

# Developing Habitat Conservation Suitable For Nam Xouang Reservoir, Vientiane Province, Lao PDR

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**Abstract:** The establishment of the conservation area considers the most important issues of the environment changing in inland waters of ASEAN Countries. To respond this issue, a study was conducted in Nam Xouang Reservoir, Lao PDR, in 2018. To determine the conservation area, data and information were collected by mapping the deep waters area of spawning grounds, feeding ground, fishing seasons, and fish species caught. The data was collected with the support of six enumerators in upper-side and downside of the reservoir to identify the fish species and fish length-weight data. Results showed that built the display boards and warning signs is an effective way of considering simultaneously, to inform the local villagers about the fishing regulations and fish conservation zones. The participation of local fishing communities and local authorities might be necessary for the successful and sustainable management of the fisheries in the Nam Xouang Reservoir.

**Keywords:** conservation zone, fisheries management, Nam Xouang Reservoir, Lao PDR

**Abstrak:** Untuk menjaga perairan daratan dari perubahan lingkungan di Negara ASEAN, salah satu cara adalah dengan menetapkan kawasan konservasi. Menanggapi isu tersebut, sebuah penelitian dilakukan di Waduk Nam Xouang, Laos, pada 2018. Untuk menentukan kawasan konservasi, data dan informasi dikumpulkan dengan memetakan wilayah perairan dalam (daerah penangkapan ikan, daerah pemijahan, daerah mencari makan, musim penangkapan ikan, dan spesies ikan yang ditangkap). Data dikumpulkan di bagian atas dan bawah waduk dengan dukungan enam enumerator untuk mengidentifikasi spesies ikan dan data panjang-berat ikan. Hasil menunjukkan bahwa memasang papan dan rambu peringatan adalah cara yang efektif untuk menginformasikan kepada penduduk desa setempat tentang peraturan penangkapan ikan dan zona konservasi ikan. Partisipasi komunitas nelayan lokal dan otoritas lokal diperlukan untuk keberhasilan pengelolaan perikanan yang berkelanjutan di Waduk Nam Xouang.

**Kata kunci:** zona konservasi, Waduk Nam Xouang, pengelolaan perikanan, Lao PDR

## 1. Introduction

Lao People's Democratic Republic (Lao PDR) is a mountainous landlocked country, located in the Lower Mekong River Basin (LMB) in Southeast Asia. The 87.7% (or 207,674 km<sup>2</sup>) of the area are laying in the LMB, and the total area of water resources for capture fisheries is estimated more than 1.24 million hectares. Lao PDR is endowed with rich and abundant natural water resources as well as man-made water bodies, and more than 481 fish species identified in Lao PDR including 22 exotic species. These inland water resources have high potentials for the development of capture fisheries and aquaculture if properly managed and developed in a sustainable manner [1][2].

The Government of Lao PDR policies favor irrigation to support rice production, by developing many new constructions of irrigation reservoirs. Several larger reservoirs support hydropower or

multiple uses, such as provide increased opportunities for fisheries and aquaculture. There are many reservoirs in Lao PDR, such as Nam Ngum Reservoir, Nam Houm Reservoir, Nam Hinboun Reservoir, Nam Ou Reservoir, Nam Song Reservoir, and Nam Xouang Reservoir.

The fisheries in reservoirs are increasingly important, and the Government authorities concerned that the communities directly depend on the fishing and aquaculture is fundamental to keep the sustainability biodiversity. It recognizes that reservoir fisheries management is an important component of rural development with their contribution to socio-economic development in the country.

Nam Xouang Reservoir was built in 1981, located in the central part of northern Lao PDR with the main purpose to irrigate the rice field, and surface area at full supply level is 2,200 hectares (DLF Lao PDR Report). Fisheries activities generate

significant income, by providing a large proportion of the protein and nutrients and other dietary requirements for the people living in the surrounding. To support the fishery activities, the Government has already established the Fisheries Management Committee.

In the National Assembly No. 03/NA 2009 [3] regarding the Fisheries Law, mention in Part I, article 3, the definition of Fish Conservation Zone means deep water areas or along the rivers which are identified by fisheries management committee or according to fisheries regulations at village level, which designated as prohibited zone for the whole year to be habitats and safe breeding of aquatic organisms. The Government exhibits the concern on developing the habitat conservation for keeping the sustainability of fish resources, as well as should be environmentally friendly and enhance the economic wellbeing of the fishers. Therefore, this paper reported the activity of developing habitat

conservation suitable for Nam Xouang Reservoir, Vientiane Province, Lao PDR.

