# Traditional use and availability of aquatic biodiversity in rice-based ecosystems

## V. Rice-fish farming tradition and current practices in northwestern Viet Nam [1]

by
Eric Meusch


Editors: Matthias Halwart & Devin Bartley
FAO Inland Water Resources and Aquaculture Service

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## INTRODUCTION

This study was done as part of the UNDP supported and nationally executed "Aquaculture Development in Northern Uplands" Project (hereafter referred to as “the Project”) which aims at poverty alleviation through building local capacity based on community participation to enable poor and remote ethnic minority groups to develop various forms of aquaculture in northwestern part of Viet Nam. The Project has selected 50 communes in 6 districts of Hoa Binh, Son La, and Lai Chau provinces. The Project’s strategy is to build capacity for the development of aquaculture by conducting study tours, training farmers and local area staff, and the “development and dissemination of appropriate aquaculture technology packages” to the poorest and isolated segments of ethnic communities. The strategy also includes selecting “Result Demonstration fish farming families” to serve as local models and ultimately act as commune level extension volunteers (UNDP, 1998). Rice-fish culture has been identified as one of the major technical focus areas of the Project along with pond culture, cage culture, and fish seed nursing.

The Project area includes the provinces of Hoa Binh, Son La and Lai Chau which are reputed for having a long history of practicing rice-fish culture. In a 1937 monograph on indigenous fish farming in Tonkin it was noted that rice-fish farming is a traditional practice particularly for the Thai minority in the uplands of Viet Nam: “an indigenous rice-fish culture system involving a local strain of common carp (*Cyprinus carpio*) was carried out in valleys in the mountainous areas of Northern Viet Nam by a Thai ethnic minority” (cited in Luu, et al. 1995). During a brief assessment conducted in 1994, Luu and co-authors concluded that traditional rice-fish farming had “largely ceased, following the formulation of cooperatives from 1963 to 1965 and their emphasis on rice.” The authors went on to speculate that traditional rice-fish may only exist in Hoa Binh and Son La and in Thai Nguyen province (Luu et al. 1995). During an FAO mission in March 2000 these observations on traditional rice-fish culture were confirmed and it was established that rice-fish farming has also been a traditional practice in all three communes served by the project in Lai Chau province.

The production potentials of various conventional rice-fish technical approaches are well known to national researchers, who have taken the environmental, social and economic benefits into consideration. Constraints to farmer adoption were identified to include lack of appropriate technology, lack of access to credit, uncontrolled use of pesticides, conflicting interests of water users, and localized problems such as flooding and theft (Cong, et al. undated).

The main objective of this study is to document indigenous knowledge on availability and use of aquatic organisms in rice-based farming in the northern uplands of Viet Nam[2]. By gaining a better understanding of traditional knowledge and practices the relevance and context of recent interventions can be better assessed and appropriate technical and management interventions be further improved.

## MATERIAL AND METHODS

This study was conducted using participatory techniques for information collection due to the specific nature of indigenous knowledge and the realization that “traditional” scientific approaches often exclude or have difficulty accessing this type of information. This is consistent with an overall increase in respect for knowledge of local people among researchers (Chambers 1983). Local peoples are often those most experienced in managing, harvesting and utilizing resources. Various techniques for accessing local knowledge have been developed such as Rapid Agroecosystem Zoning (RAZ), Rapid Rural Appraisal (RRA), and Participatory Rural Appraisal (PRA)[3]. These techniques are all cost effective, timely and involve using systematic, semi-structured activities carried out in the field. PRA adds the element of incorporating the knowledge of local people. Chambers (1994)

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[2] It is important to note that the term “rice-fish" in this study refers to aquatic resources management in rice-based production systems. This includes both capture and culture of aquatic organisms in both rice fields and other adjacent water bodies such as ponds or ditches.

[3] For more information on the subject see Conway and Barbier 1990; Chambers 1994; Beebe 1995; IIRR 1996.

describes PRA as " ...a growing family of approaches and methods to enable local people to share, enhance and analyze their knowledge of life and conditions..."

In order to assess and document the indigenous knowledge on the availability and use of aquatic organisms in rice-based farming systems, an approach that included three main components was developed and utilized. These three main components included:

- Assessment of the overall situation
- Village-level participatory inquiry
- Focussed interviews with key informants

An additional component was added to investigate the presence of traditional knowledge on aquatic resources use and management in rice-based culture systems in an area outside the project area. The area selected, based on a recommendation by RIA 1 researchers, was Thai Nguyen and Bac Kan provinces in the North-central part of the country. Also, a workshop was held to review initial findings and provide feedback on areas requiring further clarification.

Activities were coordinated and assisted by the management and staff of the Project. Support included local coordination, logistics and translation of field activities as well as written documentation.

**ASSESSMENT OF SITUATION OVERVIEW:**

At the beginning of the study key sites within the project area were visited to provide an overview of the current context of ricefield aquatic resource use and management. This activity took place during the first mission conducted from 26 January to 10 February 2002. Farmers were visited in Son La (Son La town and Thuan Chau district), Lai Chau (Tuan Giao district) and Hoa Binh (Mai Chau district) provinces. Farming households, both “project” and “non-project” were interviewed about rice farming practices, experience in culturing fish, and the importance of other aquatic resources from the rice fields. Field visits were conducted to view farming systems where farmers were conducting activities. Discussions were also held with members of the Project Provincial Implementation Units and, in the case of Lai Chau, Provincial Women’s Union Representatives.

**VILLAGE-LEVEL PARTICIPATORY INQUIRY:**

Structured, participatory village-level activities aimed at gaining a better general understanding of the local context were conducted in selected areas. The villages were selected based on the following criteria:

- The villages were located in areas that were visited during the initial assessment
- The villages represented rice-based production scenarios typical of their area
- Logistics to arrange village-level activities were possible and practical
- Both project target villages and non-target villages should be included

Villages selected included (map):

- Bung Village, Bung Lao Commune, Tuan Giao District, Lai Chau Province
- Tong Village, Son La town, Son La Province
- Mon Village, Thom Mon Commune, Thuan Chau District, Son La Province
- Mai Village, Van Mai Commune, Mai Chau District, Son La Province

Activities began by developing an understanding of general information about village features and history, and then focused on specific activities conducted in the village and the range of aquatic resources utilized and viewed as important by the villagers. Annual calendars were developed to provide an introduction to production systems (including aquatic production) and a comparison of past and present aquatic-resource management practices was conducted. Because the villagers were becoming increasingly busy with rice cultivation, village level activities were be limited to two days per village (for an overview of the methodology see Tables 1 and 2). Participant groups included a cross section of local rice farming households with special emphasis given to the presence of key informants with particular indigenous knowledge irrespective of their participation in project activities. These groups included commune representatives and groups of villagers with men and women, young and old, fish farmers and non-fish farmers. The village-level groups of participants ranged from 15-25 people.

