

Lao P.D.R.

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■ Introduction

Lao PDR is a landlocked country of 236,800 sq. km, bordered by Cambodia, Vietnam, Myanmar, Thailand and China, with an estimated population in 1987 of 4,845,800 people. It is a poor and underdeveloped country, numbering 138 out of 174 countries, on the UNDP 1996, Human Development Index. Still relatively isolated, Lao PDR has a high degree of geographic, cultural, and linguistic diversity. Agriculture continues to be the major industry in Lao PDR and 83% of the country is classified as rural areas. The country is subject to a monsoon climate and agricultural production and availability are adversely affected by flooding in the rice growing areas. Drought is also commonly experienced.

There is a large gap in income and general living condition between the urban and rural areas, with the people in the rural areas being the most disadvantaged. The World Bank has measured the national poverty level at almost 50%.

The fisheries development in Lao PDR is considered in a very early stage when compared to neighbouring countries such as Thailand, and Vietnam. Lao PDR is a landlocked country where there is no direct access to the sea. Fisheries resources are derived purely from fresh water sources. In 1996, the total sources of fisheries in the country was established as 791,720 ha, and in the year 1996, the total production was 38,000 tonnes (Table 1). The sources originated from the Mekong River and its tributaries (44.7%). Reservoirs, (4.6%), swamps, wetlands, flood plains and paddy fields (20.6%), aquaculture such as fishponds culture, cage culture, and rice-cum-fish culture (30.1%)

■ Marketing and Transportation

According to the regulation on fishing in Nam Ngum Reservoir, the purchase and sale of fish in the reservoir is assigned to an individual or group or a

company alone as contractor, who will remit taxes to the Governor/provincial authority according to the annual volume of sale. The individual or company is awarded the sole purchase and sale through bidding. The current company awarded this monopoly right has paid 16,500,000 kips (US\$ 4,125), in the year 1998 for the last existing contract. However, the contract ended last September 1998 and there has been no new open bidding until now. The company still has the monopoly of the fish-landing place in front of the dam site, in Keo Oudom district, Vientiane Province. Fishermen are strictly forbidden to sell fish to others without going through the awarded company, i.e. any sale shall be made at the company's landing place only.

It is specified in the regulation that the price for the sale and purchase of fish shall be agreed between the awarded company and fishermen, based on the market prices either by fishing season and/or fish species for mutual benefit. The company shall not excessively lower the price for fish sold by fishermen. However, fishermen in Nam Ngum Reservoir may find that the price offered by the company is rather low. It is estimated that only 50% of inland and capture fisheries from the Nam Ngum Reservoir are using the landing centre at Ban Tha Heua (belonging to the Vangvieng District, Vientiane Province) since there are markets selling fresh fish and processed fisheries products.

Fishing in the Reservoir is on a small scale where fishermen's catch range from 5 - 50 kg per day, per fishing boat, with an average fish catch about 10 -20 kg/ day, (figures from interviews with fishermen in Ran Xay Oudom, Nam Ngum Reservoir). It is not worth to transport the small amount of daily catch to the authorised landing place, because of the long distance which takes at least one hour from the fishing village to the fishing pier. There are local middlemen coming to

