aquaculture journal

MDPI

Review

Eastern European–Asian Cooperation: Aquacultural and Cultural Contributions to Increased Fish Consumption in Laos

Emese Bozánné Békefi [1], István Lénárt [2,*], Irina Markovina [2], Zsuzsanna Brlás-Molnár [1], Gergő Gyalog [1], Gyula Kasza [3], Dávid Szakos [3], Atilla Kunszabó [3] and László Váradi [4]

[1] Research Center for Fisheries and Aquaculture, Institute of Aquaculture and Environmental Safety, Hungarian University of Agriculture and Life Sciences, 5540 Szarvas, Hungary; bozanne.bekefi.emese@uni-mate.hu (E.B.B.); brlas-molnar.zsuzsanna@uni-mate.hu (Z.B.-M.); gyalog.gergo.sandor@uni-mate.hu (G.G.)
[2] Institute of Foreign Languages for Professional Purposes, Sechenov First Moscow State Medical University, Moscow 119048, Russia; markovina_i_yu@staff.sechenov.ru
[3] Institute of Food Chain Science, University of Veterinary Medicine Budapest, 1078 Budapest, Hungary; kasza.gyula@univet.hu (G.K.); szakos.david@univet.hu (D.S.); kunszabo.atilla@univet.hu (A.K.)
[4] Hungarian Aquaculture Technology and Innovation Platform, 5540 Szarvas, Hungary; varadil@akvapark.hu
* Correspondence: istvan.lenart@sechenov.ru

Abstract

Laos is one of the 32 landlocked developing countries (LLDCs) of the world, where isolation from the sea and the lack of a large-scale fishing industry have a direct effect on fish supply and fish consumption. Per capita fish consumption in LLDCs amounted to 5.1 kg/year in 2023, which is much lower than the world average (20.3 kg) as well as the Developing Regions average (20.0 kg). However, per capita fish consumption in Laos has reached 28.5 kg/year in 2023, representing the highest among the 32 LLDCs. Relying on the results and experiences of several decades of work in aquaculture development in Laos and taking into account the observations of local and international publications, documents and statistics included, the authors aimed at identifying the principal reasons for the elevated fish consumption in Laos from different perspectives, including that of aquaculture, as well as Lao language, culture, and religion. In this review, the authors analyzed the availability of aquatic resources, the role of fishing and aquaculture in the Lao economy and social life, market realities, as well as the importance of fish in Lao culture.

Keywords: central and eastern Europe; Europe–Asia collaboration; aquaculture; fish consumption; Lao language and culture; landlocked developing countries; Laos

Check for updates

Academic Editor: Aires Oliva-Teles

Received: 5 July 2026
Revised: 4 August 2026
Accepted: 10 August 2026
Published: 14 August 2026

Copyright: © 2026 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license.

1. Introduction

There are 44 landlocked countries in the world [1], with 32 of them recognized by the United Nations as landlocked developing countries (LLDCs). Seventeen of the LLDCs—including the Lao PDR—are classified as least developed and face high transportation costs for goods to be shipped to and from international markets. This discourages investment, reduces competitiveness, and isolates these countries from global trade. Isolation from the sea—besides the lack of seaports as coastal trading points—also results in the lack of a significant fishing industry, which directly impacts the availability and consumption of fish.

The average per capita GDP in LLDCs amounted to only 14% of the world average in 2018 [2]. Average per capita animal protein intake (17.2 g/day) in this country group in 2017

was much lower than the Developing Regions average (26.9 g/day), and the fish share in their animal protein intake (7.9 percent) was less than half of the Developing Regions average of 19.8 percent [3]. Per capita fish consumption in LLDCs increased from 2.6 kg/year in 1997 to 4.6 kg/year in 2017, which nevertheless still remained much lower than the world average (20.3 kg/year) and the Developing Regions average (19.4 kg/year) [2]. In 2017, approximately 75% of the total fish consumption of LLDCs was provided from domestic sources. Capture fishery production in LLDCs nearly doubled between 2000 and 2018. Capture fisheries in 2018 primarily comprised miscellaneous freshwater fishes (52.7 percent), carps (31.2 percent) and tilapias (14.8 percent) [2]. The annual growth of aquaculture production in LLDCs was 10.27 percent between 2000 and 2018, and the total aquaculture production reached 446 thousand tons by 2018 [2]. The annual growth rate nearly doubled in Developing Regions (5.91 percent) and the world (5.59 percent). The total aquaculture production is mainly composed of carps and tilapias (45.24 percent and 36.39 percent, respectively).