The group that facilitated the activities consisted of a Core team[4] and support/collaborative members of the Provincial Implementation Unit from the province in which the activity was taking place. In villages that were participating in Project activities, the Commune Action Group was instrumental in arranging local activities. Meetings were held before and after each village activity to review and discuss progress and make adjustments required to improve facilitation. Because of these meetings, methodology and techniques for conducting the village activities were refined and improved from village to village.

**Table 1** Methodology framework for village-level participatory activities

| | **Geography/ Hydrology** | **Livelihoods** | **Rice farming system** | **Aquatic resources (including aquaculture)** |
|---|---|---|---|---|
| **Information** | Local topography and water bodies, | Village history<br>Sources/seasonally of livelihood | Cropping practices, varieties, techniques<br>Changes in history & trends | Main wild species, where/when/how/who?<br>Local migration paths<br>Culture species/techniques<br>Management practices<br>History of culture |
| **Methods** | Village (resource) mapping | Historical timeline<br>Activity identification<br>Activity prioritization<br>Seasonal calendar | Historical timeline<br>Seasonal calendar<br>Context matrix | Resources identification<br>Prioritization of importance/preference<br>Historical timeline<br>Seasonal calendar<br>Context matrices |

[4] The Core team consist of the International Consultant (Mr. E. Meusch), the National Consultant (Dr. Tran Mai Thien), and the Technical Expert from RIA 1 (Mr. Bui Huy Cong). Mr Nguyen Song Ha**,** Secretary and Interpreter Project Management Unit, also played an important role with ongoing translation and facilitation support.

**Table 2** General description of activities conducted:

| Activity | Description | Participants |
|---|---|---|
| **Aquatic resources mapping** | Drawing a map with participants to show various water sources used in relationship to the village. Distances, access rights, etc should be emphasized. This is done by asking participants to draw features on a piece of paper.<br>The time-line and mapping exercises were conducted simultaneously in two groups, which then reported back to each other. | Mixed small groups |
| **Village time line** | Developing a temporal framework for discussing changes/key events that have taken place in lives of villagers. A time line will be drawn by marking key events and writing a brief description.<br>The time-line and mapping exercises were conducted simultaneously in two groups, which then reported back to each other. | Mixed small groups |
| **Activity identification** | In a group session the participants are asked to list (in no specific order) activities (both economic and non-economic) that people do throughout the year.<br>Examples of economic activities might include tending livestock or gathering fuel wood.<br>Examples of non-economic activities might include religious or cultural events. | Plenary session with all participants. |
| **Activity prioritization** | Using the list of activities, sub-groups will be asked to prioritize them in terms of order of importance. These sub-groups should be based on gender (i.e. men and women in different groups). Results reported back to the larger group. | Gender groups |
| **Aquatic resource identification** | In a group session the participants are asked to list (in no specific order) aquatic resources (organisms including fish, plants, amphibians, invertebrates) that people harvest and use throughout the year. | Plenary session with all participants. |
| **Aquatic resource prioritization** | Using the list of aquatic organisms, sub-groups will be asked to prioritize them in terms of order of importance. These sub-groups should be based on gender (i.e. men and women in different groups). Results will be reported back to the larger group. | Gender groups |
| **Seasonal calendars** | Using the key activities and aquatic resources seasonal calendars were constructed in mixed groups.<br>One group was asked to develop a calendar for rice production and other prioritized production activities (i.e. livestock , upland crops, vegetables, etc.).<br>One group as asked to develop a calendar for fish culture (pond and rice field, various capture activities, etc).<br>Each group reported results back to the larger group. | Mixed small groups. |
| **Context matrices** | Participants were asked to develop a matrix to show various trends in the development of aquaculture, focusing on rice-fish culture. In a plenary discussion participants defined “traditional” vs. “new” and agreed which perimeters would be used for comparison (i.e. seed supply, feeding, harvest, etc).<br>Following development of the matrix, participants were asked to work in small mixed groups discussing and completing the matrix.<br>Results of the group sessions were reported back and discussed by the larger group. | Plenary session with all participants.<br>Mixed small groups. |

### FOCUSED INTERVIEWS WITH KEY INFORMANTS:

Following the village-level activities, specific issues were selected for more detailed follow-up and clarification with individual farmers. These activities were conducted in Son La province due to logistical consideration and the fact that most issues identified during previous activities were represented in Son La. Key informants were identified who had knowledge of local aquatic resource management and aquaculture practices, as well a good understanding of the historical context of these practices. In some cases the informants were selected though consultation with village and commune leaders, in other cases follow-up visits were arranged with individuals met by the Consultant during previous missions. In most cases these informants were elderly men, but some women were also interviewed.

### OUTSIDE PROJECT-AREA ACTIVITIES:

It was agreed that Thai Nguyen and Bac Kan provinces would be visited to gain a better understanding of traditional practices in ricefield aquaculture outside of the project area (see Figure 1). These areas have a very strong reputation of having long traditions of practicing aquaculture. In these areas focused interviews were conducted with key informants. It was originally planned that full village-level participatory inquiry activities would be conducted similar to those held in the project area. This, however, proved not to be practical due to the fact that without local contacts (such as in the Project area) it is more the difficult and time consuming to arrange group activities. This issue was further complicated by the fact that most villagers were busy transplanting rice, therefore in the fields rather than at home, and had little free time to participate. This being the case, individual farmers who were considered local experts were located through Provincial Extension Officers and interviewed. Also, farmers who appeared to be practicing rice-fish culture were interviewed in their fields by the side of the road.

### WORKSHOP TO REVIEW INITIAL FINDINGS

A workshop was held in Hoa Binh to review the initial findings of the study. Following the completion of the first draft report, it was decided that the report would be circulated for comment. To facilitate this process, the workshop was conducted to allow various parties to comment and discuss issues raised. This workshop included 30 participants consisting of farmers, members of the Project's Provincial Implementation Units, and technical experts from RIA 1 and surrounding provinces.

Following the workshop, key points raised were followed up with key institutions and various informants with relevant experience. This follow-up included consultations with farmers, commune representatives, various specialists at RIA 1, and other projects.

### VERIFICATION THROUGH TRIANGULATION OF INFORMATION:

One important element of employing participatory methods such as those used in this study is that of confirming and validating responses. Because information gathered is anecdotal and sample sizes are determined by factors other than statistical viability, conformation and validation cannot be achieved by using typical analysis. Rather, to confirm information gathered through participatory methods, the validation technique of triangulation is used. Triangulation is done by approaching a topic from a number of different points of view using various techniques. If responses from numerous informants responding to different techniques and approaches remain consistent, it can be assumed that the information given is reasonably valid.

## RESULTS

### RESULTS FROM ASSESSMENT OF SITUATION OVERVIEW

Overview assessment activities reinforced the secondary information indicating that there is unique indigenous knowledge about ricefield fish culture in the project area. Even though this seemed to be the general case, there were notable differences from village to village and province to province. In

Son La province farmers were much more specific about the practices that were considered traditional than in Lai Chau and Hoa Binh provinces. In the latter two farmers know a great deal about aquaculture and were familiar with aquaculture systems, but were not as specific about what could be called "traditional" as the farmers in Son La. Details of results from the situation overview are included in Table 3.

