially in fines and arrests) on the part of commune, district and provincial government levels and concerned agencies.

- During the ban, support in enforcing the ban in neighbouring communes was weak because their communes were not seriously affected by electric fishing. These communes either have no lagoon area to protect or their lagoon areas are unfavourable to electric fishing. Most electric fishers came from neighbouring communes but operated in Quang Thai lagoon.
- The self management and commune steering committees did not have enough power to implement the activity by themselves. Some Trung lang villagers were opposed to it which hindered the operation of self management.

VILLAGERS' EVALUATION

The activity was very well considered by the villagers, the self management committee and the commune steering committee:

- The number of people practising electric fishing in Quang Thai lagoon has decreased by 90 - 95% at day time. At night it is also considerably lower - as determined by the number of electric fishing lamps observed.
- The community feels positive because its aquatic resources are being protected. They also realize that they are capable of solving problems on their own.
- Solidarity was created among Trung Lang villagers and the villagers of the other 4 agricultural villages in Quang Thai commune around the issue of protecting their environment and improving livelihoods. This activity developed cooperation in the protection of biological resources in and around the lagoon between Trung Lang people and the agriculture protection officers in the 4 agricultural villages of Quang Thai.
- This activity elicited the concern and help of the commune's People Committee in protecting the environment. At the same time, the PC has become aware of Trung Lang's isolation from the rest of the commune and is creating conditions to reduce this isolation.

RESEARCHERS' EVALUATION

Over the 1-year period of implementing the ban in Quang Thai, direct observations and monitoring made by researchers show positive changes in some aspects. A solution to enforce a restriction of a destructive fishing gear has been identified and initiated and is evolving. The activity has contributed to the enforcement of a ban on destructive fishing and has also built local capacity in aquatic resource protection.

- The number of electric fishers practising in Quang Thai area which encompasses the lagoon and submersed fields on it shores is much lower than previously. Though there are no official records on data document the decrease, the researchers have observed, at day time, no violators in the lagoon and only a few in the submerged fields.
- A community feeling among the villagers in dealing with common problems has been strengthened considerably

- Public awareness on aquatic and natural resources protection in general and on destructive activities like electric fishing in particular has been developed.
- An important improvement in villagers' perception of their responsibility for aquatic resources protection has occurred. Informal discussions with about 30 people including influential villagers, leaders, collaborators for aquatic research and other men and women, indicate that, the community is now aware of its responsibility to protect its aquatic resources from which it earns its livelihood. At the beginning, most villagers thought that they had no responsibility and also no right to initiate the activity. All public things like water area and common resources were considered the responsibility of the government. This perception was a result of previous subsidized policies and a top-down approach of management by the government. Through this experience, local people now agree that they are able to protect the aquatic resource with the support from local government and other agencies.
- The coastal community, specifically the fishing and fish-farming village, the local government and other local organizations have worked closely together by sharing the responsibility in managing aquatic resources. This has improved the relationship between the commune government and Trung Lang village.
- The commitment and effectiveness of commune government to aquatic resource protection is improving. Initially, when the self-management committee of Trung Lang village was established, the commune PC assisted by keeping its security force on stand-by in case of serious conflict or emergencies. Because some difficulties as well as opportunities emerged, the commune security force became more involved. The commune PC became more committed to the activity because it could not ignore the request from the villagers and, of course, enforcement of laws and regulations is its responsibility. Formerly it did not know how to act in the face of violations and was not aware of the extent of destruction made by electric fishing on aquatic resources. The initiative by Trung Lang fishers has helped the PC carry out its official duty.
- The security force of commune has become more and more effective in enforcing the ban because the local government was committed to the activity, especially after the research group helped find a small fund to build a bridge connecting the fishing village to the rest of the commune[2].

LESSONS LEARNED

In Quang Thai, where the socio-economic situation is rather poor (in terms of village economy, social isolation and economic development), it was still possible for the fishing and fishing/farming community to organize itself around an initiative of CBCRM. Good results were achieved from the ban of electric fishing:

- Fishers were able organize themselves to solve their own problems;
- The relationship between the fishing community and local government was improved by the fishers' activities;

---

[2] When the project began, the road to Trung Lang village was simply a path with 2 large timbers across a small stream. During the flood season, the village was at times cut off and children often missed school. The researchers encouraged the villagers to submit a proposal for construction of a bridge and 2 culverts which the British High Commission in Hanoi funded.

- A public awareness campaign on aquatic resource management was implemented by the community itself; and,
- The local government was involved in the enforcement of aquatic resource protection with the fishers sharing the responsibility and contributing their efforts.

In the past, villagers left all responsibility of management to the government however, in the ban of electric fishing, the local government was not able to enforce it. Both parties became aware that they needed each other to protect their coastal resources - ie. without the involvement of the local community, the commune PC could not enforce a ban on electric fishing; and, vice-versa, the local community could not enforce it without the support and help from the commune.

The ban of electric fishing is supported by national law and the provincial government is making efforts to enforce the ban in the province. Therefore, in the development of the community-imposed ban, the commune government increasingly supported the activity in both dealing with the violators and in protecting the local guards when threats were made against them. The protection of fishing grounds is complicated and creates many conflicts. Therefore, the support of government at different levels helped to ensure the effectiveness and sustainability of the ban. From this experience, researchers and fishers concluded that, especially at first stage of establishing CBCRM, involving local government is crucial.

Further attempts at managing the local fishing grounds may not receive the same support and attention from the government if the management rules are of local concern rather than national concern. Improvement in the community's responsibility and confidence is crucial in expanding the activity to other local issues.

In the present activity which began as community-based management, the results are considered successful because of the specific characteristics of the area and of the activity:

- Small scale (centred around a village of 115 households)
- Specific activity (focussed on banning electric fishing)
- Equal benefits for all villagers (resulted largely in excluding outsiders from local fishing grounds)

The ban was largely focussed against outsiders of the community since electric fishers came from other communes to fish in Quang Thai waters. This resulted in equal benefits distributed to all the local fishers from Trung Lang - ie. improved fishing in their communal grounds. This made it easier for the local fishers to organize themselves and to contribute to the activity.

The participants are aware that future activities may result in losses not only to outsiders but also some community members. The benefits from potential activities - at least direct or immediate benefits - may not be equal for all local fishers, with some losing and others gaining. Consensus and support among the villagers might decrease. It is very important to identify people responsible and capable of running an activity and to select strategies which would be acceptable to most and, especially, avoid disadvantaging the poorest.

In situations where less responsibility might be assumed by the local government and where there might be less support from part of the community, effective solutions, to deal with threats made by unco-

operating fishers, both local and outsiders, should be identified as a prerequisite to any further expansion of activities.

FURTHER RECOMMENDATIONS

Responsibility of commune government

The security force which patrols the lagoon and enforces the ban, should be provided with more support from the commune PC. At present, fishers in the community rent their boats to the security force to patrol the lagoon. This has two main problems: private boats are not equipped to chase and arrest violators; and threats were made against those fishers.

- The security force should be provided with appropriate equipment (such as boat, lamps, loudspeakers).
- The security force could be self-financed by collecting fines applied to violators of aquatic resource protection rules and by renting out the equipment to provide services in the community.
- The security force could benefit from the compulsory reserve army training for men aged 18 to 45. The training is organized by local government annually. The local government could schedule the training to coincide with the season for electric fishing.

Responsibility of Villagers

The self-management committee must continue its function in order to:

- Build public awareness around the management of coastal resources
- Apply peer pressure on violators
- Provide the security force and local government with the information necessary to effectively implement their activity
- Design, plan and expand CBCRM
- Monitor, evaluate and modify management activities
- Collectively organize and operate contributions and support

Responsibility of Researchers

- Organize workshops on the self-management of fishing gear in Quang Thai with the participation of concerned agencies and neighbouring communes.
- Continue monitoring, supporting and facilitating to identify and solve problems and difficulties in applying CBCRM.
- Support the maintenance of patrol and protection to ensure people will not use electric fishing even when it seems that electric fishing has been stopped.
- Develop cooperation with other organizations to provide alternative jobs for people and to solve

difficulties facing the community such as transportation, health care and education.

UPDATE FROM JULY 1998

The electric fishing situation in Quang Thai has now reached a critical stage. As of November 1996, the commune government took over entirely the banning activity because of the difficulties and threats made to local fishers. There was no need to continue the community-based activity since the commune's efforts were now more powerful. The project stopped its field activities in February 1997.

Electric fishers are now using a more sophisticated method by attaching an electrical device to a drag net. This practice is increasing and the resulting destruction is more serious. The simpler forms of electric fishing (by bamboo boat and walking) still occur. The main issue is that the ban, now once again the government's responsibility, is not effective. It seems that it was only effective during the brief period (about 6 months) when the fishers were involved.

Participatory Development of Peanut Crops

Trương Văn Tuyển, Trần Văn Minh and Lê Thị Nam Thuận

The total population in Quang Thai commune is about 5100 people in 1100 households, of which 1024 engage in farming. The origin of the villagers is from Quảng Thọ and Quảng Vinh. Seven (7) family clans, whose names are Văn, Phạm, Trần, Hoàng, Hồ, Lê, and Nguyễn, settled there nearly 200 years. Formerly, the area was called "Câu Kê, Kẻ Lác" by villagers living along Tam Giang lagoon, because this area was once deserted and abundant in *Lác*[1] 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 from 1954 to 1975, Quang Thai was abandoned and villagers resettled the area only after the liberation in 1975. They then had to start all over again and recover the land from the damages of war.

Quang Thai people are struggling under severe natural conditions and under marketing difficulties. It is located far from Hue city (the provincial capital and main marketing centre) as well as from Sia town, the district capital. Infrastructure is poor - there is no electricity[2] and the only main road is in bad condition making transportation and cultural and economic exchanges difficult. There are few improved techniques in agriculture and no university-graduated officials live in Quang Thai.

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 harvesting, electric fishing, pushnet and dragnet to improve their incomes. Changes in cropping patterns to improve the land productivity is important and critical to the management of coastal resources.

Participatory Rural Appraisal (PRA) was conducted in Quang Thai commune to identify the main problems and solution to poor agricultural productivity. The soils around Tam Giang Lagoon are acidic, saline-intruded, infertile, with some associated aluminum toxicity, and subject to droughts and floods. For a long time, local farmers made great efforts to cope with the severe environment and find some appropriate cropping patterns for their land. Farmers' experiences and farming extension research all indicate that certain cropping patterns are more appropriate for particular types of land. Changing cropping patterns is one alternative to improving local socio-economic development. To improve crop yield and increase the number of crops per year, irrigation, soil fertility and techniques must be improved, saline and sulphate aluminate infections resolved and crop varieties carefully selected that are appropriate to the local weather.

---

[1] *Lác* plant (also called *Cói*) is cypress grass (*Cyperus malacensis* Lamk.). It is used to make sedge mats and to bind crabs' legs to prepare for shipping and market.

[2] Electricity was installed in Quang Thai in June 1997 however at that time only 50% of households had access to it. It was not affordable to the rest.

Peanut crops can improve land productivity and diversify crop production, and thus, improve the sustainability of agriculture. The advantages of peanut growing are as follows:

- Peanuts have a short growing season thus can increase the number of crops per year.
- Peanuts grow and develop well in sandy soils.
- Returns from peanut production are high - net returns are twice as high as those of rice.
- Peanut is a legume crop capable of fixing nitrogen from the air, therefore, it can improve soil fertility.

The farming community in Trung Kieu village (Quang Thai commune, Map 4, p. 4) was assisted to replace rice with peanut in rice and cash crop fields that normally only produced 1 crop per year. In Spring and Summer 1996, selected trials were conducted by intercropping with peanuts on the upper rice fields (1-crop per year) and on the middle sandy area used for upland crops such as sweet potato, cassava, mung bean and other vegetables. The study received strong support from farmers in Trung Kieu. They were very interested in peanut production because they had an available labour force and suitable lands, however, they lacked experience in growing peanuts.

The trials can be seen as a continuation of farming systems research undertaken by Hue University of Agriculture and Forestry. The source of reference is "Three-year report on farming systems research", HUAF, 1994. Peanut as a crop was introduced in 1994 and is supported by the local government.

Traditional cropping patterns

Crop production of the Quang Thai farming community is well adapted to natural environmental conditions, especially rainfall distribution. Because sandy soils have a very low capacity in retaining moisture, the growing season takes place during the time of the year with adequate rainfall. There are two main growing seasons: Spring and Summer. Spring is characterized by water logging at the beginning (November and December) and drought at the end (April to June). Summer is characterized by drought at the beginning and possible flooding at the end.

The cropping patterns are also influenced by the socio-economic conditions and government policy. Farmers in Viet Nam are most familiar with rice growing as a result of custom, culture and subsistence farming. Rice culture was also enforced for many years following nation-wide food shortages which resulted in a government policy to increase production of rice and other essential food crops to ensure national self-sufficiency. These crops, though still commonly planted, may not be an efficient use of some farmers' fields, especially the rice fields around the lagoon which are subject to drought. In many rice fields, rice is transplanted in December, harvested in May, and then the fields are left fallow. Although this schedule varies - it relies on many factors such as field location, elevation, irrigation, rice variety and even differences among households in the same field - it is considered general practice in Quang Thai.

Growing peanuts does not only improve land use efficiency in Spring but, because it has a shorter growing season than rice, it makes it easier to prepare the land for the Summer crop before drought parches the land.

METHODOLOGY

Using PRA tools, the researchers learned about agriculture and land productivity from the farmers and discussed potential innovations and solutions. In the process, the community selected research topics. The research group agreed to provide seed and technical assistance while the farmers implemented the trials.

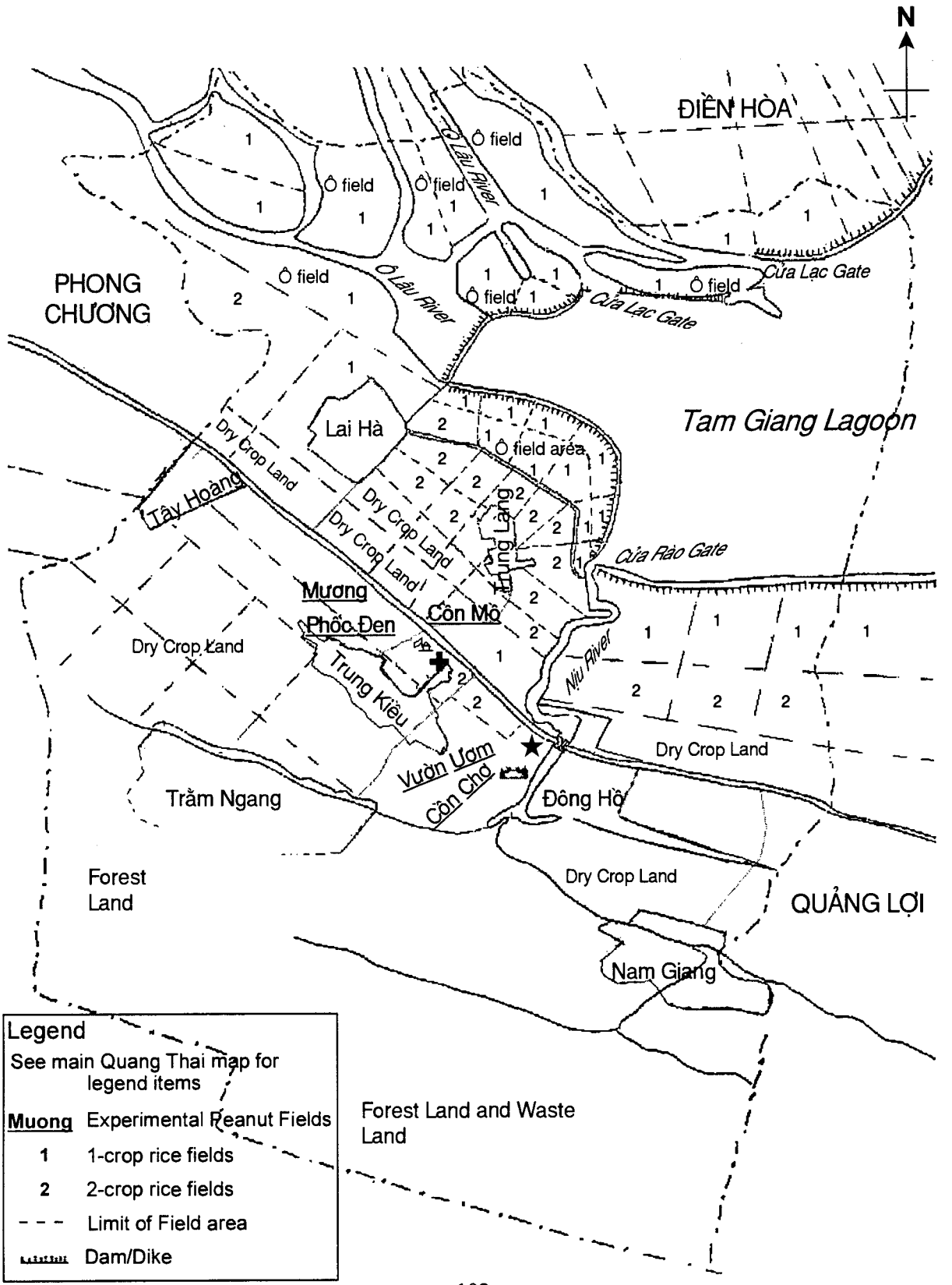
The participating households were nominated in a group meeting organized on December 28, 1995. At that meeting the agricultural group leader, Mr. Lộc, explained the requirements and agreement was reached for the selection of 19 households. Participating households were selected on a voluntary basis and all are poor but skilful in crop production. Participating households themselves selected the type of cropping pattern to be used with peanuts, the location of the trials and inputs of labour and resources involved in crop production. The choices were appropriate to household conditions such as access to land, labour and capital. The trials locations selected were in 5 different fields previously used as rice fields (Phoc Den and Con Mo) and as rice nurseries and sweet potato fields (Muong, Vuon Uom and Con Cho) (Map 7, p. 102). The size of each trial was originally set at 1 *sao* (or 500 m^2) per household. However, in practice, each household used one parcel of land which was convenient and logical to the family but varied in size. Each area was measured and recorded.

The researchers functioned as facilitators providing as many options as possible to the community and the participating households, and explaining the advantages and disadvantages of every pattern and application. The project also supplied peanut seeds and some other inputs to the farmers, however, in the calculations of net return, the farmers included the subsidy as part of their costs. The cost of converting the land was not included as this involved family labour in preparing the fields and in changing the irrigation flow. Evaluation was done by both researchers and farmers. The farmers evaluated their own economic return from the trials while the researchers measured soil fertility and analysed and evaluated the results from all the farmers combined. Data on soil fertility are not reported here: they were collected as baseline data which will be used to evaluate changes in soil fertility in the future.

The choice of data to collect was made by the households. They were provided with data recording sheets at the beginning of the growing season. The researchers and local research collaborator facilitated data recording. The data were recorded on a household basis and were later adjusted for land unit as each family had a different land area under cultivation. In all cases family labour was included in the costs of production - a choice made by the farmers. Family labour is difficult to separate from the overall costs, as experienced by some agricultural economists.

The net returns from peanut production were compared to past net returns from rice production by each farmer in the same field. Farmers were asked to recall information in the same field that was converted for peanut production: ie. crops grown (in most cases rice), yield for that field, input costs, price of paddy, etc. The net return per *sao* of rice (averaged over several interviews) was 90 VND.

Map 7. Fields in Quảng Thái Commune



Cropping patterns with peanut

Cropping patterns, and their notation, used were:

- **P** Peanut monocrop and then fallow
- **P–MB** Peanut monocrop followed by a crop of mung bean (MB)
- **P–SP** Peanut monocrop followed by a crop of sweet potato (SP)
- **P–RB** Peanut monocrop followed by a crop of red bean (RB)
- **P+M** Peanut intercropped with maize (M) and then left fallow
- **P+M–MB** Peanut intercropped with maize followed by a crop of mung bean
- **P+M–SP** Peanut intercropped with maize followed by a crop of sweet potato
- **P+C** Peanut intercropped with cassava (C) and then left fallow

The participating households, land location and cropping patterns are listed in Table 1. The location of fields in indicated in the map of Fields in Quang Thai Commune (Map 7, p. 102). Rice crop (the traditional crop) is used as a standard to compare the income of each trial. In some cases farmers set up other trials, in addition to those above. One case is Mr. Bòn who intercropped rice, peanut, maize, cassava and sweet potato on the same piece of land (1 *sao*). Since he was not on the original list of participants, his final results were not recorded but were observed by the researchers.

The data collected consists of (see Table 1):

1. Yield of peanuts in the cropping patterns studied (weight of peanuts in the shell)
2. Returns (in VND) from each crops and from the cropping patterns
3. Green material harvested from the peanut plants (used as animal feed or green manure)

RESULTS AND DISCUSSION

The data, as recorded by each family, are presented on Table 1. The results are summarized by household in Table 2 and by *sao* in Table 3 and in Figures 1 to 4 as follows:

Figure 1 - Net returns by household for both cropping seasons (Spring and Summer)

Figure 2 - Net returns per *sao* from Spring crops

Figure 3 - Net returns per *sao* from Summer crops

Figure 4 - Net returns per *sao* (500 m^2) for both cropping seasons

Table 1. Data collected by each family participating in the trial of growing peanuts, intercrop and Summer crops.

Household Name	Field Name	Cropping Pattern	Elevation[1]	Area (m^2)	Input Cost (1000 VND)	Peanut Yield (kg)	Gross Return (1000 VND)	Green Material (kg)	Intercrop Net Return (1000 VND)	Summer Crop Net Return (1000 VND)
Lê Khoát	Muong	P	2	500	91.65	80	292	400	0	0
Lê Thị Tám	Muong	P	2	500	77.55	80	320	400	0	0
Phạm Lịch	Con Cho	P	1	500	86.45	60	246	150	0	0
Văn Thị Hữu	Con Cho	P	1	250	52.75	30	123	70	0	0
Văn Khoa	Con Mo	P	3	500	100.6	70	280	420	0	0
Trần Thuấn	Con Mo	P	3	450	94.8	65	266.5	500	0	0
Phạm Vảnh	Muong	P+C	2	500	104.4	70	280	320	100	0
Lê Thị Báu	Con Mo	P+M	3	500	81.25	60	222	300	37.5	0
Văn Đức Đậu	Phoc Den	P+M	2	500	86	80	336	170	30	0
Nguyễn Tuấn	Con Cho	P+M–MB	1	700	104.8	176	739.2	400	96	45
Lê Tai	Vuon Uom	P+M–SP	1	1100	178.2	200	850	700	105	75
Phạm Quyết	Con Cho	P+M–SP	1	250	71.3	35	140	100	75	20
Nguyễn Mo	Con Cho	P+M–SP	1	480	95.65	65	273	350	22.5	35
Văn Lộc	Con Cho	P+M–SP	1	248	51.95	40	160	110	15	10
Phan Lợi	Phoc Den	P–MB	2	800	107.45	105	387.6	300	0	37.5
Hoàng Linh	Phoc Den	P–MB	2	500	99.35	75	300	350	0	45
Phạm Công Vui	Phoc Den	P–RB	2	1750	310	350	1435	450	0	65
Lê Tuất	Vuon Uom	P–SP	1	500	98.2	60	228	300	0	35
Trần Hân	Con Cho	P–SP	1	500	103.15	70	226	420	0	35

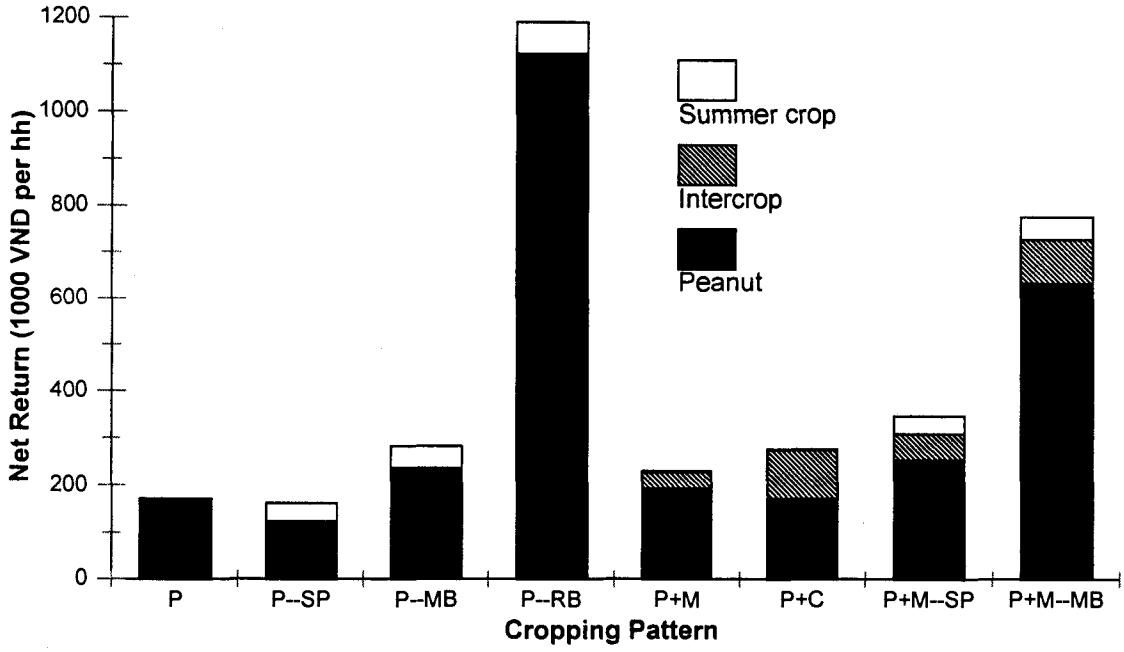
[1] 1 = Upper Field; 2 = Middle Field; 3 = Lower Field

Table 2. Mean of data collected (as an average of participating households - hh) from the different cropping patterns tested in Quang Thai, 1996 (see Figure 1).

Cropping pattern	# of hhs	Plot size (m^2/hh)	Peanut Yield (kg/hh)	Net return (1000 VND)				Green material (kg/hh)[1]
				Peanut	Intercrop	Summer Crop	Total	
P	6	450	64.2	170.6	--	--	170.6	323.3
P–SP	2	500	65	126.3	--	35	161.3	360
P–MB	2	650	90	240.4	--	41.3	281.7	325
P–RB	1	1750	350	1125	--	65	1190	450
P+M	2	500	70	195.4	33.8	--	229.1	235
P+C	1	500	70	175.6	100	--	275.6	320
P+M–SP	4	519.5	85	256.5	54.4	35	345.9	315
P+M–MB	1	700	176	634.4	96	45	775.4	400
Overall Mean		**580.4**	**93.2**	**268.9**	**25.3**	**21.2**	**315.4**	**326.8**
Standard Dev.		*± 334.1*	*± 73.2*	*± 256.3*	*± 37.5*	*± 24.0*	*± 285.*	*± 152.4*

[1] Yield of green material from peanut plants.

Figure 1. Net Return averaged by household for the different cropping patterns in Quang Thai (1996). Interpreted from Table 2. See text for notation.



Spring crops

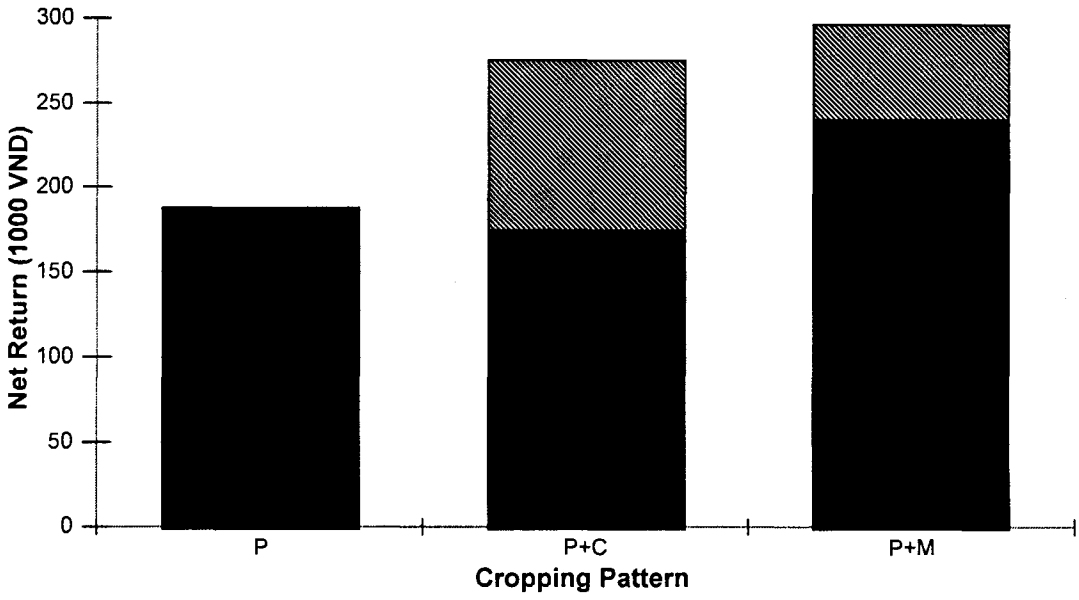
In these trials, the main Spring crop was peanut, either alone or intercroppped with maize or cassava. Since sample size is small, records from the farmers provide only preliminary results (Figure 2). Intercropping is a strategy to increase productivity by planting a secondary crop to the main crop. Intercropping can also reduce water loss by evaporation by increasing soil cover. However, intercropping can also influence the growth and development of the main crop and thus affect yield.

Peanut yield was highest when intercropped with maize (at 82.1 ± 20.1 kg/*sao*) and lower when monocultured (at 70.1 ± 11.3 kg/*sao*) and intercropped with cassava (with one replicate at 70 kg/*sao*) (Figure 2). By changing their main crop from rice to peanuts, the farmers in Trung Kieu have increased their income by 1.37 to 5 times with an average net return from peanut alone of 206,721 ± 79,185 VND/*sao*, or 2.3 times that from rice production (Table 3).

The intercrop which brings highest income is cassava (at 100,000 VND/*sao*) (Figure 2). Income from maize varies from 30,000 VND/*sao* to 150,000 VND/*sao* (Table 3). The average net income from intercrop with peanut is 60,935 ± 41,149 VND/*sao*. Although this improves farmers' incomes by a marginal amount, intercropping provides other benefits: it helps to retain moisture in sandy soil, and provides food for subsistence and other useful products from the by-products.

Evaluation of returns from both the main crop (peanut) and intercrop (cassava and maize) shows a high improvement in land use efficiency. The average net return from the new Spring cropping patterns is 258% higher than that from rice, with maximum returns from intercropping with maize (330%) and lowest from peanut monoculture (208%).

Figure 2. Average net return per sao (500 m^2) by crop and cropping pattern for the Spring Crop in Quang Thai (1996). P: Peanut, P+C: Peanut and Cassava, P+M: Peanut and Maize.

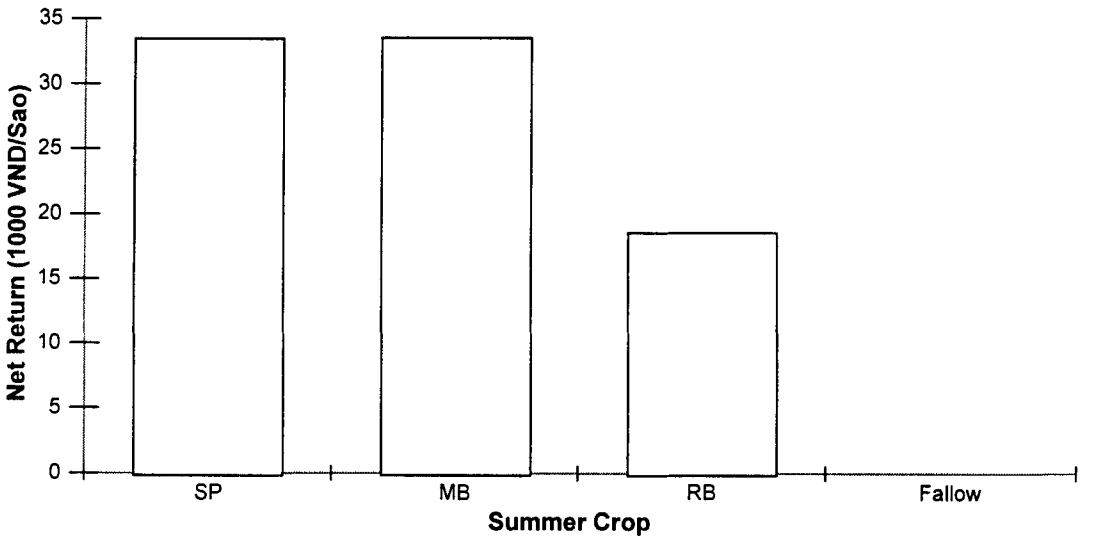


Summer crops

Traditionally in this area, farmers used local varieties of rice resistant to the drought conditions which appear every year and, especially, become acute later in the growing season. Unfortunately, these local varieties are also characterized by a longer growing season thus, by harvesting time, soil moisture is very low which makes land preparation very difficult and Summer crops almost impossible to grow. New rice varieties, characterized by high yields and a short growing season, are not suitable for most of Quang Thai lands due to their vulnerability to drought. Therefore, the efficiency of these fields was very low. Using peanut as main crop plant in Spring increased the opportunity for farmers to plant a second (Summer) crop because the growing season for peanut is shorter than that of rice.

Ten (10) participating households planted Summer crops: 6 households grew sweet potato, 3 households grew mung bean and 1 household grew red bean. Crops grown in the Summer season contribute to crop diversification, benefit household (through income and subsistence use) as well as improve land use efficiency. The calculated net returns from Summer crops, based on market price, are highest from mung bean (33,527 ± 8,857 VND/*sao*) and sweet potato (33,452 ± 6,242 VND/*sao*) and lowest for red bean (one replicate at 18,571 VND/*sao*) (Figure 3). Average income from Summer crops (at 21,184 ± 24,012 VND/hh or 31,986 ± 8,180 VND/*sao*) is not high (Tables 2 and 3).

Figure 3. Average net return per sao (500 m^2) by crop in the summer season in Quang Thai (1996). SP - Sweet Potato, MB - Mung Bean and RB - Red Bean.



Although net return was calculated from the main products (sweet potato roots and bean pods), participating households indicated that they planted a Summer crop for household consumption and as animal feed during the drought period. These products are especially beneficial considering Summer is a slack period in agriculture when farming households have available time and labour but few opportunities for income generation. Observation by researchers confirmed that even the by-products of Summer crops are beneficial - sweet potato leaves were harvested and used as pig feed, and green material from bean crops were used as green manure. However, data on green material from beans were

not collected because families left it to rot on the fields rather than gather it. The choice between sweet potato and beans was based on need: most pig-raising families, for instance, preferred to grow sweet potatoes. The choice between mung bean and red bean were made by each family based on prior experience with selected bean - familiarity with planting and keeping its seeds.

Evaluation of the whole trial - Spring and Summer

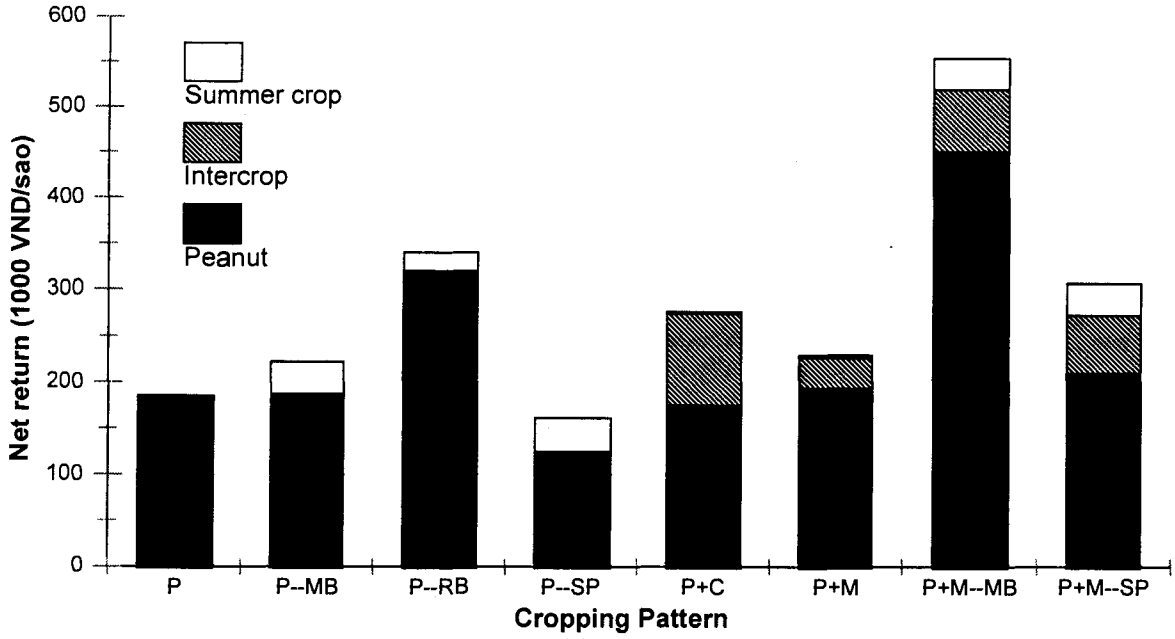
The results from data recorded by farmers from 2 seasons of implementing new cropping patterns are presented in Table 3 and Figure 4. They indicate that peanut intercropped with maize brings high production and income - especially when followed by a mung bean crop. The cropping pattern of Peanut – Red Bean is another high income earner, however, there were no replicates of this pattern thus the results are not as reliable and may be affected by farming superiority and land productivity rather than cropping pattern alone.

Average annual net return of the 8 cropping patterns is 249,212 ± 97,844 VND/*sao*/year which largely supports the villagers' conclusion that "1 peanut equals 2 rice". Planting peanuts in poor, sandy and aluminum contaminated soils, such as those found in Quang Thai and other areas on edge of the lagoon, is appropriate for the community and the exploitation and protection of land resources.

Table 3. Data collected from farmers in Quang Thai over 2 seasons in 1996 using new cropping pattern. Data is presented as a mean per *sao* (500 m^2) (see Figure 4).

Cropping Pattern	**# of hhs**	**Total area (*sao*)**	**Peanut Yield (Kg/*sao*)**	**Average Net Return (1000 VND/*sao*)**			
				Peanut	**Intercrop**	**Summer Crop**	**TOTAL**
P – fallow	6	5.4	70.4	185.5	--	--	**185.5**
P–SP	2	2	65	126.3	--	35	**161.3**
P–MB	2	2.6	70.3	187.9	--	34.2	**222.1**
P–RB	1	3.5	100	321.4	--	18.6	**340**
P+C	1	1	70	175.6	100	--	**275.6**
P+M	2	2	70	195.4	33.8	--	**229.1**
P+M–SP	4	4.156	77.3	211.3	62.9	32.7	**306.9**
P+M–MB	1	1.4	125.7	453.1	68.6	32.1	**553.9**
Overall Mean			**75.7**	**206.7**	**60.9**	**32**	**249.2**
Standard deviation			*± 15.7*	*± 79.2*	*± 41.1*	*± 8.2*	*± 97.8*

Figure 4. Average annual net return per sao (500 m^2) by crop and cropping pattern in Quang Thai (1996). Interpreted from Table 3. See text for notation.



TRIAL RESULTS BY DIFFERENT FIELDS IN QUANG THAI

Evaluation of trial results on different fields helped in follow-up decision making on expansion of the activities. The fields were given names by local people a very long time ago. The names of fields do not refer to soil fertility or productivity but only refer to location and use (Map 7, p. 102).

The farming practices in Quang Thai show that fields at different elevations have different advantages and disadvantages. Elevation, in combination with the ability to retain water is the factor that may determine yield of crops in the experiment. Because sandy soils have very low capacity of retaining water, the elevation of the land affects moisture content in the soil during the dry season and flooding during the rainy season. Therefore, the elevation is a factor considered in the selection of cropping patterns. Generally in sandy areas, upper fields are more susceptible to drought while lower fields are more susceptible to water logging which, in the case of Quang Thai, occurs at the beginning of the Spring growing season. The local people classified the fields for trial into three relative height categories:

- Upper Fields: Con Cho and Vuon Uom: Previously rice nursery and sweet potato fields
- Middle Fields: Muong and Phoc Den: Previously rice nursery and sweet potato fields
- Lower Fields: Con Mo: Previously rice field then fallow

Thus characterization of the fields is relative and can be simplified by ranking by elevation and by previous use.

- Topography (from lowest to highest elevation):
  Con Mo - Phoc Den - Muong - Vuon Uom - Con Cho
- Previous use:
  Phoc Den - Con Mo: Previous rice fields now fallow because of flooding (Con Mo) and lack of irrigation (Phoc Den)
  Muong - Vuon Uom - Con Cho: Previous rice nurseries in rotation with sweet potato

Analysis of peanut yield by field type and by elevation indicates no significant difference - the variation among households production from the same fields are higher than that between fields and between elevation. If there is a difference in elevation or field type, more data are required - especially more replicates per field.

WORK AND LABOUR DIVISION IN RICE AND PEANUT PRODUCTION

Changing cropping patterns always results in changes in labour divisions within the household production unit - especially in the work of women. Labour input for peanut is less than rice production as indicated in Table 4 and Figure 5.

Table 4. Work and labour division in rice and peanut production

Work	Labour Division	
	Rice	Peanut Intercropping
Preparing the land[1]	Men + Women	Men
Nursing seedlings	Men + Women	--
Picking seedlings	Women	--
Transplanting/Planting[2]	Women	Men + Women
Weeding	Women	Men + Women
Spraying pesticide	Men	--
Fertilizing	Men + Women	Men + Women
Harvesting	Men + Women	Men + Women
Selling Products	Mainly Women	Mainly Women

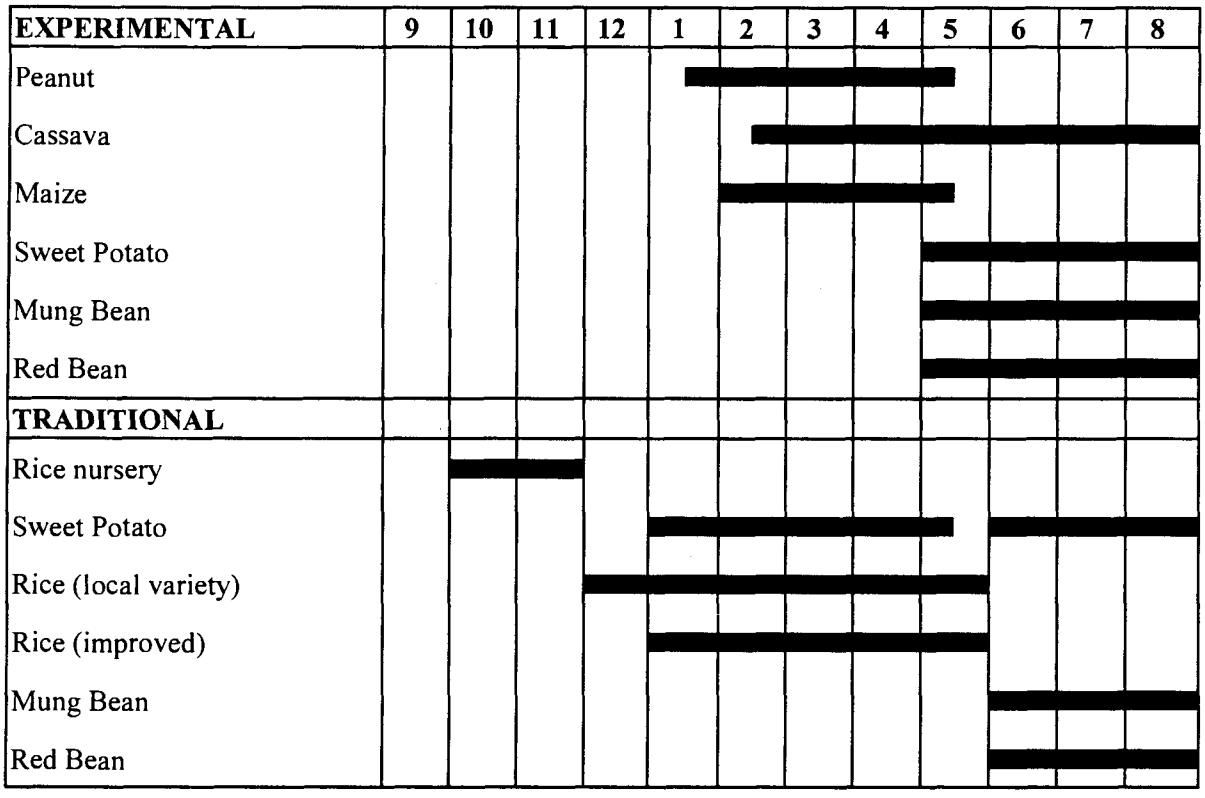
[1] Land preparation for rice requires more work than for peanuts.
[2] In the case of: Rice - transplanting
Peanuts and intercrop - direct seeding

Labour input for peanut production is less than that for rice production because of a short growing season: labour for women decreased with peanuts and the share of labour between men and women increased, because the new crop reduces the work that is the responsibility of women but increases work that is the responsibility of men. The change in cropping patterns from rice to peanut crop and other intercrop made a considerable improvement of income and also reduced labour inputs, especially that of women. This provides optional income opportunities for the community and gives more time for

women to engage in other activities such as caring for their children, taking part in economic activities and improving their knowledge and cultural lives (in terms of entertainment).