Laos is a highly understudied country both in general terms and in the field of aquaculture. The authors aim to address this general lack of information and specifically target to reveal potential reasons for the outstandingly high fish consumption in Laos that have not been investigated so far. This extensive study includes the analysis of natural (especially aquatic) and human resources, sheds light on the socio-economic background, and discusses the natural and economic environment as well as the cultural and linguistic underlying factors.

As mentioned above, the Lao PDR has the highest per capita fish consumption among the 32 LLDCs, amounting to 28.5 kg/year in 2023; that is much higher than the average of the LLDCs (5.1 kg/year). Laos is followed by the Republic of Moldova (19.5 kg/year), Uganda (15.1 kg/year) and Zambia (12.7 kg/year) [3]. Although Laos is a country with a small population where water resources are relatively abundant, it is worth taking into account the circumstances that contribute to the fact that Laos has by far the highest fish consumption among landlocked countries.

In addition to the above, this paper also aims to identify the factors influencing the decline in fish consumption and to facilitate the adoption and implementation of measures that can contribute to the sustainability of Laos' high fish consumption despite environmental, climatic and economic challenges.

2. Methods

In this paper, the authors applied a threefold approach by combining a secondary literature review with the analysis of questionnaire-based research, followed by a linguistic–cultural inquiry.

2.1. Secondary Literature Review

Secondary data collection was conducted through a systematic review of the international literature focusing on the 2019–2026 period. The analysis was based on peer-reviewed scientific journal articles, academic books, reports published by international organizations, government institutions, and international experts, as well as statistical databases. For AIRWR, aquaculture production, AFR, and GDP/capita statistics (Table 1), PSPP (Free Software Foundation, Boston, MA, USA) was applied to calculate Pearson correlation. The critical evaluation and synthesis of the available sources provided the theoretical foundation for the study, supported the interpretation of the questionnaire-based research findings, and contributed to the assessment of the development and market acceptance of novel fish products. Throughout the investigation, the authors drew on their two to three decades of expertise in aquaculture in the Lao PDR.

2.2. Questionnaire-Based Research

The analysis relied on a questionnaire-based survey consisting of 33 questions conducted with 168 respondents in the Lao PDR [4]. The anonymous, structured questionnaire was used to investigate consumers' fish and fish product consumption habits, purchasing preferences, and acceptance of newly developed fish products. The questionnaire covered fish consumption frequency, preferences for different product types and purchasing channels, willingness to taste and purchase new products, acceptable price, and the importance of factors influencing purchasing decisions. It also assessed consumer perceptions of fish products from different countries of origin, shopping habits, and sociodemographic characteristics.

The questionnaire consisted of closed-ended questions, most of which were rated using 5- or 10-point scales. Data were analyzed using appropriate statistical methods to evaluate differences and associations among consumer groups. During the statistical evaluation, a $p = 5\%$ standard error was allowed. The questionnaires were evaluated using PSPP 2.0.1 statistical software, which serves as a substitute for the proprietary Statistical Package for the Social Sciences (SPSS, IBM Corp., Armonk, NY, USA) program [5]. This method was chosen to process the data efficiently and quickly [6]. PSPP is well-suited for comparing the results obtained from the analyses [7].

2.3. Linguistic–Cultural Inquiry

Linguistic investigation of a certain word or expression—including its frequency, collocations, and their context—can be effectively performed on the basis of huge collections of texts (linguistic corpora). For this purpose, the Lao Web Corpus (loTenTen) was selected [8], which is a Lao linguistic corpus of remarkable size (appr. 105 million words) made up of texts collected from the Internet, providing a valuable representation of Lao language in use. The respective texts of the corpus were collected from Lao-language texts on the Internet in 2018–2019. The analysis was performed relying on the online corpus linguistic research tool Sketch Engine (Lexical Computing CZ s.r.o., Brno, Czech Republic) [8].