**Table 3** Summary of results from the situation overview.

| | |
|---|---|
| **Son La Province** | Fish farming households in selected locations around Son La town and in Thuan Chau district were visited. It was estimated that as many as half of the households in the villages visited culture fish. There are currently projects, both locally and internationally funded, supporting aquaculture, but one respondent claimed that people have been raising fish since the French colonial period (i.e. at least 60+ years).<br><br>Near Son La town in Ban Tong Village fish are raised in ponds and in paddies. Species reported included common carp, crucian carp, mrigal, silver barb, silver carp, tilapia, and grass carp. The common carp and crucian carp are produced locally using "traditional" techniques, while the other species are purchased from a fish seed company. "Traditional" practices for rice-fish culture include raising dikes and putting a small pond with a bamboo fence in one corner. Fish are released into the paddy after transplanting the rice and some are harvested after the first rice crop, some are kept for further culture during the second crop (typically two crops are grown). "New" practices include digging trenches, stocking grass carp in-between rice crops, and supplementary feeding of rice and corn bran. It was estimated that half of the 185 households in the village culture fish, and many of whom culture fish in rice fields.<br><br>In Thuan Chau district the responses were very similar to the area around Son La town. It was estimated that 70/260 households in Chieng Pac Commune practice ricefield fish culture, and "many" households culture fish in Tong Lenh Commune. People were familiar with growing fish in ponds as well as rice fields and produced certain species (common carp and crucian carp) locally using traditional methods. Thuan Chau differed from the area near Son La town in that there was a market for local varieties of fish seed. This is possibly due to being further away from a fish seed supplier that is located in Son La town.<br><br>Wild fish reported included common carp, crucian carp, snakehead, clarias catfish, swamp eels, and gobies. It was also mentioned that certain wild vegetables are also collected from the rice fields and other swampy areas. |
| **Lai Chau Province** | In Lai Chau province, three different locations were visited in Tuan Giao district (Noung Giang Village, Quai Nuac Commune; Quai Cang Commune; and Bung Village, Bung Lao Commune). Fewer households in the Tuan Giao area were reported to culture fish in rice fields than in Son La. Most households have ponds and people were aware how to spawn common carp and crucian carp, but ricefield aquaculture is not as typical. Many practicing rice-fish culture are following "new" recommendations (digging trenches, liming, supplemental feed, improved/exotic species), having given up the traditional culture for the better production on the newer techniques and management practices.<br><br>Wild fish were reported to have once been abundant, which was given as a reason why aquaculture had not been important in the past. One estimate was that the wild fish had reduced by 80% in the last 10 years in the river and streams, and that the ricefield fishery had not been viably productive for 15 years. One respondent mentioned, however, that although the fishes have declined that freshwater clams and snails were still relatively abundant. |
| **Hoa Binh Province** | In Hoa Binh Province, Mai Chau district was visited. Many of the communes in Mai Chau are of Thai ethnicity and seem to have a long tradition of fish culture. Every household has a pond near the house and there are very sophisticated flow-through systems using ditches and bamboo pipes providing water to the rice fields and household ponds. None of the respondents in this area claimed to have practiced rice-fish culture previous to the recent promotion by the project. It was reported that tilapia had been grown in the paddies by some, but that it was not very productive and practiced by few (tilapia were reported to have arrived in the 1960s).<br><br>Although pond culture is obviously well established, the farmer interviewed seemed to feel that "traditional" methods were not productive and that the "new" methods promoted by the project have increased production greatly. The main difference reported between "traditional" and the "new", however, simply amounted applying lime and using composted manure rather than fresh manure. This that farmers may actually know a substantial amount about fish culture, which based on observation appears to be a great deal more than revealed in the initial interviews.<br><br>Similar to Lai Chau, many of the respondents thought that rice-fish culture had not been practiced in the past because of the abundance of wild fish in the rice fields. It was estimated that the capture fishery had begun to decrease about 10 years ago, but had decreased dramatically in the last 5 years. A wide variety of species of fish, as well as fresh water clams, snails, crabs, and wild vegetables were reported to be commonly taken from the rice fields.<br><br>With regard to traditional knowledge on aquatic organisms one farmer reported that species stocked in the family pond included 'Ca Bong' which is an indigenous fish species, the seed of which is gathered in a nearby stream. |

Following these activities conducted during the first mission, the second mission was planned to continue to investigate the level and types of traditional knowledge that exist, any differences between areas, as well as specific practices that can be investigated further in future missions. It was recommended that further missions include village-level participatory activities to provide further clarification of the issues mentioned above.

## RESULTS FROM VILLAGE-LEVEL PARTICIPATORY INQUIRY

The village level participatory inquiry activities were designed to provide general information about the village, its history, local livelihood strategies, the importance of aquaculture and aquatic resources, and any trends in aquaculture development and aquatic resources use. Given the open and wide-ranging nature of the responses, the results of the participatory inquiry activities do not easily lend themselves to statistical analysis, but rather provide a better overall understanding of the local context based on the experience of local people. Details of the results from participatory inquiry activities are included in Appendix A.

### Historical context

The historical information provided by the villagers in the time-line and other activities showed a pattern that was fairly consistent among the villages participating. These generalities are included in Table 4 below.

**Table 4** General historical trends in participating villages.

| | |
|---|---|
| Pre 1954 | • Basic infrastructure such as main roads<br>• Limited rights over land use and management of production<br>• Traditional agriculture, mostly one, rainfed crop of rice<br>• Little irrigation other than “traditional” systems supplying small areas |
| 1960-1970s | • Collectivization of agriculture<br>• Infrastructure improved<br>• Irrigation systems improved and expanded<br>• A general move to double cropping of rice and improved rice varieties<br>• Disruption of villagers’ livelihoods and well-being as of result of bombing |
| 1980s-2000 | • Reformation of agriculture devolving management of production to the household level<br>• Continued infrastructure development<br>• Continued expansion of irrigation<br>• Continued intensification of techniques to increase agricultural production |

### Local livelihoods:

When asked to brainstorm about the activities conducted in the village, participants from the four villages came up with quite expansive and variable results. The total number of activities listed ranged from 42 to 59. Some villagers tended to group activities rather than split them into separate

activities (i.e. “raise poultry” rather than “raise chickens” and “raise ducks”). Some village groups included numerous non-economic activities such “visit the ill”, “weddings”, etc., while others focussed on economic activities such as types of production (i.e. crops and livestock) and vocations (i.e. weaving and carpentry). The activity provided valuable insight into the complex nature of livelihoods in the project area and a better general understanding of importance of aquaculture and aquatic resource related activities in relation to other activities. Some example activities and their ranking by village and gender are provided in Table 5.

**Housing** (or the provision thereof) was ranked first in almost every exercise, and was ranked most important by all the women’s groups. In the men’s groups, however, two of the groups chose to rank it somewhat lower.

**Rice production** was consistently, and not surprisingly, ranked in the top ten and is clearly one of the most important activities in the villages that participated. Planting upland crops such as corn and cassava was also given a constantly high prioritization. It was in the top ten in all groups except two, which ranked it eleventh.

