

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

II. Xishuangbanna, Yunnan, People's Republic of China¹

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ABSTRACT

During a 3 month field study focusing on the **living aquatic resources availability and use pattern** of the rice field ecosystems among several ethnic groups in Xishuangbanna, Yunnan Province, in the Southwest of P.R. China, more than 500 aquatic samples were collected from August to November 2001. In these samples, the largest taxon is fish, with a total of 60 species, including 35 from the family Cyprinidae, with 4 Acheilognathinae, 10 Barbinae, 1 Cultrinae, 1 Cyprininae, 15 Danioninae, 2 Gobioninae and 2 Labeoninae representing sub-families. In addition to Cyprinidae, there are 12 species of Cichlidae, 3 species Oryzatiidae and 3 species of Sisoridae, 2 species of Anabantidae, 2 species of Channidae, 1 Homalopteridae (*Balitroa brucei*), 1 Symbranchidae (*Monopterus albus*) and 1 Tetraodontidae (*Tetraodon leirurus* Bleeker). Among those taxa, Nemacheilinae and Symbranchidae (Paddy eel) are the favoured food of most minority groups, followed by Barbinae and Danioninae species. Apart from animals, there are also 20 traditionally utilized plant species recorded in rice fields. For most recorded species, their microhabitats, the traditional collecting means, the gender of the collecting groups, and also the special utilization of some species were covered. Aspects of resource depletion and changing trends in resource utilization are discussed. Due to the limited scope of the study, however, the sample is not adequate to draw a comprehensive picture of the aquatic resource utilization by ethnic minorities in Xishuangbanna. The study just covered species directly living in rice fields, but not including adjacent rivers. Hence, more detailed and longer-term studies are needed to understand the issues regarding conservation and sustainable use of the aquatic resources in the upper Mekong basin.

BACKGROUND

Rice cultivation is centred in Asia and rice-fish culture has been reported for at least two millennia in the Chinese and Indian regions. Xishuangbanna, located in the Southwest of P.R. China, Yunnan Province, is home to 14 out of China's 56 [ethnic minority groups](#). Many of these ethnic communities have been practicing rice cultivation in this region for generations, using the water supply from the Upper Mekong Basin. Most communities have a tradition of harvesting aquatic biodiversity from rice fields as an important source of protein and other uses. The purpose of this study was to consider the vast indigenous knowledge on aquatic resource utilization connected to rice farming and to explore the unique aspects of Xishuangbanna's "rice and water culture".

THE STUDY AREA

"Xishuang Banna" is a Dai language term wherein "Xishuang" means 12 and "Banna" means one administrative area with approximately 10 000 mu of rice fields². Together "Xishuangbanna" describes a place with 120 000 mu of rice fields which was an ancient kingdom with 12 administrative sub-districts. The total area covers nearly 20 000 km², occupying 5% of the area of [Yunnan](#) province, and 0.05% of the [Peoples' Republic of China](#).

² One ha is equivalent to 15 mu.

Xishuangbanna is located in the southernmost tip of Yunnan Province, bordering Myanmar in the Southwest and Laos in the Southeast. The Lancang River, also called Upper Mekong, runs 180 km across Xishuangbanna from North to South. There are three main tributaries, the Xiaohei, Nala and Liusan rivers which originate from the West, North and East of Xishuangbanna. Together with additional 2 700 branches of those three main tributaries, they form the upper Mekong's complicated watershed. In total it covers more than 17 000 km² of watershed area. The complex water network forms diverse habitats for about 100 fish species making up one fourth of Yunnan's total record of 366 species. Among those there are four families endemic to this upper Mekong region in P.R. China: Gyrinocheilidae, Akysidae, Schilbeidae and Pangasidae.

STUDY METHODS

Participatory Rural Assessment (PRA) and Rural Rapid Appraisal (RRA) methods such as semi-structured interviews, in-depth interviews, group discussions and on the spot observations were used to collect information about the minority groups' utilization of aquatic resources and their traditional collecting methods. Considering the distribution of minority groups, the upper Mekong tributaries' location and the minorities' history, the key study sites were chosen near the three main upper tributaries, and included the Dai, Akha, Lahu, Yan, Kemu, and Kucong minorities. A total of [18 sites](#) covering both upland and lowland locations and altitudes from 600-1 200 m were selected. All parts of the society including individual fisherfolk, fishmongers, women, children and Buddhist monks were interviewed, and assisted in the fishing and capturing of the samples. A total of 12 ethnic groups participated and more than 500 aquatic samples collected during the period from August to November 2001.