The practice of intercrop and Summer crops is an opportunity for households with available labour. Moreover, labour requirements for growing intercrops and Summer crops fall on a different period than those required for growing and harvesting of the main crops (rice and peanut). This means that planting intercrops and Summer crops is at a time of the year when there are less labour requirements for farming households (Figure 5).

Figure 5. Seasonal Calendar for labour requirements in the new experimental peanut cropping pattern and the traditional rice cropping. (Months in Solar calendar).



The introduction of peanut culture reduces the extreme seasonality of the previous system of rice production - a short period of intense work (in November) is replaced by 2 periods of reduced labour (some in November and some in February). In the highly intense period, one family member can not finish all the work so other members (wife and children) must share the work to get the work done on time. Highest labour requirements for rice farming are in November-December (preparing fields and transplanting) and in May (harvesting). At other times, there is much less work or none at all. Changing some rice fields to peanut production eases labour pressures on households that have few labourers. Peanut seeds are planted later than rice because the soil must be dry (January to early February) but are harvested before rice. Intercrops are planted in peanut fields at a very flexible time - either with the peanuts or after peanuts have already germinated. In these trials, cassava and maize seeds were planted between each peanut plant several days after peanuts were planted.

It should be noted that farmers growing peanuts are still growing rice but the intensity of labour

requirement in rice production is reduced. Most farmers still grow enough rice for the needs of the family however if there is a shortage, purchasing rice (mostly from neighbours) is not a problem as peanut is harvested early providing cash for such needs.

PARTICIPANTS' COMMENT AND EVALUATION

After 1 trial period (Spring and Summer, 1996), evaluations of the 19 participating households and other households on the benefit and efficiency of using peanut in the locality were as follows:

- Peanut production in poor soil in Quang Thai is suitable to villagers' expectation and desires, and local socio-economic development strategies and policies.
- Peanut yield is rather high. The yield is almost equal to average peanut yield in a neighbouring sandy area, Quang Loi, in which peanut has been planted for a long time.
- Peanut production brings higher economic benefits than rice production. The price of peanut in the shell (4200 VND/kg) is twice as high as that of paddy rice (1600 - 1700 VND/kg). In terms of return, "1 peanut equals 2 rice" - *ie.* on average, 1 *sao* of peanut provides the same net return as 2 *sao* of paddy field.
- Peanut is more marketable with a broader market
- Techniques of peanut production, which households learned together, are easy to apply and households can help each other find ways of improving yield. Labour requirement and production process of peanut are simpler than those of rice.
- Supply of fertilizers (organic and inorganic) is high in volume, because:
  - Organic fertilizer is locally produced through animal raising at household level. Organic fertilizer required for peanut production is about 300 kg/*sao*, not higher than that for rice.
  - Inorganic fertilizers are supplied by the Cooperative[3] and applied as follows: Nitrogen: 5 kg/*sao*; Phosphate: 10 kg/*sao*; Potassium: 5 kg/*sao*; and lime: 20 kg/*sao*. Except for lime, the amount of fertilizers required for peanut is not higher than for rice.
- Peanut green material is used as a green manure for tobacco and as feed for pig.

Villagers' evaluations of the intercrops and Summer crops are as follows:

Intercrop

- *Maize*: was evaluated as the best intercrop, since it was associated with the highest peanut yields and has a shorter growing season than cassava. It is appropriate and popular to all types of

[3] The cooperative supplies all the mentioned fertilizers at the beginning of the season. Farmers have a choice either to pay immediately or pay after the harvest with an interest charge. The interest rate is decided on by the cooperative board based on the origin of the capital used to purchase the fertilizers originally. If the capital originates from a government subsidy, the interest would be set at 0.6 % per month, while if it originates from cooperative savings, the interest may be higher at > 1.2 % per month. In fact the number of farmers who borrow fertilizers depends much on the interest.

households (better-off, medium and poor households) and is advantageous in planting, caring and protecting. In addition, it is encouraged by the local government which provides support through agriculture extension activities.

- *Cassava*: brings low economic benefit because of its long growing period. Cassava is dry in dry season but easily rots if rains come early.

Summer crop

- *Sweet potato*: Although net return and food product (for people) are low, sweet potato leaf is widely used as animal feed for pigs which makes it a useful crop. Mainly households with many labourers planted this crop.
- *Mung bean*: brought in lower yield because of the dry weather.
- *Red bean*: brought in the lowest yield but only one family planted it.

On the basis of the trial results and of suitability to the area, farmers in Quang Thai and in neighbouring areas want to continue growing peanuts in larger areas with larger numbers of participating households. According to villagers, growing peanuts in this poor soil area helps alleviate poverty, improves land productivity, diversifies crops, and develops the farming villages around the lagoon. This is expected to decrease exploitation pressure on the lagoon.

AFTER WORD

The best testimony for the success of this activity is shown in Table 5 which indicates how peanut farming has developed in the area under cultivation and the number of households participating.

At the end of the activity reported here, the Farmer's Association of Trung Kieu Village, Quang Thai commune applied for funding from the Asian Community Trust (Japan) and the Imai Memorial Charitable Trust for Overseas Cooperation to expand peanut growing among the farming community with the assistance of the Department of Extension and Rural Development, HUAF. The funding was approved in May 1998 for one year and was used for improving draining system in the fields, for organizing the training activities and for loans to farmers. The results of these efforts are presented in Table 5 (Truong Van Tuyen, 1999).

Table 5. Number of households adopting peanut growing, the area planted and the yield of peanut and green material from 1997 to 1999.

Indicator	Summer-fall 1997	Winter-Spring 97-98	Summer-fall 1998	Winter-Spring 98-99
No of hhs	57	69	126	150
Area	0.93	8.06	5.8	19.5
Peanut yield (kg/sao)	52.2	63.4	26.4	75
Green material (tons)	9	80	69.4	200

From Truong Van Tuyen, 1999

REFERENCES

Trương Văn Tuyển, 1999. Diversification of Crop Production to Improve Income in Quang Thai, Viet Nam: A final report on the project implementation. Submitted to the Asian Community Trust. Hue, Viet Nam.

Aquaculture - its Introduction and Development

Lê Văn Miên, Tôn Thất Pháp and Hoàng Nghĩa Duyệt

INTRODUCTION

Tam Giang lagoon is connected to the sea through 2 openings on the east side - Thuan An and Tu Hien Estuaries - and receives freshwater from many rivers, such as Huong, Bo and Dai Giang, from the Southwest (Map 3, p. 3). As a result of this geography, lagoon water is a constant mixture of fresh and salt waters with salinity fluctuations which are rather regular seasonally (due to the rainy and dry seasons) and spatially (due to distance to the estuaries or openings to the sea).

The lagoon is a shallow, brackish water area which has not only valuable resources but also high potential for aquaculture. The average depth is 2 m with a maximum, in channels, of 3 - 4 m. Salinity and bottom topography are favourable for the construction of aquaculture ponds and net enclosures[1] in most of the area, with concentrations nearest the Thuan An estuary which has the highest salinity (Map 8, p. 133). Located near Thuan An and 10 km east of Hue, Phu Tan has many advantages in terms of transportation, military, tourism, and services, and the most potential for aquaculture.

At present, because of high increase in population and decrease in aquatic resources, aquaculture is considered as an alternative to improve villagers' income and decrease exploitation pressure on the lagoon. This is also a strategy for the development of aquatic products in the locality supported by local government policy. Therefore, recently, aquaculture has developed so rapidly that its impact on the environment is strong.

This report aims at analysing the present status and development trend of aquaculture in order to propose a sustainable system of aquaculture production in this lagoon area.

HISTORICAL CHANGES

Land

Before 1953, the forest ecosystem was still thriving and able to control soil erosion and flooding. The economy in Phu Tan at that time was subsistence, relying mainly on agriculture and fishing. The main means of transportation means were boats and human shoulders. Around 1928, a dike was built at Thuan An estuary by the French to prevent salinity intrusion and increase the area under rice production. The area was a rice bowl providing food for more than 300 households or about 2000 people in 3 villages: Dien Truong, Tan An and Tan My.

In 1953, the Thuan An dike was broken by a storm. From a total of 200.53 ha in Dien Truong, Tan My

[1] Net Enclosures: An area of water enclosed with a double layer of mosquito netting in which naturally occurring species and some stocked species are protected and allowed to grow before harvesting using fish corrals and gill nets. They are distinct from fish pens which exclude naturally occurring species, are smaller in area, densely stocked with specific species and require feeding (see Net Enclosures, p. 125).

and Tan An, 99.1 ha of rice fields in the south of Thuan An road were submerged, damaged by salt water and abandoned. The 99.1 ha of submersed land increased the total water surface area of Phu Tan from 610.3 ha to 709.4 ha. Another 44.8 ha in the north of Thuan An road now produce only one crop of local variety rice with unstable and very low yields and they are almost abandoned. After the storm, farmers were forced to supplement their farm incomes by fishing. Some even abandoned farming as a main income and turned to fishing.

Since 1985, the commune's agricultural cooperative began converting some of the abandoned land in Tan My and Dien Truong to aquaculture. After Decree 64 was issued in 1994 (see **Appendix A**), the cooperative re-organized production and increased benefits to farmers. In Tan An land owners also plan to apply for permission to convert their land to aquaculture and the idea is spreading to other areas around the Tam Giang lagoon with similar conditions.

Table 1. Changes in Land uses 1953 to the present (in ha.)

Village	Settlement Area			Agricultural Land	
	1953	1994	Present	1953	1994
Dien Truong	5.66	6.6	7.06	n/a	56.91
Tan An	5.71	7.16	7.81	n/a	15.9
Tan My	5.32	6.84	7.14	n/a	28.35
Tan Duong	1.8	3.2	4.45	n/a	---
Tan Thuy	--	0.86	0.86	n/a	---
Tan Cang	--	2	3.1	n/a	---
TOTAL	18.49	26.66	30.42	200.53	101.43

Source: Mr. Võ Quế, Official of land affair, Phu Tan people's committee

Livelihoods

In the 1960s, developments such as a regular bus connecting Thuan An and Phu Tan to Hue City, the construction of a sea port at Phu Tan and a bridge connecting Thuan An and the coastal sandy dunes to Phu Tan and the mainland, created many new opportunities for jobs. Traders settled on both sides of Thuan An road (near the bridge) establishing Tan Cang Village and the beach near Thuan An became crowded with tourists in summer. As a result, more and more people settled here and eventually, 2 new villages were established (Table 1). After a big storm in 1985 which took the lives of many families living permanently on boats, the government issued a settlement policies for sampan people, granting land and supporting them to settle in an area called Cồn Mụ Thiên which became Tan Thuy village.

Table 2 indicates that in the last 40 years in Phu Tan (from 1953 to 1994), the number of households almost quadrupled. Production activities which were subsistence, have now changed to a market economy and, while the number of households engaging in farming has not increased much (from 98 to 115 households), the number of fishing households has increased almost 5 times. Services, trade and off-farm activities have also increased.

Betweeen 1553 and 1994, Phu Tan has changed a great deal: from 4 villages with a subsistence agriculture system to 6 villages with a market economy based on fishing and the service sector (Table 2). Many changes have also occurred as a result of the development of aquaculture since 1987. In 1996

in the commune, there were 1007 households (5576 people) of which 478 households were engaged in aquatic species production: 214 households in aquaculture, 123 households in lagoon fishing, and 141 households in fishing both at sea and in the lagoon.

Table 2. Changes in employment opportunities from 1953 to 1994 (in number of households)

Village	Farming		Fishing [a]		Trading		Handicraft		Off-farm		Services		TOTAL	
	1953	1994	1953	1994	1953	1994	1953	1994	1953	1994	1953	1994	1953	1994
Dien Truong	48	57	50	78	5	65	5	6	5	23	---	6	113	235
Tan An	20	17	30	115	3	39	5	6	5	31	---	7	63	215
Tan My	30	41	10	13	10	50	10	18	15	10	---	21	75	153
Tan Duong	---	---	5	113	---	19	---	3	---	17	---	4	5	156
Tan Thuy	---	---	---	141	---	1	---	---	---	1	---	2	---	145
Tan Cang	---	---	---	8	---	26	---	---	---	46	---	3	---	83
TOTAL	**98**	**115**	**95**	**468**	**18**	**200**	**20**	**33**	**25**	**128**	**---**	**43**	**256**	**987**

Source: Mr. Phan Nùng and Võ Quế, Phu Tan People's Committee Officials
[a] Fishing includes aquaculture production in 1994.

THE INTRODUCTION OF AQUACULTURE

Aquaculture in Thua Thien-Hue lagoon began in 1978 with the opening of a research station focussed on seaweed culture. After 4 years of research, the Agar Company officially opened in June 1982 and began its operations in 100 ha of ponds. Shrimp culture began in 1987 by Vatex company. From 1990 to 1993, the area of shrimp ponds increased from 20 ha to 461 ha (Table 3), while the area under seaweed cultivation increased from 226 ha to 357 ha. The area under shrimp culture in Thua Thien-Hue province increased almost 50 fold from 1990 to 1995.

Table 3. Development of shrimp aquaculture area in Thua Thien-Hue

Year	1990	1991	1992	1993	1994	1995
Pond (ha)	20	110.5	251.9	461.3	698.1	980

Source: Overview on orientation for fishery planning up to 2010, DoF

When aquaculture first developed, monoculture with high stocking densities was the focus. In 1982, the Agar Company of Hue, with Mr. Trà as its director, built a dike to enclose an area of 100 ha (of which 55 ha belonged to Dien Truong) for seaweed cultivation (Map 8, p. 133). Because production was subsidized and management poor, the company suffered losses and Mr. Tra began renting ponds to the company workers and other villagers for 1 ton seaweed/ha/year (equivalent to about 2 million VND/ha/year). These people invested their own money and labour for seaweed cultivation, and, in addition, began stocking shrimp, crab and fish in the ponds to increase their profits. They acquired experience using polyculture to get the most benefit from their rented area.

In 1987, tiger prawn was cultivated for the first time in 8 ha of experimental ponds by Vatex Company (also referred to as Hue Shrimp Company) (Map 8, p. 133). The harvest was 1.4 ton/ha bringing a price

of 120,000 VND/kg (a high price at that time). In 1989, this company expanded their area to 12.8 ha and continued profiting. This encouraged other individuals and institutes to invest in pond construction (the fishery extension station, provincial police, Mr Dự, and the Shrimp Seed Hatchery Company), increasing the area of shrimp cultivation by 10 ha (Table 5). Since then, movement of shrimp cultivation has spread throughout the whole province in areas such as Quang Cong, Quang Dien, in the northern basin, and in Phu Da, Phu Vang, along the narrow channel in the south (Map 3, p. 3).

In the following years, as state-run enterprises (such as the Agar Company and Vatex) and even a foreign company suffered losses and stopped production or rented their ponds to fishers, industrial-scale aquaculture was abandoned. After suffering losses from 1994 to 1996, the ponds rented by Vatex Company were returned to management by Phu Tan commune because the ponds were polluted. These companies, especially the Agar Company, can be considered to have finished their historic role in founding aquaculture in Tam Giang lagoon. Aquaculture, however, is still regarded as a pilot economic activity in the development of Thua Thien-Hue. The DoF's present strategy for aquaculture development supports semi-intensive culture, with villagers doing aquaculture and state-run companies supplying seed and technical support.

However, in the past 5 years, based on basic aquaculture techniques acquired from training courses held at the Fishery Extension Centre and from their own as well as others' experiences (both successes and failures), small-scale aquaculturists have developed their own aquaculture methods using extensive and improved extensive polyculture with low stocking densities. These methods are more appropriate to lagoon conditions and to their ability in management and require less investment. The economic benefits are higher compared to those from high density culture because investments for seed and feed are low, no improved technologies are required and product quality is good thus price is higher. Extensive and improved extensive methods are applied in ponds constructed in shallow areas (with dikes) or in net enclosures. Present aquaculture structures are ponds, net enclosures and cages. Ponds are most prevalent and are managed using extensive, improved extensive and semi-intensive methods. The area of net enclosures is 100 ha; extensive ponds, 100 ha; improved extensive ponds, 824 ha; semi-intensive ponds, 8.8 ha; and cages, 67.2 ha (120 cages).

Despite these innovations, aquaculture production in the lagoon is still unstable and requires further research to overcome difficulties. Disease is the main problem ravaging large areas and many ponds are now polluted and abandoned.

SEMI-INTENSIVE AQUACULTURE

Semi-intensive aquaculture is a method used to monoculture tiger prawn. Examples of such enterprises in Phu Tan are Vatex company in a pond area of 12.8 ha and Mr Hoàng, a Taiwanese entrepreneur in the Fishery Extension Centre pond area of 3 ha.

Vatex Company

This company (owned by the City of Hue) operated between 1987 and 1996 in 0.5 ha ponds, surrounded by dikes with sluice gates. Water supply was available and, on average, 20% of pond water was changed daily. Pond repair and cleaning were the main use of labour. Stocking density was 8 to 15 animals/m^2 fed industrial feed (from Thailand) with some supplements of small fish and shrimp. Ponds were harvested twice a year (stocked in lunar month I, harvested in IV and stocked in V, harvested in VIII)

until 1993 and 1994, when only 1 crop was produced each year (see **Appendix A** for lunar calendar).

Production was subsidized. In the first years, this system produced 1000 to 1400 kg/ha/crop, or, on average, 2,500 kg/ha/year. Such a harvest would normally be highly profitable to a private company, however, because the input costs were very high, the benefits returned to Hue City were less than the investments for each production year from 1989 to 1993. From 1994 to 1995, this company suffered losses, up to 60 million VND in 1994. In those years, input costs increased while harvest decreased as a result of serious environmental pollution and disease. The company was dismissed and the area returned to Phu Tan commune at the beginning of 1996. At present, this area is rented at price of 1,000,000 VND/ha, however, few people engage in aquaculture because of a lack of good water supply.

Taiwan company at the Fishery Extension Station

This company is still developing its methods. It began production in 1995 in ponds surrounded by strong dikes with a good water supply and using electrically powered aerators. Shrimp seed are stocked at high densities (15 - 20 seed/m^2) and fed industrial feed supplemented with small shrimp and fish.

In 1995, shrimp grew very well however part of the harvest was lost as a result of flooding. The company suffered a loss of 10,000 USD. In 1996, the total input cost for 1 crop of shrimp was 200 million VND with a projected harvest of 6 ton/ha in 2.3 ha of ponds. In fact, the harvest was 1 ton/ha and the quality of the shrimp was poor compared to cultivation by extensive aquaculture - only 70,000 VND/kg. They did not make a profit.

The problems associated with semi-intensive aquaculture are:

- Poor water quality and supply especially in summer when algae thrive
- The supply of shrimp seed is low and quality is poor
- Feed supply is poor
- Damage and loss by natural disasters (floods and typhoons)
- Insufficient and unreliable electrical power to drive pumps and aerators
- Capital required for investment is large

At present, Phu Xuan Shrimp Company, located in Phu Xuan commune, is the only state-run enterprise which successfully applies semi-intensive culture but it uses lower stocking densities (10 seed/m^2). In fact, semi-intensive aquaculture in its true definition is not practised in the province. The mentioned methods, even that of the Taiwanese company, are considered sub-semi-intensive. Under such severe and unstable natural conditions, semi-intensive culture may not be feasible. Even the semi-intensive method applied by the Taiwanese in Hue has failed though under relatively excellent conditions.

Monoculture of tiger prawn is not applied by small scale aquaculturists. Their own methods are compared to semi-intensive culture in Table 4.

Present methods applied by fishers are referred to as polyculture or improved extensive, and are flexible and suitable to available conditions. The economic benefits are comparable to semi-intensive but more secure. Problems associated with less intensive methods are seed supply, disease and natural disasters.

Table 4. Comparison of semi-intensive culture to the present adapted method.

"Semi-intensive" Method	Adapted Method or "Improved Extensive"
2 crops per year	1 crop per year
Pond repair before each crop	Pond repair once a year
20 - 30% daily water exchange by pumping	Water exchanged by tide
Monoculture at high density (4-15 seeds/m^2)	Polyculture with crab and fish at low density: shrimp at 2/m^2 and crab at 0.5/m^2
Harvest at the end of each crop	Continuous stocking and harvesting
Industrial feed with supplement of small fish and shrimp	Small fish and shrimp supplemented with industrial feed
High harvest but poor quality	Low harvest but high quality
High risk (Disease, calamities)	Low risk
High investment, high risk of loss	Low investment, benefit possible by diversifying livelihood

IMPROVED EXTENSIVE AQUACULTURE

This method is applied in ponds where semi-intensive culture was unsuccessful. The size of pond is, on average, 5000 m^2 surrounded by dikes with water exchange through a sluice gate using natural tidal currents or a mechanical pump. The main jobs are pond repair and maintenance, and pond preparation (pumping the pond dry to get rid of harmful animals). A fish corral is set at the sluice gate to catch lagoon fish and shrimp for stocking.

Ponds are continuously stocked and harvested with a mixture of banana prawn, greasyback shrimp, crab, mullet, rabbitfish, grass carp and seaweed - valuable species for the local or export markets. Depending on the local environment, the cultivated species can vary. Some common polyculture patterns are : Shrimp - Seaweed; shrimp - crab - fish - seaweed; and shrimp - crab - fish. Hatcheries are main seed suppliers but, since supply is low, it is supplemented with natural seed from the lagoon. There are several variations on stocking and harvesting schedules:

1) continuous stocking from the end of lunar month X to the beginning of VI with a harvest at VIII and from VIII to X, wild fish are caught in the ponds;

2) 1 crop per year: stocking from after 23 X to month II and harvesting in month VIII before first flood of the rainy season.

3) 2 crops per year: crop 1 after 23 X to month IV; and crop 2 from IV to VIII.

Waste fish or industrial feeds are used regularly. The harvest is not high but quality is good and low investment is required, so it is more profitable and safer than semi-intensive. A survey indicated that the benefit of this culture method can bring a monthly income of 288,000 VND per person.

Improved extensive method of culturing aquatic species varies in:

- Shape, size, position and depth of pond and number of sluice gates

- Species cultured
- Stocking densities of each species and total combined
- Feed supply and kind of feed
- Sources of fry and seed supply
- Source of water supply

Lack of rigid planning results in a flexibility to opportunity and circumstance. It also indicates a lack of compliance with techniques disseminated by the DoF. Compared to monoculture, polyculture has less impact on lagoon environment and also less risk of losing 100% of crop to disease.

EXTENSIVE AQUACULTURE

Extensive methods are mainly applied in the ponds rented from the Agar Company. Two groups were surveyed each consisting of 5 to 6 households who combined their capital and labour and have equal rights in decision-making for the group's activities. The ponds are 8 - 10 ha of strong construction, surrounded by a strong dike with sluice gate. The sluice gate permits exchange of water with the lagoon. Feed is rarely added and only if available. Ponds are stocked at low densities - eg. shrimp at 0.03 seed/m^2; crab at 0.02 animal/m^2 and mullet at 0.001 - 0.0015 fish/m^2.

Monthly income from this method is high at 244,000 VND per labourer. The environment is unpolluted and less diseases occur. However, the area required per household is large at 1.6 to 2.5 ha. If all the remaining water area in Phu Tan was converted, it would not suffice for the whole commune's population of 250 households. This method needs to be modified if the goal were to reduce unemployment.

Problems associated with extensive aquaculture are: seagrass or macrophytes competing with the cultured seaweed, predator fish, disease and flood.

CONVERTED AGRICULTURAL LAND

Table 5. Agricultural land converted to aquaculture (Map 8, p. 133)

Year	Name of person/organization	Location	Area (ha)
1982	Agar Company	Dien Truong - Field 41	55
1985	Villagers	Dien Truong - Field 41 (FW)	25
1985	Villagers	Dien Truong/Tan My - Field 13	5
1987	Vatex Shrimp Co.	Tan My - Lobana ponds	12.8
1990	Police Department	Phu Thuan Commune	1
1990	Shrimp Hatchery Company	Antenna area	3
1991	Fishery's Extension Centre	Foot of Thuan An Bridge	3
1992	Mr. Du	Foot of Thuan An Bridge	3
1993	Mr. Dien	Antenna area	2.8

Source: Reports of Phu Tan PC, 1994, and villagers

In Dien Truong, Tan My and Tan An, there are 19, 12 and 13.8 ha of land, respectively, which have poor, saline-intruded, acid and alum soils submerged under 0.4 to 1.3 m of water. These fields were rented through auction to farmers who pumped the water out in January, harvested the fish and shrimp and then plowed the land to prepare for rice planting. Only 1 crop of rice was harvested annually at the beginning of April, a local variety rice with low and unstable yields. Production was about 1.1 - 1.5 ton/ha/year (55-70 kg/*sào*) (1 *sào* = 500m^2), equivalent to 100,000 to 150,000 VND, while input costs totalled 86,000 VND: rice nursery land rental (20,000 VND), fertilizers (18,000 VND) and taxes and management charges (19,000 VND). Including the labour costs of 6 people for planting, maintenance and harvest, the rice production resulted in economic losses even in a good harvest year. In May, those fields were once again flooded and the farmers fished available resources using fish corrals or gillnets.

Economic efficiency was low and the risks were high. These fields were used by few farmers and often abandoned. Before the implementation of decree 64 in 1994, they were managed by the Agricultural Cooperative and farmers, who were allocated this land, had to suffer the losses. After 1978, when the Agar Company research station introduced aquaculture, the farmers gradually began to enclose small plots with bamboo or nets and stocked them with juvenile fish, crab and shrimp caught in the lagoon and added feed for more profit. Some households stopped farming altogether to culture aquatic species.

Since 1985, the Agricultural Cooperative decided to convert the poor land in Dien Truong and Tan My (31 ha total) into aquaculture land. Groups of aquaculturists were established voluntarily. Because the land borders on the Upper Ha Dao lagoon, it was used to cultivate brackish water species. In 1994, pursuant to decree 64, the Agricultural Cooperative claimed all the rice fields and converted areas and re-allocated them back to all villagers equally. On average, each person received access rights to 1 *sao* of rice field and 0.5 *sao* of aquaculture area. Farmers unable to participate in aquaculture production, rent out their land to others at a fee of 90,000 VND/*sao*/year (including an agricultural tax of 20,000 VND/*sao*/year). They continue to grow rice in their 1 *sao* rice field, go fishing with pushnet, dragnet, fish trap, etc., raise animals, make conical hats, or trade.

Dien Truong

Dien Truong has a population of 150 households (828 people). Each person has access to 0.46 *sao* of aquaculture area and 1 *sao* of rice field. The 19 ha of aquaculture land was divided into 2 equal areas and allocated to 2 groups of 75 households each (414 people).

Group 1

One area is exploited by 24 households who rent it from the other 51 households. The former worked in aquaculture in this area before land reform in 1994 while the latter did not and, since they lack labour and capital to join in the venture, they transferred their rights to the aquaculture area for 5 years. The aquaculture group grows seaweed and catches wild fish. Main expenses are seaweed seedlings and land rental. Labour is mainly used in harvesting. Households who engage in aquaculture production don't invest money and energy on pond construction and other technologies because the rental duration is too short.

Group 2

All households in group 2 participate in aquaculture. They constructed 15 ponds of 6 *sao* each in an area

of 4.5 ha. This group is divided into 15 subgroups (of 5 households or 27-28 people) with each subgroup managing one pond. The remaining 5 ha is low-lying land, usually submerged under more than 1.5 m of water, where it is not possible to construct ponds. Therefore, they share this area, under the management of the head and vice head of the group and heads of subgroups. In the ponds, seaweed, shrimp and crab are stocked and cultured and wild fish are harvested. In the deeper area, seaweed is cultured and group members can bid for the right to catch wild fish. Seaweed is cultured in the beginning of month XII (when water becomes saline), and harvested from months I to VIII; Crab is stocked in I and harvested in VI; Shrimp is stocked in I and harvested in VII; and wild fish are caught from IX to XI. Main expenses are pond construction, annual repair and preparation (plowing and liming), seed for seaweed, prawn and crab, and feed.

Tan My village

Tan My has 12 ha which has similar conditions and position to that of Dien Truong's converted area. Before 1985, this area was used for rice farming but it was later abandoned. In 1994, each villager was allocated 0.5 *sao* of land and they transferred the right to 7 households which work in 2 groups:

- 6.5 ha worked by 3 households (Bàu Cột group) which rent the area from 255 people
- 5.5 ha worked by 4 households

Bau Cot group uses nets to enclose their aquaculture area. They raise crab and seaweed and harvest wild fish. Main expenses are the construction of a dike, annual repairs, seaweed and crab seed, crab feed and rental fees. The economic efficiency is low at 5 million VND/ha but because there are few people working on the area, they don't have enough capital for investment. Another deterrent is the fact that the contract period is 5 years - not long enough to encourage investment. The area is 2 to 3 km away from their village, thus difficult to monitor and ensure safety.

Tan An village

The aquaculture area of Tan An Village is near the Quy Lai - Tan My dike at Ha Dao Upper lagoon (Map 5, p. 5). It has long been abandoned but was not converted for fear that the surrounding rice fields would get saline. Recently, villagers found a solution to this problem converting the area for freshwater aquaculture.

Plot 1

Four (4) households rent an area of 6.5 ha from 53 households. This plot is deep (0.8 - 1.2 m) and is used for crab and freshwater fish (grass and local carps) since 1994. Main expenses are fish corrals, crab and carp seed, crab feed and land rental. Labour is used for dike repair, feeding and caring, harvesting and selling fish and crab and for catching wild fish. Before 1975, one family lived off this area from fishing. Now with extensive aquaculture, it can support 4 households. However, if the community leaders allowed them to let saline water in and divide the area into smaller ponds to culture shrimp, fish, crab and seaweed, production would need more labour and would provide much higher income than the present production system.

Plot 2

An area of 3.3 ha is rented by Mr. Nguyễn Con and Mr. Nguyễn Tùng. A shallow area of 2.5 ha is used for rice production in Winter-Spring (planted in lunar month XII and harvested in IV) while a deeper area of 0.8 ha is used to stock crab and fish (crab stocked in XI, harvested in III; fish stocked in XII, harvested in VI). Wild fish available in the area are caught all year round. Main expenses are rice seed, field preparation and fertilizing, land rental, net and bamboo and crab seed.

Summary

Table 6. Summary of estimated costs and benefits of land conversion to aquaculture in Phu Tan.

Village	Production	Area	# of Hhs	Cost in million VND		Net Return in million VND		Hh income (million VND)
				Total	per ha	Total	per ha	
Dien Truong	Seaweed	9.5	24	73	7.7	83.6	8.8	3.5
	15 Ponds: crab, shrimp + seaweed	9.5	75	252	26.5	193	20.3	2.6
Tan My	Net enclosures: crab + seaweed	6.5	3	41.55	6.4	33	3.5	8.6
Tan An	Net Enclosures: crab + FW fish	6.5	4	45.3	7	26.3	2.8	6.6
	2 areas: 1. Rice 2. crab + FW fish	3.3	2	10.7	3.25	6.9	2.1	3.4
	Net Enclosures Areas (see next section)	10	6	77 [a]	7.7	78	7.8	13

Note: In each case, wild fish are harvested as part of the operation or leased out.
[a] The cost of the construction materials was not calculated over several years.

In Tan My and Tan An, the economic benefit is low because the number of people competing in the auction for the lease is low, the lease duration is short (5 years) and capital input is limited. The land is not used to its full aquaculture potential. Households involved in aquaculture receive a high income, but the overall community's benefit is low.

Though investments are high, aquaculture brings much more benefit compared to rice production. Brackish water culture brings in 2 times more return per hectare than does aquaculture of freshwater species. If investment is increased and extensive or improved extensive methods are applied (in small ponds), the economic benefit could be 3 - 4 times more than at present.

Aquaculturists in the converted areas in Dien Truong, Tan My and Tan An claim that, so far, disease occurred only once in 1994, when infected shrimp seed from Nha Trang spread to most of the shrimp. Recently, seed is supplied from Thua Thien-Hue hatcheries and diseases do not occur. In particular, in the aquaculture ponds of Group 2 in Dien Truong village, despite high stocking density, there is no disease. This indicates that present aquaculture production systems have not affected the pond environment yet.

The benefits this conversion bring are:

- It makes use of abandoned land
- Provides work for unemployed labour,
- It improves income, and
- In the case of fresh water culture, it avoids damaging neighbouring rice fields.

NET ENCLOSURES

These structures appeared in 1995, because of pressure of overexploitation by destructive gear. Of all fishing gear, fish corrals brought the highest income however, since small mesh net were introduced (decreasing mesh size from 7x7 mm to 3x3 mm) and new, more efficient gear appeared (dragnet, pushnet, etc.), daily catches have decreased drastically. The success of some aquaculturists in shrimp cultivation made fish corral operators think about cultivating shrimp in their own water area. They formed production groups and requested from the commune permission to enclose their fish corral areas for aquaculture. In 1994, under the recommendation of Phu Tan commune officials, Phu Vang district People's Committee granted licenses to the first 4 groups headed by Mr Nhuận, Mr. Lộc, Mr Bích and Mr Trường. Since then, many other groups have formed and the area of net enclosure has increased rapidly (Map 8, p. 133). While their applications were still under consideration by commune officials, many fishers enclosed their area. In 1996, out of 25 groups of fishers who enclosed their area (Table 7), only 4 groups were granted licenses. Five (5) cases were recommended to district People's Committe but not yet approved (Mr Hiền, Chương, Khương, Thẹ, Nong). The rest have not even filed applications.

Interviews with the groups of Đặng Thẹ, Phan Hiền and Nguyễn Khương, in Tan Duong village provided more information on the management of net enclosures. Net enclosures are managed by production groups consisting from 2 to 12 households (Table 7). Construction of a net enclosure is illustrated in Figure 1. The area, enclosed by 2 layers of net, is from 2 to 18 ha, but the actual area for stocking aquatic animals is a small plot of 1000 - 3000 m^2 in the centre. Three (3) to 4 fish corrals are set in the main enclosure to harvest wild species. No destruction or change to the lagoon bottom (including plants) occurs and water is exchanged through the nets by currents. The species cultivated in the stocking area usually consist of crab and shrimp.

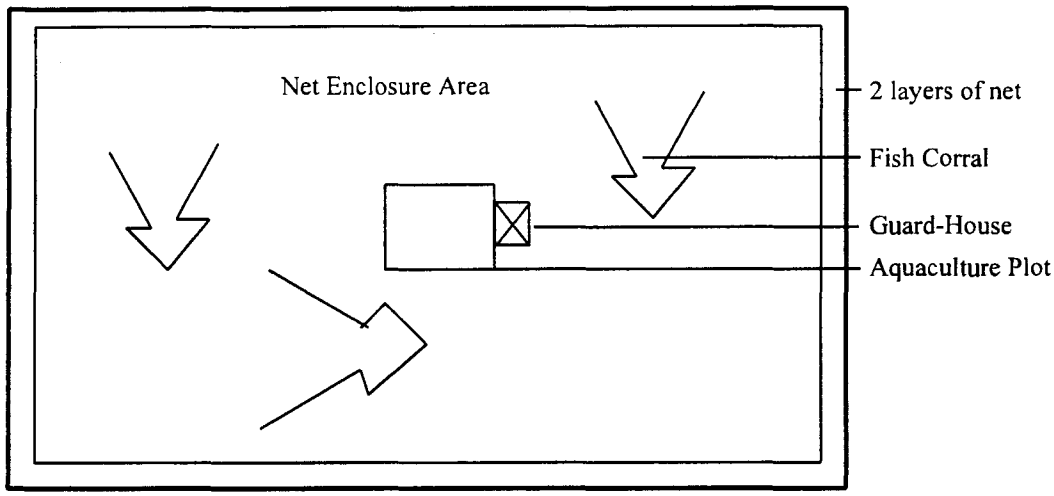
Stocking: Open area – Crab at low density (0.2 animal/m^2 or in 11.8 ha - 600 kg @ 40 crabs/kg)
– Continuous stocking and harvesting
Aquaculture plot – Tiger prawn (2.5 animals/m^2); Crab (0.5 animal/m^2)
– One stocking period and one harvesting period

Feed: Regular feeding in aquaculture plot; irregular in net enclosure area (depending on availability)

Schedule: VIII - X (flood season) – Part or entire net is detached to repair, clean and store
– Fish corrals alone are left to fish lagoon fish/shrimp
Mid to end X – Net enclosure is replaced
From XI on – Crab stocking
From XII to I – Shrimp Stocking

Households who are better off and can invest more will continue using net enclosure during the flood season to cultivate fish and shrimp. Risks are higher but profits are then higher from shrimp and fish following this period when aquatic resources in the lagoon are rare and expensive.

Figure 1. A typical net enclosure



Aquaculture brings much higher benefits than either agriculture or fishing especially as resources are being exhausted so quickly. According to fishers, net enclosure aquaculture is successful because:

- It requires less money and labour for construction and maintenance
- Water within the enclosure is continually exchanged with lagoon water
- It combines stocking and harvesting of raised species with fishing wild lagoon resources
- By feeding juvenile animals and harvesting only big sizes, market value is increased
- Less diseases occur than in ponds
- It makes use of natural feeds present in lagoon water
- It produces high quality products
- Continuous stocking and harvesting is economically highly efficient

Phu Tan is a pilot commune for aquaculture development in Tam Giang lagoon - a place where aquaculture has developed and from where it has spread over the whole lagoon. The support for aquaculture development stems from the belief that improvement in livelihoods based on natural aquatic resources is hopeless. However, it is not easy for all fishers to get rich from aquaculture thus net enclosure is an alternative which combines fishing and culture.

Net enclosures maintain a natural environment and ensure water exchange. Seagrass (or macrophyte) beds are preserved by fishers as a food source and shelter for aquatic species. The area under enclosure increases abruptly at the beginning of every new culture season. There is not sufficient information at this time to support or counter the development of net enclosures, however the speed at which net enclosures are developing is a concern for environmental and social reasons.

Net enclosures are a natural alternative when fishing grounds are over exploited and no longer favourable. Fishing grounds have reached a limit in their capacity for exploiters, gear density and labour intensity, and the aquatic resources can no longer bring plentiful products to fishers. The conversion from fish corral to net enclosure is a conversion from open fishing grounds which fixed fishers share with mobile fishers, to closed fishing grounds which only fixed fishers can exploit - a shift from community property to individual property. At the present rate of development, there will be no public lagoon area left for mobile fishers. Conflicts between mobile fishers and net enclosure fishers are becoming serious in the lagoon area and are not being resolved. Conflicts have occurred between Phu An mobile fishers and Phu Tan fish corral owners while a group of pushnet fishers from Tan Duong have presented their complaint to the local government regarding the reduction of their fishing grounds due to the development of net enclosures. These are warnings which planners of aquaculture as well as local government need to heed.

Table 7. Fishing grounds enclosed by nets for aquaculture (Map 8, p. 133)

Year	Group Leaders	Area (ha)	No. of households
1995	Phan Nhuận	2	2
1995	Hiền	6	5
1995	Khương	6	4
1995	Lộc	3	5
1996	Bích	18	8
1996	Trường	10	4
1996	Tai	3	2
1996	Cay	10	5
1996	Đàn	9	5
1996	Tường	4	4
1996	Cải + Hay	6	4
1996	Vơ + Viền	5	8
1996	Liền + Mão	7	4
1996	Tăng	6	4
1996	Chương	6	4
1996	Thẹ	12	12
1996	Lộc + Thái	5	3
1996	Sỹ	10	4
1996	Vít	4	1
1996	Ms. Tình	5	3
1996	Tất	2	1
1996	Tốt	5	2
1996	Đoàn	5	4
1996	Tồn	4	8
1996	Nong	5	1
	TOTAL	**158**	**107**
	AVERAGE	**6.32**	**4.28**

Source: Survey data, validated by Mr Quế and Mr. Nùng, Phu Tan PC Officials

IMPACTS OF AQUACULTURE DEVELOPMENT

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. Aquaculture has developed and is highly appreciated by local aquaculturists in Phu Tan. 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 communes around the lagoon.

Aquaculture is one of the main strategies in economic development in Thua Thien-Hue. Moreover, geographic and environmental conditions are favourable for enclosing lagoon areas and for constructing aquaculture ponds. However, the rapid development has impacts on the environment and resources, an issue which requires more research and discussion.

Ecological and environmental impacts

Nursery habitat

As mentioned above, most of the lagoon bottom is shallow and flat, highly favourable for aquaculture development. Already 162 ha of lagoon (39% of total water surface in Phu Tan) and 110.6 ha of submerged fields have been converted for aquaculture (Tables 5 and 7). With such rapid development, in the near future, the whole area at 2-m depth will become aquaculture area with 2 dominant structures: net enclosures and ponds.

As a consequence of pond construction, many seagrass and freshwater macrophyte beds - habitat of fry and juvenile aquatic species - have been destroyed and the shoreline has changed dramatically. At present, most shallow areas close to the lagoon edge are used for aquaculture, which reduces the lagoon area and affects the distribution of juvenile aquatic species, including native species and those migrating from the sea. The fish and shrimp juveniles, that survive intensive exploitation by more than 1000 bottom nets set along current channels (Map 8, p. 133), can not reach suitable habitats to live and grow. Ideal habitats are shallow water areas 30-50 cm deep with dense beds of aquatic plants. With these habitats gone, they have to live in deeper water where they lack food and safe shelter and where they are vulnerable to many predators. This increases the mortality rate among juveniles - one of many reasons for the decrease of catch in the lagoon. Catch rates in Ha Dao lagoon, reputed as the highest in Phu Tan, have decreased by 4 to 5 times over the last 2 or 3 years.

Though net enclosures don't destroy seagrass and freshwater macrophyte beds, they encroach on lagoon area obstructing water currents and impeding the natural fry migration. With water currents hindered, fish fry and shrimp seed have a difficult time reaching nursery areas further decreasing their chances of survival.

Overexploitation

The majority of poor fishers, who operate mobile gear, are encountering difficulties. They have to go farther and in deeper water to fish. Large adult shrimp and fish are not abundant anymore thus these fishers have been forced to replace old gear (such as hook and line and gillnet) with new fishing gear which catch small juvenile fish and shrimp before they get a chance to reproduce. With little or no

reproducing individuals, many species are at risk at disappearing from the lagoon.

Natural seed sources are important to extensive and improved extensive aquaculturists. Though statistics on this seed supply are not available, it is obvious that it makes a considerable contribution to overcome the shortage of seed for aquaculture. Exploitation of shrimp and crab seed provides an income for poor fishers who operate dragnets and pushnets. In addition, large amounts of juvenile aquatic species are exploited to meet the demand for feed in aquaculture. If exploitation of juveniles is not controlled, natural lagoon resources will continue to degrade.

Biodiversity

If aquaculturists focus on cultivating only a few valuable species in their ponds or net enclosures and continue to use less valuable species to feed cultured species, diversity in the lagoon will decrease.

Aquaculture pollution

Water circulation

Tam Giang is a semi-closed system with a tidal amplitude which fluctuates to a maximum of 50 cm and a particular climate which causes rivers to overflow and flood low-lying areas in the rainy season. During the dry season, however, river flow is very weak and the lagoon flushing rate is low. Pollution from organic substances in large aquaculture areas is common and local authorities report that diseases in cultivated species are prevalent.