**Production of livestock** such as buffalo and cattle, pigs, chickens and ducks was ranked fairly consistently in the top 15 activities. Of these, buffalo and cattle tended to rank slightly higher than the others.

**Aquaculture** as an activity ranked similarly to other types of livestock and could typically be found in the top 15 prioritized activities. Overall, it tended to be ranked at least slightly lower than other types of livestock, although this is fairly variable between villages. In Bung village, Lai Chau province, for example, aquaculture was ranked quite low in comparison with other livestock, whereas in Van Mai commune in Hoa Binh provinces aquaculture ranked higher than all others except buffalo and cattle.

**Fishing** was consistently ranked quite low and in one village it was not even listed as an activity that is conducted in the village. It might be more important to note, that although it was given low priority, it was included as a activity by 3 of 4 villages, a fact which shows that it still maybe more important than may generally be assumed.

**Table 5** Example Activity Prioritization results[5]

| Activity | Bung/ men | Bung/ women | Tong/men | Tong/ women | Mon/ men | Mon/ women | Van Mai/ men | Van Mai/ women |
|---|---|---|---|---|---|---|---|---|
| Housing | 1 | 1 | 11 | 1 | 1 | 1 | 12 | 1 |
| Rice production | 3 | 2 | 1 | 3 | 3 | 2 | 1 | 2 |
| planting fruit trees | 13 | 10 | 2 | 23 | 5 | 12 | 29 | 18 |
| maintaining irrigation system | 5 | 12 | 3 | 22 | 8 | 24 | 15 | 22 |
| raising buffalo and cattle | 7 | 7 | 10 | 6 | 10 | 13 | 4 | 5 |
| raising pigs | 6 | 8 | 4 | 5 | 11 | 16 | 6 | 7 |
| raising chickens | 6 | 8 | 6 | 8 | 12 | 17 | 7 | 8 |
| raising ducks | 6 | 8 | 6 | 7 | 13 | 15 | 7 | 8 |
| **raising fish** | **15** | **14** | **5** | **11** | **14** | **14** | **5** | **6** |
| upland crops | 4 | 9 | 8 | 4 | 2 | 11 | 11 | 9 |
| growing vegetables | 14 | 11 | 7 | 9 | 15 | 10 | 22 | 27 |

[5] Activities were ranked in order of importance, with 1 being assigned to the most important, 2 the second most important, etc. In villages were activities were grouped, all of the activities were given the same score (i.e. pigs, chickens, ducks in Bung village). Theses were listed individually for easier comparison with other groups. Activities that were not ranked are signified with “na”.

**Table 5** Example Activity Prioritization results[5]

| Activity | Bung/ men | Bung/ women | Tong/men | Tong/ women | Mon/ men | Mon/ women | Van Mai/ men | Van Mai/ women |
|---|---|---|---|---|---|---|---|---|
| weaving | 19 | 25 | 13 | 16 | 17 | 8 | 26 | 24 |
| hired labor | 32 | 15 | 38 | na | 44 | 50 | 31 | 43 |
| **fishing** | **25** | **34** | **25** | **49** | **na** | **na** | **36** | **44** |

### Aquaculture and aquatic resources

Participants in all villages were able to list large numbers of aquatic organisms that are used locally. Men and women then prioritized this list and a short list of the most important aquatic organisms was agreed[6]. These lists originally consisted of all aquatic organisms including both capture and culture fish, non-fish aquatic animals, aquatic plants, and in some cases insects. These organisms come from the range of water bodies available to the village including ponds, paddies, streams, etc. Even in Mon Village, where fishing was not ranked as an important activity, numerous non-culture aquatic organisms were included.

Table 6 below provides some examples of aquatic organisms that were ranked as the most important by villagers. In general, fish that are cultured in ponds and rice fields were considered most important, followed by various wild fish, non-fish aquatic animals and aquatic plants, both cultivated and wild.

It is interesting to note that in Mon village all of the short-listed species were produced in culture systems even though the list includes traditionally non-cultured organisms such as shrimp, snails, and mussels. When asked if they considered these species as by-catch, the participants claimed that they actively manage them in the culture system, especially in case of snails and mussels. One respondent mentioned that maintaining such organism in a pond is beneficial to the water quality.

Another interesting practice was described in Van Mai commune. The villages in Van Mai have a history of capturing two species of local fish from a nearby stream that is a tributary of the Song Ma River. *Ca Bong* and mud carp ranked very high in importance, but are considered culture rather than capture species. The fish are captured from the wild as fingerlings and then nursed to be stocked in ponds for continued culture.

**Table 6** Most important aquatic resources as prioritized by participants.

| Tong Village (short-listed 17 out of a total of 50) | Mon Village (short-listed 13 out of a total of 37) | Van Mai Commune (short-listed 15 out of total of 64) |
|---|---|---|
| Grass carp | Common carp | Ca Bong |
| Common carp | Grass carp | Grass carp |
| Mrigal | Mrigal | Mud carp |
| Tilapia | Silver barb | Common carp |
| Crusian carp | Tilapia | migal |

[6] A short list of aquatic organisms was not developed in Bung village.

**Table 6** Most important aquatic resources as prioritized by participants.

| Tong Village (short-listed 17 out of a total of 50) | Mon Village (short-listed 13 out of a total of 37) | Van Mai Commune (short-listed 15 out of total of 64) |
|---|---|---|
| Swamp eel | Shrimp | roho |
| Pa Pom | Catfish | crucian carp |
| Pa Sam | Swamp eel | Frog |
| Tiger frogs | Snails | Smaller frog |
| Shrimp | Mussels | Smaller frog |
| Mussel | Morning glory | Shrimp |
| Water crest | Celery | Snail |
| Celery | Watercress | Morning glory |
| Morning glory | | Celery |
| Phac Ben | | watercress |
| Duckweed | | |
| Xay grass | | |

Note: Bung Village listed a total of 44 organisms, but did not develop an agreed short-list.

One constraint encountered during this activity was the use of common names of organisms in local languages. Many of the species listed were unidentifiable because of this problem. As is often the case when common names are used as anecdotal evidence without specimens, translating them into another language (i.e. another common name) may further confuse the situation. In such cases then applying a scientific name is based largely on speculation. A summary list of aquatic organisms listed by participants is included in Appendix B.

### Seasonality of aquatic production

Respondents generally described the year as consisting of four seasons; winter (November to January), spring (February to April), summer (May to July) and autumn (August to October). Most rainfall comes during the period from April to August with the heaviest rains coming in July.

In most cases, rice farmers in the project area practice cultivation of two crops of rice, the spring crop (March to June) and a summer crop (June-October). The winter period from November to February is a fallow period for the rice fields. The spring crop is irrigated and the summer crop is rain-fed. In areas where irrigation is not possible, only the summer rainfed crop is grown. Upland crops are grown during the middle part of the year taking advantage of the rainfall during that period.