FINDINGS

INDIGENOUS COLLECTING METHODS

Traditional practices and modern approaches in fish culture and capture are often combined in Xishuangbanna. The traditional methods rely on catching native fishes from rivers, reservoirs and irrigation channels, while the modern methods are based on exotic species and intensive cultivation. In Xishuangbanna, fishing and collecting of aquatic animals are very frequent activities throughout the country-side; the catches provide an important source of animal protein. During the rainy season (June to October) most minority groups are involved in collecting aquatic products from many different water bodies, rice fields and wetlands. The collection is done mainly for marketing fish and for home consumption, but also for enjoying fishing as a form of recreation. During the dry season, fishing is reduced to collecting the remaining fishes trapped in shallow rivers, shallow irrigation channels and some small ponds.

In general, fishing and collecting of aquatic organisms can be dated back to long before fish culture was practiced in this area; the importance of fishing in the rural economy is considerable. For example for the Dai people, fishing is an inseparable part of their daily life, as exemplified by a Dai's famous saying: "No water, no rice and fish, and no Dai people". However, during recent decades, with the improvement of living standards and the availability of other food sources, traditional fishing has gradually declined. Meanwhile, fish cultivation in paddy rice fields or in fishponds has developed further. Among several exotic fishes that are raised and bred frequently, two species of tilapia (*Oreochromis mossambicus* and *Oreochromis niloticus*) were most favoured because of the low cost of raising fry, the low cost of feeding and the easy handling. Common carp (*Cyprinus carpio carpio*), grass carp (*Ctenopharyngodon idella*), big head carp (*Hypophthalmichthys nobilis*) silver carp (*Hypophthalmichthys molitrix*) and crucian carp (*Carassius carassius*) follow in preference. Recently, larger numbers of tambaqui (*Piaractus brachipomus*, *Colossoma macropomum*) from the Amazon are used in pond cultivation. In spite of the growing number of introduced species, the vast river systems are still an important source of local fish species.

In the following, the main differences of aquatic resource utilization among the different ethnic communities in Xishuangbanna are described.

Dai

The Dai minority group in China, especially the main branch called “Water Dai” in Xishuangbanna, shares similar language and culture, including Buddhism and its festivals, with the Thai group in Thailand, Laos, and Myanmar. The Dai people are the largest minority group in Xishuangbanna, their population being around 290 000, occupying more than one third of the total Prefecture (annual statistics of 1998). The history of Dai people in Xishuangbanna can be traced back to the Tang Dynasty, more than 1 300 years ago. They are one of the ethnic groups who first began to cultivate rice and their daily life, culture and religion have a close relationship with rice fields and water. Indigenous fishes were harvested from rice fields, irrigation channels and rivers. The catching of native fish has been practiced long before the culture of fish, and the harvest of native fishes as one protein source for the Dai played an important role in their life. During the long history of fishing, many [fishing methods](#) were developed and passed from one generation to another, and they are still part of their daily life today. Other minorities such as the Akha, Lahu, Yan, Miao, Bulang and Jinuo, who inhabited the same area with Dai people, were influenced by the Dai’s traditional utilization of aquatic resource, especially the fishing and collecting methods, but preserved their special way of fish cooking, preserving and pre-treatment methods. The Dai minority, who regards the water as their spirit and is often referred to as the “Water Minority” or “Rice Cultivation Minority”, is traditionally and culturally linked closest to aquatic resource utilization.