Tidal currents, which previously provided water exchanges to the submerged areas, have now slowed down and changed their directions. They do not reach aquaculture ponds located further inland and, as a result, the water quality in these areas is not suitable for aquaculture. Seagrasses grow very quickly in parts of 41 pond and Agar Company ponds. Algal blooms occur in the summer, polluting the Vatex shrimp ponds. Ponds in the vicinity of the port (belonging to the commune police, the Fishery's Extension Centre and Mr Du) are surrounded by new net enclosures. As a result their water supply is getting worse.

Shrimp disease

Shrimp seed are available from 2 hatchery centres in Thuan An and 2 small hatchery stations in Thuan An and Loc Vinh (located on Chan May Bay), however, in recent years, seed supply has not satisfied aquaculturists' demand. Therefore, a large amount of seed was imported from provinces in the south, mainly Da Nang and Nha Trang. Aquaculturists believe that the imported shrimp seed were carriers of the disease which spread to large areas. Without control or prevention, serious consequences will occur should the lagoon' natural shrimp become infected.

Social/Economic

Aquaculture requires high investment thus only better-off fishers or those who have access to loans are able to develop this activity. Fish corral owners who obtained rights to water areas through auction before 1975 still maintain those rights by paying taxes to the local government. They are in a favourable position to convert their areas into aquaculture if they comply with the regulations and requirements of the local government. Net enclosures for aquaculture bring benefits to a minority of better-off farmer-

fishers (23.3%) and pushes majority of poor fishers (76.7%) into deeper poverty. It causes pollution in inland ponds, hinders navigation, and limits distribution and development of aquatic resources, causing conflicts in resource utilization within and among communities.

Of 110 ha of converted area in Phu Tan, only 31 ha are used by local farmers. The rest is claimed by city or provincial institutes. Moreover, more than 69% of fishers in Phu Tan don't have access to aquaculture area. It is mainly farmers, with access to agriculture land who have converted it to aquaculture or have won most of the bids for access to the abandonned Vatex Company ponds.

More than 90% of Tan Thuy villagers, over 60% of Tan Duong villagers and some of Tan Cang villagers are poor and earn their living by operating mobile gear in the lagoon - gillnet, hook and line, pushnet, dragnet, etc. Pushnet and dragnet must be operated in shallow water (maximum 1 m) and recently most of these suitable lagoon areas have been enclosed by nets or dikes forcing these fishers to practice in farther and deeper areas. Gillnet and hook and line were, in the past, used in and around fish corrals with or without permission from the owners. These areas, now enclosed by net, are no longer accessible. Mobile fishers spend more time and energy fishing to ensure necessary demands of their families.

Confrontations don't generally happen within a community but rather between communities to avoid conflicts with neighbours. Minor conflicts are solved immediately by quarrelling or driving mobile fishers away while more serious conflicts (fighting and death threats) are settled by the district or commune governments. Some mobile fishers have recently aggravated net enclosure owners by fishing in front of and beside fish corral mouths and damaging gear and nets. Fighting has also occurred between Phu Tan aquaculturists and Phu An mobile fishers when the mobile fishers were caught using electric dragnets and cutting nets to damage the culture area. Mr. Dang The, owner of a net enclosure, is suing for damages.

One group of mobile fishers in Tan Duong sent a proposal to the PC of Phu Tan in December 1996, asking for reasonable development of aquaculture so that mobile fishers can maintain access to lagoon areas. This proposal has not been approved and, according to Mr Chương (a mobile fisher in Tan Duong) and Mr Theo (head of Tan Duong village), if the government doesn't solve the problem and recognize their rights to earn a living, they will have to move to new economic regions or resort to violence. Managers and planners should not ignore their proposal. Some poor fishing households have already emigrated to avoid violence.

The conversion of lagoon area to aquaculture area is transferring the water area rights from a large population to fewer members by the reduction of fishing grounds for mobile gear. Mobile fishers have to travel further and further to find suitable, un-claimed fishing areas. In addition to claiming ownership of water areas, net enclosures are narrowing and blocking navigational passage. Fishers travelling through such areas may get lost and tangled in net enclosures if they don't know the area well.

The development of fixed and mobile gear in the lagoon has resulted in a process of increasing the gap between the powerful rich and the powerless poor. Since fixed gear have always dominated the fishery production in the lagoon, past and present management systems - including area rights, taxation, regulations and policies of development - are focussed around the concerns of fixed gear fishers neglecting the rights of mobile gear fishers. Any changes in the development of fixed gear - such as net enclosures - result in losses to mobile fishers.

Agriculture

Farming has been sustained for many generations on the thin stretch of sandy, saline-intruded, draught-prone land. As the population increased, however, agricultural yields, from some marginal lands (with poor sandy soils) and during some extreme climatic years, have not met family requirements. In recent years, as income from farming has decreased and the price and demand of aquatic products has increased, a large number of farmers have resorted to fishing with simple, mobile gear during slack farming season thereby increasing the pressure on lagoon resources. Farmers then began converting their lands to aquaculture. This change from crop and farm animal production to aquaculture has improved economic returns however it is not without problems.

Conversion of agricultural land into aquaculture area in one area in Phu Tan required the destruction of a dike which was preventing salinity intrusion from the lagoon. Though adjacent rice fields were thought to be protected by a highway, acting as a dike, saline intrusion has affected them. 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.

CONCLUSIONS

Although aquaculture started recently in Phu Tan, it has developed quickly and spread throughout the province of Thua Thien-Hue. In Phu Tan alone, over 100 ha of submerged and saline-intruded rice fields were converted to aquaculture area. However, few fishers can afford to construct aquaculture ponds. Provincial agencies (Agar Company, Fishery Extension Station and police), city agencies (Hue Shrimp Company) and powerful people (Mr. Du) have access to most of this area. Net enclosure areas have also recently boomed: In March, 1997, there were 25 net enclosures in Phu Tan 21 of which were not licensed. This benefits a few households at the expense of many mobile fishers.

Tam Giang has great potential for aquaculture development which brings better incomes for producers. However the lagoon's 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.

REFERENCES

Division of Protection of Aquatic Resources. 1995. *Những điều cần biết về bảo vệ và Phát triển Nguồn lợi Thủy sản.* (Important things that should be known about the protection and development of aquatic resources). Agricultural Publication.

Edeson, W.R. and Van Houtter. 1995. The legislative framework governing fisheries and aquaculture in Viet Nam. *Tuyển tập Nghiên cứu Khoa học. Hội thảo Quốc gia về Môi trường và Phát triển Nuôi trồng thủy sản.* (Collection of technical reports. National Workshop on Environment and Development of Aquaculture). pp. 488 - 500.

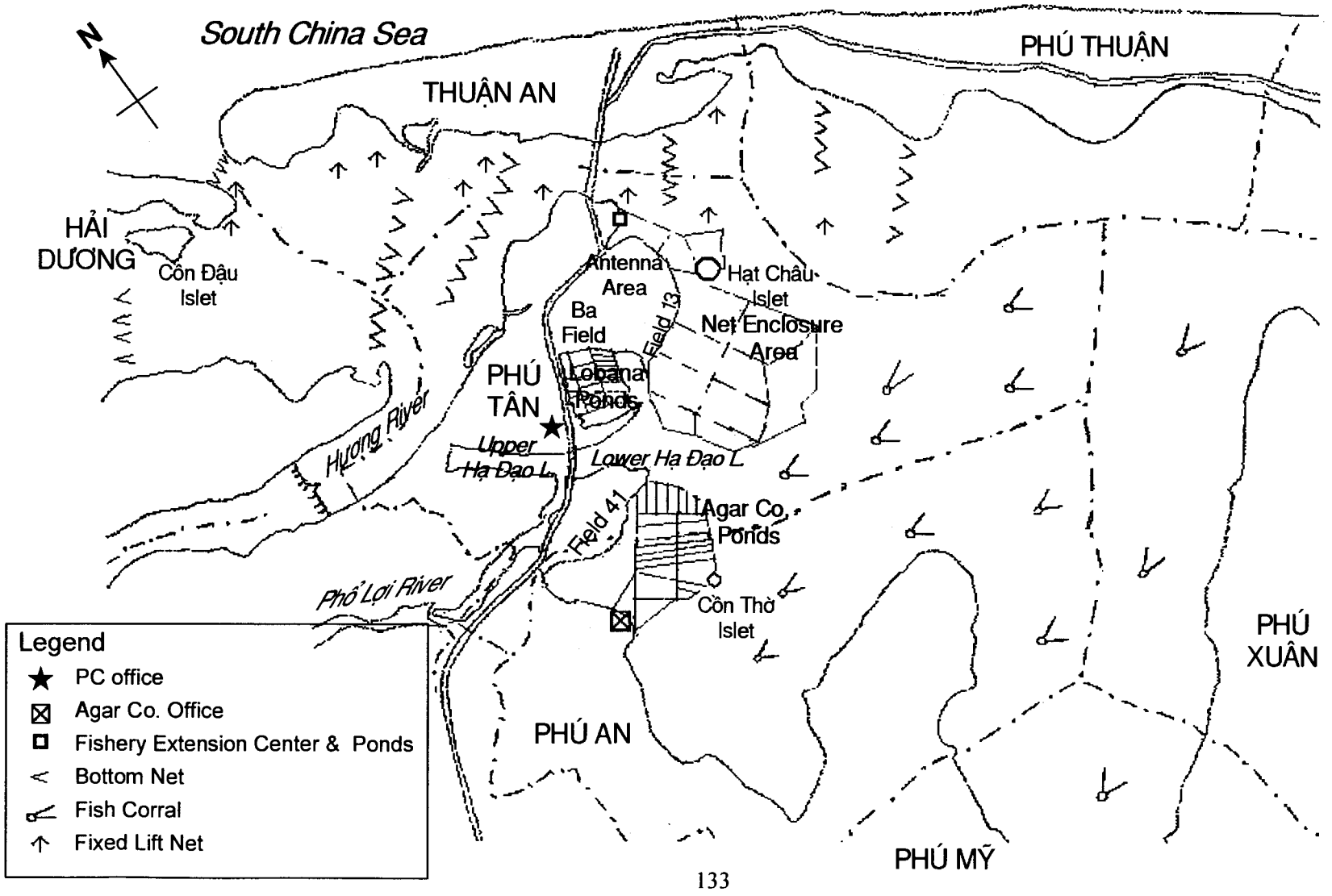
Hà Ký. 1994. *Một số chính sách bảo vệ và phát triển nguồn lợi thủy sản ở Việt nam. Tuyển tập báo cáo Khoa học. Hội thảo Quốc gia về Môi trường và Phát triển Nuôi trồng thủy sản.* (Some policies on protection and development of aquatic resources in Viet Nam, Collection of technical reports.

National Workshop on Environment and Development of Aquaculture). pp. 240 - 241.

Tôn Thất Pháp. 1996. Study on aquatic species in Phu Van Lagoon. Annual Report of the project "Management of biological resources in Tam Giang lagoon" to the International Development and Research Centre (IDRC, Canada). Hue City.

Tôn Thất Pháp. 1993. Aquatic plants living in Tam Giang ecosystem, Thua Thien-Hue province. Doctoral Dissertation, University of Hanoi.

Map 8. Aquatic Exploitation in Phú Tân and Surrounding Communes



Migration of Marine Species into the Lagoon

Lê Văn Miên and Tôn Thất Pháp

The Thuan An estuary is one of Tam Giang lagoon's 2 estuaries to the sea where marine and inland waters meet and mix (Map 3, p. 3). Two seasons - one dry and one rainy - result in 2 alternating ecological systems (marine and freshwater). Of the 2 estuaries, Thuan An is more important to marine species growing in the lagoon. Around 1928, a dike was built to keep seawater out and the lagoon became mainly fresh. Since the destruction of the dike in 1953, the lagoon ecosystem has reverted back to brackish water.

Thuan An estuary is the gate by which hundreds of tons of marine species migrate annually into the lagoon. These marine species include fry and larger individuals which enter the lagoon for short durations and those entering with a tidal current when the weather changes. Some species enter the lagoon as fry in search of food and shelter. Their growth rates over the period of stay in the lagoon are quite high as observed in fishers' catches. Unfortunately, most of the fry are captured by bottom nets with a 2x2mm mesh cod end located at the estuary (Map 8, p. 133). The ones that escape are later caught by more than 1000 bottom nets and other fixed fishing gear distributed all over the lagoon. The efficiency of this fishing gear has exhausted lagoon resources which were abundant before these gear emerged in 1965.

The aim of the research is to acquire reliable and convincing data to serve as warning to stakeholders. Documentation of the results will hopefully make a contribution to the protection and sustainable development of the Tam Giang lagoon biological resources .

METHODOLOGY

Some Vietnamese researchers and students of Hue University of Science (HUS) and French students of Ecole Nationale Superieure d'Agronomie de Rennes (ENSAR) were involved in a study of the migration of marine species through Thuan An estuary.

- In July and August, 1993 (lunar months VI and VII - see **Appendix A**), 2 French students, 1 HUS student and Le Van Mien organized a series of interviews with more than 10 fishers operating bottom nets and fixed lift nets around the Thuan An estuary.
- In July and August, 1995, 2 other French students and Le Van Mien interviewed fishers in Con Dau area (North of Thuan An estuary) (Map 5, p. 5).
- From February, 1996 to February, 1997, migration was studied in more detail and over a larger area by Phu Tan research group with the participation of 30 fishers from 7 communes surrounding Thuan An estuary (Hai Duong, Phu Thuan, Thuan An, Phu Tan, Phu An, Phu Xuan and Phu My; Map 8, p. 133). These fishers, operating 7 types of fishing gear (fish corrals, bottom nets, fixed lift nets, dragnets, pushnets, gillnets and hook and line), were involved in a study on daily catch. Data collection sheets were distributed to each fisher (see **Fishing in Sam - An Truyen - Thuan An Area**). These data were compiled to determine general information on species composition and size. The results from the fry and larvae data were analysed, combined with previous results and are presented **Appendix B.**

- From February, 1996 to May, 1996, 2 HUS students prepared their undergraduate thesis research under Le Van Mien's supervision. This research was conducted through interviews and observation on species composition, change of species composition and catch over time by some bottom nets located in Thuan An estuary. The students joined in fishing trips over six fields trips, each lasting 2 days (Table 2). While attaching bottom net to posts and waiting to haul the net up (3 - 4 hour duration), students chatted and discussed with fishers and gained a lot of information. The work at every trip was the same:
  - Estimating Total Catch: The students counted the number of bamboo baskets caught by each bottom net (each basket stores 10 - 12 kg of fish and shrimp). Using the data of one bottom net, total daily catch of the 7 bottom nets located at the estuary was estimated.
  - Species Identification: This was done while on the water unless they were difficult to identify in which case they were taken back to the laboratory.
  - Sampling Catch: About 100 gms of each catch was randomly sampled from every basket. The catch was well mixed and a sample was stored in a formalin solution and brought back to the laboratory. In the laboratory, the sample was classified into species group based on appearance. Each species group consisted of species of many different sizes. The Latin names were identified by using classification key. The total number of individuals of each species was counted and measured by length (in mm).

RESULTS

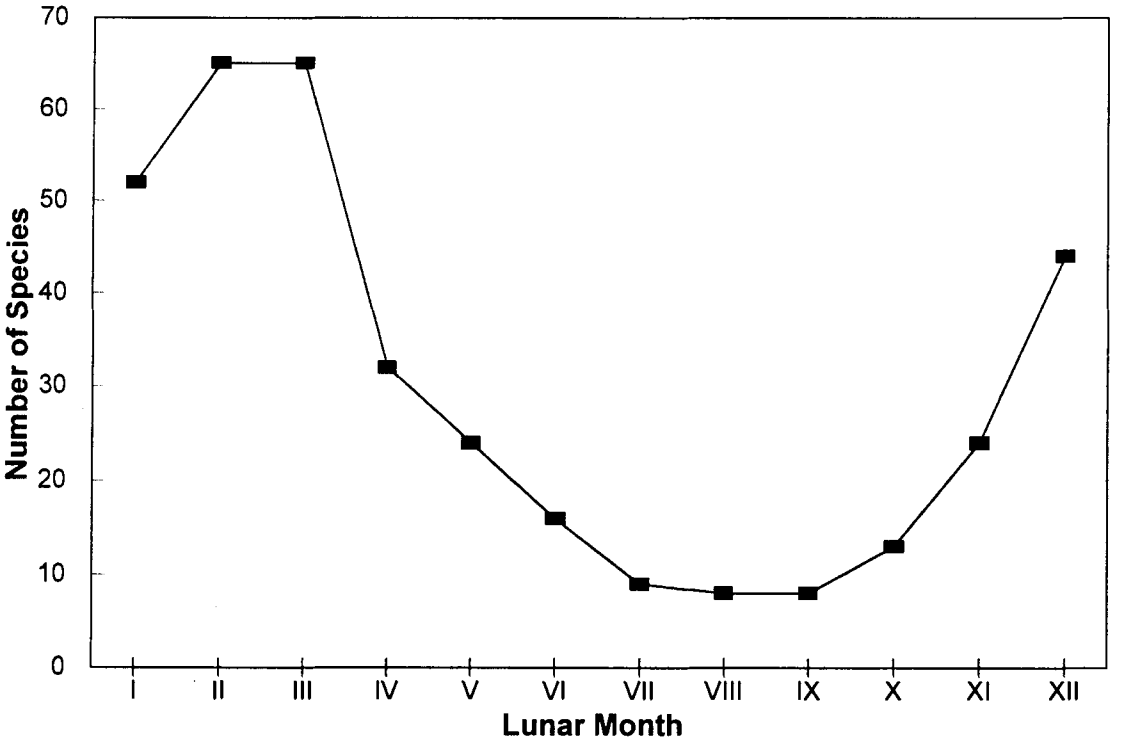
A list of migrating marine species and seasonal trends in their migration through Thuan An estuary are included in **Appendix B**. The information was collected through interviews with fishers who normally fish around the estuary. Some of the information contradicts the catch data collected from fishers in 1996-1997. The number of species migrating into the lagoon each lunar month, as collected from the catch data, is illustrated in Figure 1.

The number of fry caught by bottom nets at Thuan An are very high. Table 1 provides production details of 3 species and 2 genera caught by one bottom net at Thuan An over their migration period. Hairtail fry (*Trichiurus haumela*) is also a highly exploited species however, it is mainly caught in June only. In the following months, the number of hairtail fry caught is inconsiderable.

Table 1. Migration period of fry of 3 species and 2 genera into the lagoon and their catch by one bottom net (data collected from fisher in 1996).

Aquatic sp.	Migrating Period (Lunar months)	Total catch over migrating period	
		Weight (kg)	# of individuals
Siganus guttatus	VII	1.2	13,320
Siganus oramine	III to X	4612.3	11,522,123
Mugil sp.	IV to X	29.7	14,776
Gerres sp.	V & VII	2	303
Sphyraena obtusata	V	24	7,800

Figure 1. The number of species of fry that migrate into lagoon by lunar month. Source of data: PRA and catch data from February 1996 to February 1997.



Seasonal pattern

Migration occurs year round however it peaks in lunar months II and III and is lowest during months IX and X.

Rainy Season

During the flood period (months VIII and IX), drastic environmental changes occur under the influence of the rainy season. At this time, most marine fish (about 40 species) migrate out to sea and about 35 species of freshwater fish from brooks and rivers are carried by the floods and distributed all over the lagoon (Le Van Mien, 1996c).

Peak Migration

Migration into the lagoon begins again in early X when the sea starts becoming rough and currents increase. In the lagoon, the marine influence strengthens and gradually pushes freshwater fish back up the rivers. At the same time, more and more marine fish migrate into the lagoon: 4 species in X, 13 species in XI and a peak at 51 species in both months II and III.

Dry Season

After III, the dry season begins, the sea is calmer and the salinity of the lagoon water increases. The number of species migrating into the lagoon decreases to a minimum of 4 species in IX.

Most fishers claim that on nice days and when the tide is strong (during the new moon and full moons - the 30th and 15th of every lunar month), catches are usually high. This may be related to an increase in fish migrations. Although this is supported by some of the data collected (high catches on 29 and 30 of XII, 15 of I and 16 of III and low catches on 24 and 25 of II - see Table 2), it is contradicted by later collections (low catches on 1, 15 and 16 of III). More data are required to validate or explain the pattern perceived by fishers.

Species migrating

The research team identified 62 marine species migrating into the lagoon through Thuan An estuary. They can be classified into 3 groups:

Temporary migrators

Nine (9) species enter the lagoon for short periods of a few days and then return to sea. They may be migrating passively, with currents (tides and winds), or actively, in search of food and for reproduction. These species usually swim in large schools and enter about 1 to 3 times a month. Typical species are gizzard shad (*Clupanodon* and *Herklotsichthys* spp.), anchovies (*Stolephorus* sp. and *Setipinna taty*), goatfish (*Upeneus moluscensis*), *Acetes* sp. and squid. They are the main catch of the bottom nets located at the estuary. These migrations ensure that catches are always high throughout the year for fishers living at the estuary (on the order of tens of tons per bottom net annually).

Seasonal migrators

Seasonal migrators include 116 species that enter the lagoon to grow out (for food and shelter) and only exit when the flood season begins. Typical species are grouper (*Epinephelus* sp.), sillago (*Sillago* sp.), white croaker (*Argyrosomus argenteus*), saddle grunter (*Pomadasys maculatum*), snapper (*Lutjanus* sp.), natal stumpnose (*Rhabdosargus sarba*), and golden spinefoot (or rabbitfish - *Siganus guttatus*).

Permanent migrators

The remainder enter the lagoon to stay permanently. They grow and mature in the lagoon and adapt to its variable environmental conditions. They become typical brackish water fish. Some typical species are thornfishes (*Terapon* sp.), grassfishes (*Gerres* sp.), and gobies (*Glossogobius* and *Oxyurichthys* spp.).

Freshwater species remain in the lagoon for a very short period (2 - 3 months). Marine fish remain longer but also only 9 - 10 months. This schedule does not provide all species enough time to grow to maturity although some permanent migrators do. They are continuously caught even when they are very small post-larvae. This results in not only exhaustion of the resources but also the extinction of some species.

One of 4 genera - *Stolephorus* (*S. commersonii* and *S. indicus*), *Acetes* (pelagic shrimp), *Lutjanus* (*L. fuscensces*) and *Siganus* (*S. oramin*) - dominated the daily catch (by number of individuals) in 11 of the 12 days of fishing sampled. These species migrate in large numbers and are thus major contributors to the catch of gear located at the estuary.

Size of individuals

Only 2 genera mature at the size they are normally exploited (*Stolephorus* sp. and *Acetes* sp.) however

mature and egg bearing individuals were never observed in the catch. Other species, such as spotted halfbeak (*Hemiramphus far*), apogon (*Apogon* sp.), white croaker (*Argyrosomus argenteus*), ponyfish (*Leiognathus* sp.), grassfish (*Gerres* sp.), mullet (*Mugil* sp.) and hairtail (*Trichiurus haumela*), are nearly mature at size of exploitation but the quantity caught is inconsiderable. Most species are exploited as juveniles (12 - 30 mm) and some as post-larvae. Some exploited fish were so small (less than 12 mm length) that they could not be identified. These fish, some of which were post-larvae, amounted up to 34% of fish in the catch. An additional 5% of the catch could not be counted because they were dead and crushed against the cod end. They ranged in size from 2 to 10mm in length.

Rabbitfish

In 1996, rabbitfish (*Siganus oramin*) appeared earlier than in previous years when it usually appeared in mid to late III. On the 24th of II, 16 individuals (14.81% of total catch) were first caught at a small size of 10 to 15mm in length. Subsequently, they were caught more frequently, in larger amounts (72.58% of catch on 16th of III) and at a greater size (12 to 35 mm). Another common *Siganus* species (*S. guttatus*) was not found in the catches reported in Table 2. It usually appears at the end of the migration of *S. oramin*.

Fry of *S. oramin* (1.5 - 2.5 cm) enter the lagoon in very large amounts over a short period usually around lunar month IV and form a considerable part of the bottom net catch. They are more valuable than other fry species, which accounts for the fact that local fishers have given it a name - *cá rò* - distinct from the adult referred to as *cá kình*. Fermented, *ca ro* is a favourite aquatic speciality in Thua Thien-Hue and has a large market. Other fry species are mainly sold as feed for cultivated aquatic species and for farm animals.

Exploitation of *ca ro* ultimately results in a decrease in potential aquatic resources in the lagoon. An estimate of the loss caused by this exploitation was made based on data collected by Nguyễn Cường, a fisher operating a bottom net located in Thuan An estuary. From April to May, 1996, Cuong's bottom net caught 1035 bamboo baskets of *ca ro* (approximately 10,570,000 individuals) worth 15,525,000 VND (at 15,000 VND per basket). Six months after the migration period, *ca kinh* are commonly caught at lengths of 14 to 18 cm. Therefore, after 4 months in the lagoon, *ca ro* can potentially grow to an average length of 14 cm (equivalent to 100 gms per individual). Assuming 70% natural mortality and at a price of 1,100 VND per fish, the *ca ro* caught by a single bottom net could bring in almost 3.5 billion VND if they were caught 4 months later as *ca kinh*.

CONCLUSIONS

The pattern of migration of species across Thuan An estuary are represented in Figure 2. The information was collected from interviews with fishers, fishers' catch data and observation. The migration of marine species through Thuan An estuary follows a regular pattern in terms of seasonality of migration, species composition and number, and the relative abundance of each species.

Except for some species caught at a size close to maturity (*Stolephorus* sp. and *Acetes* sp.), most are caught very small (15 - 35 mm) or even post-larvae (3 -12 mm). Over the 12 sampling days, 26.50% of individuals were countable but not identifiable due to their small sizes and some were so small that they were crushed against the net wall and uncountable. Hundreds of tons of fish are caught at the lagoon opening to the sea to be processed into fish sauce (*nước mắm*) and fermented fish (*mắm*) and used as

fresh or dried feed for aquaculture. Fishing for fry and post-larvae results in serious overexploitation. If migration of the listed species was not impeded by bottom nets located at the lagoon estuary, their subsequent growth in the lagoon would ensure higher returns for lagoon fishers and possibly they would reproduce and replenish the lagoon with fisheries resources.

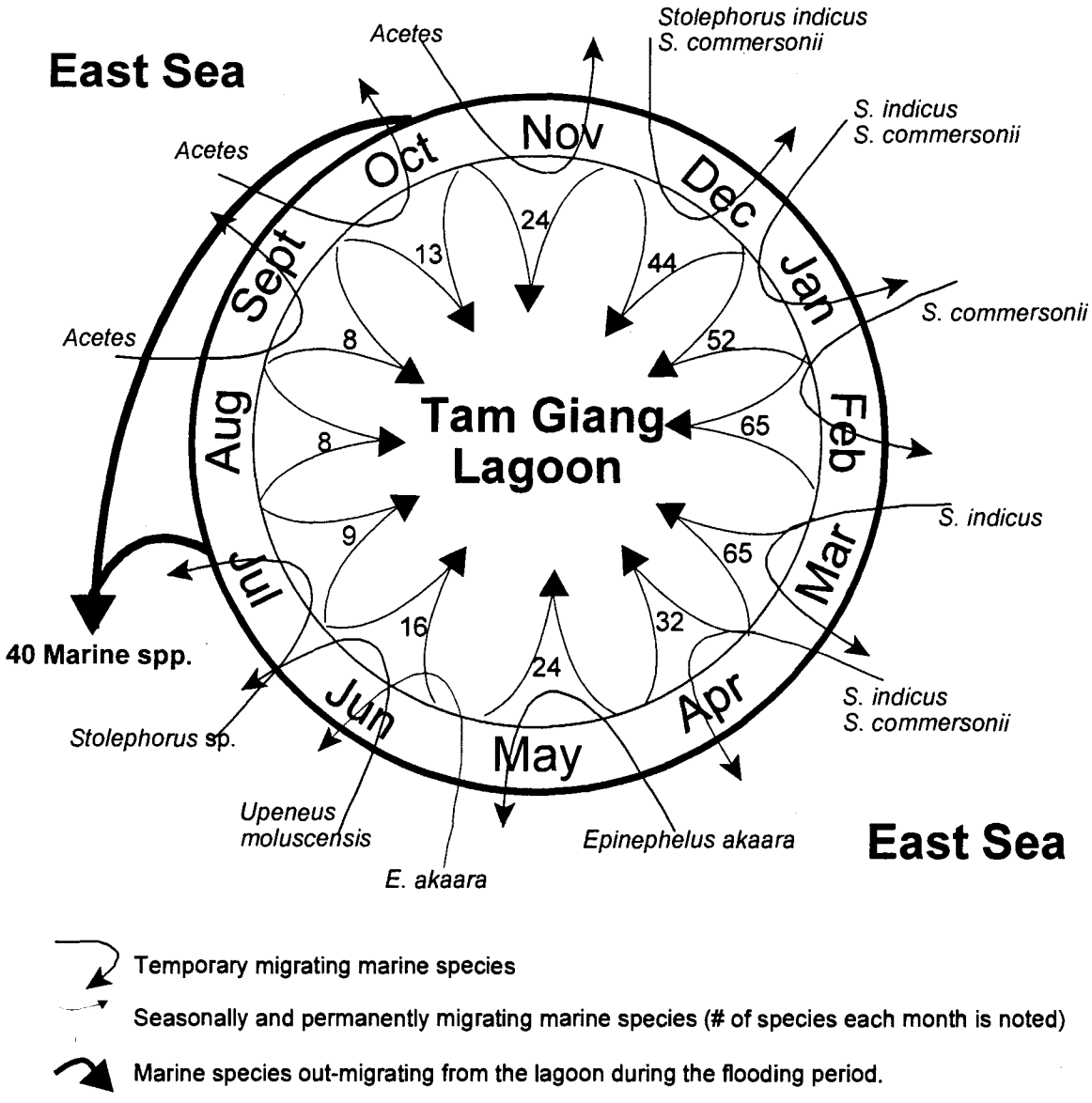
REFERENCES

Lê Văn Miên, 1996a. *Nguồn giống cá Mú tự nhiên ở đầm phá Thừa Thiên-Huế* (Natural sources of fry of red grouper in Thua Thien-Hue lagoon). Fishery Technology & Science Magazine. Ha Noi. Vol 3 1996.

Lê Văn Miên, 1996b. *Một số suy nghĩ về vấn đề nuôi trồng và khai thác thủy sản ở TTH* (Some thoughts on aquaculture and fishery exploitation in Thua Thien-Hue). Fishery Technology and Science Magazine. Ha Noi, Vol 3, 1996.

Lê Văn Miên. 1996c. *Khu hệ cá Thừa Thiên-Huế và những nét đặc thù của nó* (Fauna of fish in Thua Thien-Hue lagoon system and its original characteristics). Manuscript.

Figure 2. Migration of aquatic species through Thuan An estuary. Information collected from interviews, fishers' catch data and observation (1995 to 1997).



Temporary migrating marine species

Seasonally and permanently migrating marine species (# of species each month is noted)

Marine species out-migrating from the lagoon during the flooding period.

Table 2. Catch data from samples collected over 6 field trips of 2 fishing days each from a bottom net located in Thuan An estuary, February 18 to May 2, 1996. Samples of 100 gms taken from the total catch on each sampling day (Le Van Mien and Students)

Date	Catch (kg)	# animals/ 100gms	Identified species			Size (mm)	
			Species	# animals	%	Min	Max
29 XII Feb. 18	214	125	*S. commersonii & S. indicus*	69	55.20	20	40
			Epinephelus malabaricus	2	1.60	30	55
			Terapon jarbua	2	1.60	15	55
			Argyrosomus argenteus	3	2.40	45	120
			Mugil cephalus	4	3.20	25	130
			Trichiurus haumella	1	0.80	--	450
			Penaeus monodon	1	0.80	--	78
			Unidentified species	43	34.40	--	< 15
30 XII Feb. 19	186	165	*S. commersonii & S. indicus*	112	67.87	20	54
			Epinephelus akaara	2	1.20	20	60
			Terapon oxyrhynchus	1	0.60	--	20
			Apogon apogonides	1	0.6	--	20
			Leiognathus decorus	4	2.42	25	35
			Gerres oyena	6	3.64	25	35
			Mugil strongylocephalus	3	1.82	25	40
			Penaeus monodon	1	0.60	--	20
			Unidentified species	35	21.21	--	<15
15 I Mar. 4	245	184	*T. jarbua*	5`	2.71	20	45
			L. decorus	2	1.08	20	30
			Leiognatus equulus	3	1.63	25	45
			G. oyena	2	1.08	15	30
			Liza ceramensis	8	4.35	20	60
			Acetes sp.	156	84.78	15	25
			Unidentified species	8	4.30	--	< 15
16 I Mar. 5	124	169	*E. akaara*	1	0.94	--	32
			Pelates quadrilineatus	2	1.18	25	45
			L. decorus	4	2.36	25	35
			G. oyena	3	1.77	25	35
			Mugil sp.	2	1.18	20	160
			Acetes sp.	129	76.33	15	25
			Unidentified species	28	16.56	--	< 15
26 I Mar. 15	98	82	*S. commersonii*	58	70.73	35	50
			Strongylura strongylura	1	1.22	--	60
			A. apogonides	12	14.30	12	32
			Unidentified species	31	13.42	--	< 12
27 I Mar. 16	147	112	*S. commersonii*	87	70.73	42	65
			E. malabaricus	4	3.57	15	52
			Cheilodipterus semilineatus	9	8.03	12	25
			Lutjanus sp.	12	10.00	15	25
			Unidentified species	0	00		

Date	Catch (kg)	# animals/ 100gms	Identified species			Size (mm)	
			Species	# animals	%	Min	Max
24 II Apr. 11	18	108	*Hemiramphus far*	13	20.03	35	55
			S. strongylura	4	3.70	40	75
			E. akaara	8	7.40	20	78
			T. jarbua	2	1.85	20	35
			Gerres filamentosus	11	10.18	24	42
			Lutjanus argentimaculatus	6	5.55	25	56
			MugiI kelaarti	14	12.96	15	65
			Siganus oramin	16	14.81	12	20
			Unidentified species	74	31.48	--	< 12
25 II Apr. 12	53	87	*E. malabaricus*	1	1.14	--	32
			E. akaara	2	2.28	25	36
			T. jarbua	2	2.30	38	40
			A. apogonides	3	3.45	15	25
			Gerres filamentosus	1	1.14	--	30
			Pomadasys sp.	1	1.14	--	165
			Mugil sp.	1	1.14	--	28
			Siganus oramin	48	55.17	12	25
			Unidentified species	28	32.18	--	< 12
1 III Apr. 18	47	97	*Hemiramphus far*	2	2.06	54	132
			T. jarbua	1	1.03	--	30
			Apogon sp.	3	3.09	20	34
			Gerres filamentosus	4	4.12	28	35
			Siganus oramin	46	47.42	12	35
2 III Apr. 19	120	146	*S. indicus*	28	19.70	35	65
			Mugil sp.	14	5.98	35	188
			Siganus oramin	66	45.20	15	25
			Unidentified species	38	26.03	--	< 12
15 III May 2	40	118	*Ambassis kopsi*	5	2.24	25	36
			Lutjanus fuscensces & S. oramin	84	71.18	15	25
			Sphyraena obtusata	1	0.85	--	128
			Trichiurus haumella	1	0.85	--	76
			Unidentified species	27	22.88	--	< 12
16 III May 3	86	124	*Atherina bleekeri*	2	1.61	20	30
			Hemiramphus far	1	0.80	--	42
			Cheilodipterus lineatus	3	2.42	20	30
			Gerres filamentosus	2	1.61	20	25
			L. fuscensces & S. oramin	90	72.58	15	25
			Unidentified species	26	20.96	--	< 12
Average	**114.83**	**126.50**		**32.16**	**25.42**		

Freshwater Macrophytes - their Ecology and Exploitation

Lê Thị Nam Thuận, Trương Văn Tuyển and Nguyễn Hồng Việt

Freshwater macrophytes are a valuable resource to local villagers of Quang Thai. With a peak season from November to March, macrophyte production is the main income source for many households and thousands of tons are harvested annually to serve for farming production. Used as a green manure and mulch, macrophytes make a considerable contribution to improving crop production in the poor soils around the lagoon. The biological function of these plants is very important. As primary producers, they are an indispensable part in the lagoon food chain, creating a considerable amount of organic substance for the aquatic area by photosynthesis. Macrophytes contribute organic substances for other aquatic species. Macrophytes also play an important role in balancing the ecosystem and environment of the lagoon area.

Although macrophytes have an important function, they have not been given much attention by researchers or government officials. There is little information on their composition, harvest, or distribution, and on how environmental factors impact on the growth of macrophytes. The present research on macrophytes in Quang Thai lagoon was conducted to provide preliminary information for the planning and management of biological resources in the lagoon, focussing on the following main contents:

- Composition and distribution
- Harvest and standing crop
- Capacity of regrowth and development by season
- Impact of aquatic exploitation on its growth
- Growth of dominant species (*Vallisneria spiralis*): average leaf length, leaf width, and number of leaves.

OVERVIEW OF MACROPHYTE RESEARCH IN VIET NAM

Macrophytes are defined as plants living in water and on submersed and water-saturated lands. Macrophytes found in salt water are popularly called seagrasses. Seagrass (or macrophyte) are plants having flowers, living in waters of tropical and temperate coastal areas. Most of them grow and develop in shallow coastal areas. They adapt to living under water by a system of roots and rhizomes which firmly attach to the bottom and withstand waves and currents. They have the ability to self-pollinate in water. Thanks to these adaptations, macrophytes have a wide variety of biological and physical functions, which are also the basis of their environmental and economic roles (Fortes, 1989).

In Viet Nam, identification of seagrass flora (marine plants) was conducted by foreigners and published as early as 1790 and until 1959. Since then, the research on seagrasses was recorded in 2 volumes by Pham Hoang Ho (1993): "Vietnamese seagrasses in South Viet Nam" and "Vietnamese seagrasses in North Viet Nam". In April 1995, based on seagrass samples collected by Hai Phong Oceanography Institute during their research trips from North to South between 1972 and 1995, Nguyen Van Tien

(1996) classified and presented a list of 10 species in UNEP Workshop in Bangkok (Thailand). At this meeting, Viet Nam became one of a number of nations studying seagrasses in Southeast Asia. In Ton That Phap's research (1993) of the Tam Giang lagoon system, 11 species of macrophyte were identified, and their distribution and value were also mentioned.

In Southeast Asia, typically the Philippines, Indonesia and Thailand, seagrass and seagrass-related parameters under study are as follows (Fortes, 1995):

- Structure: Species composition, distribution, biomass, density, cover, diversity, leaf height, affinity, zonation, epiphytes, leaf area index, associated fauna.
- Dynamics: Productivity (plant, animal, bacterial), decomposition, growth rates, turnover, recruitment, mortality, letter transport, interaction, nutrient budget, mineralization, reproduction, feeding.
- Fisheries: Species composition, distribution, abundance/biomass, residence pattern, diel variation, interactions.
- Environmental factors: Substratum, depth, water clarity, light regime, water movement, temperature, quality criteria.
- Applied aspects: Seagrass as feeds, remote sensing, artificial seagrass, transplantation, pollution, socio-economics, endangered species.

In Viet Nam, there is little research on macrophyte ecosystems compared to research on seaweed and phytoplankton. Research on macrophytes to date has only covered basic taxonomy.

RESEARCH PROCEDURE

Fifteen (15) fishing and fishing-farming households and 20 farming households were involved in this survey and information collection. These households voluntarily participated in the surveys and experiments on macrophyte distribution and growth and in collecting data and information on production, marketing and use of macrophytes. They also encouraged other villagers in the community to take part and help the researchers.

Species composition, distribution and standing crop

The research on macrophyte composition, distribution, standing crop and harvest was conducted from December, 1995 to March, 1997.

Fifteen (15) plots of $1m^2$ were sampled along 4 transects in 1996: 2 from Southwest to Northeast along the width of the lagoon (from Niu River to Dien Hoa Commune, and from Son Cong village to Dien Hai Commune); and 2 from O Lau river estuary to the Southeast along the length of the lagoon (Map 9, p. 148). A few supplementary plots were also sampled to validate the information. At each plot, a sample of seagrass was collected by hand with tools such as knife and sickle and the following data were collected:

- *Species composition*: Samples were classified in the laboratory by comparing their morphology.

- *Standing crop*: Average standing crop per plot was measured as wet weight (ie. all green material was harvested, drained from water and weighed). Dominant species were selected and measured for standing crop (the dominant species studied here was *Vallisneria spiralis*).
- *Bottom type*: The bottom sediment was classified as muddy, sandy or muddy-sandy.
- *Depth of water*: Water depth was measured at each plot.
- *Salinity*: Salinity was measured by ATAGO salinity metre.

Regeneration of standing crop and impact of fishing on macrophyte development

From June, 1996 to February, 1997 the research was focussed on macrophytes' capacity for regrowth; its development by season; the impact of aquatic exploitation on growth; and growth of dominant species (*V. spiralis*) measured by the average leaf length, leaf width, and number of leaves. This research was conducted over 2 periods (June to August 1996 and September 1996 to February 1997) with an increase in the number of plots in the latter period.

In the first period (June to August 1996 - the dry season), 2 sites were sampled at regular intervals. Each site was located at different depths: Site 1 at ≤ 1m and Site 2 at ≤ 1.5 m. At each site, 2 plots were identified: one protected and one unprotected plot:

- *Protected plot*: 25 m^2, well marked with line and floaters to inhibit any activity (fishing, navigating, collecting seagrass, etc.).
- *Unprotected plot*: 25 m^2 marked without inhibiting lagoon activity within it.