Fish culture in the rice fields begins in March with attaining fish seed (often common carp eggs) which are stocked and nursed in the spring crop of rice. At harvest time, fish are held in a refuge or moved to a pond while the field is prepared for the second crop. Fish are then stocked back into the fields during the summer crop for continued grow-out. Partial harvesting often takes place during the grow-out period and the fish are harvested completely at the end of the summer rice crop. Fish that are not sold or consumed by the family are often placed in ponds for continued culture or to be held as broodstock.

In some cases it was reported that fish are moved back and forth more frequently because of a practice of reducing the water in the rice fields to induce the rice to flower. There were also some reports of flooding the rice fields during the winter fallow period for continued culture of fish.

Fishing and foraging for wild aquatic organisms was reported to occur on a low level and take place throughout the year. Most of the fishing activity in the rice fields was reported to be during the rainy period from April to August, while most of the fishing activity in streams was reported to take place before or early in the rainy season. This is possibly because the low water level makes targeting fish easier than when the water level is high.

### Historical trends in aquaculture and aquatic resources use

In all of the villages that participated in this activity there has been a general trend from very extensive, “traditional” fish culture practices to more intensely managed systems using newer, technology-based practices. There are a number of reasons why these changes have taken place, but those most reported include:

- decreases in availability/capture of wild fish,
- increased availability of seed of various non-traditional culture species,
- better access to information,
- production for sale rather than home consumption.

The changes in the fish culture practices are consistent with changes that occurred in other types of agricultural production where there has been a focus on increasing production. Previous to 1960, rice production was still practiced in a traditional manner. Local varieties of rice were used, irrigated areas with double-cropping were limited, and only local inputs were used. In the early 1960s with the beginning of collectivized production, efforts were made to improve the overall productivity of rice production. Improved varieties of rice were used, irrigation was expanded and improved, and agricultural chemicals came into use for fertilization and pest management. Since the mid 1980s when households gained the right to manage production, the trend toward increased production continued as families tried to make a living on relatively small plots of land. Table 7 shows some examples of changes in rice varieties provided during the village-level activities.

**Table 7** Examples of traditional and introduced rice varieties.

| Traditional/introduced | Varieties | General characteristics |
|---|---|---|
| Traditional rice | Tan ngan<br>Tan chuem<br>Khau La<br>Khau pot<br>Khau bong | • Long stem: 1.2-1.5 m<br>• Low density: 20-30 hills/m2<br>• Low yield<br>• Requires few inputs<br>• Seed can be kept for next crop<br>• High quality (favorable taste) |

**Table 7** Examples of traditional and introduced rice varieties.

| Traditional/introduced | Varieties | General characteristics |
|---|---|---|
| Introduced rice | Chinese hybrid<br>CR203<br>N44<br>N352<br>Bao Thai<br>San Uu 63<br>Bac Uu 63<br>IR64 | • Short stem: 0.9-1.2 m<br>• High density: 40-45 hills/m2<br>• High yield (ca. 6 ton/ha)<br>• Requires high fertilizer inputs and pest control<br>• Seed must be purchased (for hybrid varieties)<br>• Lower quality (less favored taste) |

In the case of ricefield aquaculture, it has not always been a constant progression from traditional practices to newer practices, but rather in some areas the extension of new practices has catalyzed a revival of interest in ricefield aquaculture. Several areas reported that there had been a decrease in ricefield aquaculture over the last 10 or 20 years, largely due to increased use of agricultural chemicals in rice production and increasing problems with theft. Recently, however, ricefield aquaculture has been increasing again, largely because of continuing declines in local capture fisheries and the fact that new aquaculture recommendations have the potential to increase production to a level that increased management required to solve various problems is worth the time and investment.

Traditional fish culture was described as very extensive. Seed was obtained either by collecting it from the wild or natural spawning of common carp and crucian carp being held in ponds. Fish were stocked in paddies or ponds to be collected for consumption at a later date. There was very little management other than maintaining the water level. During the period of collectivization farmers began to intensify their culture practices in ponds. Fish seed of species such as grass carp became more available and people began buying seed for stocking in ponds using supplemental feeding. Most recently there has been continued intensification in management such as using lime in pond preparation and for disease control, and intensifying ricefield culture by using more species such as improved common carp, tilapia, Indian carps and Chinese carps, and modifying the rice fields with trenches or refuges.

Stocking was the key element that defined most of the traditional culture systems. Other than stocking of fish, there was very little intervention on the part of the farmer other than maintaining water levels. There were a number of different stocking scenarios described in the traditional systems including:

- Stocking wild caught fish
- Stocking eggs of common carp and crucian carp that had been collected in the wild (see Box 1)
- Stocking eggs of common carp and crucian carp collected by placing of artificial substrate in streams
- Stocking eggs of common carp and crucian carp collected by placing artificial substrate in household culture ponds
- Stocking fingerlings nursed in rice fields that had been produced by collecting eggs
- Stocking gravid adults to spawn in rice fields.

Currently farmers are intervening beyond simply stocking seed and maintaining water. They now prepare ponds and paddies using lime and manure and they feed various types of supplemental feeds (typically agricultural by-products). Seed is often purchased and includes species that are only

produced at governmental or commercial hatcheries such as tilapia, grass carp, Indian carps, silver barb, silver carp, and bighead carp. Seed are stocked in a polyculture at deliberate rates being extended to farmers. Some of the local production of common carp, crucian carp and tilapia takes place and these seed are available locally.

Respondents claimed that fish disease is a relatively new problem. Red spot disease became a problem with grass carp in the early 1990s and has remained an important issue leading to specific measures to attempt control such as frequent liming.

Fish theft and the use of pesticides were also reported as problems in relatively recent times (within the last 20 years or so). Both of these issues are claimed to be the main reasons for decline in traditional ricefield fish culture in many areas. Farmers are currently addressing these issues by building field houses near their rice fields so they can guard against theft and practicing Integrated Pest Management (IPM) to reduce the harmful impacts of pesticides and other agricultural chemicals.

Another significant change reported was in the types of water bodies used for fish culture over the years. Traditionally, fish were cultured in rainfed rice fields with no improvements such as trenches or refuge ponds. Before the 1960s there was a much smaller area under irrigation, as traditional irrigation systems were typically very small scale. Trenching and digging refuge ponds in rice fields did not become a common practice until the 1990s. There were reportedly very few ponds until 30-40 years ago, and most of these were regarded as community ponds. Apparently under the French colonial government, farmers did not have the right to dig household ponds without consent of the landlord. This varies to some extent from location to location, but for the most part there were much fewer ponds than there are today. Currently it is common for almost every household in many communities to have at least one pond. The increase in numbers of household ponds has largely taken place in the 1970s and 1980s. A summary of characteristics of traditional and modified aquaculture systems is provided in Table 8.