The corpus linguistic analysis was complemented by a paremiological investigation focusing on idioms and proverbs in the Lao language. Proverbs and sayings were collected from available sources [9,10], then grouped based on their meaning and the underlying values represented.

Finally, the cultural–religious embeddedness of the concept of *fish* was analyzed relying on secondary literature [11,12].

3. Overview of Aquatic Resources in Aquaculture and Fisheries in Laos

Among various factors, the availability of water resources is a crucial factor that affects a country's aquaculture production. Even if Laos is a landlocked country, abundant freshwater resources are available, especially along the Mekong River. Laos lies almost entirely within the lower Mekong basin and has the largest Basin Area (202,000 km^2) and a flow of 35% shared by six countries (China, Myanmar, Laos, Thailand, Cambodia and Vietnam). The Mekong River and its 14 tributaries, large reservoirs, shallow irrigation and weirs, wetlands and swamps, and rain-fed rice fields are available for fisheries and aquaculture. The Lao PDR has twelve reservoirs which could possibly be used for culture-based fisheries. There are substantial opportunities and resources available to enhance and augment aquaculture development in Lao PDR [13,14]. According to estimations, the total water area used for capture fisheries exceeds 1.2 million ha, while 42,000 ha of water area is utilized by aquaculture [15].

In landlocked countries, the availability of renewable freshwater resources (km^3/year) is a key figure when the relation between aquaculture and water resources is investigated.

The definition of the Annual Internal Renewable Water Resources (AIRWR) is: long-term average annual flow of rivers and recharge of aquifers generated from endogenous precipitation. The freshwater aquaculture production/renewable freshwater resources ratio (AFR ton/km^3) displays a great variety between regions: Oceania, 1.56; Latin America and the Caribbean, 31.1; North America, 50.0; Europe, 68.7; Africa, 84.1; and Asia, 2409 [16]. Based on recent statistical data on aquaculture production in developing landlocked countries [17] and AIRWR [18], the AFR ratio for Laos was 806.2 t/m^3 in 2024 (Table 1).

Table 1. The freshwater aquaculture production/renewable freshwater resources ratio (AFR ton/km^3) in landlocked developing countries, where fish production exceeded 100 t in 2021.

Country	AIRWR (km^3/year)	Aquaculture Production (t)	AFR (t/km^3)	GDP/Capita (2023) (USD)
Armenia	6.9	25,800	3739.1	6673
Bhutan	78	58	0.74	4038
Burkina Faso	12.5	1293	103.4	957
Central African Republic	141	410	2.9	511
Chad	15	115	7.7	1003
Eswatini	2.6	25	9.6	4257
Lao People's Democratic Republic	190.4	153,504	806.2	2599
Malawi	16.1	4800	298.1	645
Mali	60	9090	151.5	944
North Macedonia	5.4	2337	432.8	7408
Paraguay	117	22,300	190.6	6452
Republic of Moldova	1.6	12,757	7973.1	6033
Rwanda	9.5	8392	883.4	1036
Uganda	39	103,420	2651.8	964
Zambia	80.2	88,950	1109.1	1395

Although AIRWR data date from 2022, this parameter remains stable over time. Consequently, calculating AFR using 2024 aquaculture production data is justified. GDP/capita data is based on World Bank statistics [19].

The lowest AFR value was 0.74 t/m^3 in the Central African Republic, while the highest one was 7973 t/m^3 in the Republic of Moldova. Recent data on AIRWR and freshwater aquaculture production confirmed the findings of the Boyd et al. study [16] that freshwater aquaculture production and fish consumption are not highly correlated with the availability of renewable freshwater resources. However, the proximity of rural settlements and homesteads to water areas affects knowledge of fish and its consumption. While AFR is a useful indicator of responsible water management in aquaculture, it is important to consider water use efficiency and environmental sustainability. Overall availability of freshwater resources in Laos is not a constraint to meeting the demand for high-quality and healthy fish by the population; however, the application of water-efficient and sustainable aquaculture systems and technology remains a key issue in future aquaculture development [20].