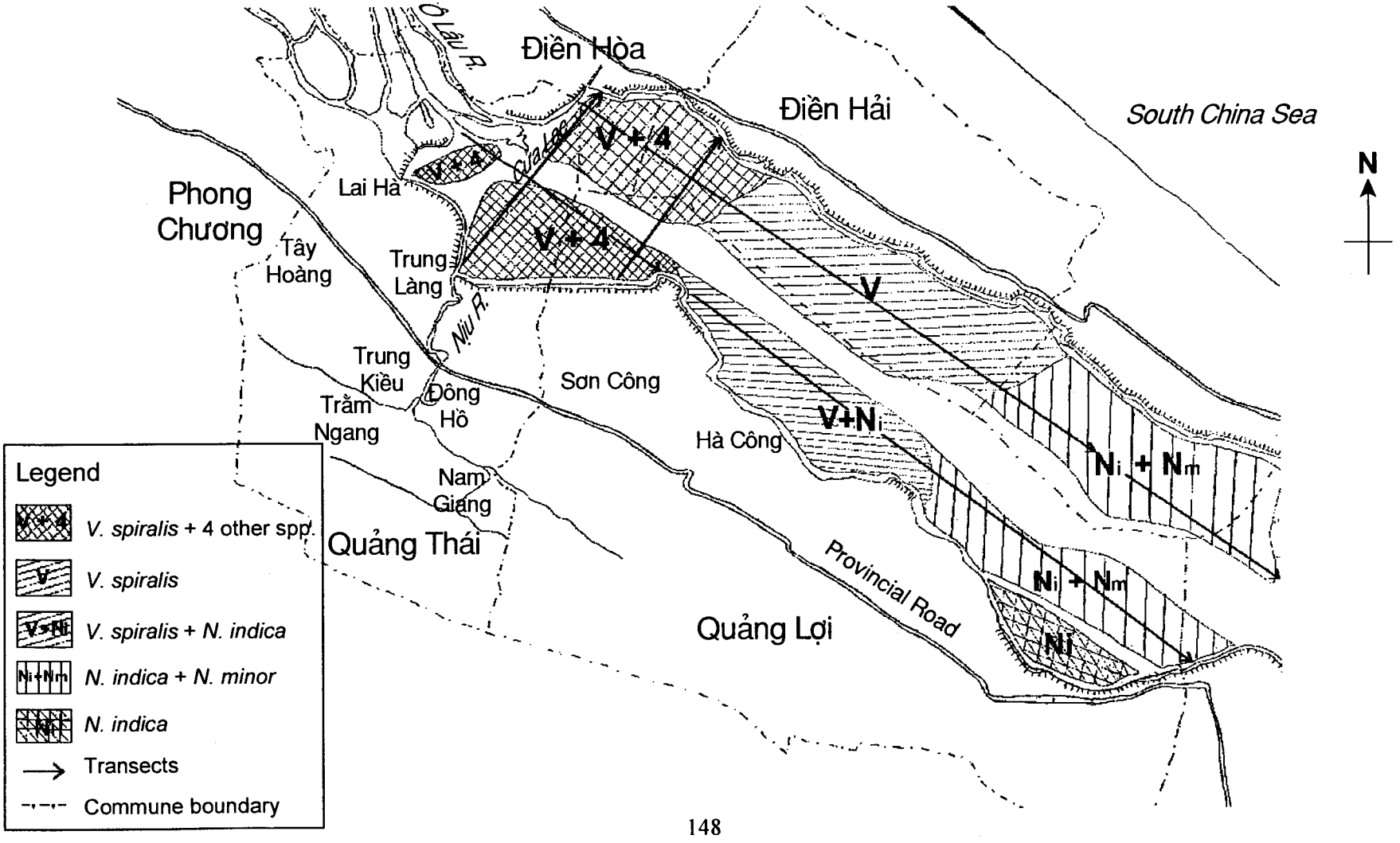
In the rainy season, from September 1996 to February 1997 the number of sites were increased by 3. The protected plots of each site were located as indicated on the map of experimental plots and harvesting areas in Quang Thai (Map 10, p. 149):

- Plot 1: closest to the shore at depth of ≤ 0.7 m
- Plots 2 and 3: the original plots 1 and 2, respectively
- Plot 4: near Dien Hai area at depth of ≤ 2 m
- Plot 5: south of Plot 4 at depth of ≤ 2.5 m

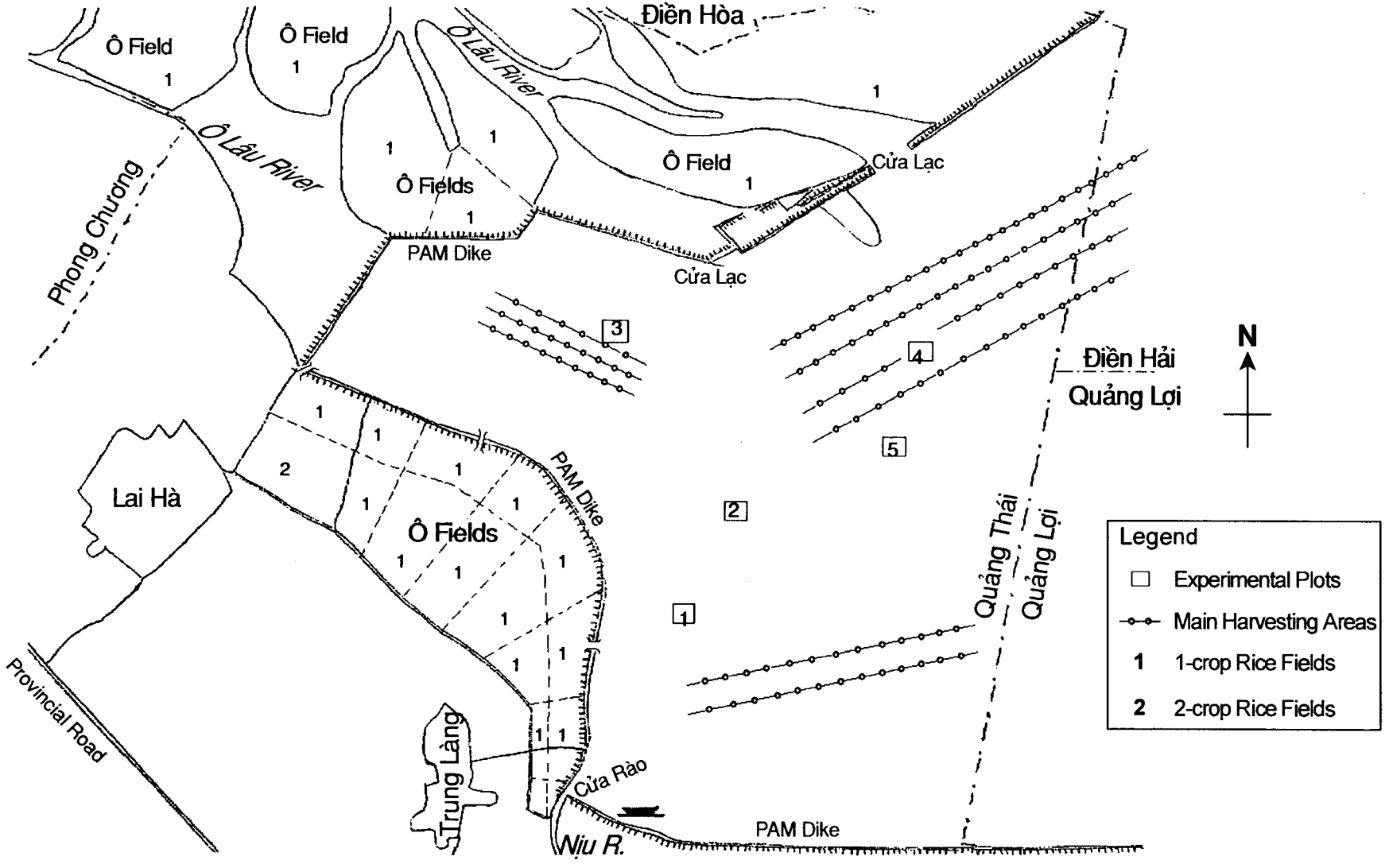
During both the dry and rainy seasons, an area of 16 m^2, from the 25-m^2 plots, was sampled to measure the effect of lagoon activity on macrophyte standing crop by cutting and measuring, every 14 to 30 days, an area of 1 m^2. After measuring the standing crop, 30 *V. spiralis* plants were randomly selected and used to study plant development - leaf width, leaf length, the number of leaves per plant and weight of the 30 plants.

The regeneration of macrophyte was measured by entirely cutting a macrophyte area of 9 m^2 within the same plots, then measuring regeneration every 14 to 30 days by cutting a square of 1 m x 1 m within the 9-m^2 area. A steel 1-m^2 frame was used to cut macrophyte. To avoid losing plants, a net was attached to the steel base and to floaters at the surface - this contained all the macrophyte within the net.

Map 9. Freshwater Macrophyte Distribution around Quảng Thái



Map 10. FW Macrophyte Experimental Plots and Harvesting Areas in Quảng Thái



SPECIES COMPOSITION

The research identified 7 species from 5 families, 5 orders and 2 classes of freshwater macrophytes in Quang Thai lagoon (Table 1). The total number of species identified in the entire Tam Giang - Cau Hai lagoon system is 11 species (Ton That Phap, 1993, and Nguyen Van Tien, 1996). Macrophytes in the research site are freshwater-originated, and distributed near the river estuary. *Vallisneria spiralis* is the dominant species with an average standing crop of 2.3 kg wet weight/m^2 over the research period. The second is *Najas indica* , with average standing crop of 1.9 kg wet weight/m^2. *Potamogeton malaianus* is also a common species with a significant standing crop.

Table 1. Macrophyte species composition in Quang Thai lagoon - Phylum *Magnoliophyta*

Class	Order	Family	Genus	Species	Vietnamese
Magnoliopsida	*Ceratophyllales*	*Ceratophyllaceae*	*Ceratophyllum*	*C. demersum*	*Rong đuôi chồn*
	Haloragales	*Haloragaceae*	*Myriophyllum*	*M. spicatum*	*Rong đuôi chó*
Liliopsida	*Hydrocharitales*	*Hydrocharitaceae*	*Vallisneria*	*V. spiralis*[a]	*Rong mái chèo*
			Hydrilla	*H. verticilata*	*Rong cỏ chon*
	Najadales	*Najadaceae*	*Najas*	*N. indica*[a]	*Rong đốt*
				N. minor	*Rong đốt*
	Potamogetonales	*Potamogetonaceae*	*Potamogeton*	*P. malaianus*[a]	*Rong đuôi ngựa*

[a] Most common species with significant standing crops

DISTRIBUTION OF MACROPHYTE SPECIES

Salinity

Macrophytes in Quang Thai lagoon are freshwater-originated and distributed near the O Lau river mouth (inside and outside of Cua Lac dike). Of the 7 identified species, *P. malaianus, V. spiralis, M. spicatum, C. demersum* and *H. verticilata* are distributed outside the river mouth and close to Cua Lac dike on the river side (less than 1 km away from river mouth), where salinity is from 0 - 5 ‰. In this area, *V. spiralis* develops well in dense beds with standing crop of 2.8 - 3.0 kg/m^2 in peak season with other species growing among it: *P. malaianus*, which grows densely but with a lower standing crop, and *Najas indica* and *N. minor* which develop poorly with average standing crops of 0.5 - 0.6 kg/m^2 (Map 9, p. 148).

Along the southern half of the lagoon from the border between Son Cong and Ha Cong villages in Quang Loi to the south east border of Quang Loi commune, the salinity is from 0 - 13 ‰ and *N. indica* grows well. It creates a thick cover on the lagoon bottom with standing crop of 3 - 3.5 kg/m^2 in peak season.

Therefore, as distance from river mouth increases, species composition changes to those more tolerant to higher salinities: saltwater-intolerant species are abundant in the river mouth area and decrease in the direction towards the sea. A decrease in the number of species is related to an increase in salinity. The presence of species from the river towards the sea can be listed as follows (Map 9, p. 148):

V. spiralis + other 4 species > *V. spiralis* > *Najas indica* + *Najas minor* > *Najas indica*

V. spiralis seems to prefer low salinities (up to 6 ‰) while *N. indica* and *N. minor* are freshwater species tolerant to higher salinities (up to 25 ‰).

Depth and bottom type

The distribution of macrophyte by depth depends on many factors: salinity, depth and bottom type (Table 2). Macrophytes are distributed in shallow areas, where sunlight reaches them for photosynthesis. The average depth in Quang Thai lagoon is 1.4 to 1.7 m with a maximum depth (≥ 3m) at the channel running from Cua Lac dike along the length of the lagoon.

The lagoon has a soft bottom which is common to the research area. Types of bottom are: sand, sandy-mud and grey/dark-blue fine mud. This is suitable for the growth and development of macrophytes, particularly sandy-mud bottoms at depths of 1 - 1.5 m (Table 2). Macrophytes grow and develop best at medium depths close to the shore (from 0.5 m to 2 m) with *V. spiralis* and *N. indica* dominating. However, this distribution depends on salinity. No macrophytes are found in the deep channel (Map 9, p. 148). *V. spiralis* is a dominant species present in lagoon area at most depths and on all types of lagoon bottom.

Table 2. Distribution of macrophyte species by depth and bottom type in Quang Thai lagoon

Macrophyte	Depth			Bottom type		
	Deep (≤2.5m)	Medium (≤1.5m)	Shallow (= 0.5m)	Mud	Sandy-mud	Sand
Vallisneria spiralis	x	x	x	x	x	x
Najas indica		x	x		x	x
Najas minor		x	x		x	x
Potamogeton malaianus	x	x		x	x	
Ceratophyllum demersum		x			x	
Myriophyllum spicatum		x	x		x	x
Hydrilla verticilata		x	x		x	x

Data, collected from standing crop measures, Spring and Summer harvests, direct observation and fishers' knowledge, indicate that the area of lagoon water where macrophytes grow is approximately 9 km^2, occupying 90% of Quang Thai lagoon area. Quang Thai lagoon itself is 11.5 % of total Tam Giang lagoon area (see Map 9, p. 148). Distribution of macrophyte in the Southwest and Northwest is different though the depth and bottom types are the similar.

Seasonality of macrophyte development

Results from observation, sampling and interviews indicate that macrophytes in Quang Thai lagoon are present year-round (Figure 1).

There are 3 periods in the development of macrophytes:

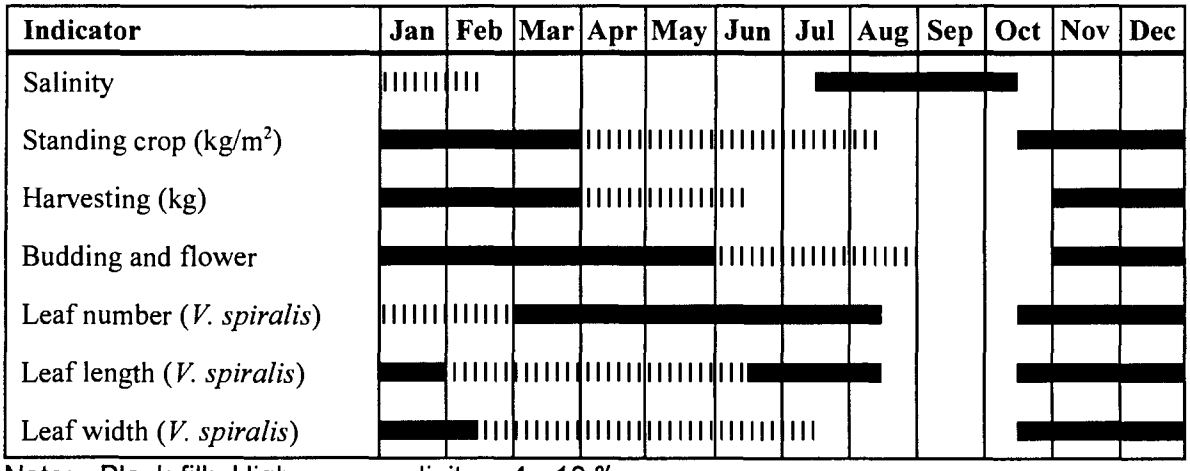
- **August to October**: The standing crop of macrophytes varies. During periods of high salinity (up to 13 ‰), plants die off but regenerate quickly when salinity decreases again. Over the research

period, this occurred several times in September. Interviews with 15 key households also validated that subsequent to repeated periods of high salinity, macrophytes develop much better. Floods also reduce the macrophyte standing crop. During this slack agricultural period, macrophytes are not harvested for crop production.

- **November to March**: Highest standing crop. This is the peak harvesting season, used for the Spring crops in the locality. The presence of macrophytes depends on many factors: salinity, harvesting activity and fishing activity.
- **April to July**: Regeneration phase. After the intense exploitation of macrophyte in November-March, the macrophytes are harvested from April to May for the Summer crop at a lower rate than for the Spring crop.

V. spiralis, exploited in the southwest portion of lagoon in April to May, has a small size but contains many buds. In Cua Lac area, *V. spiralis* and *P. malaianus* are bigger, with an average leaf length of 65 cm, an average of 14 leaves per plant and blooming at that time.

Figure 1. Seasonal calendar of macrophyte development in Quang Thai lagoon (all species except where noted).



Note: Black fill: High salinity = 4 - 10 ‰
Stripped: Moderate salinity = 0 - 4 ‰
Blank: Low salinity = 0 ‰

Standing crop

The standing crop in Quang Thai lagoon was estimated from 3 sources of information:

1. Sampled transects (15 plots from 4 transects)
2. From observation over the research period, and
3. From information volunteered by macrophyte harvesters and other fishers about standing crop, distribution, environmental conditions, exploitation outputs, and the demand for macrophytes.

Based on the above information, 2 periods were identified which are distinct in environmental conditions suitable for macrophyte development and in agriculture production in the locality which affects demand for macrophytes.

Table 3. Standing crop of all macrophyte species combined in kg/m^2 during the Spring (November to March) and Summer (April to May) harvesting seasons in 3 areas, on average and total for the Quang Thai lagoon (1995-1997)

Area	Spring (kg/m^2)	Summer (kg/m^2)
Cua Lac	2.8 - 3.0 (1.8 - 2.2)[a]	1.8 - 2.2 (1.5 - 1.7)[a]
South West[b]	2.8 - 3.5	0.9 - 1.0
North Side	0.9 - 1.2	0.2 - 0.3
Average	**1.5 - 2.0**	**0.5 - 0.7**
TOTAL[c]	**13,500 tons**	**4,500 tons**

[a] Standing crop of *V. spiralis* is indicated in brackets
[b] The main harvesting area
[c] Calculated by lower average number in the range x 9 million m^2

- In Spring, at the research plots in Cua Lac dike and O Lau river, the standing crop was high: 2.8 - 3.0 kg/m^2 with 2 main species: *V. spiralis* (2.2 - 2.3 kg/m^2) and *P. malaianus* creating a dense beds 3 to 4 m wide by approximately 200 m long.
- In Summer, in the same plots, the standing crop was lower at 1.8 - 2.2 kg/m^2 with 2 main species: *V. spiralis* (1.5 - 1.7 kg/m^2) and *P. malaianus* in similar beds of 700-800 m^2.
- After the high intensive exploitation in Spring, the standing crop in the lagoon has decreased and, as a result, standing crop in Summer is much lower.
- These are estimated values measured during intense periods of harvesting and fishing and eel raking activities in the lagoon. If these activities were decreased, standing crop would certainly be higher.

MACROPHYTE HARVESTING

Seasonality

Observation, interviews and discussions with 22 key households (3 of which were women-headed), indicate that changes in macrophyte harvest depend on standing crop and demand for local farming production thus, in Quang Thai, harvesting of macrophyte is a seasonal activity. Four harvesting seasons were identified (details for 3 of them is presented in Table 4):

- November 15 to January 30: a total of about 75 harvesting days used for the Spring crop. Standing stock of macrophytes is highest at this period and the need for agriculture is highest. They are applied on seedlings of rice, tobacco, chilli, peanuts and other cash crops grown in Spring.
- February 1 to March 30: approximately 60 harvesting days used for the Spring crop. At this time standing crop is reduced by the previous period of high exploitation. The Spring crop is well

advanced and requires macrophytes for mulching - it is used to fertilise tobacco, chilli and other cash crop plants and keep them wet and warm. Tobacco is the highest user of macrophytes due to its long growing season and speciality (see Historical Trends, p. 156). Rice is maturing at this stage and no longer requires natural fertilizer - chemicals are used instead.

- April 1 to May 20: approximately 50 harvesting days used for the Summer crops. In Quang Thai during this second cropping period, quick maturing crops are grown - sweet potato, beans, corn and cassava - on the roots of harvested Spring rice, peanuts and sweet potatoes. The demand for macrophytes is much reduced.
- June to October: On-going harvesting but in small amounts for animal feed

Macrophytes are sold by the cart (equivalent to 400 kg) which is used to transport the product from boat to field. One boat load can fill approximately 2 carts. The return from macrophyte harvesting varies by season:

- November to January: 20,000 VND/cart
- February to March: 50,000 VND/cart
- April to May: 50, 000 VND/card

Table 4. Details on seasonal harvest of macrophyte in 3 peak seasons (November 1995 to February 1997).

Season	Nov-Jan	Feb-March	April-May
# Harvesting Days	75 (2.5)	60 (2)	50 (1.7)
# Families harvesting	25	15	12
# Boat Loads/family/day	2	2	1
Total harvest (tons)	6000	2880	960
Total Value (million VND)	150	90	60
% of Standing Crop[a]	65.78 %		21.33 %

[a] % harvested relative to the estimated standing crop of the respective season (Table 3).

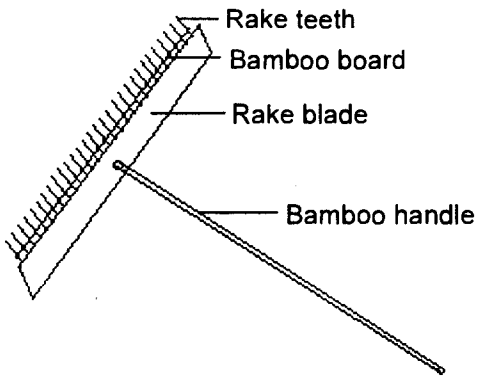
Table 4 indicates the annual trend in macrophyte harvest corresponding to agricultural production which, in Quang Thai, relies mainly on 1 crop per year. In the summer months, many rice fields are saline-intruded because tides bring in lagoon brackish water, so the cultivated area decreases by nearly half. The local irrigation system is poor and can not supply water for farming production. In June to October, harvesting is conducted at low intensity (approximately 60 tons/month) only to be used as feed for pigs, ducks and chickens. At this time, supply is low because the lagoon dynamics impede macrophyte development - salinities are too high in June and too low in October.

Harvesting gear and operation

A macrophyte rake is made by the fishers themselves with iron, bamboo and wood. The materials are used as follows (see Figure 2):

- rake blade: A large wooden board 1.2 to 1.3 m in length and 50 cm in width
- bamboo board: 2-cm thick wooden board
- rake teeth: 50 cm long iron teeth. Each tooth is fixed to the board with 2 chips of bamboo
- handle: good-quality and supple bamboo, 5 - 6m long

Figure 2. A macrophyte rake



Macrophytes are harvested by attaching a rake to each side of a motorized boat. The rakes are kept in a vertical position when collecting. When the boat is running, the 2 rakes are repeatedly dropped to the lagoon bottom for 1-2 minutes, corresponding to a distance of 20 - 22 m, and then drawn up and cleaned. On average, one rake collects 20-25 kg each time it is dropped. Macrophytes are harvested for about 3 hours per day from November to January and 5 - 6 hours from February to March. The boats can exploit any area in the lagoon. In Cua Lac area, where the current is strong, the boat must run against the current to collect macrophytes. No harvesting occurs in the O fields - the rice fields surrounding the lagoon which are flooded until summer - because the beds of the fields are uneven and damage the rake.

Use of macrophytes

Macrophytes are used for 4 purposes:

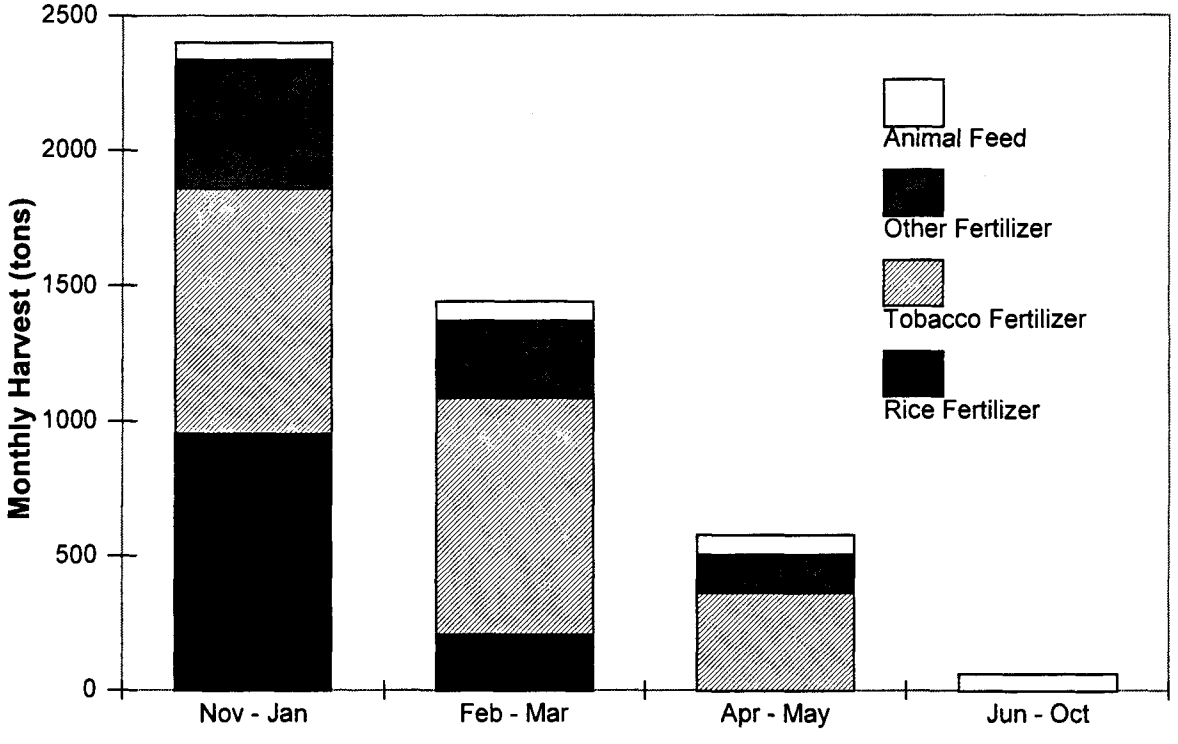
- Green manure/mulch for rice
- Green manure/mulch for tobacco
- Green manure/mulch for other cash crops (peanuts, chili, sweet potato)
- Animal feed (ducks, chickens, pigs)

Table 5 and Figure 3 summarize the information collected on the use of macrophytes from interviews with the mentioned households, with fishers and farmers working on the lagoon and in the fields, and at Hom market (the local commune market), and from observations on macrophyte harvest and use in the locality. The information indicates that the percent of macrophyte used changes seasonally according to the agricultural crops. The amount of macrophyte used for animal feed remains constant but the percentage varies relative to total harvest.

Table 5. Macrophyte harvest and use by season in metric tons per month (tons/mo) and per cent of total used (%) (November, 1995 to February, 1997).

Season	Harvest (tons/mo.)	Green Manure/Mulch for Crops						Animal Feed	
		Rice		Tobacco		Other cash crops			
		tons/mo	%	tons/mo	%	tons/mo	%	tons/mo	%
Nov - Jan	2400	960	40	900	37.5	480	20	60	2.5
Feb - Mar	1440	212	15	880	61	288	20	60	4
Apr - May	576	0	0	362	62.8	154	26.7	60	10.4
Jun - Oct	60	0	0	0	0	0	0	60	100

Figure 3. FW Macrophyte monthly harvest and use in agriculture by season in Quang Thai, 1996-97.



Historical Trends

Information on the past and present harvesting practices was collected from interviews with 15 fishing-farming households, 20 farming households and many other villagers, from observations over the research period and from a field trip on August 16, 1997 to get supplementary data. Macrophytes have been harvested and used for a long time in the locality, because of the demand of farming and animal production and the availability of macrophytes. However, the level of harvesting and use has varied

depending on demand.

Phong Lai tobacco, grown on Quang Thai sandy land, is notorious for its high yield and quality, and original flavour attributed to being fertilized with manure and mulched with macrophytes. In previous years, before commercial cigarette production, Phong Lai tobacco was an important speciality product which brought high economic benefit for local people. The area devoted to tobacco was large and macrophytes in the lagoon could not satisfy local demand. At that time, villagers had to travel by boat to harvest macrophyte in Hải Lăng lagoon, Quang Tri province. With the popularity of commercial cigarettes only old people still smoke Phong Lai tobacco and the area of culture is shrinking. Under present market economy and with improvements in crop science and technology, a wide selection of highly efficient species and varieties of crops have been introduced. In addition, the government and international organizations have invested in an irrigation system and electricity[1], increasing water supply for agricultural production. As a result of diversification, the amount of macrophyte harvested has been and will be decreasing. According to villagers' observations, regeneration and growth of macrophyte has not changed and macrophyte beds are still able to meet the high exploitation levels by local and neighbouring villagers, even in peak harvesting seasons.

STANDING CROP, REGENERATION AND DEVELOPMENT OF MACROPHYTES

High exploitation of macrophyte is necessary for villagers' life and agriculture production. Therefore data and information on standing crop and regeneration time after harvest and the impact of fishing activity on macrophyte beds must be collected in order to plan a sustainable management system for this resource. Initially 2 pairs of plots were used (June to August) which was later expanded to 5 plots (September to March) to increase reliability of the data. Difficulties such as distance from Hue to Quang Thai and lack of time affected the implementation of experiments.

Standing crop in protected and unprotected plots

Standing crop of macrophytes was measured in protected and unprotected plots during the dry and rainy seasons to determine the impact of fishing activities on the growth and development of macrophytes. The results are indicated in Table 6, and Table 7 and Figure 4, for the dry season and the rainy season, respectively. In each 25-m^2 plot, a 16-m^2 area was designated for sampling. At each sample time, a 1-m^2 section was harvested and measured. From each sample, 30 plants of *V. spiralis* were randomly selected to collect data on leaf length, leaf width and number of leaves (Table 8 and Figure 5).

In the dry season (June to August) the difference between protected and unprotected plots was quite minimal - on average 0.15 kg/m^2 (Table 6) while in the rainy season (September to March), the difference was much larger (Table 7 and Figure 4). In both seasons, the difference between standing crop in protected and unprotected plots is statistically significant.

On the first 3 sampling days in September and October, average standing crop was similar between protected and unprotected plots. This period coincides with the flood season when water levels are high and fishing and macrophyte harvesting activities are limited. Therefore, the effects of these activities on the standing crop of macrophyte in the protected and unprotected plots were minimal. From November

[1] Electricity became available in Quang Thai in June 1997. Only about 50% of Quang Thai households are using electricity as it is still unfordable to the rest.

to March, average standing crop in protected plots was much higher than that in unprotected plots especially in February and March. This difference indicates that fishing, macrophyte harvesting and travelling activities on the lagoon have an effect on macrophyte standing crop. November to March is the peak macrophyte harvesting season.

Table 6. Standing crop of macrophyte (in Kg/m^2) in protected (P) and unprotected (U) conditions in the dry season, 1996.

Date	Site 1		Site 2	
	P	U	P	U
Jun. 21	2.6	2.6	2.5	2.48
Jul. 16	2.7	2.5	2.5	2.4
Aug. 15	3	2.6	2.5	2.4
Aug. 29	2.8	2.6	2.6	2.4

Table 7. Standing crop of macrophyte (in Kg/m^2) in protected (P) and unprotected (U) conditions in the rainy season, 1996 - 1997. See Figure 4.

Date	Site 1		Site 2		Site 3		Site 4		Site 5	
	P	U	P	U	P	U	P	U	P	U
Sept. 18	2	2.10	2.30	2.40	2.50	2.50	2.40	2.46	1.76	1.90
Oct. 10	2.30	2.30	2.40	2.50	2.80	2.80	2.64	2.52	2.20	2.10
Oct. 25	2.60	2.60	2.60	2.60	2.70	2.70	2.72	2.80	2.40	2.30
Nov. 14	2.80	2.40	2.90	2.40	2.90	2.50	3.00	2.82	2.80	2.50
Dec. 5	3.00	2.60	3.40	2.70	3.40	2.60	3.25	2.58	3.00	2.50
Dec. 25	3.40	2.60	3.60	2.40	3.70	2.50	3.80	2.30	3.20	2.30
Jan. 12	3.80	2.70	3.80	3.00	3.96	2.25	4.15	1.92	3.50	1.70
Feb. 2	4.20	2.60	4.10	2.20	4.46	2.00	4.40	1.40	3.88	1.15
Mar. 3	4.5	0.70	4.50	0.60	4.60	0.60	4.70	0.50	4.22	0.50

Figure 4. FW macrophyte standing crop (in kg/m2) as a mean of 5 protected and 5 unprotected plots during the rainy season from September 1996 to March 1997 (Table 7).

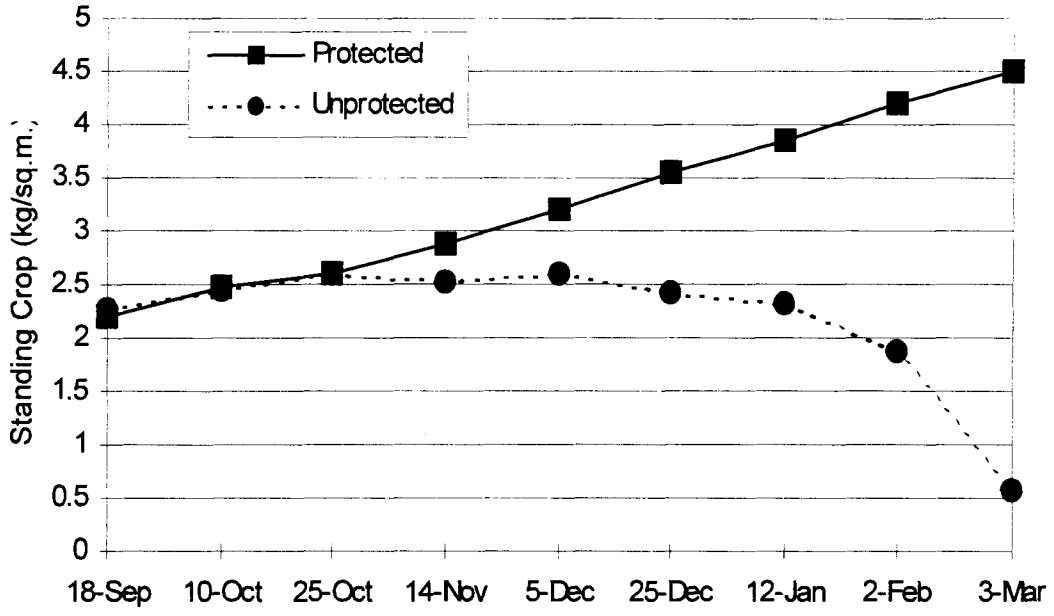
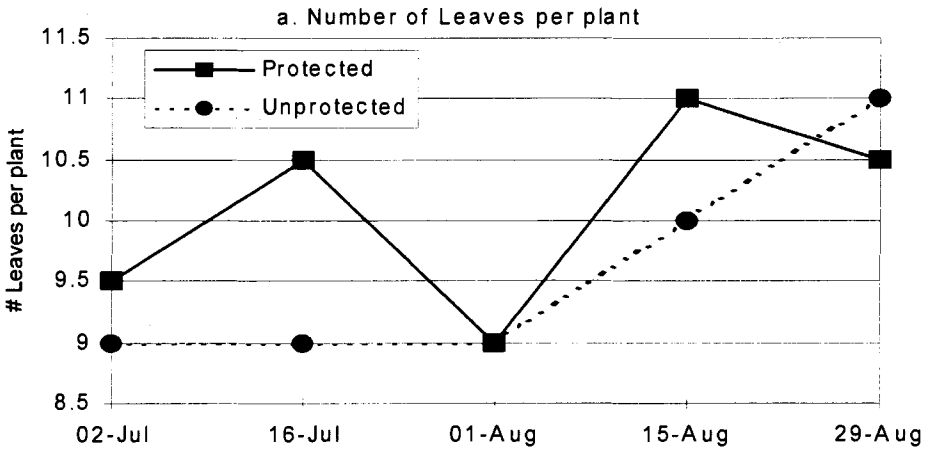
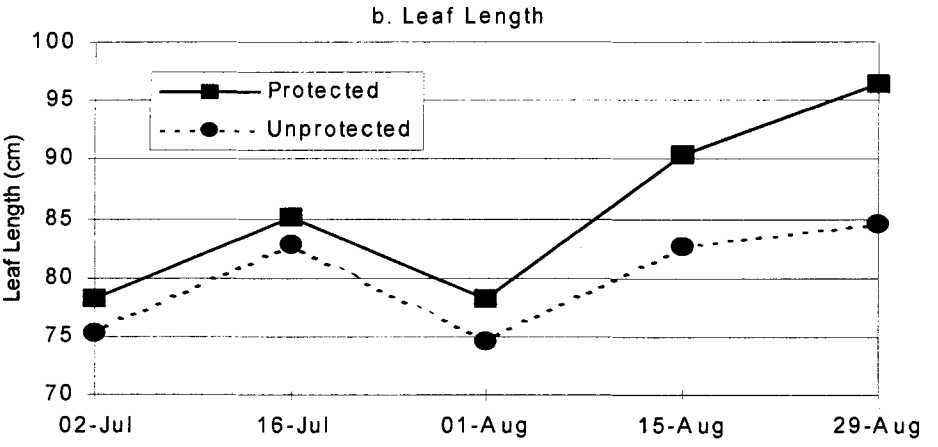


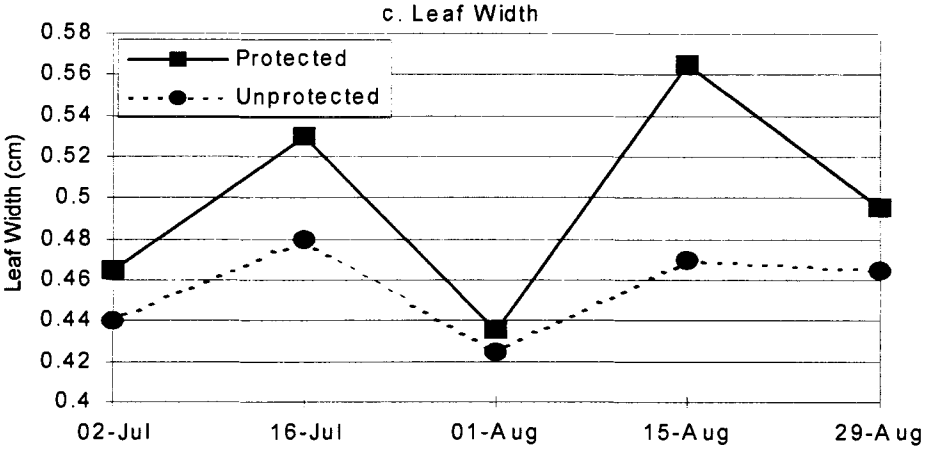
Table 8. *V. spiralis* status in protected (P) and unprotected (U) conditions in July - Aug, 1996. Data are presented as a mean and standard deviation of 30 plants. LL - Leaf Length; LW - Leaf Width, #Leaves - # leaves per plant.

Date	Parameter	Site 1		Site 2	
		P	U	P	U
Jul 2	LL (cm±s.d.)	84.90 ± 12.40	81.50 ± 16.23	71.40 ± 15.85	69.13 ± 19.27
	LW (cm±s.d.)	0.53 ± 0.11	0.50 ± 0.15	0.40 ± 0.15	0.38 ± 0.17
	#Leaves	11	10	8	8
Jul 16	LL (cm±s.d.)	88.73 ± 11.00	88.53 ± 11.02	81.33 ± 14.33	77.03 ± 16.00
	LW (cm±s.d.)	0.56 ± 0.09	0.57 ± 0.12	0.50 ± 0.20	0.39 ± 0.14
	#Leaves	12	10	9	8
Aug 1	LL (cm±s.d.)	77.66 ± 18.39	71.00 ± 17.62	78.66 ± 20.82	78.16 ± 21.12
	LW (cm±s.d.)	0.44 ± 0.06	0.41 ± 0.07	0.43 ± 0.07	0.44 ± 0.08
	#Leaves	9	9	9	9
Aug 15	LL (cm±s.d.)	93.16 ± 9.02	87.26 ± 14.24	87.70 ± 11.40	78.00 ± 15.52
	LW (cm±s.d.)	0.56 ± 0.08	0.51 ± 0.12	0.57 ± 0.10	0.43 ± 0.14
	#Leaves	12	11	10	9
Aug 29	LL (cm±s.d.)	103.13 ± 21.15	98.46 ± 10.56	89.66 ± 16.46	70.80 ± 14.23
	LW (cm±s.d.)	0.42 ± 0.05	0.43 ± 0.11	0.57 ± 0.21	0.50 ± 0.09
	#Leaves	10	12	11	10

Figure 5. FW macrophyte plant physiology in protected and unprotected plots measured from a mean of 30 plants: a) Number of Leaves per plant; b) Leaf Length (cm); and c) Leaf Width (cm) (Table 8).







Regeneration after harvest

Tables 9 and 10 and Figures 6 and 7 indicate the regeneration of macrophytes during the dry and rainy seasons, respectively. Regeneration was measured by entirely cutting an area of 9 m^2 on the first day and, on each subsequent sampling day, re-cutting a section of 1 m^2 in the original area. In the first period (June to August 1996), at each of the 2 sites, one plot was marked and thus protected from any lagoon activity while the other plot was left unprotected. In the second period, 5 plots, at depths of 0.5 m to 2.5 m, were all protected because of the difficulties in maintaining regular plots during the flood season (it was possible but difficult thus the standing crop experiments were given priority). For the latter period, 30 *V. spiralis* plants from the 1-m^2 cut were randomly selected and measured for the number of leaves per plant and leaf length and width.

Table 9. Regeneration of macrophyte standing crop in the dry season (June to August 1996) at 2 sites measured as kg per m^2. P - protected plot, U - unprotected plot.

Date	# days	Site 1		Site 2	
		P	U	P	U
Jun. 21 (CUT)	0	2.6	2.61	2.52	2.47
Jul. 2	11	0.40	0.30	0.30	0.30
Jul. 16	25	1.30	1.3	1.20	1.00
Aug. 1	41	1.9	1.70	1.70	1.60
Aug. 15	55	2.5	2.40	2.40	2.20
Aug. 29	69	2.60	2.40	2.50	2.30

Figure 6. FW macrophyte regeneration after cutting 9-m^2 plots and recutting at subsequent dates in the dry season (June to August 1996). Standing crop of 2 protected and unprotected plots.

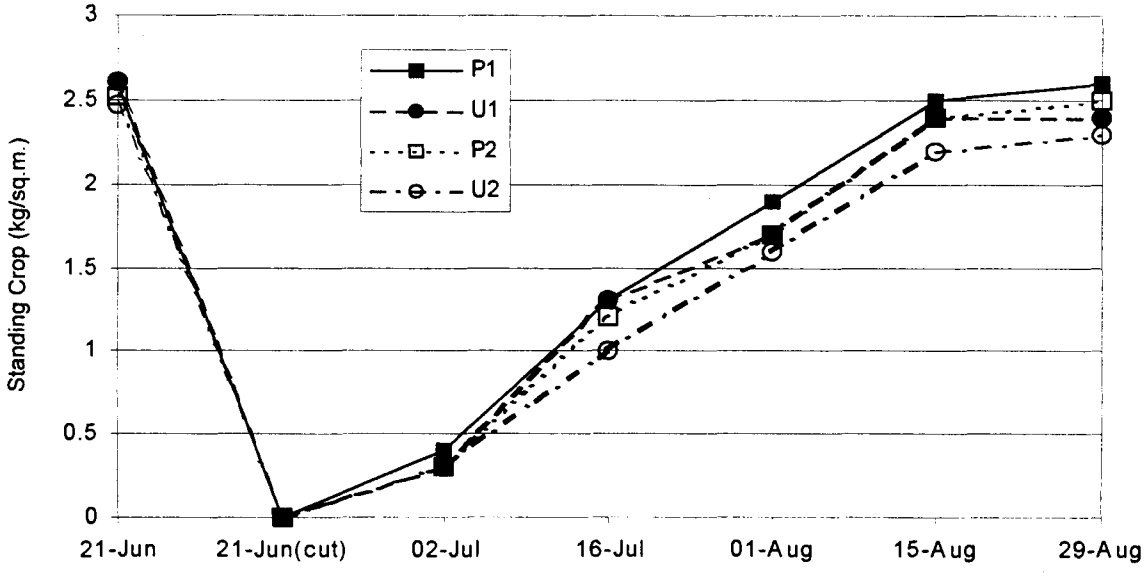
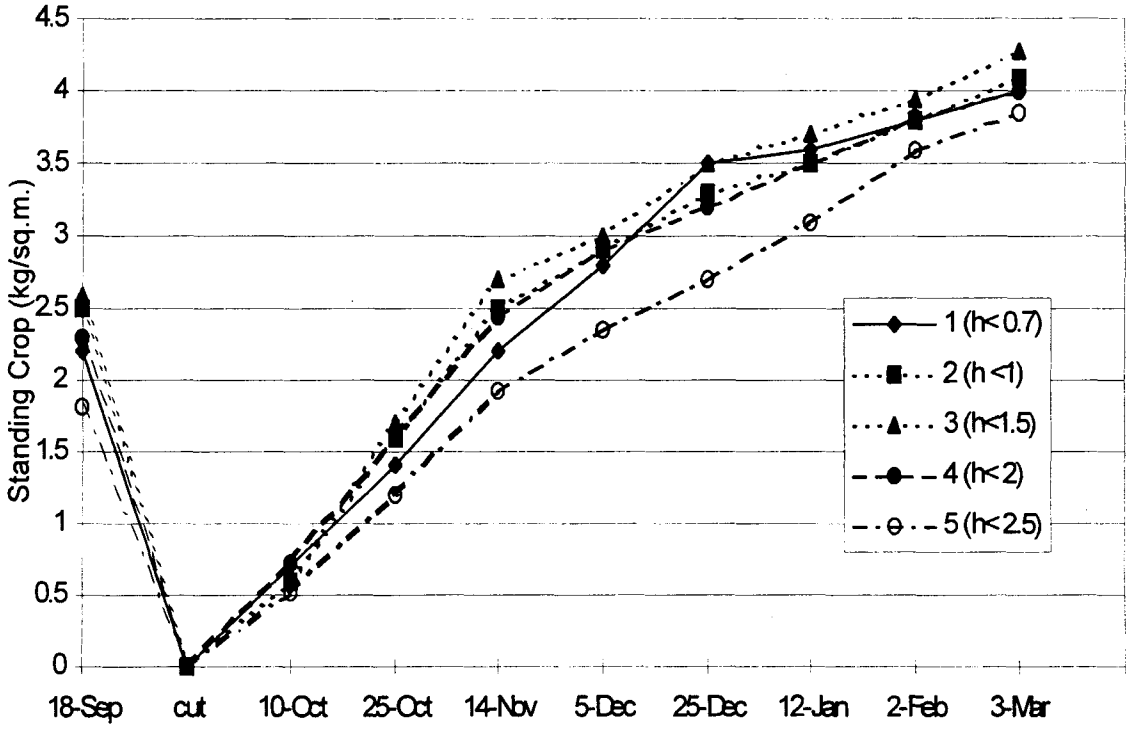


Table 10. Regeneration of macrophyte standing crop in the rainy season (September 1996 to March 1997) in 5 protected plots measured as kg per m^2.