**Table 8** Example characteristics of traditional and modified aquaculture practices.

| Traditional/modified | General characteristics |
|---|---|
| Traditional aquaculture | • Local species such as common carp and crucian carp<br>• Fish seed locally accessible<br>• Typically practiced in unimproved rice fields (fewer ponds existed)<br>• No supplemental feeding<br>• No disease problems<br>• Stocking rates and size not standardized (production per area rather than production per unit seems stressed)<br>• Low fish yields<br>• High quality product for home consumption (small size, but favored taste)<br>• Little labor and no cash inputs (no paddy or pond preparation, no feeding) |

**Table 8** Example characteristics of traditional and modified aquaculture practices.

| Traditional/modified | General characteristics |
|---|---|
| Modified aquaculture | • Many non-local and exotic species used such as Indian major carps, Chinese carps, tilapia, and hybrid common carp<br>• Fish seed produced in centralized hatcheries (typically at provincial level)<br>• Grown in household ponds and rice fields with improvements such as raised dikes and refuges<br>• Supplemental feeding<br>• Disease is a growing a problem in some species (e.g. red spot disease in grass carp)<br>• Stocking rates and sizes standardized (stressing good production per unit, while maintaining production per area)<br>• High fish yields<br>• Often produced for sale, some species considered lower quality (less favored tastes)<br>• High labor and cash inputs (fish seed, pond/paddy preparation, feed) |

## RESULTS FROM FOCUSED INTERVIEWS WITH KEY INFORMANTS

The interviews with key informants provided more detail and clarification to many issues that had emerged and been discussed during the village level activities. This not only provided details that were not easily covered in the group activities at the village level, but also provided an important opportunity for triangulation and clarification of many issues that have been implied during the village activities.

### Fish seed production

One traditional practice that seems fairly specific to the areas visited in Son La was a method of incubating common carp and crucian carp eggs for culture in rice fields. It was described as the “dry method” and was one of the traditional methods obtaining fish seed. A description of this method is provided in Box 1.

**Box 1**: Incubating common carp (or crucian carp) eggs via the “dry method”.

1. Collect eggs by placing substrate in stream or pond when common carp are spawning.
   - Carp are likely to spawn during a heavy rain following a period of hot, still weather
   - Substrate is made by placing rice straw or the roots of aquatic plants in a piece of split bamboo (see photo 1). This bamboo is then tied to a stake at the water’s edge, lying on the surface of the water perpendicular to the shore.
   - The substrate is checked frequently for eggs.
2. The substrate is collected and put in a shady place out of the water. It was sometimes taken to the house to be placed in a cloth bag, sometimes placed on the ground and covered with leaves.
3. Water is sprinkled over the substrate 2-5 times a day to keep it moist.
4. The eggs are incubated 2-3 days before placing back into the water for hatching.
   - The development of the larvae is monitored through visual observation. When the larvae develop (the eye and spinal cord visible) it is placed in the water.
   - Hatching is typically done in a rice field that has been specially prepared for nursing the fry (see photo 2).
   - When placed in the water for hatching, the eggs and newly emerged larvae must be protected from the sun.

The advantage of using this system is an improved hatching rate of the eggs. Farmers claim that they would only get 20% survival of eggs if they incubated in water, whereas they get 90% by incubating out of water. One informant said that he did not understand why it worked better, but that eggs incubated in water “turned white”. (White eggs are usually those that were not properly fertilized by sperm or killed early in development, this could also be describing a fungus infestation.)

It was not possible to observe this technique being used because the season for collecting carp eggs had already passed. It was noticed, however, that substrate material that had already been used was laying discarded near paddies in several places visited. This fact reinforces that this traditional method of seed production is still fairly commonly practiced.


A farmer demonstrates the construction of substrate for collecting fish eggs.

**Rotational rice-fish culture**

Another activity that is being practiced in the Son La area is the culture of fish in rice fields in rotation with rice. The rice field is flooded during the winter months when the rice fields are fallow and there is little competition for irrigation water. Very advanced fingerlings (100-200 grams/fish) of grass carp are stocked following harvest of the summer crop (October) to be cultured until it is time to prepare the field for the spring crop (January). Fish are reported to grow very quickly in the rice fields feeding on weeds and rice stubble with less need for supplemental feeding. After the period in the rice field the fish are moved to a pond to be held for continued culture and later sales. Although this practice avoids competition with rice for water and space, it does have to compete with local cage culture producers for large grass carp seed. Obtaining seed of the proper size was mentioned as one of the main constraints.

Rotational rice-fish culture is not considered to be a traditional practice, nor has it been part of a technical extension package. What it represents is farmer innovation combining traditional knowledge and personal experience in aquaculture to use the system in innovative ways to produce fish.

Rice field that has been modified into a nursing pond for locally spawned common carp. The fence is used to exclude ducks and the stakes in paddy are deterrents to poachers.

**Maintaining by-catch species**

Villagers in Mon village claimed to maintain stocks of snails and mussels in their household ponds. This was done by actively stocking snails and mussels into the ponds, and making sure that some are returned following any pumping or dying of the pond. In most other areas, with the exception of Bung village, there was no knowledge of such a practice, and these organisms were considered to be purely by-catch.

During an interview in Mon Village with a key informant it was explained again how snails and mussels are often stocked into household ponds. Although shrimp are usually in the pond systems as well, they enter with water during filling and are considered by-catch. Snails and mussels are actively put in the pond, sometimes following a fishing activity when too few are gathered for a meal, or when those gathered are too small. They will be thrown into the pond for future use. Once snails and mussels are established in a pond they will maintain a population even when the pond is drained and cleaned between fish crops.

A mussel collected from a household pond.

## RESULTS FROM THAI NGUYEN AND BAC KAN PROVINCES

Activities in Thai Nguyen and Bac Kan provinces showed that they do indeed have a strong tradition of ricefield fish culture. Common carp and cruising carp seed is produced locally, grown out in paddies, and then harvested or overwintered in ponds. The practices in Thai Nguyen and Bac Kan are very similar to those in Son La.

One main difference is the practice of spawning carp in ponds by placing broodstock in prepared rice fields to spawn. The broodfish are then removed, the eggs are incubated, and the fry are nursed in the paddy. Broodstock are selected from fish that have been overwintered in ponds. One informant said that a traditional indicator of when to start spawning fish was when the lemon trees blossom in approximately mid-to-late March (apparently many people did not follow this tradition because several farmers visited had already spawned and the trees had not yet bloomed). It was mentioned that previously eggs or broodstock could be captured from the wild, but the wild fishery was now so depleted that fish had to be maintained in ponds.

The rice fields used as nurseries are not planted with rice during the spring crop. They are often improved with a small refuge pond (2x2 meters), but several were observed without such refuges. This practice is so common that fallow paddies were observed in almost every area. Upon stopping to ask the farmers, we found that they were indeed nursing fish that they had spawned using the above technique.

In the Thai Nguyen and Bac Kan area there has been little promotion of newer ricefield aquaculture techniques. One extension worker mentioned that many farmers in the area are reluctant to try newer practices. Several of the farmers interviewed revealed that they prefer the local common carp to improved strains, both because of its better taste and the fact that the local common carp are not as sensitive to water flow and tend to stay in the paddies better.

The people interviewed in Thai Nguyen and Bac Kan provinces were from the Tay and the Dao ethnic groups. This shows that traditional knowledge and practices for culturing fish in rice fields is not restricted to the Thai ethnic group.