## 2. Material and Methods

A current study was conducted in Nam Xouang Reservoir, Vientiane Province, Lao PDR along 2018. Data collection was done from two districts (Phonhong and Naxaythong Districts) (Figure 1). A technical assistance was provided by training the enumerators to collect the data and information. Six enumerators were hired to observe the actual fish catch monitoring, by serving the daily data on weight-length, total catch, operational time and fishing gears used. Four enumerators were charged to collect the fisheries data and the others were focussed for collecting the fish biology data. One stopper also hired to input the data and to translate the data and information from the Lao language into English.

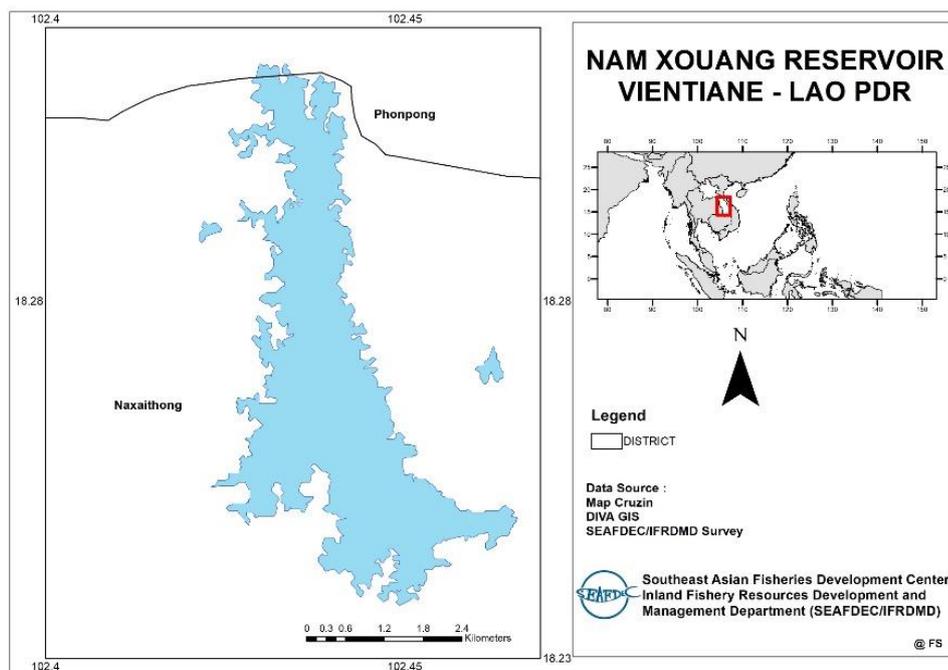


Figure 1. Research site

For monitoring the utilization of reservoir, local government established the Fisheries Management Committee (FMC). The person who involved as the management in FMC are the local fishers lived surrounding the reservoir. During the five surveys, the meeting was conducted by with local government and FMC in each district. The meeting was aimed at strengthening in managing and controlling the conservation areas. While holding the discussion, the information was gathered regarding the determination of demarcation of conservation area, improvement of the awareness to fisheries resources sustainability, requirement of data of fish identification, and

accomplishment of the social impact after the conservation area construction.

The demarcated conservations were marked by installing the buoys and let the local fishers and residents to know about the conservation areas. The map was made by determining the spawning ground and feeding ground of fish. Those areas were declared as no-fishing zone, where the fishing is not allowed in the areas to enhance new recruitment of the fish stock.

There are several enhancement practices which together contribute to a process that can be termed the recruitment of stock and intensification of production [4]. These practices cover a range between culture-enhanced capture fisheries to

intensive aquaculture. These are often adopted in a stepwise manner leading to a progressive increase in fishery production per unit area of water through increasing human controls on essential parameters of the fish assemblages, for instance 1) Stocking natural waters to improve recruitment, bias fish assemblage structure to favoured species or maintain productive species that would not breed naturally in the system; 2) Engineering of the environment to improve levels of reproduction, shelter, food resources and vital habitat; 3) Elimination of unwanted species that either compete with or predate upon target species; 4) Constituting an artificial fauna of selected species to increase the degree of control and the yield from the system; 5) Modification of water bodies to cut off an area to serve for extensive and intensive fish ponds to increase control and nutrient flows;

In this area, to further strengthen the enhancement of new recruitment of stock, the signboards of the conservation zone were distributed and installed containing the information on the importance and benefits of practicing conservation areas to the residents.