Table 1: Sources of Aquatic Animal Production in Each Province

No.	Name of Province	Hydro power reservoir	Production (Tonnes)							Total	
			Irrigation reservoir	Rivers	Swamp	Rice Fields		Fish Ponds			Cage Culture
						Rice Field	Rice + Fish	Fish	Natural		
1	Pongsaly		20.4	269.0			13.5	40.2	10.0		353.1
2	Luang Namtha		11.8	514.9		140.1	1.0	150.0	10.5		828.3
3	Bokeo		11.7	177.0		895.3	0.5	79.2	6.0		1,169.7
4	Oudomxay		19.0	77603		117.5	2.1	114.0	27.0		1,055.9
5	Luang Prabang	81.0	32.7	1,598.5		131.3	1.5	225.7	80.0		2,150.7
6	Huaphanh		20.5	435.0		111.9	100.0	52.0	50.0		769.4
7	Xiengkhoung		15.3	149.7		461.2	329.7	421.0	69.0		1,445.9
8	Sayaboury		28.0	1,425.0		45.4	3.3	174.3	188.0		1,864.0
9	Vientiane	852.9	47.1	1,006.3		93.0	51.2	2,079.2	400.0		4,529.7
10	Special area Xaysomboun		3.8	31.1				15.0			59.9
11	Vientiane Municipality		237.1	360.8	13.1	1,342.0	42.7	2,317.0	188.0	175.0	4,675.7
12	Bolikhamxay		4.1	1,482.9	28.7	262.8	0.2	134.7	84.0		1,997.4
13	Khammouane		89.5	252.8		1,337.0	0.2	196.6	128.0		2,004.1
14	Savannakhet		99.0	1,728.0	547.0	131.0	1.8	597.0	1,778.0		4,881.8
15	Saravanh		14.3	503.4		507.7	0.1	187.7	30.0		1,243.2
16	Champasak	94.0	31.6	5,992.0	222.3	878.0	0.1	672.4	624.5		8,514.9
17	Sekong	32.1	1.6	137.7				26.0	24.0		241.4
18	Attapeu		1.5	145.6				38.0	40.0		225.1
Total		1,060.0	689.0	16,986.0	811.0	6,454.2	548.0	7,540.0	3,737.0	175.0	38,000.2

Source: Department of Livestock and Fisheries (DLF, 1997)

collect fish caught from the fishermen and then transporting to sell at the authorised landing place. However, during observation at the Nam Ngum Reservoir, there were fishermen landing and selling their catch directly to the fish landing centre as well. The company has the responsibility to invest in fishing gears for fishermen, in order to encourage fishermen to conduct fishing activities for sale to them. In this case the company buy fishing gears such as gill net, small, engine boat, hooks, and other gears for the fishermen communities. The fishermen pays back the loan from sale of their catch daily at a minimum amount of 10,000 kip, which is about US\$ 2.50 in 1998.

■ Utilization of Fish Caught

The fish caught from reservoir can be grouped into 3 categories (i) for own consumption, (ii) sold as fresh fish. (iii) for processing use. Since fish is the cheapest source of protein for Lao people throughout the country, priority is given to family. When fish are traded, large size fish will be sold for additional income. Fresh or good quality of fish are processed into a variety of fish fermented products (Pa Som and Pa Dek), or smoked and dried fish while low quality or rotten fish will be processed to Pa Som, Pa Dek, Pa Heang and Pa Yang.

1. Use of ice and the quality of fish

Use of ice is limited to areas around the reservoir. The company is responsible for provision of ice to the middlemen and fishermen. The company buys crushed ice from Tha Lat market daily for 300,000 kips at 200 kips / kg. Middlemen and fishermen will estimate how much ice they need then go to take the ice from company. Ice is normally stored in bamboo basket, which is used to contain fish without insulation and will be kept and used on the following day. Hence, most of the ice melts on the way to their home by small engine boat.

Some middlemen may store ice in insulated containers. From observations made at an ice making plant in Tha Lat market which supplies ice to the landing centre, ice is made directly from the Nam Ngum Reservoir water with out any prior treatment.

Upon arrival at the fishing boat piers, fish are laid on the wooden platform and sorted by size and weight. The sanitation condition of the fish landing place at Nam Ngum Reservoir was rather poor. Most of the fish

at the landing site were still fresh because the fish were collected from gill nets and hooks that morning and transported to the fishing pier areas almost immediately. If the catch is too small, fishermen will take the fish back to their home and sell to middlemen. Some fish may be of low quality due to the time they spend in the net before it was retrieved.

Sorted fish are then packed in 10 kg double layer plastic bag and placed between ice layers in bamboo baskets. Fish are not packed in direct contact with ice because the ice may alter the natural colour of some fish, which may cause rejection by some consumers. Higher value fish may be packed in bags and iced in the same manner but in insulated plastic containers instead of bamboo baskets.

Fish are then loaded into an open truck for further transport to Vientiane municipality fish market. A truck will leave only when it is fully loaded. It is noticed that during the delay while waiting for a full load, fish containers were left under the sun without additional ice. Trucks were also left uncovered during transport to markets in Vientiane municipality. Both factors will cause drastic deterioration of fish quality. The distance between Tha Lat landing place to the fish market in Vientiane municipality is approximately 90 km. The transportation by trucks takes approximately 2 hours. Sale to the authorised company starts at 8:00 am and end at approximately 3:00 pm. The amount of fish landed at this fish landing centre, range from 400 to 2,000 kg/day, from June till March. During the season from April to May, the amount of fish landed is approximately 300 to 500 kg/day.