## RESULTS FROM FOLLOW-UP ON “WORKSHOP TO REVIEW INITIAL FINDINGS”

Workshop activities largely confirmed information from earlier missions. The feedback provided on accessing fish seed, the integrated nature of productions systems, and the complexity of the biodiversity in the rice-based production systems was consistent with the information included in the draft report. There were, however, two additional issues raised by participants:

- traditional treatment of fish disease (as opposed to occurrence of disease)
- traditional knowledge about rice as the primary crop of rice-based systems

### Traditional treatment of fish disease

Although fish disease is a relatively new phenomenon in the study area, farmers have had growing experience with red spot disease in grass carp over the last 3-5 years. All farmers interviewed in Son La had experienced it and used various local means for its treatment. Common in all cases was the use of a specific, unidentified type of banana plant. The stalks of the plant are chopped up and put in the ponds as a water treatment and to be consumed by the fish. It is typical for banana of all types to be used as feed, but only this type is used as treatment. It is believed that such a treatment helps prevent the spread of the disease to uninfected fish.

Other local treatments mentioned included using another small, unidentified herbaceous plant as feed, and applying salt to the pond. These are both typically used in combination with the banana stalks mentioned above. Again, the strategy is to keep the disease from spreading, rather than cure fish that are already infected.

### Traditional knowledge about rice

Because a more thorough study about the traditional knowledge on rice production is beyond the scope and means of this study, the follow-up focused on traditional knowledge about features of rice that are important for rice-fish culture. Although it is often said that that some rice varieties are better for integration with fish culture than other varieties, farmers interviewed on the subject had differing opinions on the subject.

Probably the most typical response is that certain varieties are more appropriate than others for integration with fish culture. There was preference given to local varieties of sticky rice that have taller stem height and a lower transplanting density. These rice varieties are grown in deeper water and provide more space for the fish to move between plants thus offering a better culture environment for fish. A differing opinion, however, was that there are no guidelines to follow when selecting a rice variety to integrate with fish culture. Any variety can be used, but the management practices concerning fish culture should be adjusted accordingly. For example, the size of fish stocked should be determined by the water depth that can be maintained with a given variety of rice.

During the interviews concerning the rice varieties informants provided some additional information concerning constraints to rice–fish integration. There is currently an increasing trend to smaller and smaller plot sizes due to growing population pressure. Families have to make their living from less land, and are therefore required to maximize production from the area being cultivated. One of the many results of this situation is that paddy bunds have been reduced in size so they take up as little land area as possible. This trend of minimizing paddy bunds goes against one of the basic requirements of rice-fish integration, which is maintaining acceptable water levels.

## IMPORTANCE, RELEVANCE, AND APPLICATION OF TRADITIONAL KNOWLEDGE

### Accessing fish seed

One extremely noteworthy element of traditional knowledge in the project area is the management and production of fish seed. This includes identifying and maintaining broodstock, spawning (through natural means), incubating eggs, and extensively nursing fry and fingerlings at the household level. It is widely accepted that decentralized fish seed production mechanisms such as household or local-level hatcheries are more effective at impacting rural livelihoods than centralized national or provincial fish seed production (FAO/NACA 2002). The traditional production of common carp and crucian carp seed is so common that several families in many villages produce it.

The “dry method” for incubating common carp eggs is an example of traditional knowledge that could prove to have wider application. If the farmers’ problem of “white eggs” is describing a fungus infestation, then removing the eggs from the water isolates the fungus and makes it unable to spread to and infect other eggs. This knowledge could have application for small-scale hatcheries whose facilities have poor quality water and/or limited capacity for water exchange.

However, the traditional methods are particularly constrained by the reliance in many cases on wild stocks as the source of seed. Wild stocks are generally reported as declining, a situation that could threaten the local availability of seed. This threat is most obvious with the Ca Bong (*Spinibarbus denticulatus)* and the mud carp (*Cirrhinus molitorella)*, both being captured from the wild as fingerlings for culture in ponds. The collection of eggs from wild common carp and crucian carp is also potentially unsustainable given the reported decline in wild stocks. This being the case, it is important to assist farmers to develop improved practices for maintaining and managing broodstock within their culture systems.


Natural water bodies are often the source of fish seed.

Because many farmers have a basic understanding of the production of fish seed, there is potential to build on their current systems. This includes refining systems that are already being used, as well as developing improved systems that would enable farmers to produce other species of fish.

## MANAGEMENT OF PRODUCTION SYSTEMS

### Integration of systems

Farmers' use of ponds and paddies as convergent, intermingling systems rather than separate, discrete ones is common to many traditional systems. Even though this is the case, few technical recommendations consider this aspect of small-scale, rural aquaculture production systems. It is possible that a lot could be gained by learning more about the management systems and bio-resource flows used by traditional fish farmers. Traditional systems are often considered simple, but in most cases they are actually quite complex. This is evident by small-scale farmers' ability to conserve resources such as inputs and labor, and to manage risks through diversification. Without these skills, it would be difficult for most small-scale farmers to make a living. The numerous variations of traditional integrated production systems need to be well studied and understood before making recommendations how to improve these systems. Potential use of adjacent and non-adjacent water bodies, integrated in concurrent or rotational systems helps farmers with limited resources develop synergies and spread risks. Guidelines based on farmer experience could be developed as a tool for extension.

### Overall strategy for production

Another example of an alternative management approach in traditional fish culture is the strategy for stocking fish seed. When fish seed are stocked as eggs or gravid broodfish it is difficult to determine the exact stocking rate. Farmers tend to feel that the more that survive the better. This typically leads to what many would consider overstocking and undersized fish and that the system could be improved by controlling stocking rates to produce larger fish. It is important to consider, however, that in forage-based production systems (such as grazing livestock, or fish in an extensive culture system) the production-per-individual and production-per-unit area are often inversely proportional. A strategy to produce many small fish might be preferable to a strategy to produce fewer, but larger fish. This being the case, a better understanding of traditional systems should be established before replacing them with "improved" systems.

### The importance of secondary production

The practice of farmers “stocking” and “maintaining” species in their pond culture systems that are not typically considered culture species such as snails and mussels is an interesting example of expanding the pond polyculture to include non-fish species. Although in this case the practice is very extensive and is difficult to discern as “culture” rather than “by-catch”, these species are often considered by villagers as among the most important aquatic species. There is a growing realization among some researchers that by-catch can be a very important part of a production system, and it is the part of production that is most likely to benefit poorer groups. While the main products of aquaculture are often sold for cash, by-catch is more likely to be consumed at home. When by-catch is sold, it is typically for lower prices that poorer households are more able to afford.

Although there is a great deal of expertise and knowledge about the fish fauna of northern Viet Nam, this is not the case for other aquatic animals found in rice-based production systems. As for many of the aquatic animals, the role of many of the aquatic plants in the rice based production systems is not well understood. Once a better understanding of the role and function of these plants in livelihoods is developed, collaborative research could be conducted to develop further recommendations for extension.