Akha

The Aini and Hani minorities in China belong to the Akha-Group which extends to Thailand, Myanmar, and Laos. The total population in Xishuangbanna is around 160 000 people. Most Akha people live in hilly areas at altitudes ranging from 800 to 1 200 m. Their main food supply is upland rice grown in shifting cultivation fields on mountain slopes. In general, their hilly areas are far from the main Lancang River and its main tributaries, hence, most Akha people seldom practice fishing in big rivers, but resort to small rivers and irrigation canals that belong to other minorities, e.g. the Dai. In general, the Akha people do not have as close a relationship with water as the Dai. However, they celebrate a special fishing day before their “New Rice Festival”. During this day they collect fishes and crabs to celebrate the harvesting of rice. For fishing they traditionally use their “*Yiyan Kuban*”, a basket similar to the Dai’s “*Saixin*”, which today has almost disappeared from the villages. Nowadays only children go to small rivers or irrigation canals for fishing and most of them still use their traditional “*Yiyan Kuban*”. Often adults prefer electro-fishing and poisoning as a more “modern” and “efficient” way to fish. However, these fishing methods are illegal in P.R. China. Some villagers began to raise introduced fishes such as *Oreochromis mossambicus* and *Oreochromis niloticus* together with common carp and grass carp in small fish ponds, or they practiced rice field fish farming. However, rice-fish culture is currently hampered by the low price of fish as it requires more effort than fish farming in ponds.

Lahu

The Lahu minority in Xishuangbanna, with a population of 48 000 people, is the third largest minority group in this region. There are two groups of Lahu, the Yellow Lahu and the Black Lahu. In the past, both groups of Lahu inhabited the mountains where they lived by hunting and slash-and-burn agriculture. Later, the Yellow Lahu moved to lower mountain areas and gradually adopted the Dai’s paddy rice cultivation and learnt some of the Dai’s traditional ways of fishing as well. Most of the Black Lahu still live in higher mountain areas, still practice upland rice cultivation, and seldom find opportunity for fishing. Those who live in areas with abundant water resources began to raise fish such as tilapia, common carp, grass carp and crucian carp to meet their daily diet needs. Fishing was practiced as a substitute for hunting which was prohibited by the Government to protect endangered species. The Yellow Lahu, living in lower areas with more access to information and to local markets, also practice fish cultivation more and more intensively, choosing fish farming as a means to increase household income. Unfortunately, some Lahu also adopted environmentally destructive fishing means by using electricity and explosives.

Bulang

The population of the Bulang minority contains about 36 000 people; it is the forth largest ethnic group in Xishuangbanna. The Bulang is considered the oldest ethnic community of Xishuangbanna, living here long before the Dai people arrived. The Bulang people of today have similar language, clothing pattern, and religion with Dai people, and they celebrate the same important festivals. Most Bulang villages in Xishuangbanna are located in the hilly mountains of Bulangshan Township in Menghai city where one tributary of the Mekong, the Liusha River, passes through. Owing to their relatively poor living conditions in remote mountain areas with difficult access to local markets and lack of market information, until now, most Bulang people cultivated upland or rainfed rice fields. Hence, they seldom had a chance to fish in irrigation channels like the Dai minority. But gradually, some of the Bulang people have begun to practice domestic fish raising, mainly for self-consumption, and small amounts to sell in the closest local market.

Jinuo

The Jinuo minority with about 18 000 people is the fifth largest minority group in Xishuangbanna. Their communities are concentrated in the Jinuo mountains. Traditionally, the Jinuo are hill tribes practicing slash-and-burn agriculture. Later, the Jinuo have adopted paddy rice cultivation step by step under the influence of the Dai people and with the support of the local government. Along with rice production, the Jinuo people also learnt many kinds of [fishing methods](#) from the Dai and they began to try domestic fish farming as well. The most frequently raised species are *O. mossambicus* and *O. niloticus*, common carp, grass carp and bighead carp, but for most villages located far from the local township market, the domestic fish production just can meet the families' self-consumption needs. Only in a few villages around Jinguoshan township a few villagers tried fish farming in larger ponds to sell fish to the local market, but they are facing competition with migrant fish vendors.