In order to determine possible correlations between AIRWR, aquaculture production, AFR, and GDP/capita statistics (Table 1), Pearson correlation indices were calculated using PSPP software with the below results (Table 2).

Table 2. The Pearson correlation indices of LLDCs AIRWR, aquaculture production, AFR, and GDP/capita statistics (using PSPP software).

Variable Pair	Correlation (r)	Significance Level (*p*-Value)	Interpretation
AFR ↔ Aquaculture production	0.82	0.001	Strong positive correlation
AFR ↔ GDP/capita	0.41	0.128	Moderate positive correlation
Aquaculture production ↔ GDP/capita	0.36	0.187	Moderate positive correlation
AIRWR ↔ AFR	0.12	0.674	Very weak correlation
AIRWR ↔ GDP/capita	0.05	0.860	No meaningful correlation
AIRWR ↔ Aquaculture production	0.18	0.523	Weak correlation

While no or weak correlation was observed between AIRWR and the other variables, AFR showed a strong positive correlation with aquaculture production, while GDP/capita displayed a moderate positive correlation with both AFR and aquaculture production (given the small sample size (N = 15), correlation estimates should be interpreted with caution).

Although water resources are abundant in the Lao PDR, the growing and urbanizing population in conjunction with government strategies for economic development rooted in hydropower, agricultural commercialization and mining highlight the complex and dynamic interrelationship between water, food, and energy. In such a situation, despite the lack of physical water scarcity, improving water management is crucial to sustaining national economic growth and advancing human development [21].

Regarding the role of dams in Lao PDR, they vary in scale, ranging from large reservoirs designed for electricity generation and agricultural irrigation to small diversion weirs that serve both functions at the local level. For hydropower dams or reservoirs, Lao PDR had a total of over 60 hydropower dams and reservoirs in 2025. Hydropower in Laos has many potential benefits: increasing electrification across rural Laos and Southeast Asia, decreasing reliance on fossil fuels, improving social development through investment in social programs, and supporting the national economy of Laos. However, hydropower dam construction can cause lasting damage to river ecosystems by altering flow regimes, fragmenting habitats, obstructing the natural migration of fish, resulting in a drastic reduction in fish biodiversity that can lead to the extinction of many fish species.

As for irrigation dams, although these types of dams could create positive effects on fisheries productivity, e.g., supporting fisheries and aquaculture opportunities and providing fishery habitats during the dry season, they could also result in negative impacts on productivity due to habitat dysconnectivity and alteration of water flow regimes. As far as future construction and operation of hydropower dams are concerned, the Lao government must establish and implement a balanced policy between promoting country-wide economic development and protecting the local environment and those who rely on it [22–25].

Integration of fisheries and aquaculture into irrigation schemes is not yet common practice but is a way the performance of irrigation schemes could be enhanced, with both livelihood-related and broader economic benefits [26]. Rice–fish farming was introduced to Laos in 1937, and the 0.82 million ha rice production area offers great potential for aquaculture through integrated rice–fish farming; however, this technology is applied in the case of less than 1 percent of the area [27,28]. In recent decades, several promotion and extension projects have been carried out by governmental, intergovernmental and non-

governmental organizations; however, further efforts are needed to use the benefits of rice–fish farming in the efficient and sustainable application of water resources [13,20,29].

One of the priority sectors of the national blue economy framework [30] in the Lao PDR is fisheries and aquaculture, which has already demonstrated its positive contribution to the efficient use of water resources and environmental protection through the application of advanced systems and technologies and through responsible management [30].