Date	# days	Plot Number (Depth in m.)				
		1 (h< 0.7)	2 (h <1)	3 (h<1.5)	4 (h< 2)	5 (h< 2.5)
Sept. 18 (CUT)	0	2.20	2.50	2.60	2.30	1.82
Oct. 10	22	0.70	0.60	0.60	0.72	0.52
Oct. 25	37	1.40	1.60	1.70	1.60	1.20
Nov. 14	57	2.20	2.50	2.70	2.45	1.92
Dec. 5	78	2.80	2.90	3.00	2.90	2.35
Dec. 25	98	3.50	3.30	3.50	3.20	2.70
Jan. 12	116	3.60	3.50	3.70	3.50	3.10
Feb. 2	137	3.80	3.80	3.94	3.82	3.60
Mar. 3	166	4.00	4.10	4.28	4.00	3.85

Figure 7. FW macrophyte regeneration after cutting 9-m2 plots and recutting at subsequent dates in the rainy season from September 1996 to March 1997. Measured as standing crop in 5 protected plots at different depths (depth increases from plot 1 to 5) (Table 10).



Macrophyte beds regenerate fully by 2 months after harvest (Figures 6 and 7). In the dry season after 5 observation times, standing crop regenerated to the initial standing crop of June 21 in protected plots while in unprotected plots, it regenerated to a lower value though the difference between protected and unprotected plots was not significantly different. Salinity, bottom type and depth were the same for the protected and unprotected plots at each site.

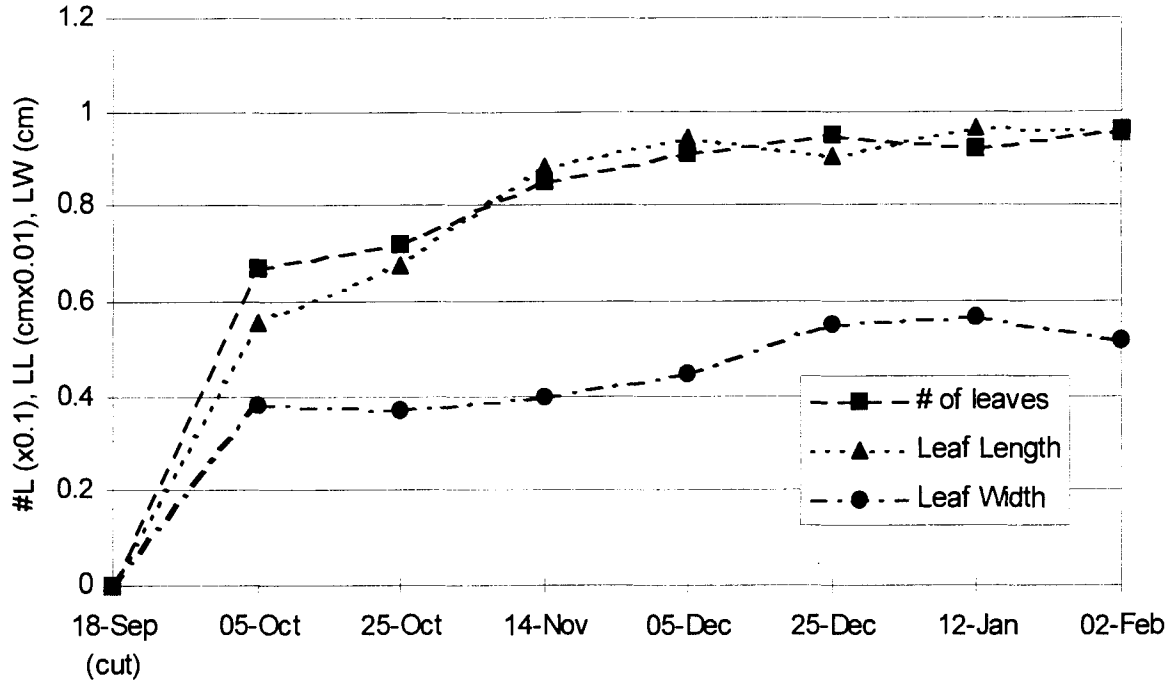
In the rainy season, the average standing crop at the end of the experiment was higher than at the start which corresponds to the seasonality of macrophyte development. The highest standing crops are in plots 2 and 3 and the lowest is in plot 5. The difference among plots was highly significant. At the fourth observation time (approximately 2 months after cutting), the standing crop was equal to the initial standing crop. In the subsequent 5 observations (3.5 months), standing crop in the plots still increased, but the rate of new growth decreased. These plots are protected from fishing production and boat travel therefore, the slower growth in the latter observation times must be due to biological characteristics of macrophyte development. Observation indicated that the number of old plants was high and the number of young plants increased because macrophyte plants were reproducing asexually and sexually. In the period of December to March, macrophyte plants grew the best, standing crop was highest for all year, corresponding to annual peak harvest season. After this, primary plants died naturally and were replaced by the younger secondary plants.

Table 11. *V. spiralis* regeneration measured from standing crop, number of leaves per plant, and leaf width and length (average of 30 plants from 5 plots).

Date	Standing crop (kg/30 plants)	# of leaves (# ± st.dev.)	Leaf Length (cm ± st.dev.)	Leaf Width (cm ± st.dev.)
Sept. 18 (CUT)	0	0	0	0
Oct. 10	0.19	6.7 ± 0.6	55.9 ± 6.1	0.38 ± 0.03
Oct. 25	0.34	7.2 ± 0.9	67.8 ± 8.1	0.37 ± 0.05
Nov. 14	0.39	8.5 ± 1.0	88.2 ± 9.6	0.40 ± 0.04
Dec. 5	0.47	9.1 ± 0.9	94.1 ± 10.8	0.45 ± 0.05
Dec. 25	0.62	9.5 ± 0.9	90.6 ± 8.5	0.55 ± 0.05
Jan. 12	0.68	9.2 ± 1.1	96.6 ± 8.4	0.57 ± 0.06
Feb. 2	0.64	9.6 ± 0.9	95.3 ± 7.9	0.52 ± 0.04

The results in Table 11 and Figure 8 show that average values for leaf number, length, width and standing crop increase in the whole 5 plots over subsequent observation times. Initially after cutting, *V. spiralis* developed well in all indicators following a standard growth curve - high growth initially (October to December) and then a slower period (December to January). All indicators reached a maximum on January 12 which corresponds to the peak harvest season. After reaching a maximum, *V. spiralis* standing crop decreased on February 2 which may indicate that harvesting of macrophyte is a critical factor stimulating growth and development of macrophytes. The initial growth spurt may also indicate that, after the floods, mud and nutrients are made available on the bottom layer of the lagoon therefore macrophytes develop well - leaves are thicker than before and as a result, standing crop is higher.

Figure 8. V. spiralis regeneration after cutting on Sep. 18, 1996 measured until Feb. 2, 1997 by sampling 30 plants to estimate the number of leaves per plant (# L x 0.1), leaf length (LL in cm x 0.01) and leaf width (LW in cm). Interpreted from Table 11.



Macrophyte beds as habitat for aquatic species

Most researchers claim there are interactions between macrophytes and other aquatic species. Macrophyte beds are ideal as feed and habitat for many aquatic species (fish and invertebrates) to grow and spawn. Diversity of fish species and invertebrates in areas with and without macrophytes is an important factor to measure. However, the research was not successfully completed.

The research was conducted by catching aquatic species with a bamboo enclosure and fish trap. The enclosure was made of 10 bamboo sheets. Each sheet, measuring 1.2 m in height and 1 m in width, was made of slices of bamboo with a distance of 0.3 - 0.5 cm between them. The bamboo sheets were easily attached to each other and detached. Stones tied to a rope were dragged on the lagoon bottom to scare the aquatic species into the bamboo area. The operation lasted 45 minutes. This was attempted 3 times in areas with seagrass and areas without. The data (from August 16 and 29 and September 18) were too erratic and, most often, no animals were caught indicating that it was too easy for them to escape. Better methodology needs to be development to measure the importance of seagrass beds to aquatic species production.

Prolific macrophyte beds are associated with bird populations which feed on fish, crustacean and molluscs. Observation and interviews provided information that many species of birds inhabit the area for parts or all of the year. They gather in this area to find food. Most of the birds are large in size. A list of bird species and their presence are presented in Table 12.

Table 12. Bird species present in Quang Thai lagoon area (Lunar calendar used for presence)

Vnese name	*Latin* and English Names	Area	Presence
Chim bích [a]	black plume, ivory bill, shaped like a crow, wades like a duck (1 kg)	centre of lagoon	year round
Vịt trời	*Anas platyrhynchos* - Mallard	O field, submersion area	high: IX - III low: X - XI
Triếc	*Ardea purpurea* - Purple heron	lagoon edge, O field	VIII - II
Cò trắng	*Egretta garzetta* - Little egret	lagoon edge, O field	VIII - II
Cưỡi	*Bubulcus ibis* - Cattle egret	lagoon edge, O field	VIII - II
Le Le	*Podiceps ruficollis* - Little grebe	Lagoon centre	All year
Ngỗng trời	*Anser anser* - Grey-lag goose	O field, lagoon edge	All year
Hia Hia [a]	legs like duck, black body (0.4 - 0.5 kg)	O field, lagoon centre	All year
Hải âu	*Procellaria leucomelaena* -	Lagoon centre	All year
Chim trích [a]	like *chim bich* but longer legs and sharper bill, black body (2 - 3 kg)	O field, lagoon edge	all year

[a] Birds not identified because the Vietnamese names are local names.

These birds gather in large flocks of thousands of animals and forage in the O fields (rice fields that are submerged most of the year) and in the lagoon. Some species reproduce in the area. *Chim trich* lays about 10 eggs per nest in lunar month VIII (see **Appendix A**). The birds are not regularly hunted - people only rarely catch birds as entertainment by trapping or using nets. The villagers believe that the inhabitation of birds means peace and abundance of fish and shrimp.

The interactions between biological resources and other animals such as birds need to be studied in more depth to plan the protection and conservation of this estuarine ecosystem.

CONCLUSIONS

- Seven (7) freshwater macrophyte species have been identified in Quang Thai lagoon, of which *Vallisneria spiralis* is dominant. They are distributed in about 900 ha in Quang Thai lagoon area, mainly on the Southwest side. They are present almost all year round but standing crop is highest from November to January.
- Macrophytes are used as green manure and mulch for rice seedlings, tobacco and other cash crops, and feed for animal production. Harvesting of macrophyte depends on need in agriculture. The peak harvesting season is used for the Spring crop from November to January.
- Regeneration of macrophyte standing crop after harvesting takes about 2 months. The rate of regeneration depends on salinity, depth and bottom types. Fishing activity (especially eel raking,

it seems), macrophyte harvesting and boat travel also have impact on growth and development of macrophyte. These conclusions are preliminary and need to be validated.

- Leaf length, leaf number, leaf width and weight of dominant species (*V. spiralis*) are highest from November to January, corresponding to Spring harvesting season. Fishing activities also affect the development of these indicators.

Macrophytes, present in Quang Thai and many other areas in Tam Giang lagoon, play an important role to farming production as a main source of green manure and mulch to improve crop production. The villagers claim that macrophytes are not overexploited. Observation and interviews on August 16, 1997, indicate that macrophytes are developing better in 1997 than in the previous year. However, the question remains as how to exploit and use the resources reasonably if the demand of macrophyte for agricultural production or other potential uses should increase. More research to determine annual growth, development and bio-chemical cycles of macrophytes is needed to evaluate the health of this resource and provide a basis on which to develop effective exploitation, use and protection strategies of macrophytes in Quang Thai lagoon. Further research is also needed on the impact of macrophyte harvesting on fisheries resources and the surrounding ecosystem.

REFERENCES

Đoàn Suy Nghĩ and Tôn Thất Pháp. 1993. *Tính chất thủy lý - thủy hóa môi trường phá Tam Giang - Tỉnh Thừa Thiên Huế. Thông tin khoa học và công nghệ tỉnh Thừa Thiên Huế.* (Magazine "Science and Technology Information in Thua Thien-Hue"). Vol 2. 1994.

Fortes, M.D., 1989. Seagrasses: a Resource Unknown in the ASEAN Region. ICLARM education series 5, 46pp. International Center for Living Aquatic Resources Management, Manila, Philippines.

Fortes, M.D., 1995. Seagrass of East Asia: Environmental and Management Perspectives. RCU/EAS Technical Report Series no. 6. UNEP. Bangkok, Thailand. 79pp.

Klein R.M, Klein D.T. 1970. *Phương Pháp Nghiên Cứu Thực Vật.* (Research methodology on vegetation). Vol I. Translation by Nguyễn Tiến Bản and Nguyễn Như Khanh, 1979. Science and Techniques Publication. Ha Noi.

Nguyễn Chu Hồi. 1991. *Điều kiện tự nhiên và hệ sinh thái đầm phá Tam Giang, Cầu Hai, Lăng Cô. Thông tin khoa học và công nghệ tỉnh Thừa Thiên Huế.*. (Natural environments and ecosystem of Tam Giang, Cau Hai and Lang Co lagoon. Magazine "Science and Technology Information in Thua Thien-Hue"). Vol 2. 1994.

Nguyễn Văn Tiến. 1996. *Một số dẫn liệu về rong biển và thực vật thủy sinh bậc cao ở hệ đầm phá Tam Giang-Cầu Hai, Thừa Thiên Huế.* (Information on seagrass and freshwater macrophyte in Tam Giang-Cau Hai lagoon system, Thua Thien-Hue). Workshop on Thua Thien-Hue lagoon. Collection of Reports.

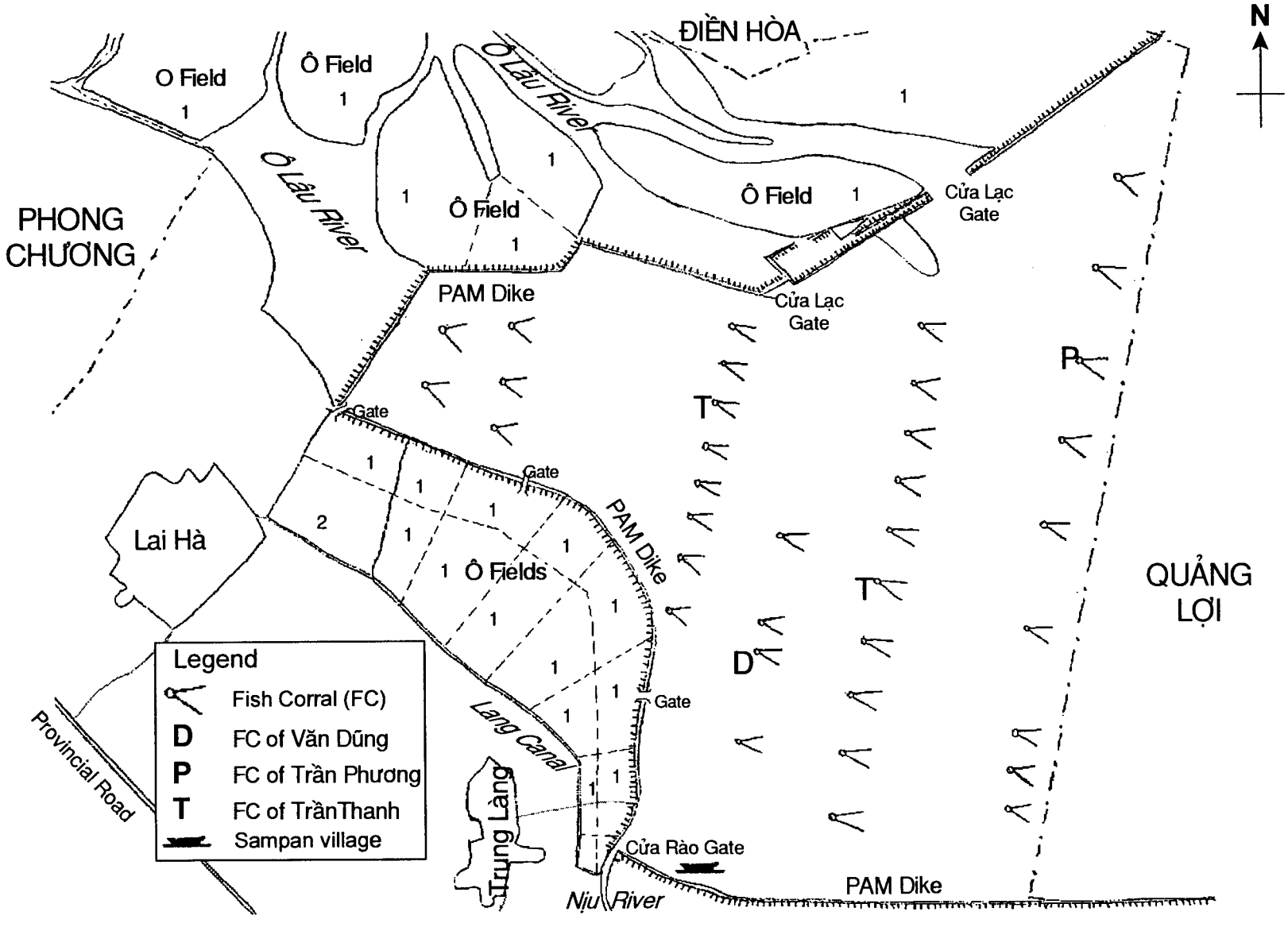
Perkins, E.J. 1974. The biology of estuaries and coastal water. Academic Press. London. New York.

Phạm Hoàng Hộ. 1993. *Cây cỏ Việt Nam.* (Plants in Viet Nam). Vol I, II, III. Mekong Printing Publication. USA.

Tôn Thất Pháp. 1993. *Nghiên cứu thực vật thủy sinh ở phá Tam Giang tỉnh Thừa Thiên Huế.* (Research on aquatic plants in Tam Giang lagoon - Thua Thien-Hue). Doctoral thesis on biology. Ha Noi University.

Vũ Trung Tạng. 1994. *Các hệ sinh thái cửa sông Việt nam.* (Estuary ecosystem in Viet Nam). Science and Techniques Publication. Ha Noi.

Map 11. Fish Corral Grounds in Quảng Thái



Fishing in Quang Thai Commune

Lê Thị Nam Thuận, Trương Văn Tuyển and Nguyễn Hồng Việt

QUANG THAI LAGOON

Quang Thai Commune is located on the northern end of the Tam Giang Lagoon (Map 4, p. 4 and Map 11, p. 168). The lagoon near Quang Thai receives water from the O Lau river and is a transitional ecological zone between the river and sea. Salinity and its fluctuations are low because Quang Thai is at the northern end of the lagoon system, nearly 30 km from the Thuan An estuary. The Quang Thai area is a unique and complicated ecosystem and abounds in biological resources. Dense beds of freshwater macrophytes are a good source of food and a good habitat for juvenile and mature aquatic species.

Fishing provides income and food for about 100 households (more than 700 people) in Trung Lang village and for additional families of other villages of Quang Thai Commune and neighbouring communes. As well, this area shelters a large number of fish-eating birds year round and is an important source of plant material in agriculture (see **Freshwater Macrophytes – their Ecology and Exploitation**). In recent years, because of population stress and poverty, more than 50 boats of fishers using the illegal electric fishing gear have been operating daily in this lagoon area (see **Community Banning of Electric Fishing**).

In fact, poverty and difficult farming production are some of the main reasons for the increase in exploitation in the lagoon – it is used as a last resort to supplement meagre incomes. Although the lagoon and the rice fields on its shores have a great potential in fishing and aquaculture, they are exploited unsustainably and without planning. As a result, the biological resources in the lagoon are decreasing and the environment is seriously affected.

By protecting the environment and the lagoon resources they are exploiting, the local fishers can ensure a future for themselves and future generations. Research and documentation of information relating to aquatic resources, their exploitation and utilization are necessary to plan a management strategy. The results can contribute to designing protection and sustainable exploitation of these valuable resources.

RESEARCH METHODOLOGY

Secondary data on fixed gear (fish corral) and mobile gear (pushnet, dragnet, trawl, etc.) were collected from the DoF, HUS and fishery officials.

Measurements of environmental parameters were conducted using:

- ATAGO salinity metre (every 5 days)
- HANNA oxygen metre and temperature metre
- pH metre

Information from villagers was collected through observation, interviews and data collection. Data collection sheets were designed and completed by fishers from March 1996 to February 1997.

Collected data and information were gathered, analysed and assessed over the research time and reports

were made. Research contents included identification of:

- Environmental parameters at the research site
- Fishers and fishing gear in Trung Lang
- Aquatic species exploited
- Catch by different fisher groups
- Size at catch of main fish species
- Marketing of aquatic products

Data collection sheets

Data Collection Sheet 1

Full name of fisher: Address: Fishing gear: Month: Fishing ground:								
Day	Total weight (Kg)	Valuable fish species			Shrimp (kg)	Family consumption	Weather (sunny, rainy, tidal current)	Other species (in descending order)
		Name	Weight	# animal/kg				
1 ... 30								

Data Collection Sheet 2

Side A - **Daily Household Catch Statistics** Month: year: 1996/1997 Full Name: Fishing Gear: Address:								
Day	Income (1000 VND)	Weight (kg)					Departure time	Return time
		Fish	Shrimp	*Caridina*	Eel	Clam		
1 ... 30 31								
Side B - Main species caught in a month Average monthly price of: fish, shrimp, *Caridina* (dry and fresh) and eel.								

Sheet 1 was used from March to July, 1996 by 9 selected households recommended by the community. Three (3) Group 2 fishers continued recording their catches until February, 1997, namely Trần Ngọc Thành (55 years old), Văn Dũng (31 years old) and Trần Phương (53 years old).

In addition to data collection sheets, these fishers were equipped with 5-kg scales to weigh their catch.

Because the level of education in the community is low and fishers were not used to recording, the researchers regularly instructed them on how to record and checked many times to ensure data accuracy. This activity required careful communication and a friendly relationship with villagers. This is an important factor in research with villagers' participation.

After a few months, the researchers realized that the data collection sheet had to be modified to collect other necessary information and reduce the time fishers had to spend on it. Sheet 2 was used to get additional data on the number of species and catch, fishing effort and price of products. From that information, daily income from fishing was determined. However, Sheet 2 omits data on catch weight, family consumption and size of species. Thus both data collection sheets were used at the same time to supplement and validate data collected from different groups and households and to increase the reliability of data.

With the simpler sheet 2, data collection was expanded to involve the third fishing group (fishing-farming or Group 5) in Quang Thai. Group 5 consists of more than 65 households which account for over half of community. Therefore, since August 1996, the research method was changed both in content and scale to supplement and collect more sufficient and detailed information. Households collecting data were as follows:

- Fishing Group 1 (Mobile gear users): Trần Toàn, Phan Chương, Ms. Phạm Thị Lơn, Phan Chu, and Phan Thanh (Sheet 2)
- Fishing Group 2 (Fixed gear users): Trần Ngọc Thành, Văn Dũng, and Trần Phương (Sheets 1 and 2)
- Fishing/Farming Group 5 (Mobile and fixed gear users): Phan Dai, Hoàng Bụi, Trần Quê, Trần Mẫn, Nguyễn Huân, Trần Phiên, Văn Cát, Phạm Thị Lách, Trần Huê, Phan Thìn, Phan Danh, Nguyễn Xuyến, Phan Lễ and Mr. Hoàng Xưởng (Sheet 2)

Sheets 1 and 2 were used to record daily catches of aquatic species for every month. The sheets were replaced with new ones at the end of every month. This was done regularly over the research period by the researchers and a local collaborator - Mr. Tran Ngoc Thanh. Thanh is an experienced and skilful farmer and fisher, who knows how to record data, knows the local lagoon very well, is enthusiastic and has prestige in the community.

Every month, in addition to exchanging data collection sheets, we collected information using PRA tools from participating households as well as others. Communication, exchange, interviews and observation were implemented with both men and women of all ages and various livelihoods at different times and places in village or on the lagoon.

The identification of aquatic species present in Quang Thai lagoon - fishes, molluscs and crustaceans - was based on classification keys by Vuong Di Khang (1995), Nguyen Nhat Thi (1995) and Pham Van Mien *et al* (1981). Species recorded in the data collection sheets are listed in **Appendix B**.

RESULTS AND DISCUSSION

Environmental parameters at the research site

The area of Quang Thai lagoon is more than 1000 ha, the length of which lies from a northwest to southeast direction along the coast (Map 4, p. 4). The lagoon borders are: to the North - the O Lau estuary and rice fields; to the Southeast - Quang Loi commune waters; to the Northeast - Dien Hoa commune waters; and to the West - Quang Thai commune. Generally, the lagoon bottom is sloping near the edge and even in the centre and has the shape of a river bed. The depth is approximately 1 m with maximum depth of 1.8 m at low tide. In the dry season, marine water enters the lagoon through Thuan An estuary but fluctuates in time and depth. In the rainy season (from Lunar IX to XII – see **Appendix A**), 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 sometimes fresh. In the dry season (from Lunar I to VIII), salinity fluctuates and in some cases rises to over 10‰ (maximum measured over the research period). The water in Quang Thai lagoon is always moving - in the North it is exchanged with waters from the O Lau river and in the South with water from Huong river and Thuan An estuary.

Table 1. Dissolved Oxygen (DO) and pH in the Quang Thai Lagoon during the dry (Lunar I to VIII) and rainy (Lunar IX to XII) seasons.

Parameter	Dry Season		Wet Season	
	Surface	Bottom	Surface	Bottom
DO (mg O_2/ L)	8.15 - 9.64	5.34 - 5.45	6.80 - 7.20	4.90 - 5.30
pH	7.15 - 7.31		5.60 - 6.20	5.90 - 6.92

In the dry season, pH is high and stable. Dissolved oxygen is also high because temperature is high in this season. Freshwater macrophytes which grow abundantly, increase dissolved oxygen in the water through photosynthesis. In the rainy season, pH is low and fluctuating, and varies by depth. Dissolved oxygen is also low because the O Lau river releases organic substances. The process of decomposition consumes dissolved oxygen in the water.

The environmental parameters (pH, salinity and dissolved oxygen) measured over the research period are consistent with research results from the Faculty of Biology at HUS and Hai Phong Oceanography Institute (1995).

Fishers and fishing gear in Trung Lang

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. Trung Lang, whose main economic activity is fishing in the lagoon, is one of 7 villages in Quang Thai. The social structure of the village consists of 3 groups each with different production activities:

Group 1: Established after 1985, consists of 16 households mainly operating mobile fishing gear

(originally 21 households from which 5 have left the village)

Group 2: Established before 1985, consists of 18 households mainly operating fixed fishing gear.

Group 5: Established before 1985, consists of more than 65 farming and fishing households operating:
+ Fixed fishing gear: fish corral, FAD and mullet trap.
+ Mobile fishing gear: gillnet, dragnet, pushnet, eel rake, clam collecting (by hand), etc.

Table 2. The number of fishing gear in Trung Lang village operated by the 3 fishing groups.

Group	Fish corral	FAD	Gillnet	Dragnet	Pushnet	Eel rake	Hook & line
1	4		18	9	18	12	4
2	40	10	4	50	16	30	
5	15	5	8	10	65	9	
TOTAL	**59**	**15**	**30**	**69**	**99**	**51**	**4**

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 capital 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. Most gear are operated in shallow water near the shore of the lagoon and are simple and low-cost but use nets with very small mesh size of 5x5mm 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 at its peak while in 1997 average catches were less than 2kg.

As presented in Table 2, there are nearly 330 fishing gear of various types operated in Quang Thai lagoon by Trung Lang fishers. This does not include gear and boats operated by villagers from Phong Chuong, Dien Hai and Dien Hoa. Extrapolating from Table 2, there are, on average, 2 boats and 2 mobile gear operated by Quang Thai villagers in 10 ha of water area. During the freshwater macrophyte harvest (see **Freshwater Macrophytes – their Ecology and Exploitation**), this number rises abruptly to 40-50 boats per day in peak season and to 20 - 30 boats per day over the rest of the macrophyte harvesting season. After the Lunar New Year (*Tết*), there are about 50 boats daily fishing by gillnet and rapping (tapping on the boat to attract fish into the net).

Taxes on farming production are levied based on soil type and is determined based on the average production from that piece of land over several consecutive years. On average in Viet Nam, the tax is 4.5 kg paddy rice/*sào* (1 *sào* = 500 m^2) for the winter crop although in Quang Thai the tax is lower due to lower yields. It is collected in cash according to the price at harvest. For example, in 1997, the average tax was 6,300 VND/*sao* for winter crop in Quang Thai. Tax on summer crops is about 1/3 of that of winter crop. If other crops are planted, the taxes are equivalent to rice production. Every farmer pays taxes. In comparison, from the fishery, the local government levies a tax on fish corral units only and the level is still low (under 40,000 VND/fish corral unit/year). Relative to income earned, taxes paid by farmers are much higher than those paid by fishers. This and the fact that only a small percentage of fishers are taxed indicates that there is a unbalanced contribution for social welfare from 2 main economic activities (farming and fishing) in the locality.

Aquatic species exploited in Quang Thai lagoon

Aquatic species in Quang Thai lagoon are abundant in number and composition. Main exploited aquatic species are snakehead, common carp, walking catfish, freshwater macrobrachium, greasybacked shrimp, eel, mullet, local carp, grassfish, *Caridina* (a small freshwater crustacean) and clam. Freshwater macrophyte is also an important exploited species used in farming and animal production in the locality.

Data from 3 collaborating fish corral households and from observation indicate that the presence of aquatic species in Quang Thai differs in time. This difference appears to be due to changes in salinity, currents, bottom type and vegetation cover. Ecological and biological characteristics of species determine their occurrence at different times (Figure 1).

Figure 1 indicates some species caught by fish corral which are present at high frequencies in the area: goby (*Glossogobius giuris*), local carp (*Cyprinus centralus*), grassfish (*Gerres oyena*), grouper (*Epinephelus malabaricus*), and thornfish (*Therapon theraps*). These species are not only present in the lagoon most of the time but their price is high as well. From catch data of aquatic species in the area, the frequency of some species has been identified and presented in Table 3.

Figure 1. Seasonal Calendar of some aquatic species caught by fish corrals in Quang Thai lagoon (months correspond to solar calendar).

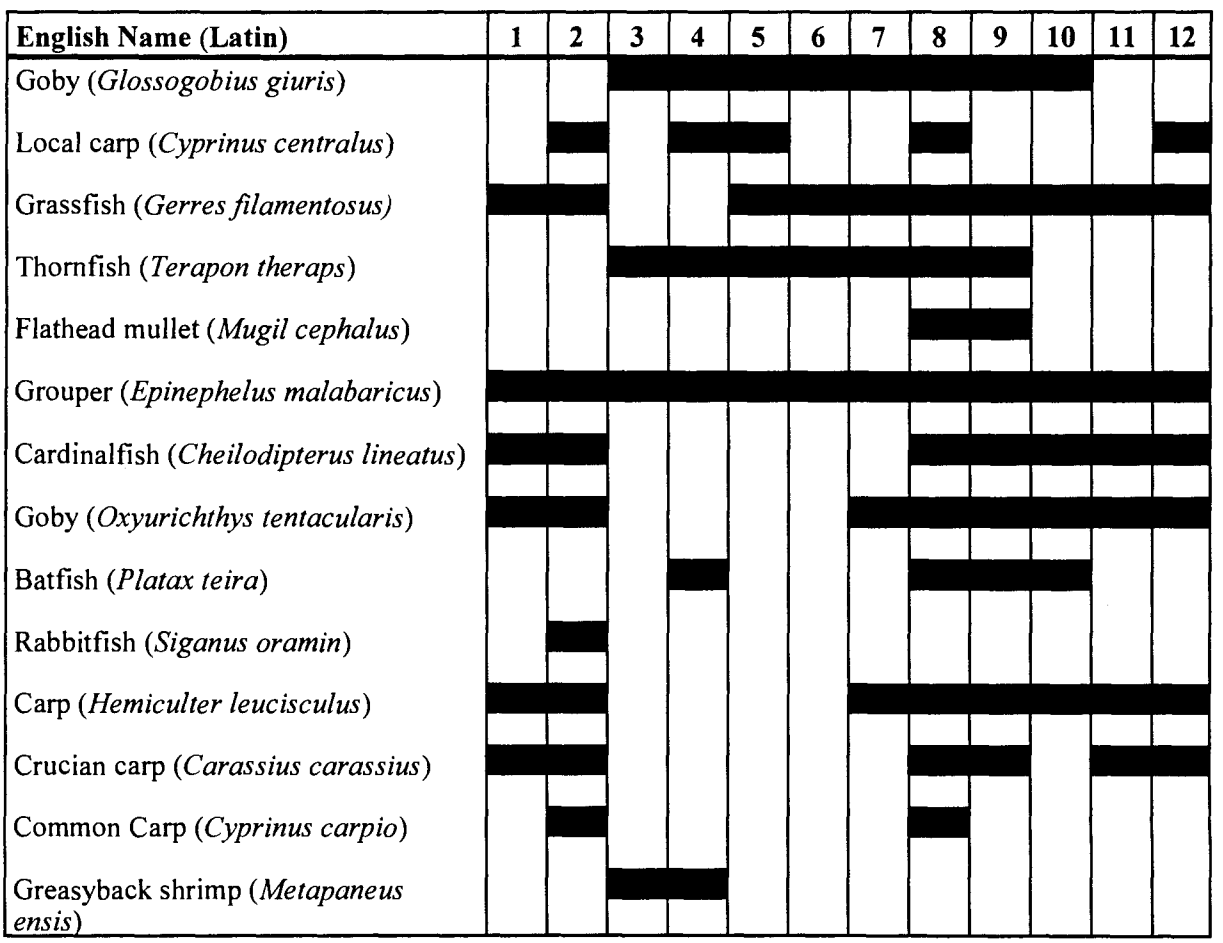


Table 3. Frequency of catch by fish corral of some species in Quang Thai lagoon over the research period

Name	# days caught	Annual Frequency[a]
G. giuris	228	0.68
C. centralus	206	0.61
Gerres oyena	175	0.52
T. theraps	105	0.31
E. malabaricus	113	0.34
O. tentacularis	126	0.37
C. lineatus	103	0.31

[a] Annual Frequency = $\frac{\text{\# days caught}}{\text{Total \# fishing days (335)}}$

Production of fishing gear

Fixed Fishing Gear Group (Group 2)

Over the research period, a lot of information on production from fish corrals has been collected. Information from 3 representative households was analysed to understand the catch, main species, and total household production by these gear.

The map of fish corral grounds in Quang Thai (Map 11, p. 168) indicates the location of the 4 fish corrals:

- Tran Phuong: Average depth: 1.7 m
- Van Dung: Average depth: 1.3 m
- Tran Thanh: Average depth: 1.5 m
- Tran Thanh: Average depth: 1 m

Detailed results of monthly production of these 3 households (data from 2 corrals for Thanh) are presented in the Figures 2 to 4. Catch from the 3 households is highest in March with a second production peak occurring in December for Thanh and Dung and in August for Phuong. March is a slack time in agriculture and the 3 households focus mainly on fishing, so aquatic production is higher. In addition, the temperature starts increasing and the water level decreases to a level more suitable for fishing. In December, the increase in catches of Thanh and Dung is related to the end of the flood season when more aquatic species enter the lagoon with strong tidal currents. As a result, the households increase their fishing effort. In August, production is high for Phuong household probably because the salinity is at a transitional level between high (end of dry season) and low (early rainy season). At this time, freshwater fish migrate into the lagoon in search of food in large numbers. The difference in the second peak in the 3 households can be explained by the locations of their fish corrals.

From data collected from the 3 households, average daily catch and total production by household have been estimated. These results are presented in Table 4 and Figure 5.

Figure 2. Average daily marketed and family consumed catch for each month (March 1996 to February 1997) caught in 2 fish corrals of Tran Ngoc Thanh household.

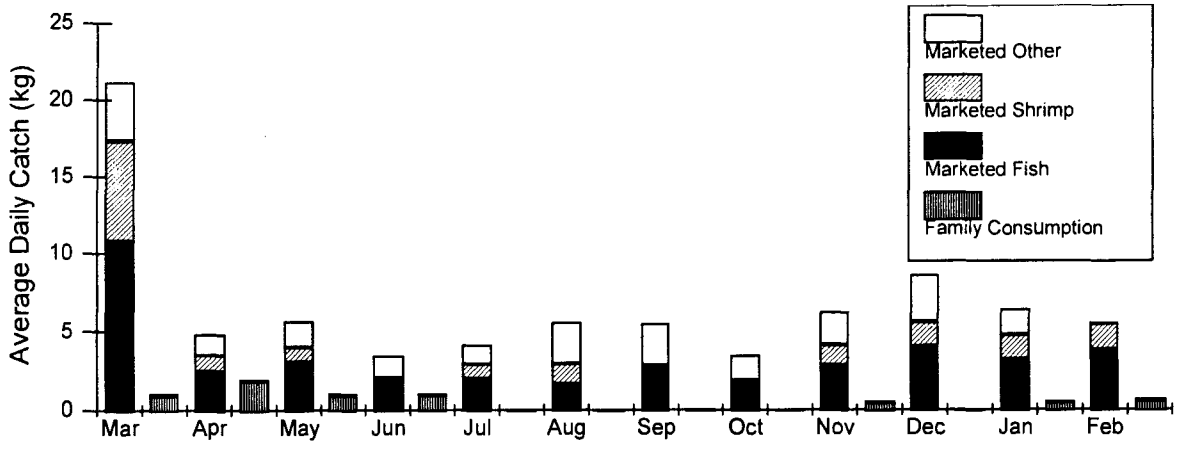


Figure 3. Average daily marketed and family consumed catch for each month (March 1996 to February 1997) caught in 1 fish corral of Tran Phuong household.

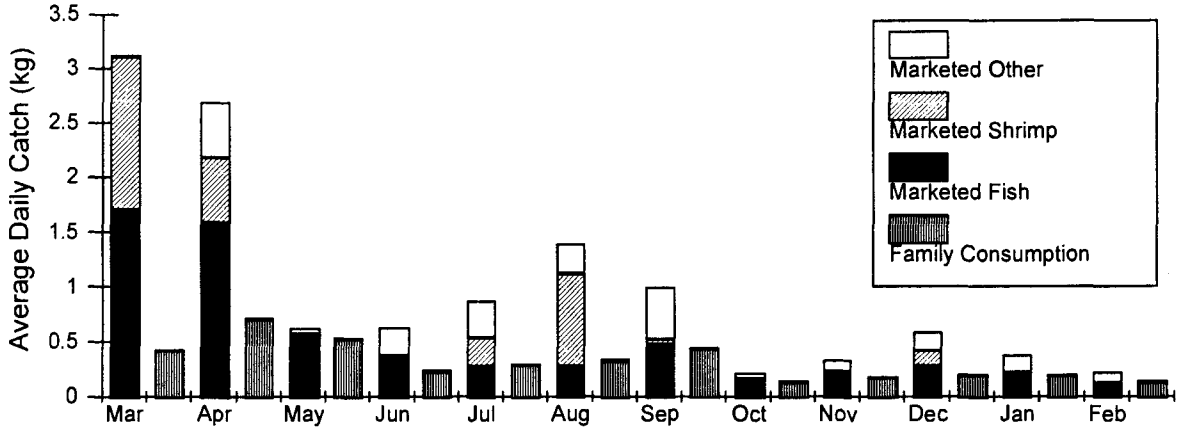


Figure 4. Average daily marketed and family consumed catch for each month (March 1996 to February 1997) caught in 1 fish corral of Van Dung household.

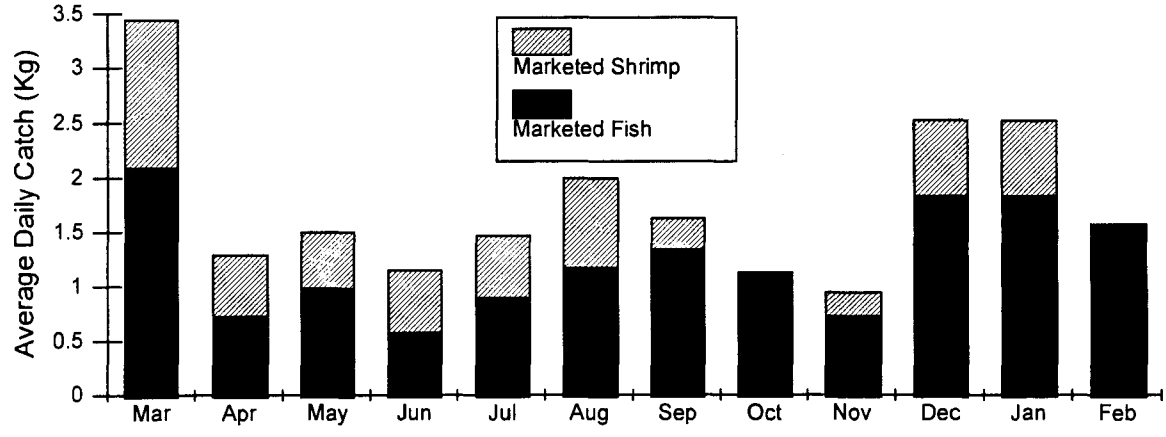


Table 4. Average catch and total production over research time by Tran Ngoc Thanh household (2 fish corrals), Tran Phuong household (1 fish corral) and Van Dung household (1 fish corral).

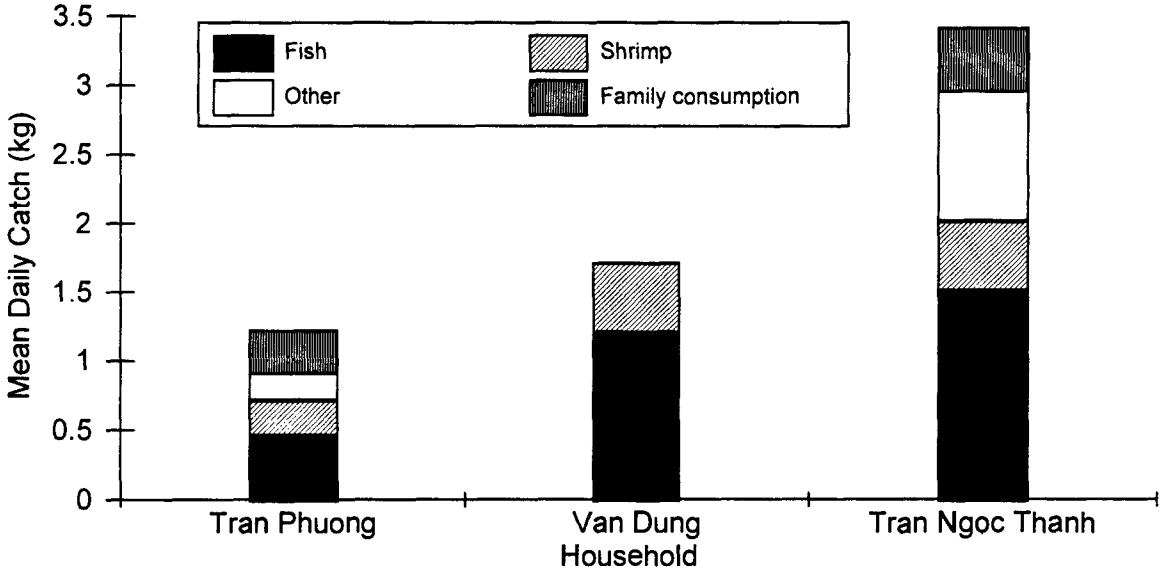
Type of Catch	Thanh [a]		Phuong [b]		Dung [c]	
	Kg ± sd	%	Kg ± sd	%	Kg ± sd	%
Fish	3.05 ± 2.20	44.7	0.48 ± 0.61	39.5	1.22 ± 0.73	71.6
Shrimp	1.00 ± 1.25	14.7	0.24 ± 0.50	19.5	0.49 ± 0.44	28.4
Other (*Caridina*)	1.89 ± 1.09	27.7	0.19 ± 0.36	15.5	--	--
Family consumption	0.89 ± 0.50	13.1	0.31 ± 0.21	25.5	--	--
Total Daily Catch	6.82	100	1.23	100	1.71 ± 0.87	100
# Fishing Days	330		346		340	

[a] Fish species caught by Thanh: goby, carp, grassfish, featherback, mullet, grouper, thornfish, rabbitfish, sleeper, macrobrachium, cardinal

[b] Fish species caught by Phuong: cardinal, goby, thornfish, grassfish, mullet. Catch for Phuong's family consumption was only brought home for 341 days.