Yao

The Yao minority in Xishuangbanna, with a population of 15 800 people, is the sixth largest minority group in this area. The Yao minority has been practicing slash-and-burn agriculture for a long time, but nowadays, some have moved from the hills to lower areas and also have begun to practice paddy rice cultivation. Having lived close to Dai communities for some time, they learnt most of the Dai's traditional ways of fishing, and also capturing other kinds of aquatic animals such as frogs and soft-shell turtles, which became an important part of their protein supply. In addition, some introduced fish species such as *O. mossambicus* and *O. niloticus*, common carp, grass carp and bighead carp are also raised for self-consumption by Yao farmers in their own established small fishponds.

Kucong

The Kucong are one of the smallest ethnic groups in Xishuangbanna. It is said they are a branch of the Lahu minority group, but according to our interview, the Kucong people said that their language and custom are very different from those of the Lahu, and neither their traditional way of fishing nor other aquatic resource utilization patterns are similar to the Lahu. The Kucong people employ only a few means of fishing and almost all of them are learnt from the Dai as they have been living with Dai people for a long time. But they don't pay attention to the fish species collected and the way of cooking as they just catch fish in small rivers when it is not the season for farming. Thus, fishing is not an essential part of their daily life. Nowadays, households in the villages began to try fish cultivation in small ponds among rice fields for their own consumption, focusing on the introduced species *O. mossambicus*, *O. niloticus* and *C. idella*.

Kemu

The Kemu ethnic group lives in only two villages in Xishuangbanna and their population is only around 500 people. Because their population number is very small, they were not given official status as a recognized minority in the P.R. China. As they lived with Dai communities for a long time, they

learnt paddy rice cultivation from them and adopted some of the Dai's traditional fishing ways. Nowadays, they also have begun to try fish culture by raising exotic fish species such as tilapias and carps in small fishponds near their rice fields to meet their own families' demands.

Other minority groups

Aside from the minorities described above, there are communities of Yi, Hui, Bai, Wa, Zhuan, Miao, Lishu, Naxi and Mongolian which mainly migrated from other parts of China. Other small ethnic groups like the Laopin and Kami are said to have migrated from Laos and Myanmar a long time ago and settled down in Menla and Menhai county, their population containing not more than several hundred people. These minority groups also use some simple fishing means that are very similar to the Dai's, and they also breed tilapias, common carp, and grass carp in their small fishponds mainly for self-consumption.

FREQUENTLY CAPTURED NATIVE FISH SPECIES

Focusing on rice field ecosystems, more than 500 samples of aquatic organisms were collected during the period of August to November 2001. [Sampling locations](#) are on 18 key sites in the Upper Mekong basin. The largest numbers of [fish](#) frequently captured and utilized by minority groups are the Cyprinidae. Among the 60 species collected, there are 35 species of Cyprinidae, nearly 60% of the total catch. The species include 4 Acheilognathinae, 10 Barbinae, 1 Cultrinae, 1 Cyprininae, 15 Danioninae, 2 Gobioninae and 2 Labeoninae. Next to Cyprinidae are Cichlidae (12 species), the third most abundant are Oryzatiidae and Sisoridae (3 species each), followed by 2 species of Anabantidae, 2 species of Channidae, 1 Homalopteridae (*Balitora brucei*), 1 Symbranchidae (*Monopterus albus*) and 1 Tetraodontidae (*Tetraodon leiurus*). Among these taxa, Nemacheilinae and Symbranchidae (paddy eel) are the fish most favoured by the minority communities, followed by the Barbinae and Danioninae. The [preference](#) is based on the taste of the meat, less fish bones and the easier capture of some species.

OTHER AQUATIC FAUNA

Aside from fish other aquatic fauna utilized by local people include [frogs](#), [snails](#), [crabs and shrimps](#). Aquatic insects are considered a by-product of fishing and not regarded high. However, they are not discarded and collected as well to form part of local dishes.

PLANTS

Semi-aquatic plants in rice fields, along the dikes of rice fields or along irrigation channels are often collected mainly for vegetables and fruits, but some are used for herbal medicine and to fill cushions.