### 3. Results and Discussion

#### 3.1. Present status of inland fisheries in Nam Xouang Reservoir

Capture fisheries and aquaculture in Lao PDR are based on water resource ecosystems mainly consisting of rivers and streams, hydropower and irrigation reservoirs, diversion weirs, small water bodies, flood plains and wet-season rice-fields. The estimate of actual fish consumption per capita (kg/capita/year) of inland fish is 24.5 kg [2]. The most fishing in Lao PDR is subsistence fishing activity as well as in Nam Xouang Reservoir, although there is significant commercial fishing in the Nam Ngum Reservoir [2]. The data of present status of Nam Xouang Reservoir is still lack, since this reservoir was built in 1981. The Nam Xouang Reservoir has a Fisheries Management Committee (FMC), that is situated in covering two areas in Vientiane Metropolis, and Vientiane Province. The

two areas are Phonhong District and Naxaythong District that have 25 and 20 FMC, respectively. The main occupation of the communities is to work in the rice field and fisheries. The data of annual fish production was gathered by FMC from 2014 to 2017, and it can estimate the Catch per Unit Effort (CPUE) (Table 1). CPUE is a method used to determine the yield of fisheries production which is averaged in annual. Fisheries production in an area has increased, or decreased production can be known from the results of CPUE [5].

In this research, identifying the key issues of the fishery activities and fish biological data collection becomes important. A lack of information and statistical data on inland fisheries has undermined their importance and the subsequent management of the resources. With a growing population, it is necessary to maintain the contributions of inland fisheries to food security and to increase production. Prioritization of freshwater habitat management and conservation is dependent on the availability of species baseline information at the regional level [6].

Compared with 481 fish species identified in Lao PDR, Nam Xouang reservoir is only inhabited by 21 species. The biodiversity of fish in reservoirs is formed on the biodiversity of the original rivers, particularly the principal river system. However, after impoundment, there may be significant changes in fish fauna due to changes in the hydrological regime and biological conditions. There is a huge loss to our indigenous fish species due to constructions of dams that have severely affected migratory fishes. The frequent water level fluctuations in the reservoirs lead to deposition of silt and other suspended particles. The effects exist on biotic communities in the reservoirs. The most apparent impact of reservoirs is the permanent destruction of terrestrial ecosystems through inundation. Construction of reservoirs affects fish species diversity by sudden environmental changes from lotic to lentic. This changing due to which many species either escape to new conducive environments while few species get adapted to the changing environment [7].

Table 1. Nam Xouang Reservoir annual fish catch estimates for 2014 to 2017

Year	Production (kgs)	Effort (unit)	CPUE
	Phonhong District		
2014	208,925	5,264	39,689
2015	216,506	5,436	39,828
2016	201,345	5,092	39,541
2017	203,619	5,047	40,345
Naxaythong District			
2014	81,895	12,749	6,424
2015	81,479	12,665	6,433
2016	72,456	11,222	6,457
2017	63,156	9,647	6,547

Table 2 shows the list of the finding 21 species, and the enumerators informed that the dominants fish in each district are *Oxyeleotris marmoratus* in Naxaythong District while *Osteochilus*

*melanopleurus* in Phonhong District. After that, Figure 2 shows the relationship between length and weight of two species from each district, those representatives for dominant and economic species.