2. Quality of fish

Processing and marketing of fisheries products around Nam Ngum Reservoir is facing constraint. This is due to the fact that the authorised company has the right to the purchase and sale of all the fish in the reservoir. The company would prefer to buy fresh fish as much as possible from the fishermen. Although processed fish may add value to fresh fish and provide additional income to the fishermen's families but this is in conflict with the interest of the company. If processing is continued and the scale is enlarged, less fresh fish would be traded. In order to discourage fishermen or their wives to process fish for sale, the company confiscates or tax all fisheries products that pass through the fish landing center. This may hamper the

improvement of processing and marketing of fisheries product at other piers. Responsible official authorities should look into this matter, otherwise fish processing will slowly diminish. The people in the area will then have less chance of generating income through these activities. More smuggling of fish and fisheries products through other fishing boats piers may be encouraged. This will affect the collection statistics of fish caught in the reservoir as well.

■ Fish Processing

Fish processing in Lao PDR is limited to household scale. Fishermen's wives do the processing. Fish used as raw material are mostly low quality or low value fish. Fisheries products are limited to a few types of fermented products such as Pa Som, Pa Dek, Pa Heng, Pa Kern and Pa Yang. Take for example, a case study of fish processing at Ban Xai Oudom village (Ban Xai Oudom), where almost 100% of the village adopts fishing as a major profession. If Pa Khem is caught on a sunny day, fishermen's wives will dry them under the sun all day and sell to the middlemen who will come and collect fish and fisheries products in the village. The demand for fisheries products is higher than supply. If the villagers in Ban Xai Oudom can sell their products freely, without restriction by the authorised fish landing centre, the processing in this village is likely to expand to small or medium scale. This is due to the fact that raw materials are abundant since it is a fishing community and the fish processors are motivated by the better prices of processed products. However, upon observation, there is no electricity supply in this village. Ice must be bought and carried from the other side of the reservoir. Insulated containers are not widely used because of the high prices and lack of access of ice.

■ Food Inspection and Quality Control in LAO PDR

Food standards and regulations, have not been officially established. Hence, the inspection for import is limited to checking of documents and the correct identification of food products. Temperatures of refrigerated trucks containing frozen food such as fish and seafood imported from Thailand are regularly checked upon entry. Importers must submit a list of proposed goods to be imported to the Fisheries Development Division (FDD). Currently there are 10

inspectors stationed in Vientiane municipality.

To control the quality of manufactured food in Lao PDR, the Food and Drug Department inspectors occasionally go out and conduct random sample checks on processed food; such as canned and bottled products from the market and then send them for analysis at FDQCC laboratories. Quality control of traditional products is not on the top priority list as priority is given to industrial oriented products. Quality control of fresh animal products such as meats is directly under Ministry of Agriculture and Forestry (MAF). The Department Of Health is responsible for disease and health control. However, considering laboratory facilities and the competency of the staffs of FDD and FDQCC, if a national inspection agency for fish and fisheries products is to be established, the Ministry of Health should play a leading role.

1. Pathogens in fish

The processors can control this hazard by proper cooking, pasteurizing or retorting. The proper application control is essential because of the likelihood that any pathogens, which may be present in seafood products, are introduced through poor handling practices (e.g. by the aquaculture producer, the fishermen or the producer). It is very important to develop Good Manufacturing Practices (GMP).

Freshwater fish are the most important intermediate reservoir of food-borne trematodes. The fish belonging to the family Cyprinidae (carp) are the major intermediate hosts of *Clonorchis sinensis* and *Opisthochis* sp. More than 100 species of freshwater fish have been shown to be naturally infected with *Clonorchis sinensis* and more than 35 species with *Opisthochis* sp.