HARVEST AND UTILIZATION

The annual average per capita fish consumption of 18 villages (18 key sampling sites) is 10-15 kg; this figure is slightly higher than that in Laos, where 7-10 kg per capita reportedly are consumed. Among the 10-15 kg fish only one fifth to one third come from capture, the rest mainly comes from fish culture, predominantly tilapias and carps. However, 10 years ago, capture and culture contributed about equally. Next to fishes, paddy snails are the second largest category of aquatic organisms collected by minority groups. In order to obtain a higher harvest of those aquatic organisms, some minorities use less pesticides and herbicides in certain parts of their rice fields.

FOOD PREPARATION

Dai people have their own traditional way of preparing fish for food. A special set of spices and cooking ingredients needs to be cooked with fish. More than 10 spices are collected from nature including *Pongamia pinata*, *Acacia* sp. (acid acacia), *Callipteris esculenta*, *Eryngium foetidum*,

Zanthoxylum myriacanthum, *Zanthorylum* and many kinds of bamboo shoots (mainly *Dendrocalamus* spp. after the shoots are fermented and pickled). Unique Dai flavoured food dishes are “Nuosong Hie Ba”, “Basong”, “Baou”, and “Babin” (toasted fish). Crabs collected from rice fields or rivers are prepared in a traditional sauce named “Nami Bu” (crab sauce). The rich culture developed around living with fish led to the saying: “Mu hu Ba, Mu hu Dai” (If you don’t know about fish, you don’t know about the Dai people.).

The “Moya” (village doctor) treats some disease with fish. *Banyan* (*Chanas gachus*, a snakehead species) is used as an important component of the medicine to treat stomach cancer; *Badiaonui* (*Trichogaster trichopterus*), after being pickled and fermented, is used to treat oedema; *Mian Yayou*, one kind of aquatic insect, is used to treat children enuresis.

The surplus aquatic products of the rainy season are preserved in a variety of forms such as salted, fermented, sun dried, and smoked. The traditional way of salting and fermenting is in bamboo stems named “Bangmai Bong Basong” (bamboo stem sour fish). Those preserved fish, sun dried frogs, and “Nami Bu” (crab sauce) are sold in the local markets or kept for the dry season when food supply is relatively short.

GENDER AND AGE-GROUP DIFFERENCES IN COLLECTING

Although the situation is slightly different from one species to another, capturing and collecting are not limited to any gender or age. Men usually use some of the heavy fishing tools such as the cast net or fishing rods, especially when they are used for big fish like *Bagarius yarrelli* or *Wallago attu* in the main tributaries of the Mekong, or the Mekong itself. Some small fish collecting devices like *Hin*, *Suo* or *Page* are only used by women, although children and men sometimes help.

MARKET SITUATION AND PRICES

In a market survey in Jinghong, the capital city of Xishuangbanna, a high diversity of native aquatic organisms including small local fishes, eels, crabs, shrimps, paddy snails and paddy frogs were found. For the small fishes (not more than a finger’s length) collected from rice fields, irrigation canals or rivers, the price is 16-20 Yuan/kg, but the *O. mossambicus* and *O. niloticus*, as well as carps of palm size (about 20 cm length), go for 10 Yuan/kg only³. The native eel is sold as a price of 20 Yuan/kg when caught wild, but when raised in ponds fetches only 16 Yuan/kg. Frogs cost 12-16 Yuan/kg. In general, most people rather go for the fresh taste of fish caught in the wild, hence the native aquatic products especially when caught wild are more competitive.

FISH FARMING IN RICE-FIELDS

In the year 2000, aquaculture in Xishuangbanna covered 3 606 ha with a total production of 12 053 tons. This figure includes 1 890 tons of fish from 600 ha rice-fish farming, 16.7% of the total area, and 15.7% of the total amount of fish production. According to the agro-climatic characteristics in Xishuangbanna, there are still considerable areas of land that could be developed for aquaculture either as fish ponds or as rice-fish culture. The local fishery department did intensive extension work for the support especially of rice-fish farming, but the situation has not developed further, probably

Bangmai Bong Basong...



.....is one of the Chinese Dai minority’s most traditional and typical ways of preserving fish in a bamboo stem.

The so-called “sour fish” is a product of several weeks of fermentation.

Fresh fish, caught from rice fields or the river is first washed and scales and viscera removed (small fishes are used whole), then it is put into one part of the bamboo stem (“jar”), mixing it with salt and different spices such as chili, thus creating a tasty fish sauce during the fermentation.