4. Socio-Economic Importance of Aquaculture and Fisheries in the Lao PDR

In the Lao PDR, the agricultural sector (crop production, aquaculture and fisheries, animal husbandry, and forestry) is one of the main pillars of the national economy. About 71% of the employed population work in the agricultural sector, mainly on small family farms. As high as 48% of GDP (the second fastest-growing GDP in the region after China) comes from agriculture (including fisheries and aquaculture) and the exploitation of natural resources. The contribution of aquaculture and fisheries has been estimated at 7–13% of GDP [13,31]. The sustainable use of natural resources is therefore of strategic importance to the socio-economic development of the Lao PDR, which has abundant aquatic resources for fisheries and aquaculture [32]. Aquaculture and fisheries play an important role in providing employment as well as protein to the Lao population. The fish come mainly from the Mekong River and its tributaries. There are about 590 fish species in Lao waters, 94% of which are native, but 17 species of economic importance play a central role in aquaculture, especially in small-scale farming and fish supply [33]. Aquaculture production is of increasing importance, having reached 153,504 tons in 2024 [34]. The development of aquaculture production between 2010 and 2024 is shown in Figure 1.

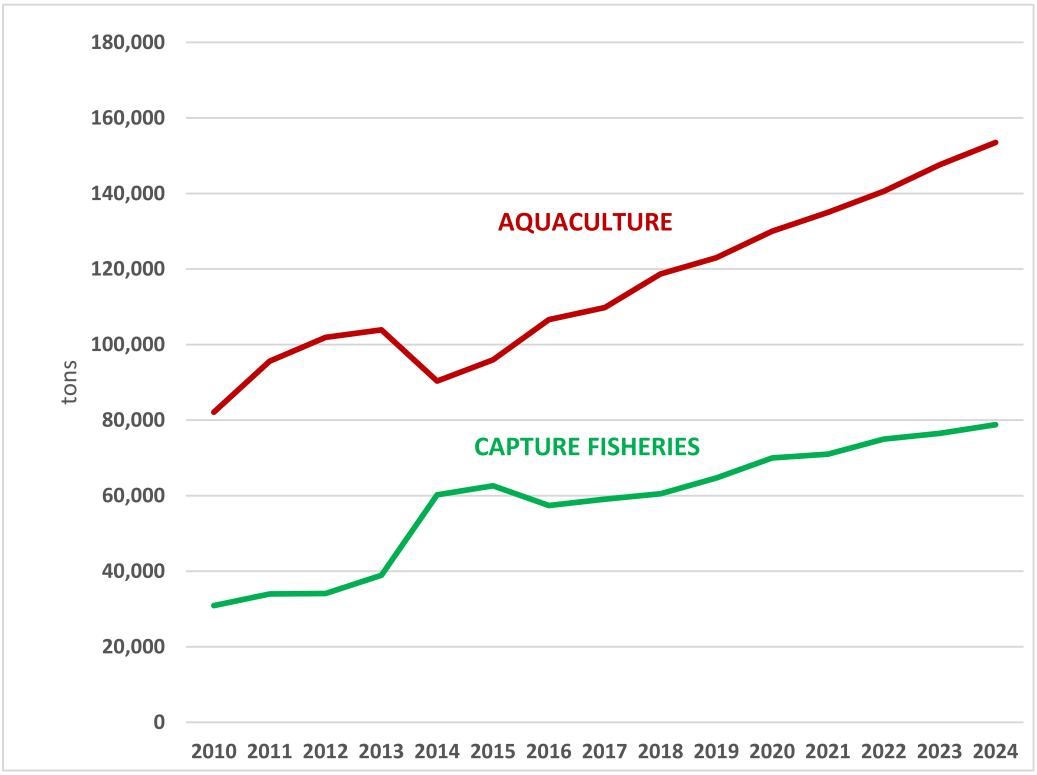

Figure 1. Aquaculture production shows a growing tendency, while capture fisheries are leveling in the Lao PDR (FAO, 2026, [34,35]).

Although the accuracy of the data provided is questionable, the increase in aquaculture production is clear. The composition of species in aquaculture is shown in Figure 2

according to which the dominant species in production (59,300 tons, 39.0% of total production) in 2024 was tilapia, which is intensively farmed in cages located in larger rivers. The three Chinese herbivorous species together account for 14.0% and the three Indian carp species for 13.7% of total aquaculture production. Common carp accounted for 4.0% of total production in 2024 [34].