[c] Fish species caught by Dung: Grouper, goby, snapper, grassfish

Figure 5. Average daily catch per fish corral by families in Group 2 - the fixed gear group. Interpreted from Table 4.



The average production differs among the 3 households. The highest average production per fish corral is by Mr. Thanh and lowest by Mr. Phuong. The difference in average production and total production by these 3 households is because of the different locations of fish corrals. Both Thanh and Dung households had 2 fish corrals though Dung's data were collected from only 1 fish corral - the second one was abandoned in December 1995 because of a shortage of labour. Mr. Thanh fished his 2 fish corrals throughout the period with relatively equal outputs.

Dung claims he used 5% of his catch for home consumption although he did not record the data onto the data collection sheets. Omissions in data collection by some fishers is typical of participatory research.

Mobile Fishing Gear Group (Group 1)

Data collected from 5 collaborating households of Group 1 (Tran Toan, Phan Chuong, Phan Chu, Phan Thanh, and Ms. Pham Thi Lon) using dragnets and pushnets are analysed and presented in Table 5 and Figure 6.

Table 5. Average fishing production of 5 households in Group 1 using dragnet and pushnet. The number of fishing days was calculated as a total of the 5 households of Group 1 and were used to calculate the mean and standard deviations.

Main exploited species	# of fishing days	Average Catch Kg (%)	Income 1000 VND (%)
Fish	842	2.84 ± 1.05 (45.9)	13.53 ± 4.58 (44.4)
Shrimp	774	1.69 ± 0.41 (27.3)	11.82 ± 2.87 (38.7)
Caridina	842	1.27 ± 0.42 (20.5)	1.27 ± 0.42 (4.2)
Eel	649	0.39 ± 0.45 (6.3)	3.88 ± 4.58 (12.7)
TOTAL	**842**	**6.19 ± 1.04**	**30.51 ± 5.3**

Table 5 indicates that average catch by mobile gear is higher than fixed gear. However, the value of the catch is not higher. Average daily income per household is only 30,510 VND. This income level is just enough for family expenditures and they don't have other sources of income - they engage in fishing only because they have no access to agricultural land. Though production is high, the value is low because of the gear design and mesh sizes of nets which catch low priced small fish and shrimp. Eel is an important species exploited by Group 1. Though the daily catch of eel is lowest, its price is higher than that of other fish and shrimp so the ratio of income from eel per total income is higher than *caridina*'s (a species whose daily catch is much higher than that of eel). Some of these gear result in the destruction of the environment. The fishing method of the dragnet, for instance, is to drag the net along the lagoon bottom which means few species can escape from capture (including freshwater bivalves such as *Meretrix meretrix* and *Corbicula*). Therefore, it is understandable that the average daily catch by Group 1 is higher than that of Group 2.

Fishing/Farming Group (Group 5)

In Groups 1 and 2, the main livelihood is fishing production (except for some members of Group 2), while members of Group 5 engage in both fishing and farming. Fishing gear in Group 5 include both fixed and mobile gear depending on the economic level of the individual households. This group has the most number of members of all 3 groups in Trung Lang. From this group, 15 households who operate different types of gear were randomly chosen to participate in the research. In the analysis, the 15 households were divided into 5 sub-groups of fishing gear and the results are shown on Table 6 and Figure 7.

Figure 6. Daily catch and income of 5 households of Group 1 using Pushnet and Dragnet. Daily catch was recorded from Mar, 1996 to Feb, 1997 while income was recorded from Aug, 1996 to Feb, 1997. Income was estimated from collected information on total income and weight and price of each species. See Table 5.

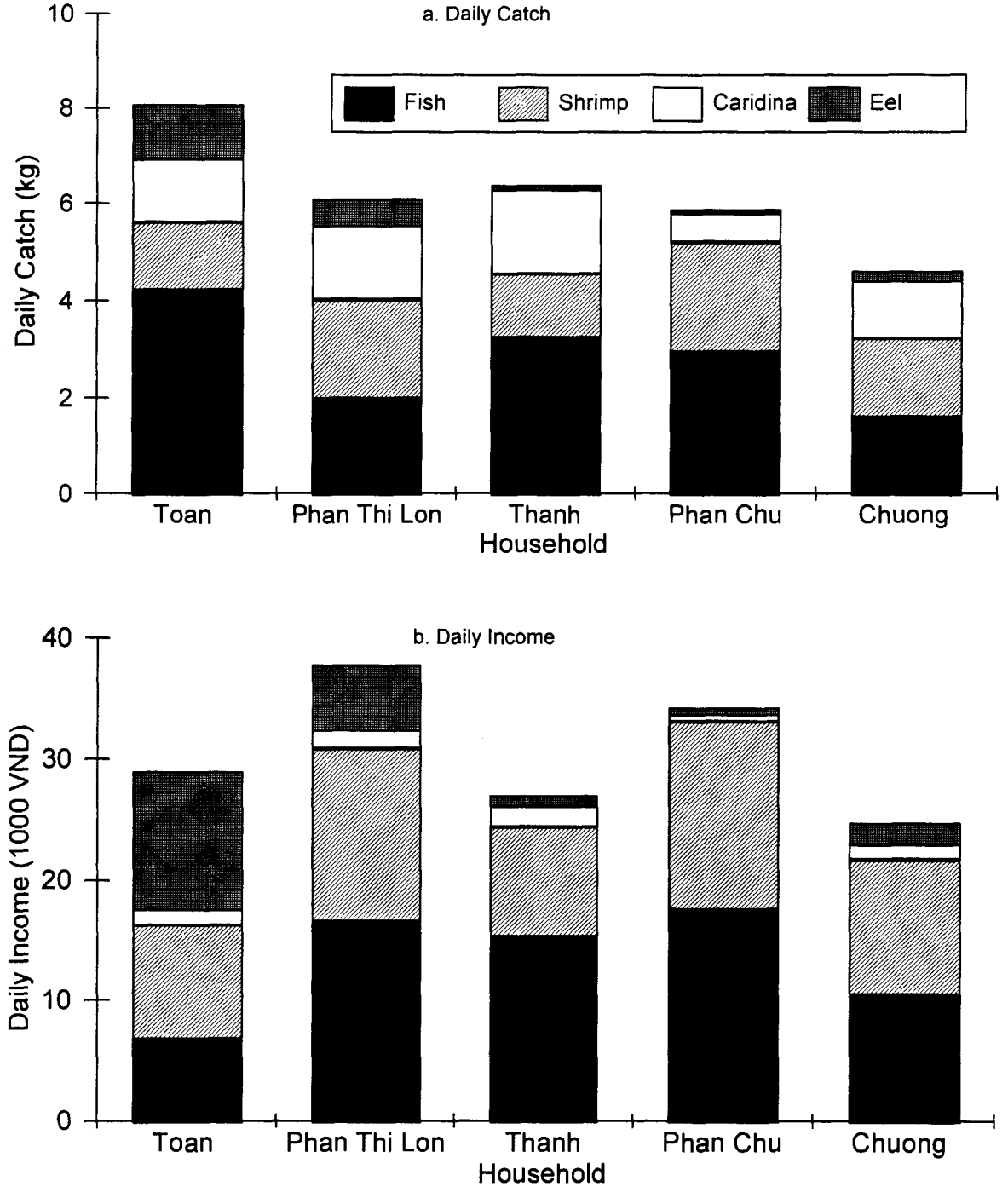
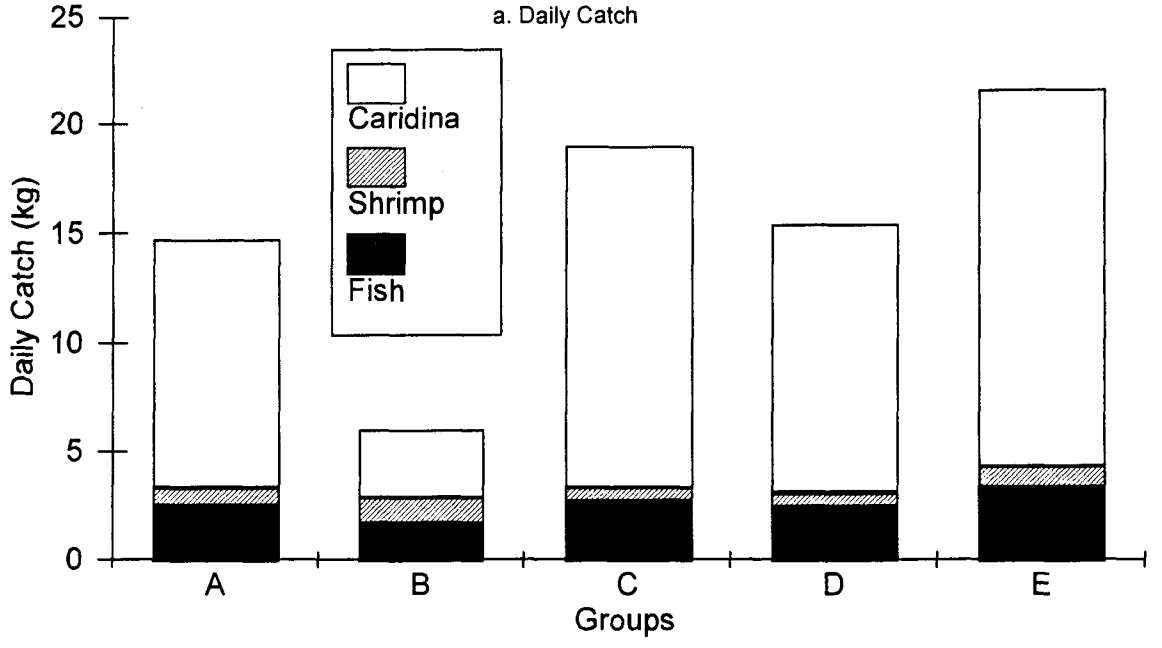


Figure 7. Daily catch and income per household of Group 5 subdivided by gear type: A – fish corral, dragnet and pushnet; B – fish corral and pushnet; C – dragnet, pushnet and gillnet; D – dragnet and pushnet; and E – pushnet only. see Table 6.



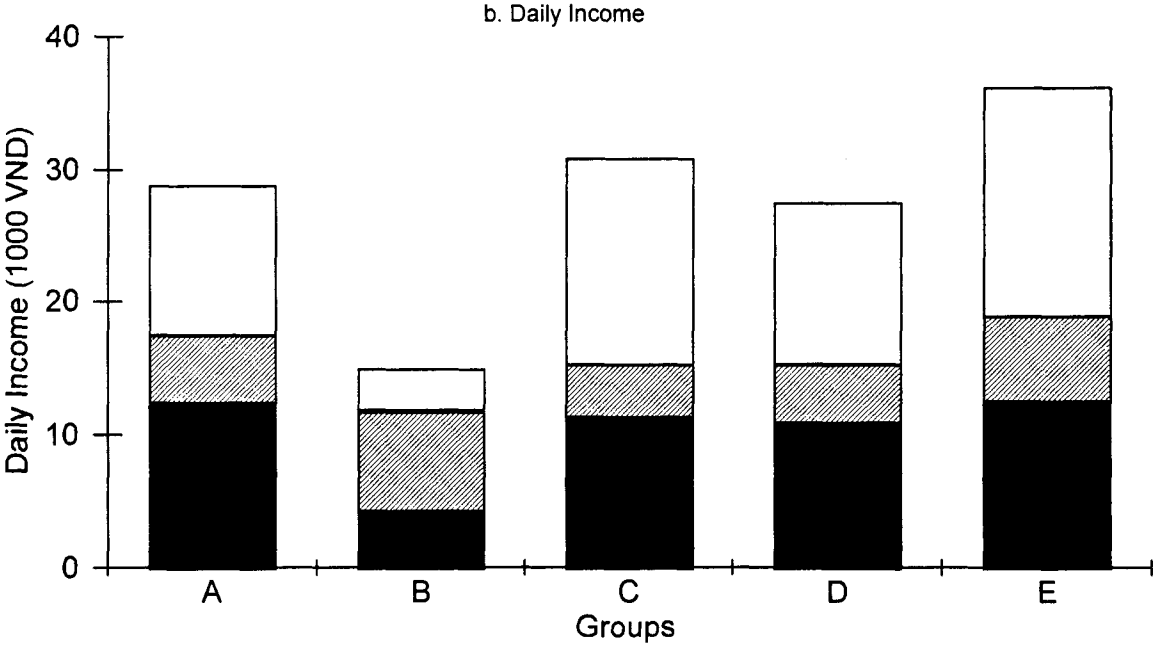


Table 6. Average daily catch (Kg ± standard deviation and % by species) and income (x 1000 VND) per household of 5 sub-Groups: **A** – 3 households using fish corral, dragnet and pushnet (Phan Thin, Phan Danh, Nguyen Xuyen); **B** – 2 households using fish corral and pushnet (Hoang Xuong and Phan Le); **C** – 1 household using dragnet, pushnet and gillnet (Tran Hue); **D** – 7 households using dragnet and pushnet (Phan Thi Lach, Tran Man, Van Cat, Tran Que, Tran Phien, Hoang Bui, Nguyen Huan); and **E** – 1 household using pushnet only (Phan Dai)

Species	A		B		C		D		E	
	Kg ± sd (%)	**1000 d (%)**	**Kg ± sd (%)**	**1000 d (%)**	**Kg ± sd (%)**	**1000 d (%)**	**Kg ± sd (%)**	**1000 d (%)**	**Kg ± sd (%)**	**1000 d (%)**
Fish	2.6±1.2 (17.9)	12.46 (43.3)	1.8 ± 1.0 (30.6)	4.4 (29.3)	2.8 ± 1.3 (14.7)	11.5 (37.2)	2.5 ± 0.4 (12.4)	11.1 (40.3)	3.4 ± 1.0 (15.8)	16.3 (35)
Shrimp	0.7±1.0 (4.8)	4.97 (17.3)	1.1 ± 0.2 (18.1)	7.5 (50.5)	0.5 ± 0.8 (2.9)	3.8 (12.2)	0.6 ± 0.3 (3.9)	4.2 (15.3)	0.9 ± 1.0 (4.1)	6.2 (17.2)
Caridina	11.3±8.4 (77.2)	11.32 (39.4)	3.0 ± 1.1 (51.5)	3.0 (20.5)	15.6±7.5 (82.4)	15.6 (50.6)	12.2±5.8 (79.8)	12.2 (44.4)	17.3±8.1 (80.1)	17.3 (47.7)
TOTAL	**14.7**	**28.76**	**5.9**	**14.9**	**18.9**	**30.9**	**15.3**	**27.5**	**21.6**	**39.8**
# days	525		255		202		1406		214	
# Hhs	3		2		1		7		1	

On average, *Caridina* production is highest for all 5 subgroups (Figure 7). Among the subgroups, *Caridina* is highest in Subgroup E (pushnet) at an average catch of 17.3 kg/day and lowest in Subgroup B at 3.0 kg/day. This indicates that pushnet is a gear that exploits *Caridina* efficiently, as well as other small species in the lagoon. The relative catches of fish and shrimp vary among groups. This might be due to seasonality of species presence (see Figure1) but requires more work to validate. In subgroup D, catch depends more on fishing gear than seasonality.

Tables 4, 5 and 6 indicate that average daily production of the 5 subgroups of Group 5 is highest (14.51 kg/day) compared to Group 2 (3.47 kg/day) and Group 1 (6.19 kg/day). In Group 5, production by weight of *Caridina* is highest (78%) and its income is 43% of total income (Table 6). In Groups 1 and 2, fish is highest in average daily production: 46% in Groups 1 and 2 (Tables 4 and 5). *Caridina*, a considerable part of the catch in Groups 1 and 5, is not listed as a main species in Group 2.

Though average catch by households in Group 1 is higher than that of Groups 2 and 5, the total income and standard of living of Group 1 is lower than the latter groups. We have noted several reasons for this in terms of economic and social aspects:

- Most Group 1 members do not have rights to fixed fishing grounds as do members of Groups 2 and 5.
- The size of species caught by mobile gear is much smaller than that caught by fixed gear. It consists mainly of small fish, *Caridina* and *Macrobrachium* which bring low income. Catch by fixed gear consists of more valuable species such as local carp, grouper and greasybacked shrimp.
- Group 1 members are the newest settlers to the area (after 1985) thus they don't have access to agricultural land to grow food for their own consumption. Although most fishers have this desire

only members of Group 5 and some households in Group 2 have access to agricultural land. Thus most of the daily earnings of Group 1 members is used in purchasing rice and food for the family while the other groups can produce their own staple foods.

As described in **Settlement of Sampan People**, Trung Lang was established mostly by sampan people in 1905. By the time the latest settlers arrived (members of Group 1), there was no land and fish corral grounds available for these new settlers.

Production by fixed gear is of higher value than that by mobile gear. From observation, we see that households in Group 5 have a better quality of life than those of Groups 1 and 2, because the former engage in fishing and farming. They can afford basic living costs as well as savings. We conclude that, if farming on the lagoon shore is developed, exploitation in the lagoon would decrease - especially operation of mobile gear which are destructive to resources and ecological balance in the area.

SIZE AT CATCH OF CERTAIN SPECIES

The size of catch of aquatic species is the concern of many aspects of fishery science and management. The fishing community in Trung Lang operates most types of fishing gear common in the whole lagoon system. Species caught by fixed gear (in this case fish corral) are often bigger than those caught by mobile gear though the mesh size of the 2 types of gear is the same. This phenomena can be explained as follows:

- In fixed gear: Species captured, especially small ones, have time to escape because the cod end is emptied once a day.
- In mobile gear: The catch is collected every 10-15 minutes therefore, small shrimp, fish or *Caridina* are not able to escape.

Research on the size of species caught by mobile gear has not yet been conducted for lack of time and resources. Preliminary results on size at catch of aquatic species by fixed gear is presented in Table 7.

Table 7. Size at catch by species (in number of animals per kg) compared to size at reproduction as estimated by researchers from the Department of Biology, HUS. Data were recorded by the households of Tran Ngo Thanh and Tran Phuong over the research period.

Household	Species	# of days of observation	Size (# animals/kg ± s.d.)	# animals per kg at reproduction
Phuong	Goby (*G. giuris*)	329	28 ± 6.40	10 - 13
Thanh	Goby (*G. giuris*)	205	35 ± 8	10 - 13
	Grassfish (*G. oyena*)	91	71 ± 4	40 - 50
	Local Carp (*C. centralus*)	13	4 ± 0,5	1.6 - 3
	Grunt (*T. theraps*)	2	21 ± 1	20 - 28.5

Table 7 indicates that the most frequently caught species is goby (*Glossogobius giuris*). It was caught for 329 days by Tran Phuong household and for 205 days by Tran Ngoc Thanh household where it was the main species in the catch from April to December. In January and February, the catch of goby decreased while catches of grassfish and local carp increased. The data collected by Tran Phuong household indicated that the size at catch of goby was unchanged over most of the year (at 30 animals/kg) except for May when it was caught twice as big (15 animals/kg). For most days, the standard deviation recorded was zero. This is an error in data recording by fishers: for fear of wasting time measuring small species, the recorder only measured several times, and then estimated using his/her own experience. This is a common problem with data collected through participatory research.

In Thanh household, goby was biggest in June (at nearly 18 animals/kg) and its size gradually decreased until December (43 animals/kg). The size at catch of grassfish, as recorded by the household, is questionable at 70 animals/kg. At this size, grassfish would be extremely small - the stock of this species would be in grave danger.

Interviews with fish corral owners have revealed that fish corrals located near the water channels and in deep water (like the fish corral of Tran Phuong) bring in high catches and larger species than those located elsewhere (far from the channel and in shallow water). This is one of the reasons why the fish corral of Tran Phuong household catches, on average, larger sizes.

Compared to the reproductive data, the size of species at catch is very small. Therefore, appropriate protection of the aquatic resources is a necessary measure. If the species exploited by fixed gear have such small sizes, then species exploited by mobile gear are even much smaller. Exploitation of small-sized species with high frequency decreases lagoon aquatic resources, and daily catch as research results have shown.

MARKETING OF AQUATIC PRODUCTS

Daily aquatic products are sold at the boat landing area, at the main market in Quang Thai (locally called Niu or Hom market) for local consumption and for neighbouring areas. Because of low incomes, fishers immediately exchange their daily catch for family needs right after exploitation. Market demand (including restaurant and household) for some aquatic species (snakehead, eel, etc) is higher because these species are favourites to people's taste. Villagers are encouraged to keep their catch as fresh as possible before selling.

Caridina

Over the research period, through observation, interviews and discussions with villagers, we had a chance to make some conclusions on local processing of aquatic products. In contrast to the fishing activities in Trung Lang, aquatic processing is not developed. In Trung Lang and Quang Thai in general, there are no processing activities such as production of fish sauce, fermented fish or dried fish. The only type of processing is the drying of *Caridina*, an important exploited species of most mobile fishers and fisher-farmers in Trung Lang. *Caridina* is dried for a few days depending on weather and temperature and then sold or stored for future use by the household. Popularizing home-based processing of *Caridina* into a fermented product would improve household income and especially improve nutrition during flood season. The processing of *Caridina* would also improve the use of *Caridina* locally and create jobs for poor women in the community. It is necessary to build villagers' awareness to the fact that preserving

food at peak fishing season provides food for the poor season.

Clam

In Quang Thai, the annual production of clam is on the order of several hundred tons with a peak season from Lunar months III to VIII. Surf clam (*Mactra quadrangularis*) is the most common species with some Venus clam (*Meretrix meretrix*) also exploited. Whole clams are exported out of the community to larger markets while shucked clams are sold for local consumption. Nearly 16 households - mainly women and children - collect clam. Clam shells pile up on the sides of the road conjuring the idea of a small lime producing factory to help improve the poor quality of Quang Thai soil. If this is implemented, it would help create jobs for villagers, make use of available materials, improve agricultural production, and protect the environment both near the lagoon edge and in the lagoon area.

CONCLUSIONS

- Quang Thai lagoon, which has an area of more than 1000 ha, is a busy fishing ground with more than 330 fishing gear operated by Quang Thai villagers and many other gear from neighbouring communes.
- 41 aquatic species of 22 families and 10 orders have been identified, of which Perciformes species are most predominant with 16 species (>55%). Bottom aquatic species are abundant and have large stock sizes especially the venus clam (*Meretrix meretrix*) (See **Appendix B**).
- There are two types of fishing gear in the community: fixed gear and mobile gear. Average daily catch differs among the households belonging to 3 production groups in Trung Lang: Group 2 (fixed gear operators) catch 2.86 kg/day; Group 1 (mobile gear operators) catch 6.04 kg/day; and Group 5 (fishers/farmers) catch 14 kg/day. Daily average production per cod end of fish corral is very low at 1.58 kg/day.
- The main species exploited in Quang Thai lagoon are snakehead, goby, common carp, walking catfish, freshwater macrobrachium, greasybacked shrimp, swamp eel, mullet, local carp, grassfish, *Caridina*, and clams. Fixed gear mainly exploit goby, grassfish, grunt and mullet; mobile gear mainly exploit *Caridina*, freshwater macrobrachium, featherback and swamp eels.
- Main species caught by fish corral are goby (*Glossogobius giuris*), grassfish (*Gerres oyena*), thornfish (*Terapon theraps*), local carp (*Cyprinus centralus*) and goby (*Oxyurichthys tentacularis*). They are exploited most of the year. However, their sizes at catch are generally small which means that stock of aquatic species in the lagoon are in danger. More valuable species such as eel (*Anguilla nebulosa*), greasyback shrimp (*Metapenaeus ensis*), and crabs are rare.

RECOMMENDATIONS

To reduce exploitation pressure on lagoon resources and protect aquatic resources, the following recommendations are proposed based on research results:

- Develop aquaculture in the locality
- Develop appropriate cropping patterns to improve farming production on the lagoon shores
- Develop aquatic species processing to make use of available local products and increase the value

of the exploited species.

- Implement policies on health care, education, agriculture extension and fishery extension to alleviate poverty in the locality and to improve the community's awareness of protection of environment and natural resources.

REFERENCES

Hoàng Đức Đạt. 1978. *Tính đa dạng trong thích nghi sinh sản của 1 số loài cá ở VN*(Diversification in reproductive adaptation of some fish species in Viet Nam). Science Research Magazine, Hue University. Vol. I.

Nguyễn Nhật Thị. 1995. *Một số nhận xét về khu hệ sinh vật và tiềm năng nguồn lợi thủy sản đầm phá Tam Giang Cầu Hai*(Some comments on biological fauna and potential of aquatic resources in Tam Giang-Cau Hai lagoon). Workshop on Thua Thien-Hue Lagoon system. Collection of reports.

Nikolski, 1963. *Sinh thái học cá* (Fish ecology). Country Publication. Ha Noi.

Phạm Văn Miên *et al.* 1981. *Kết quả điều tra cơ bản hệ đầm phá phía Nam Bình Trị Thiên* (Research Results on lagoon system in South of Binh Tri Thien). Fishery Magazine. Vol 3. Ha Noi.

Tạp chí Thủy sản Tháng 4 (Fishery Magazines. April). 1992.

Tạp chí Thủy sản Tháng 9 (Fishery Magazines. September). 1995.

Tạp chí Khoa học và Công Nghệ Thủy Sản Tháng 2 (Fishery Science and Technology. February). 1995.

Võ Văn Phú. 1995. *Khu hệ cá và đặc điểm sinh học của mười loài cá kinh tế ở hệ đầm phá Thừa Thiên Huế*(Fish fauna and biological characteristics of 10 valuable fish species in Thua Thien-Hue lagoon system). Thesis for biological doctor. National University. Ha Noi.

Vũ Trung Tạng. 1994. *Các hệ sinh thái cửa sông Việt Nam* (Ecology of River Estuaries in Viet Nam (Exploitation, Maintenance, and development of aquatic resources)). Science and Techniques Publication. Ha Noi.

Vũ Trung Tạng and Đặng Thị Sy. 1979. *Nguồn lợi thủy sản các đầm phá phía Nam sông Hương và vấn đề khai thác hợp lý nguồn lợi đó*(Aquatic resources in lagoons south of Huong river and sustainable exploitation of those resources). Marine Research Collection. Book I. Nha Trang.

Vương Dĩ Khang. 1995. *Ngư loài phân loại học*(Classification of Aquatic species). Country Publication. Ha Noi.

Zaxoxov, A.V. 1981. *Biến động số lượng của đàn cá khai thác* (Changes in number of exploited fish). Science and Techniques Publication. Ha Noi.

Fishing in Sam - An Truyen - Thuan An Area

Tôn Thất Pháp

Tam Giang lagoon system is the largest coastal lagoon in Viet Nam. Its topography and environment support abundant resources. Therefore, a large population has settled around the lagoon with 2 main production activities: agriculture and fishing. Fishing has developed relative to lagoon resources, however at present, fishery production has surpassed the capacity of the lagoon due to pressures of population and poverty. It is urgent to gather and make available information on fishery production in the lagoon as a basis for designing an effective protection system for lagoon resources.

RESEARCH METHODOLOGY

Identification of research site

Based on 3 months of research and collected secondary data, the water area from Thuan An estuary to An Truyen and Sam lagoons was selected as the research area for the study of aquatic resources and fishing activities in the central part of Tam Giang lagoon. It includes what are considered to be 4 lagoon basins: Sam, An Truyen, Thuan An and Hai Duong (Map 5, p. 5). The area has the following characteristics:

- It is strongly affected by the sea through Thuan An estuary. Salinity ranges from 25 to 30 ‰ in the dry season and 0 - 5 ‰ in the rainy season.
- It contains the highest density of fixed gear in the lagoon: fish corral, bottom net and fixed lift net.
- It is an area where almost all traditional fishing gear are operated, especially bottom nets exploiting fry sources entering through the Thuan An estuary.

To cover this area, the research site was expanded to include 6 communes: Phu Tan, Hai Duong, Thuan An, Phu Thuan, Phu Xuan and Phu An (Map 8, p. 133).

Designing of research topics

Based on project objectives and the results of field trips applying RRA and PRA tools, the assessment of resources and fishing activities in Phu Tan area was identified as an important research topic of the group. Main research contents are:

- Evolution of fishing gear and effect of fishing gear fishing activities on resources
- Species composition and seasonal changes in species composition.
- Migration, distribution and change in the sizes of fry in the lagoon
- Conflicts among fishing activities in the research site
- Effects of the present system of management on the protection of aquatic species.

Research process

RRA and PRA were the main research methods applied by the group. Villagers were also involved in the research on:

- Daily catch by gear
- Species composition
- Size of aquatic species caught
- Fishing duration or fishing effort for each day

Measurements were done directly by collaborating fishers who recorded their data using data collection sheets. The data collection sheet show below was designed by the researchers in consultation with commune leaders, who understand well their villagers' education level. The final draft was discussed with fishers for editing before printing and distribution. Fishers were instructed on how to measure samples and record data.

Each collaborating fisher was provided with a weight scale, measuring tape, pens and data collection sheets. Fishers observed, measured and recorded data daily. Completed data sheets were gathered, entered into the computer, analysed and presented in simple table form and in colourful diagrams. These were reported back to fishers, so that they could understand and discuss the results in monthly meetings.

Data Collection Sheet completed daily by fishers in the 6 communes

Data Collection Sheet - Management of Biological Resources in TG Lagoon - Phu Tan Group

Date: Fishing Gear: Full Name: Age: Address:

#	Species Name	# Individuals	Weight (kg)	Size (cm)		Place of Sale	Fishing Duration	Weather
				Biggest	Smallest			
1 2 ...								

Two meetings, one at the mid-point and one at the end of the research period, were held with the participation of local government - representatives from commune and district governments and from Division of Protection of Aquatic Resources, DoF - to get constructive ideas and comments on research results from the researchers and fishers.

Table 1 lists the 30 fishers from 6 communes involved in the research, representing typical fishing gear. The research period lasted from March to December 1996 although not all fishers participated for the entire period.

Half of the fishers (15) participated for only about 3 months and some even quit after a few days of research. The 3 main reasons quitting are:

- The fishers realized that they would not receive direct benefits from participation. Although in discussions and invitations for participation, they agreed to collaborate for a common benefit - the

protection and restoration of the lagoon resources - they still had other expectations.

- The fishers were not patient enough to measure samples and record data. In addition, the work consumed their time, causing delays in selling their catch at the market thus reducing the price they received for the catch.
- Some fishers believed that data provided by them would be used by local government to assess the destructive effect of their gear and to determine taxes.

DEVELOPMENT OF FISHING GEAR

Traditional fishing gear in Tam Giang have developed over a long period of time with efforts of imagination and labour. Originally, fishing gear did not 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 as to become destructive to lagoon resources and environment.

Synthetic Materials / Mesh Size

During the first half of the 20th Century, fishing gear were made with natural materials such as bamboo and rattan. In the 1960s, polyethylene materials began to be used, marking a new step in increasing the efficiency of gear. Nets made of synthetic material quickly replaced traditional materials. Subsequently finer alterations were made: nets of various mesh sizes became available and the construction of gear were altered to catch all sizes of all species. For example, some fishers now even use 3 layers of net ensuring no escapees. Using gear with synthetic materials has advantages: lower price, durability, easy transportation and storage, and less labour requirements, especially for fish corral. After the big storm in 1985, when most bamboo fish corrals were damaged, they were replaced with synthetic materials. This major event marks the disappearance of bamboo fish corral in the whole lagoon. Bottom net and dragnet are also considered destructive because they are made of small mesh sizes and capture fry.

Mechanization

In the late 1960s, mechanization introduced another radical change in fishing gear. Motorized pushnet and dragnet originated from gear used manually by wading in the water. At present, motorized dragnet and pushnet and other fishing methods using electric power are officially banned by national and local governments (Division of Protection of Aquatic Resources, 1995). Motorized boats increased fishing effort not only in the way the gear are used but also in the fishing area covered.

Destructive tools

Fishing with dynamite was common during the war and is still used in some areas in the lagoon, especially in deeper water. Dynamite fishing is usually accompanied and preceded by setting a FAD in deep water. Recently, with the availability of batteries, electric fishing in freshwater and lagoon areas has emerged (see **Community Banning of Electric Fishing**). Electric fishing and electric dragnet are commonly used in the lagoon. Electric fishing is common in Quang Thai at the northern end of Tam Giang lagoon and in Cau Hai lagoon at the southern end of Tam Giang Lagoon. Electric dragnets, which are even more destructive, are common in Sam - An Truyen lagoon, Phu An commune.

Table 1. Fishers, their fishing gear and fishing grounds participating in the research.

No	Name	Fishing gear	Fishing Area[a]	Dates Participated	Data use [b]
1	Đặng Văn Thẹ [c]	Net enclosure	Phu Tan	Mar - Feb	T. 4 / F. 5, 6c, 8
2	Nguyễn Hoanh [c]	Net enclosure	Phu Tan	Mar - Jul	
3	Nguyễn Thị Tình	Gillnet	Phu Tan	3 days only	
4	Trần Văn Chứng [c]	Gillnet	Phu Tan	Mar - Dec	T. 4 / F. 5
5	Nguyễn Theo [c]	Dragnet	Phu Tan	Mar - Dec	T. 4 / F. 5, 6b
6	Lê Băm	Fixed lift net	Phu Tan	Mar - May	
7	La Bảng	Bottom net	Phu Tan	Mar - Apr	
8	Nguyễn Luân	Fish corral	Phu Tan	Mar - May	
9	Trần Nguyên	Pushnet	Phu Tan	Mar - Aug	T. 4 / F. 6b
10	Trần Đàm	Gillnet	Phu An	Mar - Apr	
11	Trần Đạm	Gillnet	Phu An	Mar - Apr	
12	Trần Văn Đạng [c]	Fish corral	Phu An	Mar - Dec	T. 4 / F. 5
13	Đặng Văn Tấn [c]	Fish corral	Phu An	Mar - Dec	T. 4 / F. 5
14	Hồ Văn Lanh	Lamp	Phu An	Mar - Apr	
15	Nguyễn Thưỡng	Bottom net	Phu An	Mar - Apr	
16	Trần Thanh Duệ	Fixed lift net	Thuan An	Mar - Jul	T. 4 / F. 6a
17	Trần Thảo [c]	Hook and line	Thuan An	Mar - Dec	T. 4 / F. 5
18	Nguyễn Văn Hạ [c]	Pushnet	Phu Thuan	Mar - Dec	T. 4 / F. 5, 6b
19	Đặng Văn Lãng [c]	Motorized dragnet	Phu Thuan	Mar - Dec	T. 4 / F. 5, 6a
20	Trần Minh Phới [c]	Dragnet	Phu Thuan	Mar - Dec	T. 4 / F. 5, 6b
21	Trần Văn Ngọc [c]	Gillnet	Phu Thuan	Mar - Dec	T. 4 / F. 5
22	Nguyễn Toàn [c]	Bottom net	Phu Thuan	Mar - Dec	T. 4 / F. 5, 6a
23	Hà Lợi [c]	Fish corral	Phu Xuan	Mar - Feb	T. 4 / F. 4,5,6c,8
24	Hồ Đoàn [c]	Fish corral	Phu Xuan	Mar - Feb	T. 4 / F. 4,5,6c,8
25	Nguyễn Tấn	Bottom net	Hai Duong	Mar - Jun	
26	Nguyễn Cường	Bottom net	Hai Duong	Mar - Jun	T. 4 / F. 6a
27	Đặng Yiêm	Fish corral	Hai Duong	Mar - Jun	
28	Đào Điểu	Fish corral	Hai Duong	Mar - Jun	
29	Đỗ Bớp	Gillnet	Hai Duong	Mar - Jun	
30	Phan Đờn [c]	Fixed lift net	Hai Duong	Mar - Dec	T. 4 / F. 5, 6a

[a] Fishing area also refers to commune of fisher's residence.
[b] Tables (T.) and Figures (F.) for which the data was used.
[c] Fishers who actively and regularly participated over the research period.

FISHING GEAR DENSITY AND USE

Recent statistics on Tam Giang Lagoon indicate that there are 13 main types of gear classified into 2 groups: fixed gear and mobile gear (Table 2) (see **Appendix A**). Fish corrals and FADs, without the use of dynamite, are fixed gear suitable to shallow areas with level bottoms. FADs using dynamite are located in deeper areas. Bottom nets are located in deep areas with strong currents. Fixed lift nets are set in areas close to the estuaries, strongly affected by tides. The map of aquatic exploitation in Phu Tan and surrounding communes (Map 8, p. 133) illustrates an approximate distribution of the fixed gear in the research area. The bottom topography of Tam Giang lagoon is in some places symmetrical (ie. both 'banks' of the lagoon slope evenly to a deepest point) and in others asymmetrical (ie. one side is shallow over a wider area). The topography is ideal for setting fish corrals and bottom nets and their numbers have increased in recent years (Table 3, Figure 1). Density of fish corrals is highest in Sam - An Truyen lagoon, then in Tam Giang lagoon and Cau Hai. The density of bottom nets is highest in Thuan An, then Thuy Tu and then Tam Giang. The density of FADs is highest in Thuy Tu, then Sam - An Truyen and then Tam Giang. The period from 1984 to 1996 has seen an increase of fish corrals and bottom nets in all areas and a decrease in FADs in all areas. Fish corrals operate day and night when a lamp is lit over the cod-end to attract fish and shrimp.

Table 2. List of main fishing gear in Tam Giang Lagoon classified as fixed and mobile gear.

	Fixed Fishing Gear		Mobile Fishing Gear
1	Fish Corral	1	Eel Rake
2	Bottom Net	2	Dragnet
3	Fixed Lift Net	3	Pushnet (Shallow water)
4	FAD	4	Pushnet (Deep water)
5	Mullet Trap	5	Gillnets
		6	Hook and Line
		7	Crab Trap
		8	Macrophyte Rake

The bottom net is a traditional gear of Tam Giang lagoon fishers which uses currents to catch fish. It is shaped like a sleeve narrowing at the end (like a cone) and fish and shrimp are rolled into its mouth by the current and get caught at the end which is tied closed when fishing. At high tide, the net is attached to the bamboo poles. As the tide runs out, water flows through the net and fish and shrimp are caught in the end. This is the main fishing time of the bottom net. At slack tide, the end is untied and emptied and the bottom net removed. Bottom nets are operated at night most of the year, and both at day and night during the flood season when currents are strong.

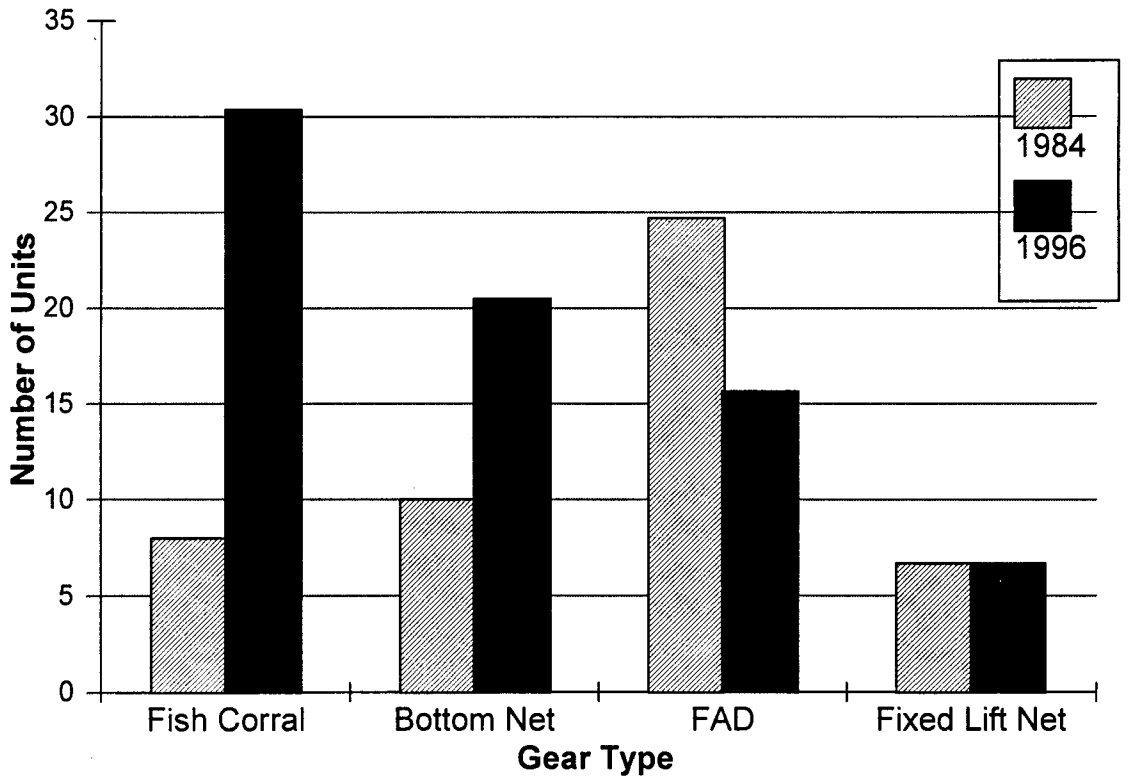
Table 3. Density of fixed gear in some lagoon basins of the Tam Giang Lagoon system (in units/km^2)

Lagoon Area	Fish corral		Bottom net		FAD		Fixed lift net	
	1984	1996	1984	1996	1984	1996	1984	1996
Cau Hai	1.6	5.5	--	--	--	--	--	--
Thuy Tu	--	--	6	7	11.3	8	--	--
Sam -A.T	1.8	14.6	--	--	10.5	5.7	--	--
Thuan An	--	--	--	7.5	--	--	6.7	6.7
Tam Giang [a]	4.57	10.27	4	6	2.9	1.96	--	--

Source: Phan Uy Phong, 1996

[a] Tam Giang refers to the northern basin of the Tam Giang lagoon system.

Figure 1. Increase in fixed gear in the Tam Giang Lagoon system from 1984 to 1996. Interpreted from Table 3.



The high number and density of fishing gear in the lagoon are caused by population increase and poverty. Certainly, favourable lagoon topography and lax management are factors facilitating the increase of gear.

In brief, there are 3 types of fishing grounds for fixed gear: (1) fish corral, (2) bottom net, and (3) bottom net - fixed lift net. Fishing grounds of fish corrals are also that of FAD, dragnet, pushnet and gillnet. Gillnet, motorized dragnet and FAD (in deep areas) are also operated in bottom net grounds. Gillnet and hook and line are found in bottom net - fixed lift net grounds. Relative to the whole lagoon system, Sam - An Truyen lagoon in Thuan An is an area where almost all types of fishing gear operate with highest density. This lagoon can be divided into 3 areas: fish corral grounds at the southwestern edge, bottom net grounds at the southeastern edge and bottom net - fixed lift net grounds at the northeastern edge (Map 8, p. 133).

SPECIES COMPOSITION

Data collected from 8 fishing gear in the research site over a year shows that 80 aquatic species of fish, shrimp and crab were exploited at the research site (see **Appendix B**). The number of species caught by different gear is clearly different with the highest number of species caught by fixed gear: fish corral (69 species), bottom net (45 species) and fixed lift net (33 species). Except for motorized dragnet (30 species), the number of species caught by mobile gear is lower: dragnet (9 species), pushnet (15 species), hook and line (9 species), and gillnet (6 species) (Table 4).

Fish corrals bring high catches and large number of species and operate steadily year round. Therefore, species composition in catches of fish corral was used to determine seasonal presence of species. The number of species is higher in May, June and July with more than 50 species. The number of species is less than 30 in the rainy season (December and January) (Figure 2). Fish corral catches were also used to determine the relative catch of each species (as a percent of total catch) (Table 5). The species listed in the table are considered main exploited species in the lagoon.