Then the “jar” is sealed with the other part of the bamboo stem and the fish is fermented for at least two weeks.

Bangmai Bong Basong served with rice is a common dish that is especially popular during the water splashing festival where it is usually served to honoured guests.



³ 8 Chinese Renminbi Yuan = 1 USD (2001)

due to the lower market price of farmed products as compared to wild catch. Most local people prefer the native fishes captured from nature or semi-natural water bodies such as rivers, reservoirs, irrigation channels, ponds, and even rice fields, mainly for the fresh taste and health aspects.

MAIN REASONS FOR THE DEPLETION OF AQUATIC RESOURCES

At almost all 18 key sampling sites, when we talked to villagers, one common concern was that “fish has become less and less” during the last decade. It was often told that before, when you did one hour of fishing, the harvest was good for one day of food for the whole family, but now, even when you go fishing for one day, you can only catch enough for one meal of one person. This situation is more or less the same for the whole Lancang river area in Yunnan Province. According to a broadcast by the main Chinese TV station, CCTV-1 (15 November 2001), among the 400 species of fishes in Yunnan Province, more than 60 fish species have become very rare and very difficult to find, and some of them are extinct already.

Impact of pesticides

In Xishuangbanna, after the 1980s, some labour saving methods such as chemical weed and pest control were introduced gradually. Endorced by local government extension services, more and more minorities adopted and followed the recommendations to utilize pesticides and herbicides for more efficient and quicker killing of weeds and pests. In the last decade, even more types of pesticides were introduced and distributed. By using these poisons, the farmers intended to gain more harvest, but at the same time more and more aquatic species were adversely affected.

Impact of fertilizers

The situation of fertilizer utilization by minorities in Xishuangbanna is similar as with pesticides. The more crop harvest the farmers envision, the more fertilizer they use, and as a consequence more negative impacts on the aquatic ecosystems occur. Simultaneously, less people resort to using farm manures.

Impact of ploughing with heavy machinery

Two decades ago, the Dai and other minority groups in Xishuangbanna ploughed their rice fields with the help of water buffalos. Later, agriculture machinery made its way into this region gradually. It made the rice cultivation more efficient, but at the same time, the machinery did more harm to some aquatic species as compared to ploughing with the water buffalo.

Impact of destructive fishing methods

“Modern” fishing methods using electricity, explosives, and chemical poison were gradually adopted by farmers over the last decade. Although these methods are all forbidden by the fishery law of P.R. China, many people are practicing it, not only in small waters and tributaries, but also in the Upper Mekong itself to catch big fish like *Bagarius yarrelli*, *Pangasius sanitwongsei*, *Wallago attu* and for some other big catfish species. Fortunately, after the promulgation of the Chinese fishery law and the rules and regulations for the Lancang river conservation, a lot of effort by the local Government went into aquatic resource protection and management to control illegal fishing methods. But as administrative enforcement is almost absent, these fishing means are controlled efficiently only in very few places.

Impact of exotic species

Some aquatic species, especially the African tilapias, the South American tambaqui, northern carps, some aquarium escapees, and the South American golden apple snail (*Pomacea canaliculata*) were introduced to Xishuangbanna in the last decade. These exotic species were neither evaluated carefully on their economic nor ecological impacts and may result in some local aquatic species’ competition or even extinction.

Impact of dam construction projects

For the purposes of generating electricity and for irrigation purposes, a number of big dams will be constructed along the Mekong River, especially in the upper Mekong-Lancang sub-region. The big dams will form a big risk for the survival of some migrating fish species, e.g. *Pangasius sanitwongsei*. Solving this problem is not just as simple as to build one additional fish channel, as dams have considerable impact on the balance of the river system as a whole. Nowadays, many scientists do not agree with the idea of building more dams along the Mekong for generation of electricity to further boost the economic development of the Mekong region. The impacts of the dams will not only be felt that much by local communities of Xishuangbanna, but more dramatic in the downstream countries. It is likely that even the Tonle Sap lake of Cambodia will be disturbed in its eternal cycle of low and high water levels which has created one of the most outstanding freshwater ecosystems in the world with exceptional biodiversity and productivity.⁴

CONCLUSIONS AND RECOMMENDATIONS

Capturing and collecting native fish and other aquatic organism in rice fields and rivers is a traditional practice of all minority communities in Xishuangbanna. In particular, the Dai ethnic culture has special and strong links to water and its organisms. Aquatic organisms form an important part of the daily protein intake for Xishuangbanna's minority groups, but also generate income at the local markets.