In Lao PDR, some species of freshwater fish are potential intermediate reservoir host of *Opisthochis viverrini* and *Haplorchis* sp. *Cyclocheilichthys repassan* (Pa Tjok), *C. apogon*, *C. siaja*, *C. armatus* (Mekongensis), *Hampala dispa* (Pa Sout), *H. macrolepidota*, *Puntius orperoides* (Pa Pok), *P. gonionotus* (Pa Pak), *P. vichoever*, *Pleicanthus* (Pa Bee) and *Cirrhinus jullini* (Pa Soi).

2. Controlling parasites

The process of heating raw fish to a temperature sufficient to kill bacteria pathogens is also sufficient to kill parasites. However, in many countries, the traditional

habit of eating raw or undercooked seafood pose as a big problem, especially in endemic countries of fish-borne trematode disease like China, Thailand (Northeast), Lao PDR (Southern province), Cambodia and Vietnam (North and Central).

In Lao PDR, special interest is paid to these products like the “Koipa” (raw fish in spicy salad) or Pa Dek, Pa Som (salted semi-fermented fish).

3. Safety assurance

Traditionally, fish processors have regarded safety assurance or quality assurance as the responsibility of the Government agencies and the means used by these agencies have been the formulation of food laws and regulations, inspection of facilities and processes and final products testing.

In contrast to the principles in traditional quality programmes relying heavily on quality control of end products, a preventive strategy based on a thorough study of prevailing conditions is much more likely to provide a better guarantee of quality and safety even at a reduced cost.

The need for an effective safety assurance system is increasing. Quality assurance is the modern term for describing the control, evaluation and auditing of food processing systems. The primary function is to provide confidence, for both the management and then the ultimate customers that the company is supplying products to. Such a strategy was first introduced by microbiologists more than 20 years ago to increase the

safety of food products and is named the Hazard Analysis Critical Control Point (HACCP) systems.

The main elements of HACCP systems are:

1. Identify potential hazards, assess the risk (likelihood), of occurrence.
2. Determine the critical control point (CCPs) to determine the steps that can be controlled to eliminate or minimize the hazard.
3. Establish the criteria (tolerances, target level) that must be met to ensure that a CCP is under control.
4. Establish a monitoring system.
5. Establish the corrective action when CCP is not under control.
6. Establish procedure for verification.
7. Establish documentation and record keeping.

4. Define and implement the HACCP system

HACCP can be defined and implemented at aquaculture areas and processing areas as parasite hazards are different between these two areas. A multidisciplinary “HACCP Team” including experts in public health, phraseology, epidemiology, aquaculture, fisheries biology, fisheries extension, fisheries inspection carries out the work to design a HACCP based quality assurance programme.

HACCP work plan of the aquaculture areas to give final products of “clean fish ” or fish free from *Opisthorchis* infection. There are 4 critical control points that must be under controlled:

S/N	Affected Source	Hazards	Control
1.	Water Quality	<ul style="list-style-type: none"> • Presence of <i>Opisthorchis</i> eggs as a result of human and/or animal faecal contamination. • Presence of fish infected with <i>Opisthorchis metacercariae</i>. • Presence of infected or non-infected fish host snails (<i>Bithinia</i> and <i>Melania</i> sp.), with <i>Opisthorchis</i> sporecysts. 	<ul style="list-style-type: none"> • Dry well the ponds for several days (2 days) and treat the ponds with chemicals such as calcium oxide, • Rainwater used to refill the fish pond (the water must be free from parasite eggs, snails and infected fish)
2.	Fish fry	<ul style="list-style-type: none"> • Fish fry infected with <i>Opisthorchis metacercaria</i> 	<ul style="list-style-type: none"> • Check that fish fry are free from parasite infection before releasing. May be taken from non-endemic areas.
3.	Fish feeds	<ul style="list-style-type: none"> • Presence of <i>Opisthorchis</i> eggs as a result of human and/or animal faecal contamination. 	<ul style="list-style-type: none"> • Use fishmeal pellets which has been checked and are free from parasite eggs. • The use of animal or human faeces for feeding is prohibited.