Figure 2. Changes in aquatic species composition in catches of fishers in Sam-An Truyen Lagoon. Data collected from 2 fish corrals.

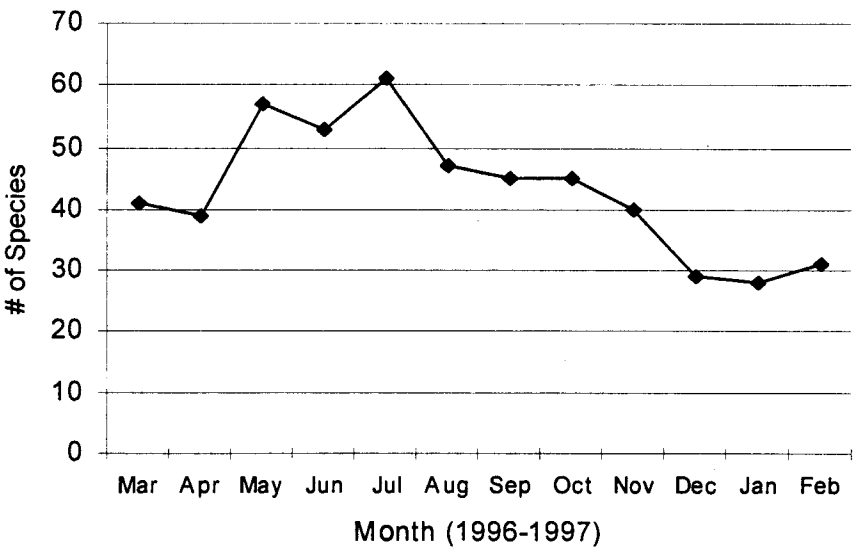


Table 4. Summary of data recorded by fishers: Exploited species, fishing time, season and effort and size of species caught.

Fishing Gear	Catch (kg)	# Spp.	Exploited Species (%)			Effort (hours)	Fishing Time		Fishing season	Average Range of Size (cm)		
			Fish	Shrimp	Crab		Day	Night		Fish	Shrimp	Crab
Fish corral	8.33	69	63.5	30	6.5	36138	X	X	Dry & Rainy	6.9-11.5	4.4-7.7	4.8-10
Bottom net	21.43	45	71	20.9	8.2	35980		X	Dry	6.21-8.67	7.8-10.86	35717
Fixed lift net	18.48	33	88.6	5.6	1.8	36012		X	Dry	7.45-11.6	5.99-12	5.72-11.5
Motorized dragnet	1.15	31	58.4	41.6	--	35980	X	X	Dry & Rainy	7.4-11.77	7.6-12.6	--
Pushnet	0.23	15	47.4	29.5	23.1	35950		X	Dry	4.8-6.25	5.7-7.9	7.6-10.75
Hook & line	0.89	9	100	--	--	36010	X		Dry	4.7-9.8	--	--
Dragnet	0.69	9	14.9	82.3	2.9	36012		X	Dry	5.6-7.8	3.6-5.8	35614
Gillnet	1	6	90.8	9.2	--	36010	X		Dry & Rainy	14-17	–	15

Table 5. Main species caught by fish corral in Sam-An Truyen lagoon presented as relative catch by weight of each species (% of total catch) from March, 1996 to February 1997.

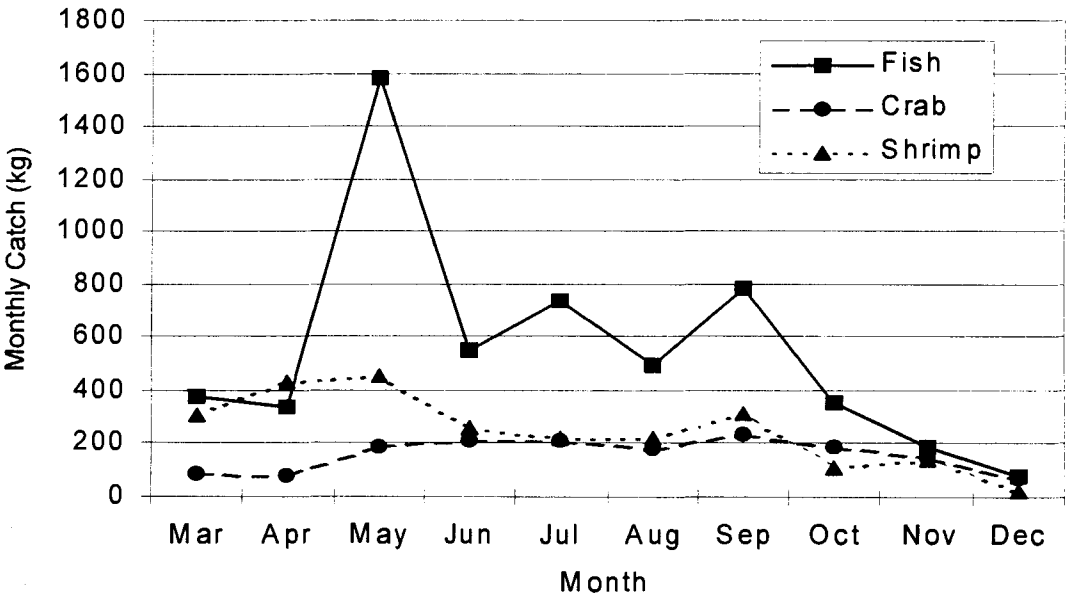
Species	Relative catch of each species (% of total catch)													
	Mar96	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan97	Feb	Mar	Mean
Metapenaeus ensis	21.8	22.4	35.0	5.7	0.9	0.7	1.9	6.9	39.1	41.1	46.2	51.2	25.3	**22.9**
Gerres sp.	63.0	32.6	2.8	18.6	13.6	6.8	1.1	1.5	3.2	15.1	5.3	15.5	37.0	**16.6**
Siganus oramine	--	--	14.3	17.9	21.7	29.1	4.6	0.3	--	--	--	--	--	**6.8**
Penaeus semisulcatus	--	--	3.0	8.6	7.3	20.8	23.7	15.3	--	--	--	0.1	0.3	**6.1**
Oxyurichthys sp.	13.3	8.7	4.1	3.5	0.6	2.3	7.2	2.6	2.7	2.6	3.3	12.0	8.5	**5.5**
Pelates quadrilineatus	--	3.3	6.1	7.5	5.0	6.8	13.0	23.3	0.1	--	--	0.1	0.8	**5.1**
Apogon sp.	--	15.8	0.0	0.2	0.9	0.8	1.2	13.3	9.0	6.1	4.5	1.5	0.7	**4.2**
Portunus sanguinolentus	--	--	7.3	17.2	10.8	6.3	5.9	3.1	--	--	--	--	--	**3.9**
Terapon jarbua	0.2	4.3	8.1	6.9	0.8	1.6	0.3	0.2	0.7	1.2	16.1	0.9	1.6	**3.3**
Holotes sexlineatus	--	--	1.3	1.2	8.6	9.2	6.9	3.6	0.1	--	--	0.0	0.3	**2.4**
Solea & Synaptura spp.	--	--	--	--	--	--	--	--	11.0	2.7	4.8	1.0	--	**1.5**
Scylla serrata	1.3	0.4	0.3	0.8	2.5	0.2	0.3	0.1	0.2	0.1	4.5	2.9	2.7	**1.2**
Pisodonophis boro	--	--	1.6	--	--	--	2.5	--	2.7	6.5	--	--	--	**1.0**
Tylosurus anastomella	--	--	--	0.5	12.2	--	--	--	--	--	--	--	--	**1.0**
Lutjanus argentimaculatus	--	--	0.8	0.3	1.4	1.5	1.8	2.3	3.6	0.6	--	--	--	**0.9**
Mugil sp.	0.2	1.4	0.5	0.6	0.3	0.4	--	0.0	0.5	1.9	4.0	1.1	0.9	**0.9**
Leiognathus sp.	--	--	--	--	--	1.9	--	5.3	3.2	--	--	--	--	**0.8**
Monodactylus argenteus	--	--	--	--	--	--	--	--	5.5	3.2	1.5	--	--	**0.8**
Sphyraena obtusata	--	0.1	0.5	0.0	0.5	1.3	1.0	0.3	1.0	2.1	1.3	0.5	0.5	**0.7**
Sillago sp.	--	--	--	--	--	--	--	--	1.7	2.2	3.0	--	1.2	**0.6**
Siganus guttatus	--	--	--	--	--	--	--	3.6	2.7	--	--	--	--	**0.5**
Terapon oxyrhynchus	--	0.5	0.6	0.1	0.6	0.5	0.1	0.0	0.5	1.2	0.7	0.2	0.7	**0.4**
Shrimp (Tom hoi) [a]	--	--	--	--	1.0	--	4.5	--	--	--	--	--	--	**0.4**
P. monodon	--	--	0.8	1.3	1.0	1.0	0.5	0.1	0.0	0.0	0.0	0.1	0.3	**0.4**
Crab (Ra.m) [a]	--	--	1.9	2.5	0.6	--	--	--	--	--	--	--	--	**0.4**
Atherina bleekeri	--	--	--	--	--	--	--	--	4.6	--	--	--	--	**0.4**
P. merguiensis	--	--	--	4.5	--	--	--	--	--	--	--	--	--	**0.3**
Platycephalus indicus	--	--	--	--	--	2.1	--	--	--	--	2.2	--	--	**0.3**
Muraenesox cinereus	--	--	0.9	--	--	--	2.6	--	--	--	--	--	--	**0.3**
Hemiramphus far	--	--	1.2	--	--	--	--	--	1.4	0.9	--	--	--	**0.3**
Stolephorus sp.	--	--	--	--	--	--	--	--	2.4	--	--	--	--	**0.2**
Glossogobius giuris	--	--	0.5	0.6	0.6	--	--	--	--	--	--	--	--	**0.1**
Epinephelus sp.	--	--	0.4	0.1	--	--	--	--	--	--	--	1.1	--	**0.1**
Penaeus orientalis	--	--	1.0	--	--	--	--	--	--	--	--	--	--	**0.1**
Other species	0.4	10.6	7.1	1.6	9.2	6.8	21.2	13.6	8.8	12.6	2.6	12.1	19.6	**9.7**

[a] Species not classified by researchers. According to DoF staff, *Tom Hoi* is *Metapenaeus ensis* although the fishers consider it a separate species (considering its size, perhaps the juvenile of *M. ensis*). *Ram* is a freshwater crab.

FISHING SEASON AND CATCH BY GEAR

Fishing production can be separate into 2 production periods: (1) a main season corresponding to the dry season from March to August (including exploitation during early floods); (2) a minor season from September to February. Highest production occurs from May to July and from September to October (Figure 3). The majority of caught species are fish, second are shrimp and least are crab.

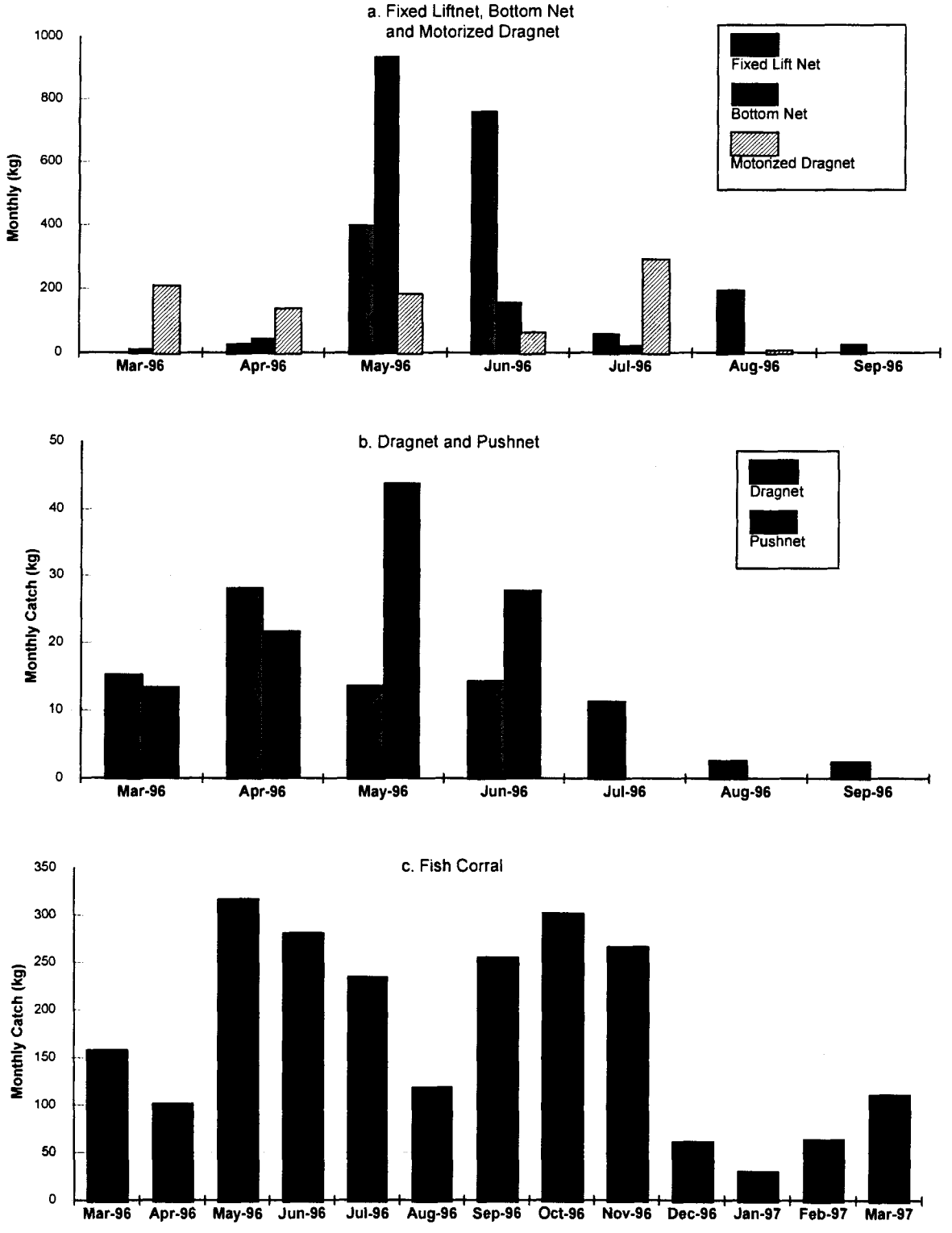
Figure 3. Total monthly catches of aquatic species in the research area (March to December, 1996). Data collected from 15 participating fishers (see Table 1).



Monthly catch data by each gear is drawn in Figures 4a, b and c. Characteristics of each gear (summarized in Table 4) are described below:

- Fish corrals are operated year round at day and night with 2 peak production periods. Main species exploited are fish, shrimp and crab (fish is highest) with an average catch rate of 8.33 kg for 10-12 hours effort. Fish corrals are located in open water or enclosed within a net (net enclosure). This later variation is described in detail in **Aquaculture - its Introduction and Development**. In Figure 4c, catch data from these 2 variations were used.
- Bottom nets operate mainly in dry season with catches of 21.43 kg for 5-7 hours effort and with highest production in May. Fish and shrimp are main species caught.
- Motorized dragnet brings even production over the dry season with a peak in July. It is operated at night and catches mainly fish and shrimp species at 1.15 kg for 5-7 hours effort.
- Pushnet brings high catches from April to June with a peak in May and species caught are fish, crab and shrimp with catch of 0.23 kg for 5-6 hours effort.

Figure 4. Mean total monthly catch by fishers using: **a)** fixed lift net (mean of 2 fishers), bottom net (mean of 2 fishers) and 1 motorized dragnet; **b)** dragnet (mean of 2) and 1 pushnet; and **c)** fish corral (mean of 3 with 1 located within a net enclosure).



- Hook and line catch mainly fish species at low catch rates with a maximum in April. Production of fixed lift net is highest in June and the main exploited species are fish with high catch rates at 18 kg for 8 hours effort.
- Dragnet catches are low and even in March, May and July, and highest in April and the main exploited species is shrimp at 0.69 kg for 6-8 hours of fishing.
- Gillnets are mostly operated at daytime and catch mainly fish species at 1 kg per 4-8 hours effort.

THE SYSTEM OF FISHING PRODUCTION

The analysis of fishing production in Sam - An Truyen - Thuan lagoon indicates some remarkable features described below:

- All fishing gear have small mesh sizes, therefore all sizes of aquatic species are caught; Electric fishing gear are secretly operated. Motorized dragnet, banned as a destructive gear, is still used in Phu Thuan area. Bottom nets closest to Thuan An estuary annually catch a considerable amount of fry, especially *Rò* (*Siganus oramine*) (see **Migration of Marine Species into the Lagoon**).
- The density of fishing gear, especially fish corrals, bottom nets and fixed lift nets seems to have reached the lagoon's capacity. Production by gear is not high and the size at catch of individuals is medium and small (fry).
- Overexploitation of valuable species (shrimp and crab) has decreased the resources. Fish corral catches of mud crab (*Scylla serrata*) and tiger prawn are very low at present compared to those from fish corrals contained within net enclosures (Figure 5).
- Aquaculture in a diversity of structures (ponds, net enclosures and cages) and systems (from semi-intensive to improved extensive and extensive) is developing rapidly at the research site. Ponds, cages and net enclosures are encroaching the lagoon water area in Phu Tan and are developing over lagoon shallow water. Therefore, in Phu Tan commune, lagoon water areas of about 2m depth are being converted into aquaculture area (see **Aquaculture - its Introduction and Development**).

CONFLICTS IN FISHERY PRODUCTION

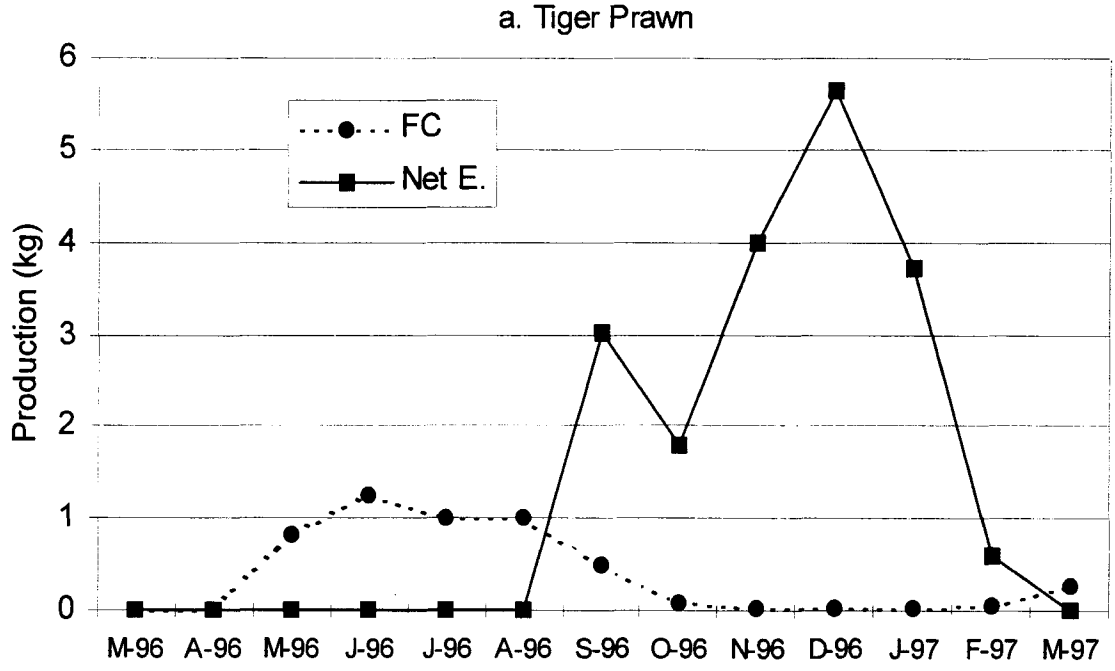
The lagoon area under study is over exploited with a dense and diverse distribution of fishing gear. In spite of being aware of resource depletion and the destructive effect of their gear, fishers are competing to exploit the resources by any means to meet their daily needs. As a consequence, they break fishery regulations and conflicts among fishers are unavoidable.

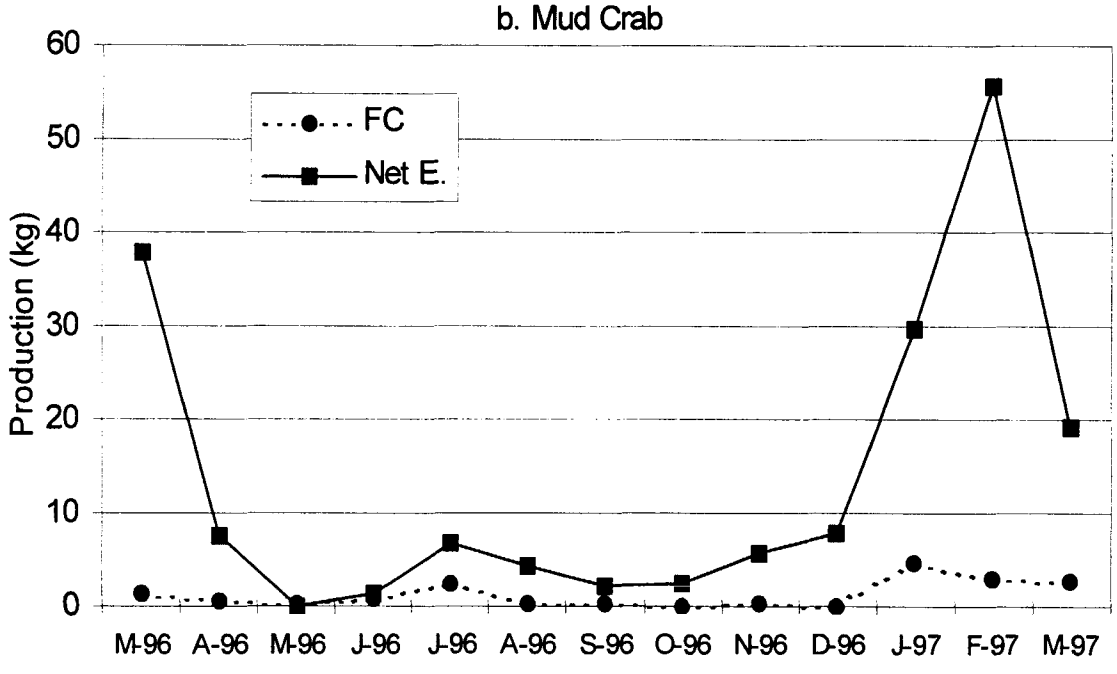
Main conflicts can be summarized as follows:

- Conflicts between mobile fishers and fishers operating net enclosures:

  As more and more net enclosures encroach the lagoon, mobile fishers lose their fishing grounds and become frustrated and at times react violently. One incident resulted in damage to net enclosures.

Figure 5. Comparison of tiger prawn (*Penaeus monodon*) and mud crab (*Scylla serrata*) mean monthly catch from fish corral (mean of 2) compared to catch from a fish corral within a net enclosure. Data collected from March 1996 to March 1997.





- Conflicts between electric fishers and fish corral owners:

  Electric fishers exploit in areas of fish corrals and in net enclosures destroying many aquatic species and decreasing catches of fish corrals. Lack of enforcement of the ban of electric fishing has led to conflicts among villagers in most communes.

- Conflicts between fishers and aquaculturists:

  Aquaculture ponds are built on the edge of the lagoon in shallow lagoon water or in abandoned flooded rice fields. These areas were important fishing grounds of the poorest fishers using simple gear such as pushnet and dragnet. As these areas are privatized (by individuals or groups), those fishers are displaced.

In brief, there are 2 main reasons for conflict: 1) strong development of aquaculture, and 2) competition between mobile and fixed gear fishers. The latter conflict is a consequence of fishing activities under an ineffective management with insufficient resources for a poor and plentiful community. Lax management by local government creates opportunities for some fishers to take advantage by operating illegal fishing methods harmful to the aquatic species production in the lagoon as well as to other fishers' livelihoods.

CONCLUSIONS

The following are a brief summary of the information collected over 2 years of research:

- Eighty (80) aquatic species of fish, shrimp and crab are exploited in the research area. The number of fish species caught is highest, shrimp is second and crab species are fewest (see **Appendix B**).
- The main fishing season is during the dry season with catches increasing in the last months of the season and peak during the change in water salinity (from saline to fresh) when floods begin. During the rainy season production is inconsiderable and fishing effort decreases. Some gear stop operating and some operate intermittently (bottom net, fixed lift net, pushnet, and dragnet).
- The data recorded by fishers are not very accurate however the relative number of each species in the catch is recorded well. These data were used to estimate the predominance of species caught in the lagoon.
- The research site (Sam - An Truyen - Thuan An lagoon) is diverse in fishing production and aquaculture. Fishing effort is high with the highest density of fixed gear in the whole lagoon. Aquaculture is developing so successfully that much shallow lagoon area has been converted into aquaculture area. The present management system is not really effective nor appropriate - local governments do not pay enough attention to the problems - resulting in serious conflicts.
- Community-based management, successful in many communities throughout Asia, was present in the lagoon during Feudal times (see **An Historical Perspective on the Management of Lagoon Resources**). Considering the basic desire of villagers to have an effective management system which ensures the security and rights of all fishers, a management system which emphasizes villagers' roles seems appropriate. This would help protect aquatic resources and the livelihood of local fishing communities as well as provide a base for building a common management system for the whole lagoon.

REFERENCES

Cao Đình Hùng. 1996. *Nghiên cứu hệ thống nuôi trồng thủy sản ở phá Tam Giang, tỉnh Thừa Thiên Huế.* (Research on aquaculture system in Tam Giang, Thua Thien-Hue province). Graduation thesis. BSc - College of Sciences, Hue University.

Division of Protection of Aquatic Resources. 1995. *Những điều cần biết về bảo vệ và phát triển nguồn lợi thủy sản.* (Important things to know on protection and development of aquatic resources). Agricultural Publication.

Edeson, W.R., and Van Houtter. 1995. The legislative framework governing fisheries and aquaculture in Viet Nam. Collection of scientific research. National Conference on Environment and Development of Aquaculture. Pages 488 - 500.

Hà Ký. 1994. *Một số chính sách bảo vệ và phát triển nguồn lợi thủy sản Việt nam.* (Some policies on protection and development of Vietnamese aquatic resources). Collection of scientific reports. National conference on Environment and Development of Aquaculture. Pages 240 - 241.

Nguyễn Như Tùng *et al.* 1984. *Quy hoạch tổng thể đầm phá tỉnh Bình Trị Thiên.* (General planning of lagoon system in Binh Tri Thien province).

Nguyễn Quang Trung Tiến. 1995. *Ngư nghiệp Việt nam nửa đầu thế kỷ XX.* (Vietnamese Fisheries in the early half of the 20th century). Thuận Hóa Publication.

Nguyễn Quang Vinh Bình. 1996. *Quản lý nguồn lợi thủy sản hệ đầm phá Tam Giang* (Management of aquatic resources in Tam Giang lagoon system). Thuan Hoa Publication.

Nguyễn Xuân Quang. 1996. *Nghiên cứu sự di nhập của các loài thủy sản chính vào phá Tam Giang qua cửa biển Thuận An.* (Research on fry migration of main species through Thuan An estuary). Graduation thesis. BSc - College of Sciences, Hue University.

Phạm Thị Duyên Anh, 1996. *Nghiên cứu ảnh hưởng của những chủ trương chính sách của nhà nước và tập quán của cộng đồng cư dân đối với quản lý, sử dụng, bảo vệ nguồn lợi thủy sản, môi trường ở phá Tam Giang, tỉnh Thừa Thiên Huế.* (Research on effects of government policies and community's informal rules on management, use and protection of aquatic resources and environment in Tam Giang lagoon, Thua Thien-Hue province). Graduation thesis. BSc - College of Sciences, Hue University.

Phạm Thị Hoa. 1996. *Nghiên cứu vai trò phụ nữ trong cộng đồng cư dân phá Tam Giang, tỉnh Thừa Thiên Huế.* (Research on women's role in community in Tam Giang lagoon, Thua Thien-Hue province). Graduation thesis. BSc - College of Sciences, Hue University.

Phan Uy Phong. 1996. *Nghiên cứu hệ thống khai thác thủy sản ở phá Tam Giang, tỉnh Thừa Thiên Huế.* (Research on system of aquatic species exploitation (fishing production) in Tam Giang lagoon, Thua Thien-Hue province). Graduation thesis. BSc - College of Sciences, Hue University.

Sub-division of Protection of aquatic resources in Thua Thien-Hue province. *Bảo vệ nguồn lợi thủy sản là trách nhiệm của mỗi công dân.* (Protection of aquatic resources is obligation of every citizen).

Fishing in Vinh Ha Commune

Võ Văn Phú, Nguyễn Quang Vinh Bình, Nguyễn Xuân Khoa and Tôn Thất Chất

Ha Giang Village, located in Vinh Ha commune, Phu Vang District, is a fishing village with a population of 427 people (63 households). The village was settled since the 1960s, but most families came after 1975. They fish in the Cau Hai Lagoon, the southern basin of the Tam Giang Lagoon system.

CAU HAI LAGOON

The Cau Hai lagoon is affected by both marine and fresh waters. Marine water enters through the Tu Hien estuary connecting the lagoon to the sea. The volume of water exchanged with the sea depends on coastal marine currents, tides and on seasonal weather patterns. Sediment banking, caused by coastal winds and water currents, closed the Tu Hien estuary in 1994 and the salinity of the lagoon water decreased to 2 - 3 ‰ at its peak (when it was normally 20‰). In 1996, after several failed attempts, Tu Hien was successfully re-opened by dredging and strengthening of its banks.

Fresh water flows into the lagoon from rivers (Dai Giang, Nong, Truoi and Cau Hai), irrigation canals and ground water (Map 3, p. 3). The average annual rainfall in Nam Dong District (a watershed area for the rivers running into the lagoon) is very high - 4388.40 mm in 1995 and 8025.60 mm in 1994 (Nien Giam Thong Ke, 1995). With most of the precipitation occurring in September to December, the salinity changes drastically from the end of the dry season to the beginning of the rainy season. From October to February, the lagoon water is fresh and floods occur frequently, therefore water turbidity is high and, at times, conditions are not appropriate for the growth of aquatic species. In some years, the lagoon water level reaches 3 m above average which affects the ecology of the lagoon as well as fishery production.

The lagoon also receives household and agricultural run-off from Phu Loc District and the southern part of Phu Vang district. Villagers commonly use chemical fertilizers and pesticides which run into the lagoon. The amount of pesticide discharge has not yet been studied.

METHODOLOGY

Secondary data on fish corral and bottom net were collected from the DoF, HUS, fishery researchers and documents listed in the Reference section (p. 211). This information was validated and supplemented by the Ha Giang community through interviews.

Questions on the seasonality of catch, species composition of catch and catch by gear were the basis of the research on aquatic resources in Ha Giang. Data collection sheets were designed by researchers and revised with the cooperation of villagers to record data on daily catch. Sheets were distributed to the selected households who recorded their daily catch and collected monthly by the researchers.

To ensure the accuracy of data, 3 local collaborators and 2 students were involved in collecting data and supervising data recording. Collected data were gathered, analysed and reported to the participating households and to the whole community by researchers. The research results were validated in the community by the researchers. Some households, not financially supported by the project's activities, voluntarily participated in the research and provided data of daily catch for researchers.

SPECIES COMPOSITION IN CATCH

Appendix B indicates the presence of 26 species in Vinh Ha during both dry and rainy seasons, 6 species during the dry season only and 16 species during the rainy season only. All 48 species can be classified into 3 ecological groups based on different origins: brackish water, marine water and freshwater. Marine and brackish species are the most common, occupying more than 85% of the total fish and invertebrate population. In the lagoon, environmental parameters fluctuate - especially salinity. The lagoon water is affected by rivers originating in the Truong Son range and by tidal currents which are diurnal in Central Viet Nam. Therefore, there are many marine-originated and freshwater-originated aquatic species which can adapt spatially and temporally to high salinity changes.

Brackish water species

This is the main group of aquatic fauna in the Tam Giang lagoon system and brings high and consistent production throughout the year. They are referred to as brackish water group but are mainly marine-originated species that are highly tolerant to fluctuations in temperature and salinity in tropical coastal areas and are present year round in the lagoon. Species are from families Engraulididae, Ophichthidae, Mugilidae, Serranidae, Leiognathidae, Gerreidae, Lutjanidae, Gobiidae, Siganidae and Penaeidae.

Marine species

Though these species can adapt to low salinity (relative to marine water), their tolerance to salinity fluctuations is low. Thus their production varies according to the tide and most of them are caught when the tide is high. Catch increases from lunar months V - VIII in the dry season when salinity in the lagoon area is rather high (15 - 20 ‰) and marine species enter the lagoon in schools. Representative marine orders are Synodontidae, Bagridae, Hemiramphidae, Belonidae, Centropomidae, Teraponidae, Sillaginidae, Sparidae, Monodactylidae, Platycephalidae, Bothidae and Portunidae (mangrove crab) and others. Some families of this group can reach maturity and spawn in the lagoon (such as Platycephalidae, Mugilidae) while others migrate into the lagoon for food (Muraenidae, Luthanidae and Penaeidae). Some notable species include grunt (*Terapon jarbua*), *Pelates sp.*, yellow back sea bream (*Acanthopagrus latus*), and mangrove crab (*Scylla serrata*). Some marine fish which enter the lagoon to lay their eggs are snapper (*Lutjanus johnii*), anchovy (*Stolephorus commersonii*) and gizzardshad (*Clupanodon*).

Species such as bar-tailed flathead (*Platycephalus indicus*), silver pomfret (*Monodactylus argenteus*), yellow back sea bream (*Acanthopagrus latus*) and snapper (*Lutjanus johnii*) have high production and are important for fishing income in Vinh Ha.

Freshwater species

Because their tolerance to salinity fluctuation is low, freshwater species are found mainly in the estuaries and submerged fields and only spread into the lagoon during the rainy season. Rainfall in Vinh Ha is highest of Central Viet Nam (3000 mm/year) during lunar months IX - XII. At that time, tidal currents decrease and salinity is very low (0.1 - 0.5 ‰). The main freshwater species identified are mainly Cyprinidae with some Notopteridae and Synbranchidae. The most commonly caught species is *Cyprinus centralus*. Some species bring considerable production during the rainy season, filling the gap in production caused by absence of marine species. In 1995 when Tu Hien estuary closed, the salinity in Cau Hai lagoon decreased. As a result, aquatic plants, a good food source for *Cyprinus centralus*, grew

very well. Available feed and favourable environment increased the production *of Cyprinus centralus* until the end of 1996, a year after Tu Hien was re-opened.

Valuable aquatic species

Out of the 48 species identified in Vinh Ha lagoon, many species bring high production, and are caught for many months of the year. They are classified as valuable species (Table 1) and most of them make great contributions to fishery production in the area. Through the research, 9 valuable species were identified (Table 1). Many of them originate in brackish water. They are of small size, short longevity, have a short reproductive cycle and occur in high numbers. Others species are of freshwater origin (local carp, clam).

Table 1. Valuable aquatic species which bring high production in Vinh Ha lagoon.

Latin name of species	English name	Seasonal presence		Size (mm)
		Rainy	Dry	
Herklotsichthys punctatus	Spotted herring	x	x	160-200
Cyprinus centralus	Local carp	x		200-400
Pelates quadrilineatus	Trumpeter	x	x	70-160
Mugil cephalus	Stripped mullet	x	x	200-350
Mugil kelaarti	Mullet	x	x	100-250
Oxyurichthys tentacularis	Goby	x	x	50-250
Siganus guttatus	Golden spinefoot	x	x	70-250
Metapenaeus ensis	Greasyback shrimp	x	x	20-80
Meretrix meretrix	Enamel venus shell	x		50-100

Among the identified species, 3 species are recorded in the red book of Viet Nam, a list of precious and rare species (Vietnamese Red Book, 1992): *Herklotsichthys punctatus*, *Leiocassis hainamensis*, and *Syngnathus pelaricus*.

SEASONAL CALENDAR OF SPECIES COMPOSITION

Seasonal calendar of species composition caught by the 2 gear over research time is shown in Figures 1 and 2.

Figure 1. Seasonal Calendar of some main species caught by fish corral.

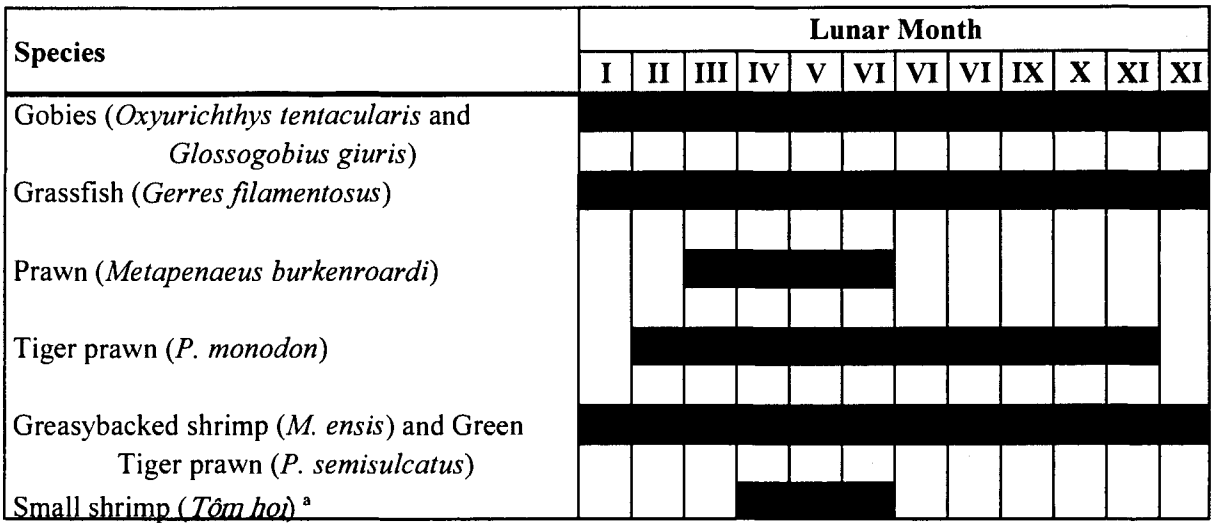
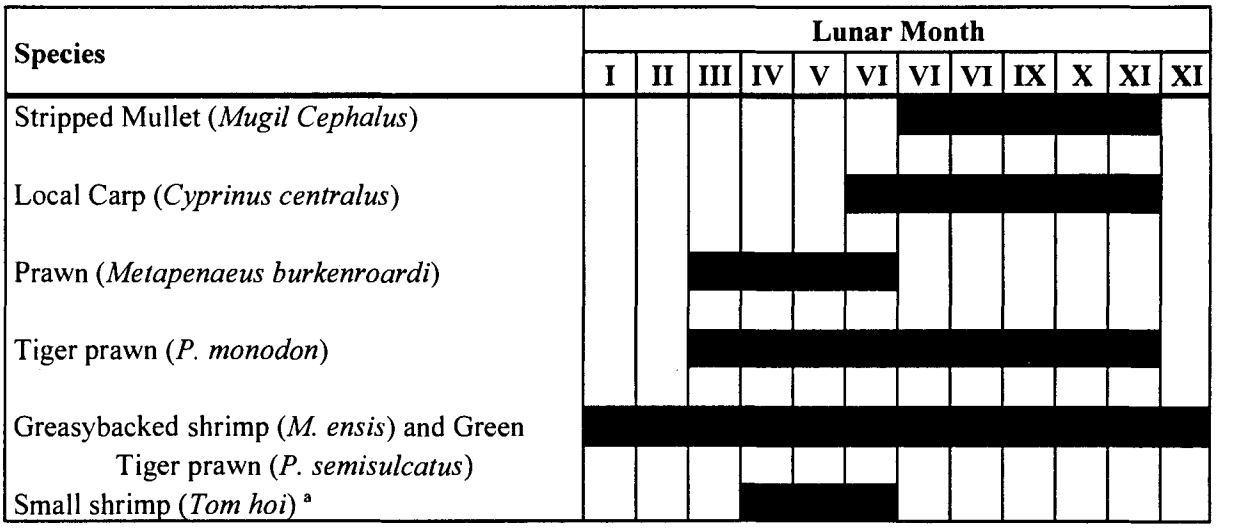


Figure 2. Seasonal Calendar of some main species caught by Bottom Net.



[a] *Tôm hoi* has not been classified by the researchers. Although considered as a separate species by fishers, staff of the DoFclaim it is *M. ensis*. Considering its size, it might be the juvenile.

EXPLOITATION OF AQUATIC RESOURCES IN VINH HA

All the villagers belong to the same cooperative group[1] (see **Appendix A**). There are only 65 people fishing full time - the rest of the villagers are children, old people and women. Although there are only 27 motorized boats, every fishing household has a small non-motorized boat made from a mat of tarred bamboo (similar to a kayak with an open deck) which is propelled using a double-ended paddle.

After the rainy season, when the water level is low, clarity of water increases, and water currents are stable, a freshwater macrophyte, *Vallisneria spiralis*, grows well in the lagoon. Harvesting of the macrophyte during the poor fishing season, brings a supplemental income to the villagers. In the local lagoon area, more than a hundred boats with farmers and fishers around the area harvest macrophytes with each boat harvesting up to 200 kg of wet macrophyte daily. Several hundred tons of wet macrophyte (equivalent to nearly 10 million VND) are harvested annually in February, March, April, September and December. It is used as pig feed and as green manure (see **Freshwater Macrophytes - their Ecology and Exploitation**). Macrophyte beds are a good habitat for post-larvae of shrimp, crab and fish, increase the amount of dissolved oxygen in the water, and consume the fertilizers discharged from agricultural production (nitrate and phosphate). Good growth of macrophytes has a positive effect on lagoon environment. Unfortunately, harvesting of macrophytes stirs mud on the lagoon bottom and destroys the habitats of juvenile aquatic species directly affecting the growth and development of aquatic species. It may also destroy eggs of aquatic species laid during harvesting period.

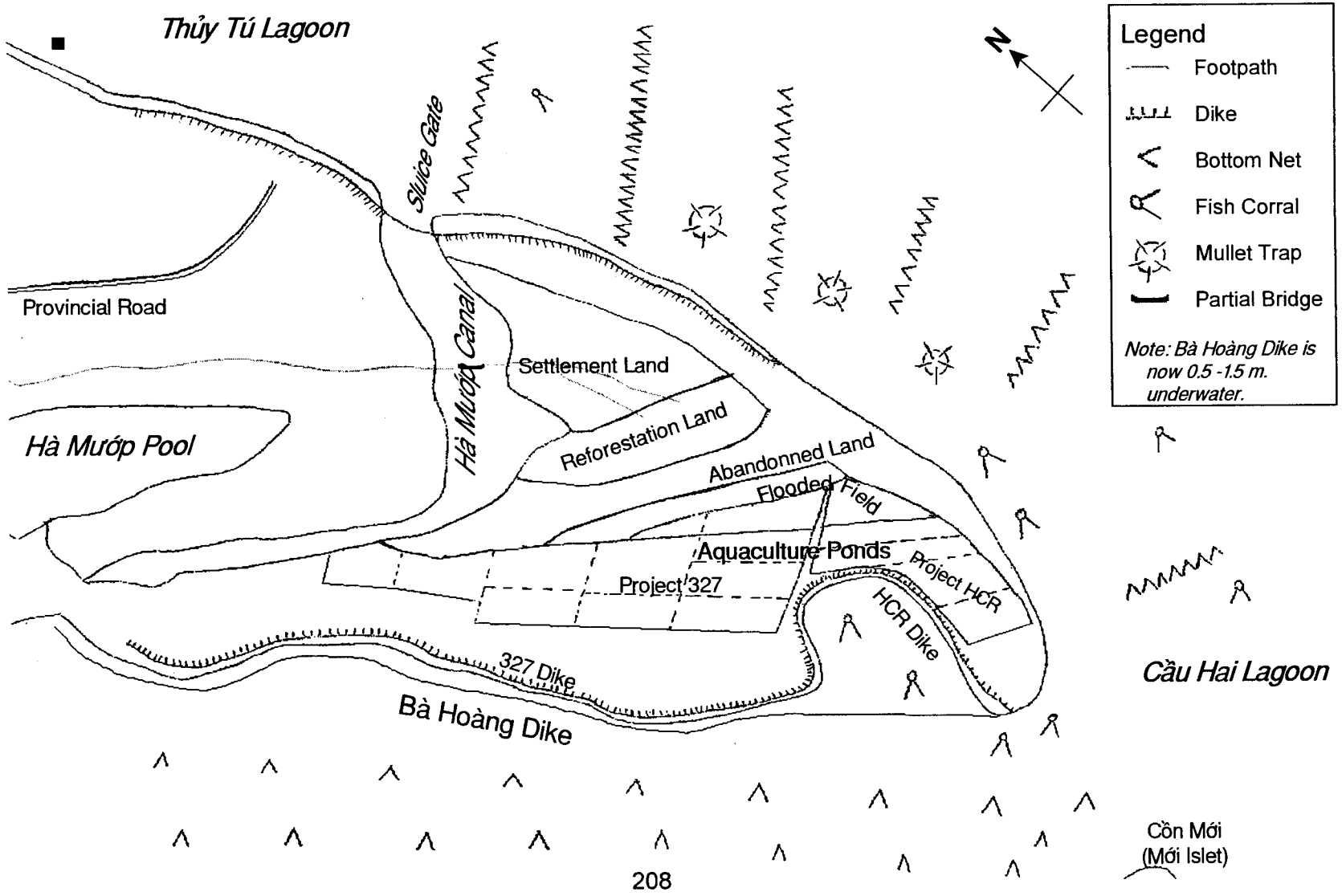
Table 2 lists the main fishing gear in Ha Giang. Fish corrals and bottom nets are dominant with a fish corral costing 10 to 15 million VND and a bottom net costing 4 to 6 million VND. The resource map of Ha Giang Village (Map 12, p. 208) indicates the location of fixed gear in the lagoon. Other gear, mainly mobile gear, appear in lower numbers, cost less and earn less income.