The cultivation of aquatic organisms in ponds and rice fields is gaining importance as more consumers and farmers realize the effects of health food, produced without chemical pesticides and fertilizers, on their own health. However, over-harvesting of wild resources is leading to a fast depletion of fish and other aquatic resources.

The introduction of exotic aquatic species has great impacts on the traditional resource patterns, traditional capture means and some local unique cultural elements. Among all the introduced species, *O. mossambicus*, *O. niloticus* and *P. canaliculata* are occupying most important positions in today's local production and food consumption. Especially the introduction of *O. mossambicus* and *O. niloticus* has changed the traditional fishery considerably. Two decades ago, most local people just captured native fish in rice fields, irrigation channels, rivers and reservoirs, and only a few tried to breed common carp and grass carp, but not in intensive ways. After the introduction of tilapias, a lot of fishponds were established and more and more people began to raise fish intensively, with maximum production levels reaching 2 000 kg per mu. Nowadays, everywhere in the Upper Mekong region, tilapias are raised to altitudes of 1 200 m. It is normal that during floods in rainy season some tilapias escape from fishponds to natural water bodies, and are changing the original composition of the aquatic communities. At this moment, no details about the positive and negative aspects of the changes are available.

It is recommended that a comprehensive study shall be carried out for the better understanding of the aquatic ecosystems of the Upper Mekong region. Almost all the available data are from a survey carried out in 1983 by the Xishuangbanna Nature Reserve integrated investigation group, and the study on the fish species of the Lancang River network carried out by the Yunnan Aquatic Culture Institute and the Kunming Institute of Zoology of CAS are from 1973. The data are largely out of date and not applicable for today's decision-making and for aiding long-term conservation, sustainable use and development strategies.

It is essential to support intensive fish cultivation. With the improvement of living standards and the availability of other quality food for the communities in Xishuangbanna, the collecting of fish and other aquatic organisms from rice fields or irrigation systems do not meet the peoples' needs anymore. Fish farming as practiced by some minorities inhabiting lower areas with easier access to markets is usually done in small simple fishponds for the farm household's own consumption. Support is needed to improve culture techniques to be able to compete in local and other markets.

⁴ It should be noted that apart from the construction of dams currently a navigation project is being implemented to make the river navigable from Luang Prabang in Laos for 400 km upstream into China. This involves blowing away rapids, dredging of the riverbed and the filling of deep pools. Both short and long term impacts are likely to be very severe.

Organic fish cultivation or healthy and “green” fishery might be promoted to meet the markets’ desire. Environment friendly and healthy production would not only benefit the domestic market, but might open a door for nation-wide and international marketing.

Also, aquatic resources management needs to follow the criteria of sustainable resources management. Considering the reasons leading to the shrinking and depletion of aquatic resources (pesticides, fertilizers, illegal fishing methods, use of heavy machinery for ploughing, introduction of exotic species, and the planned dam construction projects), the Government’s management should be strengthened to conduct efficient legal enforcement and to conduct and implement complex land-use planning with all stakeholders with the aim to create sustainable forms of development for Xishuangbanna and the Upper Mekong area.

One important element of the Upper Mekong basin is its unique cultural diversity. It is essential to conduct more culture related research involving indigenous knowledge in all areas of natural resources management.

The Mekong is the most important international river in Southeast Asia. For all the countries along its watersheds, more efforts to conserve this big river and sustainably use its natural resources are necessary and an urgent issue. Joint conservation needs to be committed not only by the Mekong Committee, but has to become a combined effort of all the Mekong Region countries. As this moment, a systematic and comprehensive study on the feasibility and impacts of large dam constructions along the Mekong are the first priority.

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