S/N	Affected Source	Hazards	Control
4.	Fishponds' conditions	<ul style="list-style-type: none"> The contamination of fishpond water with <i>Opisthorchis</i> eggs from human and/or animal sources as well as invasion of the fishponds by infected snails. 	<ul style="list-style-type: none"> The fishponds must be isolated from sources of contamination such as latrine, pig-pen, cat, dog, and drainage by establishing a fence around the fishponds. Faeces are collected from the fish farms and its family members. They must be free from <i>Opisthorchis</i> infection. Basic education about hygiene is provided to everyone in the family. A regular visual monitoring inspection will be done every day to check for any abnormality. Aquatic weeds overgrowth on the experimental ponds bank is constantly removed since leaves can serve as the best breeding place for intermediate snails hosts.

■ Future Post-harvest Activities

Team Leader and Expert in fish-borne parasite/food safety (Dr. Paiboon Sithithaworn) have discussed with Chief Technical Advisor (CTA) of the National Aquatic Resources Institute (NARI) project, Mr. Sten Sverdrup Jensen, about post-harvest technology activities to be included in the scope of Living Aquatic Resources Research Institute (LARRI). The consultants were informed that although such activities are considered to be important areas for inclusion in the scope and mandate of LARRI, the DLF does not expect research activities within these subject areas to be initiated from the onset. Initially, it would be appropriate to maintain these areas on an awareness level that is monitoring development outside LARRI. In the near future, LARRI will be transferred to operate under the National Agriculture Forestry Research Institute (NAFRI), directly reporting to Ministry of Agriculture and Forestry (MAF), instead of DLF as originally planned. LARRI activities will emphasize on research activities on aquatic resources, reservoir fisheries management, wellands, management, aquaculture and establishment of national fisheries information and statistics.

LARRI has of 17 staff including the National Project Director (NPD). All staff have been transferred from FDD. Seven technical staff of LARRI have acquired MSC in Fisheries or relevant areas from various international

academic institute. There are also five BSc and four Diploma graduates that have majored in Fisheries and Chemistry, and a Certificate graduate in basic computer. However, there is no staff specialist in post-harvest technology.

After the transfer of many qualified staff to LARRI, the FDD consist of 9 technical staff, including the Director and Deputy Director of FDD, and one NPD of FAO/TCP/8823 Project and 3 technical staff involved in the Fisheries Extension Project Lao 97/007, FAO/UNDP Project. Almost all the staff working at FDD, have acquired a MSc and Postgraduate Diploma in Fisheries Sciences.

The FAO/TCP/8823 Project has set aside some budget for equipment procurement with an aim to promote the continuation of the project in terms of research and extension of post-harvest technology improvement and marketing of traditional fisheries products as well as the control of food-borne trematodes (FBT). Extensive training on basic post-harvest technology as well as parasite identification must be given to the potential staff of the FDD, or DLF whichever office is determined to carry out the work in this field. FAO, under the TCP project may contribute by allocating some budget for such intensive training (minimum of 3 months period). The livestock and fisheries inspection laboratory has the potential to expand to cover fish

inspection and quality control aspect. This is due to the fact that the laboratory facilities already exist and the staff possesses basic knowledge in the areas of meat inspection and food analysis, which can apply to both fish and fisheries products.

■ Conclusion and Recommendations

In order to follow up and continue the activities of this project, both within the project duration and the future, the following recommendations are given below:

- (1) For future improvement in the areas of handling of fresh fish, processing of traditional fisheries products and control of FBT, the FDD should conduct basic surveys and develop the quality and safety of fish and fisheries products in the market, both in terms of general hygiene and FBT. The staff should be given extensive training on parasite identification since FBT will adversely affect consumer health.
- (2) Staff of FDD and provincial staff of DLF should be given opportunities to upgrade through extensive training in post-harvest technology including basic chemical, microbiological, and physical analysis. If new staffs are recruited, at least one staff should pursue a BSc or MSc in food science and technology, fisheries products, food microbiology or food chemistry.
- (3) The FDD should decide on its policy and direction in the areas of post-harvest technology, safety and quality control as soon as possible. The equipment list should be justified and based in accordance with the activities to be conducted and relevant to the scope and objective of this project.
- (4) Sanitation and hygiene of the fish landing place at Nam Ngum Reservoir should be improved. People handling fish and involved in marketing and transportation should be aware of the importance of fish quality and the use of ice. This will increase the supply of good quality fish to the consumers.
- (5) In order to improve handling and sanitation of fresh fish in the market place, DLF may cooperate with the local authority and create awareness among fish traders on food safety and hygiene.