Table 2. Fishing gear and catch by gear in Vinh Ha lagoon estimated over the research period from March 1996 to February 1997.

Fishing gear	No. of gear	No. of hhs	Daily catch/gear	Frequency of use (times/year)	Daily production (Kg)	Annual production (Kg)
Fish corral	37	37	5.04	300	186.3	55888.5
Bottom net	57	16	2.82	300	161	48295.5
Mullet trap	3	3	0.9	240	2.7	648
Banana gillnet	12	6	0.2	120	2.4	288
Goby gillnet	15	8	0.15	120	2.25	270
Eel rake	14	14	0.15	130	2.1	273
Hook and line	15	4	0.1	70	0.15	10.5
7 gear types	**153**	**63**		**TOTAL**	**105,673.5 kg/year**	

[1] In all of Vinh Ha commune, there are 20 cooperative groups - most of them agricultural.

Map 12. Resource Map of Hà Giang Village, Vinh Hà Commune



Ha Giang's total aquatic species production is 105.7 tons/year (Table 2). Of the catch, 85% is fish and 15% is invertebrate - mainly shrimp. According to Nguyen Mong (1991), 11 species of shrimp from 4 genera have been identified in Tam Giang lagoon. Main species exploited in Ha Giang are tiger prawn (*Penaeus monodon*), banana prawn (*Penaeus merguiensis*) and greasyback prawn (*Metapenaeus ensis*). Production of these 3 species alone in the whole lagoon system is 360 tons/year (DoF Statistics 1995, Thua Thien - Hue Province).

Mud or mangrove crab (*Scylla serrata*) is also exploited. It is caught by mobile gear and by wading in water and using a lamp to attract, see and catch crab. Production of crab is high, especially from February to August. Crab is sold and transported, mainly by water, to Hue City and neighbouring markets. Because of poor transportation, there is no crab cultivation.

While crustaceans are caught in dry season when salinity is high, mollusks are exploited in rainy season. Main species are venus clam (*Meretrix meretrix*) and freshwater clam (*Corbicula moreletiana*). Economic benefits from clams are not high, but they are a speciality of the lagoon.

Catch by fish corral and bottom net occupy a considerable part of total fishery production in Vinh Ha as well as in the whole Tam Giang lagoon. Traditionally, access rights to fishing grounds for fish corral was allocated to villagers and, at present, though these rights have not been officially granted by the government, they are not denied nor is their transfer denied. Though access to these grounds is not exclusive, mobile fishers who want to fish in a fish corral ground must obtain permission from the fish corral owner.

Figure 3 shows the relation between the catches of bottom net and fish corral and salinity. Salinity is lowest in January (0.2 ‰), increases gradually to its peak in August (23.5 ‰) and then decreases. In general, salinity is highest (> 15 ‰) at the end of summer (June until the beginning of September) and lowest (< 2.5 ‰) during the rainy and cold months (from mid-November to February). Production by fish corral is highest in August, at the end of dry season, and at the beginning of rainy season. In general, production decreases from August to December and increases from March to August. Seasonality of production by bottom nets follows that of fish corrals.

AQUACULTURE

In the last 3 years, aquaculture of brackish water species was practised with diverse patterns and species. The area under aquaculture (pond, submerged area, cage or net enclosure) has expanded to 13.5 ha (Map 12, p. 208). However, the potential area for aquaculture, from abandoned and submerged lands, is 65 ha. Main species cultured are greasyback shrimp (*Metapenaeus ensis*), tiger prawn (*Penaeus monodon*), rabbitfish (*Siganus guttatus*), grass carp (*Ctenopharyngodon idellus*), Java tilapia (*Oreochromis mossambicus*) and Nile tipalia *(O. niloticus*) (Table 3).

In recent years, the cultivation of shrimp, the preferred species for economic reasons, has expanded. However, because currents through Tu Hien estuary are weaker, the lagoon waters around Vinh Ha are becoming less saline. In September 1996 to April 1997, salinity was low at less than 10 ‰ and increased very slowly to its peak in August 1997. This affected the catch and culture of shrimp in Cau Hai lagoon and shrimp culture, with yields as low as 250 kg/ha/year, was abandoned.

Figure 3. Relationship between monthly catch of fish corral and bottom net (per unit) and Salinity (‰). Catch was estimated from fishers' data collected from March 1996 to February 1997.

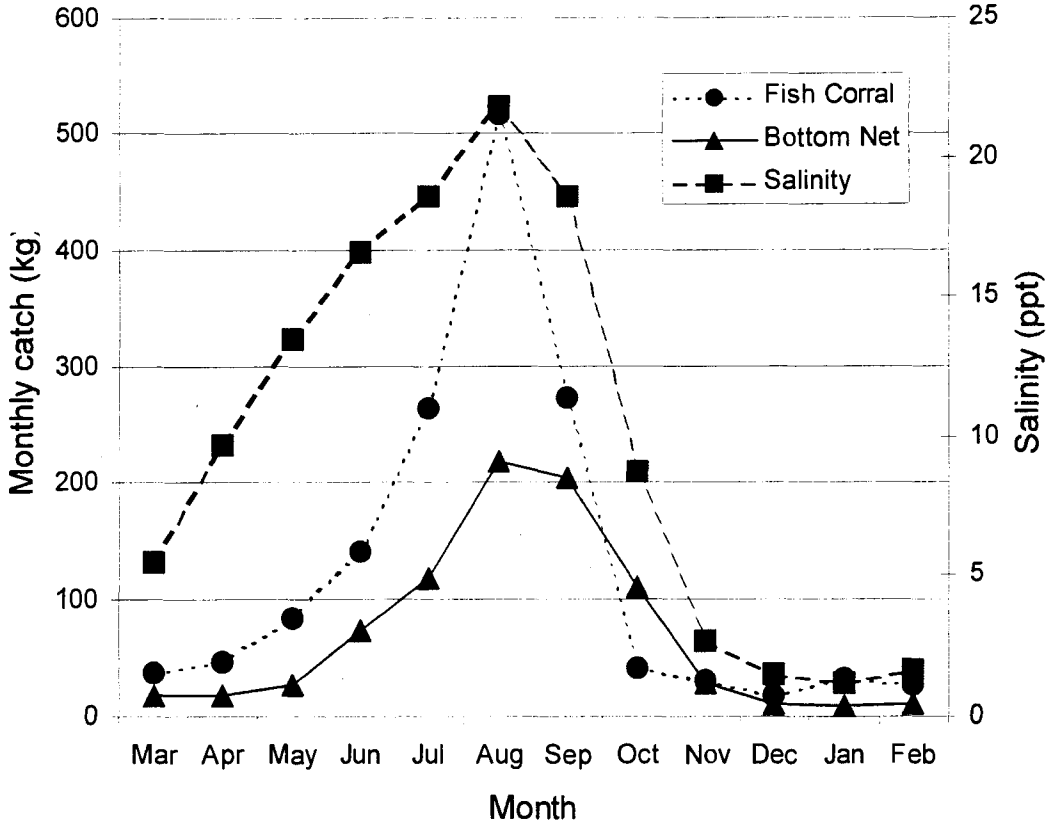


Table 3. Aquatic species cultivated in Vinh Ha, Phu Vang.

Latin name	English name	Preferred Environment
Ctenopharyngodon idellus	Grass carp	Freshwater
Clarias fuscus	Walking Catfish	Freshwater
Monopterus albus	Swamp-eel	Freshwater
Oreochromis mossambicus	Java tilapia[a]	Tolerant to fluctuations
Oreochromis niloticus	Nile tilapia[a]	Tolerant to fluctuations
Metapenaeus ensis	Greasyback prawn	Brackish water
Penaeus monodon	Tiger prawn	Brackish water

[a] Not reproducing

The appropriate period for the culture of brackish water shrimp is from the end of March to the beginning of October. From March to October 1996, salinity ranged from 6 to 22 ‰. Turbidity, measured

alum contamination and the presence of grass is high. Shrimp raising here is difficult and money must be invested into dredging ponds and building canals for water exchange.

REFERENCES

Guranova, E.F, 1972. *Khu hệ vịnh Bắc Bộ và các điều kiện sông của nó.* (Fauna of Tokin Bay and its conditions). Institute of Zoology, Russia Institute of Science Academy on Marine living organism and Viet Nam fishery production. General division of Fishery. Ha Noi. page 282 - 411. Translation by Phạm Thị Minh Giang.

Niên Giám Thống Kê. 1995. (Annual Statistics). Division of Statistics, Thua Thien-Hue province.

Nguyễn Khắc Hường. 1991. *Cá Biển Việt Nam*, (Vietnamese marine fish), Vol II, Book 1. Science and Techniques Publication. Ho Chi Minh city. 295 pages.

Nguyễn Mộng, 1991. *Kết quả điều tra khu hệ động vật, động vật đáy ở đầm phá tỉnh Thừa Thiên Huế.* (Research results on fauna of animal, bottom animals in Thua Thien-Hue lagoon). Scientific information. Hue University of Science. Number 7. Pages 96 - 99.

Nguyễn Nhật Thi. 1991. *Cá biển Việt Nam, cá Xương vịnh Bắc Bộ.* (Marine fish in Viet Nam, Xuong fish in Tokin bay). Science and Techniques Publication. Ha Noi. 462 pages.

Shirota, A. 1996. The plankton of South Viet Nam. Freshwater and marine plankton. Oversea technical cooperation Agency. Japan. 560 pages.

Tirant, G. 1929. Memoire sur les poissons de la riviere de Hue. Reiprinieen. Sai Gon. P 18 - 34.

Tôn Thất Pháp, 1993. *Cấu trúc thành phần loài và một số dẫn liệu sinh thái khu hệ thực vật thủy sinh ở phá Tam Giang tỉnh Thừa Thiên Huế.* (Species composition and data on ecology of aquatic vegetation fauna in Tam Giang lagoon, Thua Thien-Hue. Magazine of Science and Technology. No. 2. Board of Science and Techniques. Thua Thien-Hue.

Vietnamese Red Book. 1992. Part of Zoology. Ministry of Science, Technology and Environment. Ha Noi. Pages 238 - 316.

Võ Văn Phú. 1993. *Thành phần loài cá ở đầm phá tỉnh Thừa Thiên Huế.* (Fish composition in Thua Thien-Hue lagoon). . Magazine of Science and Technology. No. 2. Board of Science and Techniques, Thua Thien-Hue. pages 113 - 177.

Võ Văn Phú. 1995. *Khu Hệ cá và đặc điểm sinh học của mười loài cá ở đầm phá tỉnh Thừa Thiên Huế.* (Fish fauna and biological characteristics of 10 fish species in Thua Thien-Hue lagoon). Doctor thesis. National University. Ha Noi.

Vũ Trung Tạng. 1994. *Các hệ sinh thái cửa sông Việt Nam.* (Ecosystem of Vietnamese estuaries). Science and Techniques Publication. Ha Noi. 271 pages.

Vũ Trung Tạng and Đặng Thị Sy. 1978. *Nguồn lợi thủy sản các đầm phá phía Nam sông Hương và những vấn đề khai thác hợp lý nguồn lợi đó.* (Aquatic resources in lagoon in the Southern Huong River and sustainable exploitation of the resources). Collection of reports. Part I. Vol 1. Nha Trang. page 301 - 315.

Appendix A. Background on Viet Nam, the Lagoon and Fishing

The Socialist Republic of Viet Nam is located on the Indochinese peninsula in South East Asia. Its land area is 329,566 sq km with a 3,260 km coastline on the South China Sea. It shares 950 km of border with Cambodia in the south west, 1,650 km of border with Laos in the west and 1,150 km of border with China in the north. Viet Nam's population was 73 million inhabitants in 1994, 80% of whom live in the rural areas (Tran Ai My, 1995).

Viet Nam was under Chinese domination from 111 BC to 939 AD, a period marred by rebellions, revolts and insurrections. It was then that Viet Nam adopted the Chinese law and calendar. Subsequent to that period, Vietnamese history is marked by feudal wars, conquests and a succession of dynasties and emperors - some at war with China and some embracing its protection. The country was divided into different kingdoms ruled by mandarin families at war with each other. The country was finally unified, with the assistance of the French, in 1802 by Nguyễn Ánh (Gia Long) who reigned until 1820 as emperor over the entire Viet Nam. He reorganized the whole country, harmonized weights, measures and money, revised laws and introduced land reforms. Hue City became the capital of the country.

The French, present in the area since the early 1600s, dominated Viet Nam from 1859 to 1954. The take-over was spurred on by actions against Catholic missions and commercial interests. Resistance against the French was maintained throughout the colonial period but became strong and successful under the communists (Viet Minh) led by Ho Chi Minh. The Franco-Viet Minh war lasted from 1946 to 1954. The end of the war was signalled by the signing of the Geneva Accord which temporarily separated Viet Nam into 2 countries. A campaign to 'liberate' the south was initiated by the government in Ha Noi which led to the Viet Nam war, with participation of the United States.

Thua Thien-Hue, located just south of the Demilitarised Zone (DMZ) in present-day Quang Tri, was the scene of repeated battles and massacres both in the mountains as well as on the lagoon - from A Luoi to the coast. The hills and mountains all over the province were sprayed repeatedly by Agent Orange - most areas up to 3 times and some even 5 times. Most rural villagers were forced to abandon their homes and either flee or move to military-controlled camps. Hue City was the scene of the bloodiest battles of the infamous 1968 Tet Offensive when over 10,000 people died, most of them civilians.

After more than 20 years of political division and 30 years of violent warfare, Saigon (present day Ho Chi Minh City), the southern capital, surrendered to Hanoi, the northern capital, on April 30, 1975. This surrender marked the end of the Viet Nam war and is celebrated as *Liberation Day*. The Democratic Republic of Viet Nam (North Viet Nam) and the Republic of Viet Nam (South Viet Nam) were officially re-unified and renamed the Socialist Republic of Viet Nam (SRV) in July 1976. The country embraced the socialist centralist system of the North - a system new to the central and southern provinces (including Thua Thien-Hue province, the project's site). Viet Nam's political system is dominated by the Communist Party which influences every level of the country's social and political life. Due to difficulties in communication between the Party headquarters and its branches, it has espoused a decentralized system which gives local leaders more freedom and leeway in applying rules and initiatives.

People's Committee (PC)

Viet Nam is divided into provinces (*tỉnh*) each subdivided into districts (*huyện*) which are then further

divided into communes (*xã*). The People's Committee (PC), the government at each political level, is composed of local organizations with a defined structure and under a singular leadership. In Viet Nam, it is the major organ of administration under the Communist Party of Viet Nam (Tran Ai My, 1995). The lowest political level is the Commune where the project activities focussed. Communes are divided into villages (*làng*) which are further subdivided into hamlets (*xóm*) but, other than the village headman under the commune government, these have no formal government structure.

Mass Organizations

Mass Organizations are sectoral organizations, eg. Youth Union, Women's Union, Farmer's Union. In Viet Nam they are organized nationwide and recognized at four political levels (Commune, District, Provincial and National). They have sub-organizations at lower levels of village and hamlet (Tran Ai My, 1995).

Cooperatives and Production Groups

After 1954 in the north and 1975 in whole country, the cooperative system was enforced by the national government in all sectors of the economy. Under the socialist/communist system, the government of the times did not allow a private sector. There were only two forms of property rights: the national and the collective. Corresponding to those rights, only the state and cooperative organizations or enterprises were allowed to operate.

In agriculture, cooperatives replaced the traditional family farms of the past. Agricultural and fishery cooperatives were formed at the commune, village or hamlet level. The cooperative had the legal rights to all resources and means of production. It made all plans for production and decisions for the distribution of benefits as prescribed by higher levels of management. Cooperatives organized production, distributed equipment, seeds, fertilizers and pesticides, and marketed the products. Most farmers and fishers living within the boundary of the cooperative were members of the cooperative. This was not officially compulsory but they had no choice as the private sector was not allowed. They were assigned work and allocated income by the cooperative (Truong Van Tuyen, pers.com.). Cooperatives were divided into production groups with each group consisting of about 60 to 90 households.

In 1986, the government introduced the "*đổi mới*" policy of renovation which resulted in a transition to a market economy. In 1989, it was enforced at the national level and the household was re-established as the basic unit of agricultural production. This policy recognized the right of the family to use land and sell agricultural output surplus on the open market. As anticipated, this increased agricultural output and the country switched from importing rice to feed its population (1977-1988) to exporting rice from 1989 onward (Tran Ai My, 1995).

Under this renovation, the private sector was now legal. Agricultural and fisheries households were recognized as independent economic units. They can now make decisions on the production and use of their products. Under this new system, agricultural lands and major means of production were re-allocated to individual farmers and fishers.

At present, though cooperatives are supported as a major sector under socialism and are still active in some areas, in many other areas, cooperatives no longer exist. The cooperative is in the process of changing its function towards efficient farmers' and fishers' organizations. In general, it has no decision-

making power as previously, but it is now supposed to function in servicing and supporting organizations for production. In most cases the cooperative is responsible for providing services such as water management, supply of agricultural/fisheries inputs, resource management, and as a intermediary between extension agencies and farmers/fishers.

Currency

The Vietnamese Đồng (VND) is the official currency which traded at approximately 11 000 VND to the US dollar in the first half of 1996. In 2000, the US dollar traded at about 14000 VND.

Sampan People (Dân thủy diện)

Dân thủy diện means living on the water surface and is the official term used to refer to people in Viet Nam who live on boats on rivers, lagoons and on the sea. These landless people, referred to in French as *sampaniers* (thus the origin of "Sampan People" the name used throughout this publication), have for generations lived and raised their families on boats. They have always been marginalised from mainstream society which is based on land ownership and rice growing. Even after Liberation (1975) when cooperatives were set up they were not included in the system. Although the government has tried to reduce their isolation by registering them with communes and relocating many of them on land (usually upland areas and New Economic Zones), most are still marginalised with little access to health care, education, and other social services.

Mainstream society has, for generations, treated them with scorn as lower class citizens. The term "*dân kẻ nôốc*" which means living in boat is a derogatory term used by most people.

Lunar Calendar (Âm lịch)

The Vietnamese lunar calendar closely resembles the Chinese one. Year 1 corresponds to 2637 BC and each lunar month has 29 or 30 days resulting in a year of 355 days. Thus every third year is a leap year with an extra month added to keep it in sync with the solar year. *Tết*, the Vietnamese new year is the first day of the 1st lunar month which falls between mid-January to mid-February in the solar calendar. The lunar calendar is used by farmers, fishers and aquaculturists as it is a better indicator of the seasons (ie. The start and end of rains closely follow the lunar calendar even during leap years since centuries observations have resulted in a complex system of inserting the extra month in the correct seasonal period). Lunar months are indicated throughout this book in Roman numerals (I to XII). Much of the data in this book was collected in 1996 when *Tet* fell on the 19th of February. As it was not a leap year, adding 1.5 months to the lunar date approximates the solar date. A few date conversions follow:

1st day of XII	January 20, 1996
1st day of I	February 19, 1996
1st day of II	March 19, 1996
1st day of IV	May 17, 1996
1st day of VI	July 15, 1996
1st day of VII	September 13, 1996
1st day of X	November 11, 1996
1st day of XII	January 9, 1997
1st day of I	February 7, 1997

Fishing Gear

Fish Corral (*Nò sáo*) is the most common fixed gear in the lagoon. It is set with the predominant current – for instance at the mouth of a river, the opening of the corral is near the river mouth while the trap or cod end is down current. Thus it catches the aquatic species that swim with the current. Seen from above, they are V-shaped and, flying into Hue, they are a prominent feature of the lagoon. Bamboo poles are set into the lagoon bottom at regular intervals and mosquito netting is hung between them. At the point of the V, a cod end (or *Nò*) traps the fish and invertebrates and is emptied regularly.

Bottom Net (*Đáy*) is a net shaped like a sleeve which tapers at the end (like a cone). It is hung between 2 poles which are driven into the lagoon bottom. At high tide, the net is attached to the poles. As the tide runs out, water flows through the net and fish and shrimp are caught in the end which is tied closed. At slack tide, the end is untied and emptied and the bottom net removed. Bottom nets are operated at night most of the year, and both at day and night during the flood season when currents are strong. They are set in deep water where currents are strong - predominantly in the Thuan An lagoon opening where they catch fry entering the lagoon (see **Migration of Marine Species into the Lagoon**).

Fish Aggregating Device (FAD) (*Chuôm*) works on the principle of attracting fish to a safe habitat. It is made up of bamboo and other sticks, bushes and stones set on or driven into the lagoon bottom. After a few weeks or months, when the area has been 'settled' by fish and invertebrates, the fisher encircles the FAD with a net and catches them.

Fixed Lift Net (*Rớ Giàn*) is a square-shaped net of very small mesh size which is lowered to the bottom of the lagoon for a period of time and lifted again catching all the aquatic life that settled on it. There is a trap in the centre of it, so that the fisher can bring his boat under the net, open the trap and let all the fish fall into the boat. The presence of a lift net is marked by a bamboo structure set up beside it which houses the winch that pulls the net up and the fisher that operates it. A mobile version of the same gear (Mobile Lift Net - *Rớ Bà*) is operated from the stern of a boat.

Mullet Trap (*Dạy* or *Lưới Nhảy*) is a circular fixed fishing gear consisting of 2 nets - one net is underwater and leads the swimming mullet into the centre of the circle while the other net, above water, has deep pockets sewn into the side which traps the mullets as they jump to escape.

Hook and Line or fishing rods (*Câu*) are still used by lone fishers in the lagoon fishing from a small bamboo boat with a double ended paddle.

Pushnet (*Xẻo*) is operated mainly by women by wading in shallow water. A fine mesh net within a triangular frame is pushed through the water, with one side along the bottom, to catch small crustaceans and fish. On the point or top of the gear is a small cod end or trap in which the animals are caught.

Motorized Pushnet (*Te máy* or *Quệu*) is much larger than a pushnet and is operated from a motorized boat. The gear is fixed to the bow of the boat and scoops up aquatic species from the water. Since it does not normally touch the bottom of the lagoon, the motorized pushnet is made of softer mesh and has a deep pocket which holds the trapped fish until the net is raised.

Dragnet (*Xiếc*) is operated by pulling the 2 ends of a long net over the bottom of the lagoon. A small net

(normally operated in the lagoon) is used by 2 people wading in the lagoon (for instance a husband and wife team); while a large net (often seen along the coast of Viet Nam) is operated by a team of villagers with a small boat to set the net. Women, men, young and old pull each end of the net onto the beach.

Gillnet (*Lưới* or *rê*) is a net which catches fish by hooking them by the gills. It is set temporarily in the lagoon with one end attached to a float and the other to a boat. The base of the net is weighed with lead while the top of the net has floats to hold the net upright in the water. Noise is often made by tapping an oar against the side of the boat to scare the fish towards the net. In the lagoon, there are many different types of gillnets which are specifically designed to catch certain species. Some main ones are Banana Gillnet (*Lưới bạc*), Goby Gillnet (*Lưới thệ*) and Crab Gillnet (*Lưới cua*).

Eel Rake (*Cào lươn*) and Macrophyte Rake (*Cào rong*) operate in a similar fashion. Rakes are lowered onto the lagoon bottom from a moving motorized boat. After several minutes of travel, they are raised again and cleaned of their catch (either eels or freshwater macrophytes). A macrophyte rake is shown in Figure 2 (p. 155) of **Freshwater Macrophytes - their Ecology and Exploitation**. An eel rake has curved rake teeth in which the body of the eels get jammed.

Electric Fishing (*Rà điện*) uses a transformer to increase the voltage of a 9-volt battery to more than 200-volts. Two rods, transmitting the voltage into the water, are used to electrocute and stun the fish which float up and the larger ones are scooped up in a small basket at the end of one rod. The high voltage also kills most small aquatic species which have no commercial value and are not collected. This gear is either operated from a boat on the lagoon, or in the rice fields on foot with the battery and transformer held in a knapsack.

References

Huard, P. and M. Durand. 1994. Viet Nam, Civilization and Culture. Ecole Française d'Extrême Orient. Paris and Hanoi. 452pp.

Storey, R. 1993. Vietnam: a travel survival kit. Lonely Planet Publications. Australia. 450pp.

Trần Ái Mỹ. 1995. Participatory Monitoring of the Sustainability of Household Livelihood Projects: A portrayal in a Vietnamese Commune. A thesis submitted to the Department of Community Development, College of Social Work and Community Development (CSWCD), University of the Philippines, Dilliman, Quezon City, Philippines.

Appendix B. List of Fish and Invertebrate Species Exploited in the Lagoon

This table presents species identified and collected between March, 1996 to February 1997. See **Fishing in Quang Thai Commune**, **Fishing in Sam - An Truyen - Thuan An Area**, and **Fishing in Vinh Ha Commune**.

ORDER/Family	Latin Name	English Name	Vietnamese names	Vinh Ha Fishing		Quang Thai Fishing		Phu Tan	
				Rainy	Dry	Rainy	Dry	Fishing Solar Mo.	Migration[1] Lunar Mo.
FISHES									
CLUPEIFORMES									
Clupeidae	*Herklotsichthys punctatus*	Spotted Herring	*Cá mòi cờ chấm*	x	x			1,7-8,10,12	VII-X[a]
	Clupanodon thrissa	Gizzardshad flower	*Cá mòi cờ hoa*					1-3,12	VII-IX[a]
Engraulididae	*Stolephorus commersonii*	Commerson's Anchovy	*Cá cơm thường*		x				I-IV,VI[a]
	Stolephorus tri		*Cá cơm sông*	x	x				
	Stolephorus indicus	Indian Anchovy	*Cá cơm*						I-III[a]
	Setipinna taty	Hairfin Anchovy	*Cá lẹp*					7	VII-X[a]
	Thryssa dussumieri	Glassnose	*Cá lẹp*						VII-IX[a]
	Stolephorus sp.		*Cá cơm*						II-VII[a]
Chanidae	*Chanos chanos*	Milkfish	*Măng biển*						XII-II[c]
OSTEOGLOSSIFORMES									
Notopteridae	*Notopterus notopterus*	Featherback	*Cá thát lát*	x		x			
ANGUILLIFORMES									
Anguillidae	*Anguilla japonica*	FW eel	*Cá chình nhật*			x			
	Anguilla nebulosa		*Cá chình hoa*			x			
	Anguilla sp	True eel	*Chình*					10-11	
Ophichthidae	*Pisodonophis boro*	Estuary snake eel	*Cá nhệch boro*	x	x		x	1-12	XII-III[c]
	Ophichthus cephalozona	Snake eel	*Chình/Lệch hàu*					6	
Muraenidae	*Gymnomuraena concolor*	Moray eel	*Lịch tràn/lệch huyết*	x	x			4-5,7-8	I-IV, IX-X[c]
	Echidna polyzona	Barred moray	*Lịch rằn/lệch rằn*					10	II-IV, IX-X[c]
Moringuidae	*Moringua microchir*	Worm eels	*Lệch roi*					7-9,11	
Muraenesocidae	*Muraenesox cinereus*	Pike conger	*Dưa xám/luy*					2,7	II-IV[c]
	Congresox tabalon	Indian pike conger	*Lạc*					2-3,5-10	II-IV[c]

CYPRINIFORMES									
Cyprinidae	*Cyprinus carpio*	Common carp	*Cá chép*			x	x		
	Cyprinus centralus	Local carp	*Cá dày*	x		x	x		
	Carassioides cantonnensis		*Cá dưng*			x	x		
	Carassius auratus	Crucian carp	*Cá diếc (vàng)*	x		x	x		
	Carassius carassius	Crucian carp	*Cá diếc*			x	x		
	Rasbora lateristriata		*Cá mại (sọc)*	x		x	x		
	Puntius semifasciolatus	Barb	*Cá cấn*	x		x	x		
	Hemiculter leucisculus	Hemicultur	*Cá mương*			x	x		
SILURIFORMES									
Bagridae	*Leiocassis hainamensis*	Bagrid catfish	*Cá nghạnh*		x		x	2-9,11	
Clariidae	*Clarias fuscus*	Walking catfish	*Cá trê*				x		
Ariidae	*Arius falcarius*	Sea catfish	*Úc*					9	
Plotosidae	*Plotosus anguillicandatus*	Eel-tailed catfish	*Cá ngát*					3	IX-XII[c]
AULOPIFORMES									
Synodontidae	*Saurida gracilis*	Graceful lizardfish	*Mòi cờ hoa*						XII-III[a]
ATHERINIFORMES									
Atherinidae	*Atherina bleekeri*	Silverside	*Cá suốt*						III-V[c]
BELONIFORMES									
Hemiramphidae	*Hemiramphus georgii*	Halfbeak	*Cá kìm*		x		x		
	Hemiramphus far	Spotted halfbeak	*Kìm chấm*					1-12	XII-VII[c]
Belonidae	*Tylosurus anastomella*	Needlefish	*Cá nhoái mõm nhọn*		x			1,3,5-10	XII-VI[c]
	Strongylura strongylura	Needlefish	*Cá nhoái*						I-VII[c]
SYNGNATHIFORMES									
Syngnathidae	*Syngnathus pelaricus*	Pipefish	*Cá chìa vôi*		x				
SYNBRANCHIFORMES									
Synbranchidae	*Monopterus albus*	Swamp eel	*Lươn*	x		x	x	3,5-8,10-11	
PERCIFORMES									
Centropomidae	*Lates calcarifer*	Giant seaperch	*Chẽm*					3,6-12	XI-II[c]
Channidae	*Ambassis kopsii*	Glassies	*Cá sơn biển*		x				

Appendix B. Contnd.

ORDER/Family	Latin Name	English Name	Vietnamese names	Vinh Ha Fishing		Quang Thai Fishing		Phu Tan	
				Rainy	Dry	Rainy	Dry	Fishing Solar Mo.	Migration[1] Lunar Mo.
Serranidae	*Epinephelus malabaricus*	Malabar rockcod	*Mú điểm đai/ Mú chấm*	x	x	x	x	2-5	X-III[b]
	Epinephelus areolatus	Square-tailed rockcod	*Mú thụy*						XI-III[b]
	Epinephelus lanceolatus	Brindlebass	*Mú thụy*						XI-III[b]
	Epinephelus longispinis	Streakyspot rockcod							XI-III[b]
	Epinephelus merra	Honeycomb rockcod							XI-III[b]
Teraponidae	*Terapon jarbua*	Thornfish	*Căng đàn/ Ong căng*		x		x	1-12	X-IV[c]
	Terapon theraps	Straight-lined thornfish	*Cá căng, ong*				x		
	Terapon oxyrhynchus	Thornfish	*Ong bầu*					1-12	XI-III[c]
	Pelates quadrilineatus	Trumpeter	*Cá căng 4 sọc*	x	x		x	1-11	XII-III[c]
	Pelates sp.	Trumpeter	*Cá ong*		x				
	Holotes sexlineatus	Grunt fish	*Ong hương*						XI-IV[c]
Priacanthidae	*Priacanthus brevirostris*	Bigeye	*Nóc 3 gai*						XII-VI[c]
Apogonidae	*Cheilodipterus lineatus*	Tiger Cardinal	*Cá sơn trăng*	x	x	x	x		I-IV[c]
	Apogon apogonides	Short toothed cardinal	*Cá sơn một màu*		x				I-IV[c]
	Apogon sp	Apogon	*Sơn*					1-12	
Sillaginidae	*Sillago sihama*	Silver sillago	*Cá đục biển*		x				
	Sillago maculata	Blotchy sillago	*Đục*					1-12	XII-II[c]
Sciaenidae	*Argyrosomus argenteus*	White croaker	*Đù bạc*						I-IV[c]
Carangidae	*Caranx sp*	Scad	*Khế/ Tráo*					6	
	Seriola aureovittata	Trevally	*Bò vàng*					5	
	Seriolina nigrofasciata	Blackbanded kingfish	*Cu cam*					1,5-8,10-11	
Leiognathidae	*Leiognathus decorus*	Shortnose ponyfish	*Cá liệt*	x	x				II-IV[c]
	Leiognathus sp	ponyfish	*Cá ngãng*					1-12	
	Leiognathus equulus	ponyfish	*Liệt chạng, Ngãng ngựa*						XII-V[c]
	Secutor interruptus	Soapy	*Liệt/ Ngang*						II-V, XII[c]

Gerreidae	*Gerres oyena*	Slenderspine pursemouth	*Cá móm*	x	x	x	x		II-V[c]
	Gerres filamentosus	Threadfin pursemouth	*Cá móm gai dài*	x	x	x	x		XII-IV[c]
	Gerres lucidus								II-V[c]
	Gerres sp	Grassfish	*Móm*					1-12	
Mullidae	*Upeneus moluscensis*	Goatfish	*Phèn một sọc*						V-IX[a]
Haemulidae	*Pomadasys maculatum*	Saddle grunter	*Sạo*					5-6	III-VI[b]
	Pomadasys hasta		*Sạo*					9	
Lutjanidae	*Lutjanus johnii*	Blackspot snapper	*Cá hồng chấm*	x	x			6,9-12	XII-III[a]
	Lutjanus vaigiensis	Yellowstriped snapper	*Cá hồng trơn*	x	x				
	Lutjanus argentimaculatus	River snapper	*Hồng*					1-11	XII-IV[c]
	Lutjanus fuscensces		*Hồng*						II-VII[b]
	Lutjanus erythropterus	Redfin snapper	*Hồng vây đỏ*						XII-III[c]
Sparidae	*Acanthopagrus latus*	Yellowfin seabream	*Tập/ Hanh*		x				
	Rhabdosargus sarba	Natal stumpnose	*Hanh*						III-V[b]
Monodactylidae	*Monodactylus argenteus*	Natal moony	*Cá chim trắng*		x			1,3-12	I-III[c]
Scatophagidae	*Scatophagus argus*	Scat	*Cá nâu*					4-5,9-10	XII-V[c]
Labridae	*Halichoeres hortulanus*	Wrasse	*Me*					1,5-10,12	V-VIII[a]
Mugilidae	*Mugil cephalus*	Flathead mullet	*Cá đối mục*	x	x	x	x	4-8,11	XI-III[c]
	Mugil kelaarti		*Cá đối lá*	x	x	x	x		XI-III[c]
	Mugil stongylocephalus		*Cá đối nhọn*	x	x	x	x		XI-III[c]
	Liza macrolepis	Large-scale mullet	*Rằng*					3-7,11-12	
	Valamugil cunnesius								X-III[c]
	Liza carinatus		*Đối lưng gồ*						XII-IV[c]
	Liza ceramensis								XII-IV[c]
	Mugil planiceps								XII-IV[c]
	Mugil sp	Mullet	*Cá đối*					1-12	
Sphyraenidae	*Sphyraena obtusata*	Obtuse barracuda	*Nhồng*					5-8,10	III-VI[b]
Eleotrididae	*Eleotris fusca*	Dusky sleeper	*Cá bống ao màu tối*	x	x	x	x	9	
	Butis butis	Duckbill sleeper	*Cá bống cau*	x	x				

Appendix B. Contnd.

ORDER/Family	Latin Name	English Name	Vietnamese names	Vinh Ha Fishing		Quang Thai Fishing		Phu Tan	
				Rainy	Dry	Rainy	Dry	Fishing Solar Mo.	Migration[1] Lunar Mo.
Gobiidae	*Glossogobius giuris*	Tank goby	*Cá bống trắng*			x	x	1-2	
	Oxyurichthys tentacularis	Goby	*Cá bống van mắt/Cá thệ*	x	x	x	x		
	Oxyurichthys opthlmonema	Eyebrow goby	*Cá bống ranh*	x	x				
	Oxyurichthys sp.	Goby	*Cá thệ chó*	x	x			1-12	
Siganidae	*Siganus guttatus*	Golden spinefoot	*Cá dìa chấm vàng/dìa sọc*	x	x		x	7	V-VIII[b]
	Siganus oramin	Rabbitfish	*Cá kình/Cá dìa*				x	2-12	II-VI[b]
Anabantidae	*Anabas testudineus*	Climbing perch	*Cá rô đồng*			x	x		
Belontiidae	*Trichogaster trichopterus*	3-Spotted gourami	*Cá thia tho*			x	x		
	Macropodus sp	Paradise fish	*Thia*					6	
Ephippidae	*Platax teira*	Longfin batfish	*Cá tràng, chim, tràn*			x			
Trichiuridae	*Trichiurus haumela*	Hairtail/cutlass	*Hố trắng*					5	I-III[a]
SCORPAENIFORMES									
Platycephalidae	*Platycephalus indicus*	Bartailed flathead	*Cá chai*		x			1-12	II-IV[c]
PLEURONECTIFORMES									
Bothidae	*Pseudorhombus cinnamoneus*	Lefteye flounder	*Cá bơn vi chấm hoa*		x				
Soleidae	*Synaptura polyzona*	Sole	*Bơn*					1-12	I-III[c]
	Solea humilis	Sole	*Vành/ bơn*					1-2,5-12	II-III[c]
TETRAODONTIFORMES									
Tetraodontidae	*Sphoeroides ocellatus*	Blunthead	*Cá nóc tròn sọc cung*	x	x				
	Tetraodon sp	Puffer	*Cá nóc*					4-8	XII-VII[c]
CRUSTACEA									
Order Stomatopoda									
	Squilla sp	Mantis shrimps	*Tôm tít (bọ sãi)*					5,7	II-VI[c]
Order Decapoda									
Penaeidae	*Penaeus monodon*	Tiger prawn	*Tôm sú*	x	x			1-12	X-III[b]
	Penaeus merguiensis	Banana prawn	*Tôm bạc*	x	x			3-11	X-II[c]

	Penaeus semisulcatus	Green Tiger prawn	*Tôm rằn*					2-10	X-III[c]
	Penaeus orientalis		*Tôm nàng*					2-7	
	Metapenaeus burkenroardi		*Tôm gân*				x	3-9	
	Metapenaeus ensis	Greasyback shrimp	*Tôm đất, Hoi, Chì*	x	x		x	1-12	
	Acetes sp.	Pelagic shrimp	*Khuyết*					3-5,8-10	X-III[a]
Infraorder Caridae	*Macrobrachium nipponese*	Macrobrachium	*Tôm càng*			x	x	4-6	
	Caridina sp.	FW Atyidae	*Tép nhỏ*			x	x		
Infraorder Brachyura									
	Scylla serrata	Mud crab	*Cua biển*		x			1-12	X-III[c]
	Portunus sanguinolentus	3-spot swimming crab	*Vọ/ Ghẹ 3 chấm*					2,4-9	XI-IV[c]
	Portunus pelaricus	Blue swimming crab	*Ghẹ xanh*						XII-V[c]
MOLLUSCA									
Class Bivalvia									
Order Veneroida									
Corbiculidae	*Corbicula moreletiana*		*Ốc nước lợ*	x	x				
Unionidae	*Meretrix meretrix*	Venus clams	*Trìa cát*		x	x	x		
Mactridae	*Mactra quadrangularis*	Surf clams	*Trìa bùn*			x	x		

[1] Migration denotes the lunar months when the species are migrating into the lagoon via the Thuan An Estuary (see **Migration of Marine Species into the Lagoon**)

[a] Species that enter the lagoon for a short duration and then return to sea

[b] Species that are present in the lagoon over the dry season and return to sea in the flood season

[c] Species that adapt into typical brackishwater species - they are present year-round in the lagoon

REFERENCES

Smith, M.M. and P.C. Heemstra. 1986. Smiths' Sea Fishers. Springer-Verlag. N.Y. 1047 pp.

Kottelat, M., A.J. Whitten, S.N. Kartikasari and S. Wirjoatmodjo. 1992. Freshwater Fishes of Sumatra, Borneo, Java and Sulawesi. Periplus Editions, Jakarta, Indonesia. 292pp.

Appendix C. Project People

PROJECT MANAGEMENT COMMITTEE MEMBERS

Prof. Dr. Võ Hùng, Project Leader, HUAF
MSc. Trương Văn Tuyển, Project Coordinator, HUAF
Prof. Dr. Nguyễn Thanh, HUS
Dr. Tôn Thất Pháp, HUS
Mr. Nguyễn Lương Hiền, DoF
Mr. Nguyễn Quang Vinh Bình, DoF

PROJECT MEMBERS

Hue University of Agriculture and Forestry - HUAF (*Đại học Nông Lâm Huế*)

MSc. Trương Văn Tuyển *
Dr. Trần Văn Minh *
MSc. Bùi Thị Tám *
Mr. Tôn Thất Chất *
MSc. Hoàng Nghĩa Duyệt *
MSc. Lê Đức Ngoan
MSc. Nguyễn Thị Thanh

Hue University of Science - HUS (*Đại học Khoa học Huế*)

Dr. Tôn Thất Pháp *
Dr. Võ Văn Phú *
Dr. Nguyễn Xuân Hồng *
Mr. Trần Văn Tuấn *
Mr. Lê Văn Miên *
Mr. Nguyễn Hữu Thông *
MSc. Lê Thị Nam Thuận *
Mr. Nguyễn Xuân Khoa *
Mr. Trần Thanh Bình

Thua Thien-Hue Department of Fishery - DoF (*Sở Thủy sản Thừa Thiên-Huế*)

Ms. Võ Thị Hồng *
Mr. Nguyễn Hồng Việt *
Mr. Nguyễn Quang Vinh Bình *

* Authors of papers included in this book

Project Administrator/Translator - Lai Thi Qúy Thu

PROJECT OFFICE

Hue University of Agriculture and Forestry
24 Phung Hung, Hue City, Viet Nam
Email: lagunhue@dng.vnn.vn

The work detailed in this book is the beginning of a challenging voyage.....

Attaining the goal of community based coastal resources management (CBCRM) is a very complex and long process. This book is not about implementing or developing CBCRM, but it is about:

- initiating research towards CBCRM
- approaching resource users and building a relationship based on trust and confidence
- identifying the issues and aspects that need to be examined before contemplating changes in management
- realizing how difficult participatory research truly is.

In this book, the reader may find descriptions of management changes developed by the researchers and fishers and farmers living around the lagoon; the challenges facing CBCRM efforts; livelihood issues of the people relying on lagoon resources; reviews of the history of resource management; problems with rapid aquaculture development; marketing studies; and much more.

The collection of papers describes the results of two years of participatory research conducted by an interdisciplinary team of researchers from the Hue University of Agriculture and Forestry, Hue University of Science and the Provincial Department of Fisheries. The research was funded in 1995 by the Canadian International Development Agency (CIDA) and the International Development Research Centre (IDRC) , through a joint national project called "Viet Nam Sustainable Economic Development (VISED).

Published by The Coastal Resources Research Network (CoRR), Dalhousie University, Canada.
CoRR is an IDRC-funded network which advises coastal projects and trains researchers in support of CBCRM.

Design : Carol Kennedy
Photographs: Veronika Brzeski