Table 2. Fish inhabited in Nam Xouang Reservoir

No.	Local Name	Common Name	Scientific Name
1.	Pa kheng	Climbing perch	<i>Anabas testudineus</i> (Bloch, 1792)
2.	Pa douk	Philippine catfish	<i>Clarias batrachus</i> (Linnaeus, 1758)
3.	Pa khor	Striped snakehead	<i>Channa striata</i> (Bloch, 1793)
4.	Pa khorjon		<i>Channa Lucius</i> (Cuvier, 1831)
5.	Pa do	Indonesian snakehead	<i>Channa micropeltes</i> (Cuvier, 1831)
6.	Pa dokgiew		<i>Cyclocheilichthys armatus</i> (Valenciennes, 1842)
7.	Pa soodyai	Hampala barb	<i>Hampala macrolepidota</i> (Kuhl & Van Hasselt, 1823)
8.	Pa soodnoi		<i>Hampala dispar</i> (Smith, 1934)
9.	Pa kotleuang		<i>Hemibagrus filamentus</i> (Fang &Chaux, 1949)
10.	Pa lot	Peacock eel	<i>Macrognathus siamensis</i> (Günther, 1861)
11.	Ian	Asian swamp eel	<i>Monopterus albus</i> (Zuiew, 1793)
12.	Pa kot	Asian redtail catfish	<i>Mystus nemurus</i> (Valenciennes, 1840)
13.	Pa tong	Bronze featherback	<i>Notopterus notopterus</i> (Pallas, 1769)
14.	Pa nin	Nile tilapia	<i>Oreochromis niloticus</i> (Linnaeus, 1758)
15.	Pa nikkhao		<i>Osteochilus melanopleurus</i> (Bleeker, 1852)
16.	Pa bou	Marble goby	<i>Oxyeleotris marmoratus</i> (Bleeker, 1852)
17.	Pa suay		<i>Pangasius krempfi</i> (Fang &Chaux, 1949)
18.	Pa ka	Malayan leaffish	<i>Pristolepis fasciata</i> (Bleeker, 1851)
19.	Pa khao mon		<i>Puntius brevis</i> (Bleeker, 1849)
20.	Pa kadert	Three spot gourami	<i>Trichopodus trichopterus</i> (Pallas, 1770)
21.	Pa salid	Snakeskin gourami	<i>Trichopodus pectoralis</i> (Regan 1910)

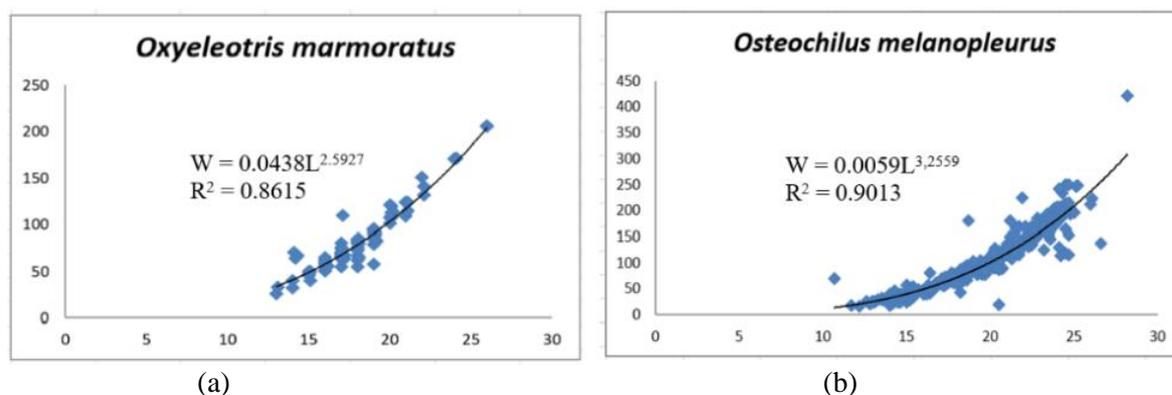


Figure 2. Length-weight relationship of selected fish in Nam Xouang Reservoir, (a) Naxaythong District; (b) Phonhong District

The length-weight relationship is useful to estimate the condition of fish in different water bodies or during different seasons [8] [9]. The valid b values should range from 2.5 to 3.5 [10]. However, the b value ranged from 2.5927 and 3.2559 for both of fish in this study that it might be due to the influence of water quality or food availability on fish growth [11]. The relationship data presented provide a basic knowledge on these species which can be

used in further studies. It can help to improve the information needed to derive at proper management measures.

The local fishers of Nam Xouang reservoir commonly use almost the same types of fishing gear for both the dry and wet seasons. Most of the local fishers mainly use gillnet, long line, set hook and line, and others (Figure 3).