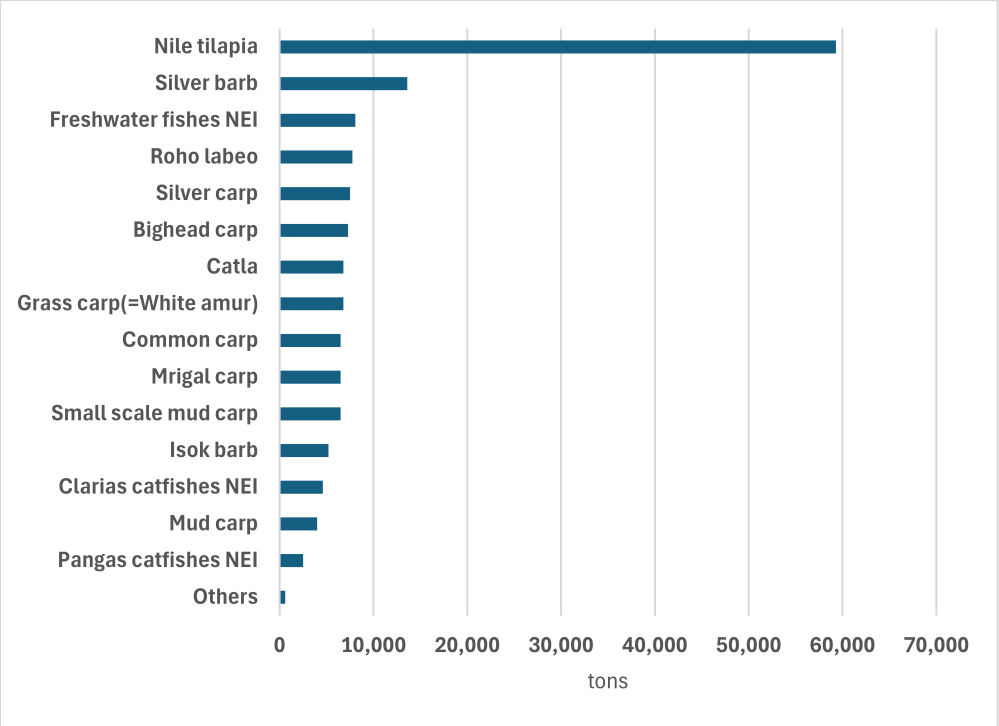

Figure 2. Species distribution in aquaculture production in the Lao PDR in 2024 (FAO, 2026 [34]).

Pond fish production is a traditional but still significant sector of aquaculture in the Lao PDR, which is the basis of livelihood for many people living in rural areas. The main fish species cultured in ponds are Chinese herbivores, Indian carps and common carp. Cage fish culture has developed dynamically over the last 20 years and has become the most important sector of Lao aquaculture, mainly aiming at producing tilapia. Similarly to other Asian countries, fish culture has been integrated with other food production systems, mainly with livestock and rice farming. The opportunities offered by various integrated systems and technologies in the development of a circular economy have not been explored yet [36].

Capture fisheries and culture-based fisheries are important activities in Laos in providing animal protein for rural communities by using various water resources such as the Mekong River and its tributaries; large hydropower reservoirs; natural pools, lakes and small wetlands; irrigation reservoirs, weirs and the large areas of wet-season rice-fields and seasonal Mekong flood plains. The fisheries sector is still at the "subsistence and semi-subsistence" level; however, there are examples of organized fisheries in large reservoirs and systematic stocking in small reservoirs under community management [37–39].

In Lao PDR, fisheries and aquaculture activities are governed by the Ministry of Agriculture and Environment (MAE) (previously: Ministry of Agriculture and Forestry, MAF) through its Department of Livestock and Fisheries (DLF). Following the Agreement with the Mekong River Commission (MRC) in 1995, the Lao government is laying more emphasis on water resources and environmental management, in which fisheries would be one of seven key sub-sectors. Since then, regional integration of the sector and its international collaborations have been improved [37,39,40].