### Integration with rice

In general it is believed that the intensification of rice production is often at the expense of production of other aquatic organisms such as fish. There are perhaps many reasons for this, but most are linked to the “green revolution” and its high yielding varieties. In Viet Nam, issues related to rice production that may impact the use of the aquatic environment for fish culture, both traditional and intensified, include:

- Reduction in production area per household leading to less of an ability to sacrifice production land for reinforced bunds.
- Changes to rice varieties that require more chemical inputs, less water, and lead to synchronous production.
- Increased use and abuse of pesticides due to less disease tolerant rice varieties and increasing synchronicity of production (uniformity that would increase the risk of large scale outbreaks of diseases and pests).

The village level activities revealed that there has been a general shift from traditional rice varieties and production practices to more intensified production through the use of improved varieties and modified techniques. In 2000, a census of rice varieties was conducted in the northern provinces that recorded 236 varieties of rice being cultivated; only 75 of these had over 100 ha planted. This census was a one-off exercise conducted as part of a donor funded project, but the general perception is that numbers of rice varieties being maintained is decreasing over time (Dr. Do Nang Vinh, personal communication).

As mentioned above, farmers interviewed had differing opinions about the selection of rice varieties to be integrated with fish culture. One underlying reason for this difference in opinion could be in the local practices for maintaining rice seed stock. In areas where seed of traditional rice varieties has been maintained over the years, it is possible that a strong preference exists. In areas that have not maintained local varieties and grow mostly improved and/or hybrid rice, seed must be accessed from an outside source. This being the case, varieties promoted and available from year to year may be different, requiring that the farmers develop a flexible approach to rice–fish integration.

The Institute of Agricultural Genetics is responsible for developing and maintaining useful and productive varieties of rice. They feel that there is potential to work toward rice varieties that are specifically adapted for integration with fish (Dr. Do Nang Vinh and Dr. Pham Ngoc Luong, personal communication). One interesting possibility would be to link traditional knowledge of the farmers with the expertise of experienced plant breeders to develop varieties based on criteria set through consultation with local people.

### Wild aquatic resources

Households collect and use various wild aquatic species and in some cases they are still seen as important to livelihoods (especially in the case of some non-fish species), although many of these have been greatly depleted within the last 10-20 years. The initial list of biodiversity from the traditional rice-based production systems compiled during the village level activities includes 42 fish, 22 other aquatic animals and 10 plants[7]. The ecological function and importance to rural livelihoods of many of these organisms is far from understood. To better understand the system, an improved knowledge of these organisms in the system will need to be established. This should include clear identification of the organisms, where they are found, when they are harvested, how they are harvested and how they are used.


Household fishing with small gear such as this trap is typical.

**Table 9** Potential for development of local traditional practices

| Practice | Potential for development |
|---|---|
| Fish seed acquisition | • Develop farmer recommendations and extension materials based on farmers' knowledge of household production of common carp<br>• Facilitate participatory investigation on ways to improve current practice (ie. reduce reliance on wild broodfish)<br>• Investigate techniques to produce other species at the house hold level. |

[7] Note that the discussion on the actual number of species is rather complicated not only due to taxonomic problems but also as the use of common names both within Vietnamese and the local, ethnic minority languages is not consistent.

**Table 9** Potential for development of local traditional practices

| Practice | Potential for development |
|---|---|
| Integrated pond/ricefield production systems | • Refine and localize existing recommendations on "2 rice – 1 fish" integration<br>• Inventory strategies currently being used by farmers<br>• Identify appropriate ways for continued refinement based on farmers experience (through participatory farmer trials)<br>• Facilitate the development of criteria for improvement of rice varieties for integration with fish culture based on farmers experiences and priorities. |
| Enhancement of by-catch | • Conduct case studies of farmers aquatic production systems (pond and paddies) and clarify the importance and function of all the components (including by-catch)<br>• Coordinate efforts with the on-going SRS project funded by DFID<br>• Conduct farmer investigative trials to develop promising recommendations |
| Rice-field fishing and foraging activities | • Conduct studies to better understand the role of various aquatic species in rural livelihoods<br>• Conduct studies into the value of products from ricefield fishing and foraging activities<br>• Investigate the live-cycles of important, yet less-known, species |
| Use of non-target plant products | • Investigate the use of aquatic plants (human consumption, livestock feed, other uses) and their importance in rural livelihoods |

It is estimated that there are about 200 species of fish in the provinces of Lai Chau, Son La and Hoa Binh. A study conducted in 1999 found 127 species of fish in Son La province alone (Mr. Nguyin Van Hao and Mr. Ngo Sy Van, personal communication). One of the reasons behind this complexity is that the area straddles the watersheds of 3 major river systems. Most of the area is in the watersheds of the Song Ma and Red River systems, but a small portion of the northwest drains into the Mekong.

An improved knowledge and understanding about aquatic organisms in rural livelihoods should include aquatic plants. Many of these plants are important in the diets of rural households, while others such as azolla, duckweeds, etc. are used for other purposes such as green manure for rice production and as livestock feed for pigs, ducks, and chicken. Rice and livestock production are very important to livelihoods, so the use of these aquatic products as inputs is potentially important as well.

A summary of the points above are included in Table 9.

## CONCLUSIONS

This study shows that there is a very robust combination of traditional and current aquaculture activities taking place in the project area. Farmers are very familiar with the management of aquatic resources and often incorporate them into their production systems. These practices are common among the Thai ethnic group, but can be found in other ethnic groups as well. Although farmers are practicing and benefiting from more recent technical interventions, they tend to maintain parts of traditional practice in their systems. In addition to practicing traditional methods and learning new techniques, farmers are also developing their own innovations to improve production from ponds and rice fields.

There are numerous interesting lessons that can be drawn from the aquatic resources management practices in the mountainous areas of Northern Viet Nam. The current challenge is to build on the foundation that already exists in these upland areas. There is no need for “technology transfer”, but rather technology development and refinement to fit into pre-existing local systems.

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## ABSTRACT

A study was conducted as part of the UNDP funded, nationally executed project Aquaculture Development in Northern Uplands, to investigate and record traditional knowledge about aquatic resources use and management in rice-based farming systems. This study was conducted mainly in the project impact area in Hoa Binh, Son La and Lai Chau provinces in northwestern Viet Nam. Participatory activities were conducted with a total of four villages both within and outside of the project target areas. Individual farmers were interviewed in a number of locations in the three provinces of Hoa Binh, Son La and Lai Chau, as well as the provinces of Thai Nguyen and Bac Kan. Results show that livelihoods in mountainous areas are very diverse, and that aquaculture is of moderately high importance along with other livestock rearing activities such as pigs or poultry. Growing fish in rice fields and household ponds has a long history in some ethic groups and many households practice aquaculture in some form. Farmers practice local production of common carp seed using traditional methods and are familiar with many aspects of related to management of aquaculture systems. Wild aquatic organisms are greatly reduced in the study area and fishing is considered of little importance to people’s livelihoods. Some wild aquatic organisms, however, still ranked high in importance and are therefore still available in the wild, often as a by-product of aquaculture systems.