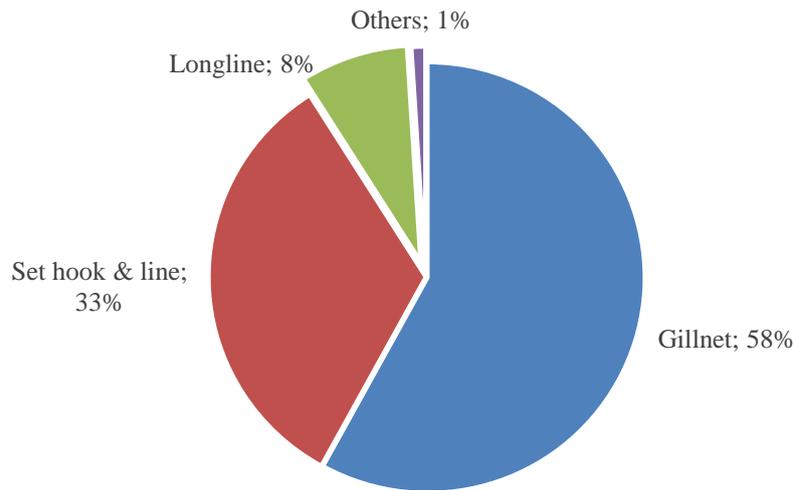


Figure 3. Percentage of used fishing gears at Nam Xouang reservoir

During the present study recorded that the enumerators used the gill-net, usually a very selective fishing gear. Some fishing methods and gear types may impact on the fisheries and the environment. Different mesh sizes ranging from 3 inches to 9 inches were observed in the gill nets used. As passive gear, gill net catches the migration of fish through the area where the nets are set, and the operculum of fishes get entangled into the meshes of nets when the fishes try to pass through it. Depending upon mesh size, the size of the fish caught for this was usually 250 grams to 10 kg. The fishes are occasionally caught up to 20-30 kg or even more size fishes. The fishing methods vary from catching with hands to the operation of large and designed nets for fishing. Various types of fishing gears were reported operating in the fisheries sector and have increased the fish caught [12] [13].

### 3.2. Establish the Conservation Zone

There are five conservation zones in Nam Xouang Reservoir, where four areas served for the close season. The main activities of FMC include: monthly meeting, rule, and regulation on fisheries, define the fisheries conservation zone, patrolling in the conservation area, fish releasing, training and transfer knowledge and information to the community, and revolving fund [14]. The main problems found in the area are illegal fishing, theft of fishing gear, lack of knowledge on fisheries law, and regulation as well as unclear the conservation area.

The recent study selected Nam Xouang Reservoir to be the pilot site due to no project implementation and the lack of knowledge on fisheries law for fishers and regulation as well as the co-management. The study summarized the main issue found in Nam Xouang Reservoir is the management of the conservation zone. The preliminary meetings were held to strengthen and

unify the rules and regulations of Phonhong and Naxaythong Districts as part of the management plan. This activity was conducted to build the same perception of developing habitat conservation. After having the same opinion on habitat conservation, the meeting was organized to install the buoys for demarcation of the conservation zone. The area was plotting and mapping as the fish habitat conservation. The pointed zone is based on the preliminary study that concerned on fish identification, fish composition, and fish growth. Thereafter, the FMC identified the spawning ground and feeding ground from vegetation grows in the waters, and waters always inundate the areas. For determining the nursery grounds, the FMC choose the area depending on two criteria, i.e., 1) the density of juveniles was higher than in other areas, and 2) repeatedly used over the years. Twenty-eight buoys with marking were installed to let the local fishers and residents knowing about the conservation areas.

On the last survey, the signboards for conservation zone demarcation are set up and the ceremony was organized to inform the local fishers on rules. The ceremony was attended and welcomed by Director of Deputy General of Fishery Division and the Major of each district. Some regulations were set up near the reservoir. The habitat conservation developed particularly built behind the temple because residents and tourists respect the Monks who are keeping the zones. Figure 4 shows the decided area for the habitat conservation, which the area appointed because the FMC had declared to not allowed the fishing activity in the areas in order to enhance new recruitment of the fish stock. The fishing regulation signboards in Nam Xouang Reservoir, Lao PDR were installed in eight villages of two districts hence it held the awareness creation on fisheries co-management including the community rule and regulations. The signboards are to promote

the responsible on utilization on inland fisheries activity and mentioned for the Regulation for Fisheries Management of Fisheries Community

Zone. This regulation does not allow personal and the group of the people use any fishing gears and other animal aquatic in this whole zone.



Figure 4. (a) Decided of demarcation for conservation zone in Nam Xouang Reservoir; (b) The signboards installed near Nam Xouang Reservoir.

#### 4. Conclusion

The gill-net caught the migration of fish which through the area of this gear set up. The length-weight relationship from the fish caught is useful to estimate the condition of fish in different water bodies or during different seasons, due to the influence of water quality or food availability on fish growth. It can help to improve the information needed to derive at proper management measures.

The building of both display boards and warning signs is an effective way to consider simultaneously, to inform the local villagers about the fishing regulations and fish conservation zones by influencing on compliance issues, awareness-raising campaigns, and behavior enforcement. The participation of local fishing communities and local authorities might be necessary for the successful and sustainable management of the fisheries in the Nam Xouang Reservoir.

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