Climate change also heavily affects the Lao aquaculture sector by posing a growing threat to rural livelihoods, in both upland and lowland areas where socio-economic vulnerabilities and limited adaptive capacity heighten risks [41,42]. Climate change mainly affects agriculture, but it also heavily threatens Laos's freshwater fisheries and aquaculture through extreme weather events, shifting rainfall, and rising temperatures, which reduce fish yields, damage rural livelihoods, and risk food security. Fish consumption therefore is also affected negatively due to socio-economic consequences, including income instability, food and nutritional insecurity and heightened vulnerability of small-scale fishers and fish farmers. There are international projects and national initiatives aimed at mitigating the negative effects of climate change through introduction of climate-resilient practices, ecosystem-based management, technological innovation and adaptive strategies [43–45] that need to be further strengthened in the future.

Since the 1990s, various laws (Agricultural Law, Penal Law, Forestry Law, Water Resources Law, and the Aquatic and Wild Animals Law) have been the basis for guidelines and instructions issued by local authorities to local communities for the management of aquatic resources. A Fisheries Law was enacted in 2009 that has been replaced by a new "Law on Aquatic Animals, Fisheries and Aquaculture" [46]. The special role of fish in the Lao socio-economy is well indicated by the definition of the Law that recognizes four major uses of aquatic animals: (1) utilization for public benefits (e.g., scientific research, tourism, sports, shows); (2) utilization for family benefits (e.g., consumption, medicines, decoration); (3) costumery utilization (e.g., release of fishes during traditional ceremonies) and (4) utilization for business purposes (e.g., farming, exporting and importing).

Even if the utilization of fish and aquatic animals for public and family benefits and for traditional ceremonies remains important in the socio-economy of the country, the opportunities in business utilization are increasingly recognized. A key issue in aquaculture development is commercialization through the transition from subsistence farming to market production. This is a great challenge for farmers, as their priorities move from diversity and risk minimization toward product quality and safety to meet market demand [47].

The planning of appropriate programs and actions in line with the policy of transition from subsistence farming to market production requires the application of a holistic value chain concept. Major findings of a preliminary fish value chain analysis (VCA) are summarized in the following [32]:

- The quality of inputs (seed and feed) should be further improved; however, strengthening farm management (including financial and business management) is a key issue in aquaculture development.
- Processing aquatic products and meeting safety and quality standards should be strongly encouraged and supported, while there is also a need for product promotion based on consumers' demand.
- The role of fish farmers and their associations should be strengthened along the value chain, especially in trading activities, but also in planning and governance.
- Appropriate policies, laws and regulations are available, but their enforcement should be supported through strengthening relevant governmental and provincial resources.
- In order to meet the challenges aquaculture and fisheries face, the institutional system in research, innovation and human resources development should be strengthened both at the government and the provincial level.

Regarding the findings of the VCA and the results of previous government-funded and donor projects, basic conditions are available to elaborate specific action plans and to implement them efficiently both in the public and private sectors. The policy framework for the commercialization of agriculture is in place, in which the aquaculture and fisheries sector is one of the priority areas [40,48]. The economy of the Lao People's Democratic

Republic has been growing gradually over the years, with an average growth rate of about 6.5% between 2010 and 2019. However, in recent years, Lao PDR's economy has been experiencing a range of challenges, including a sharp depreciation of the national currency, high inflation, and persistent macroeconomic instability. This is due to ineffective domestic economic reforms and an overall decline in the global economy [28,30]. However, a well-managed aquaculture sector has great potential to contribute to the improvement of the economic situation, being a vital element of the National Green Growth Strategy of the Lao PDR and even of the Sustainable Blue Economy in the ASEAN Region [49,50].

5. Cultural, Linguistic, and Religious Significance of Fish in Laos

The fact that 80% of the Lao population lives in rural areas, heavily relying on the consumption of fish and other aquatic animals with a remarkable level of 25.3 kg/capita/year [37,51] and a proportion of fisheries in the national GDP of 6.8% [52] makes it clear that fish is a fundamental component of Laotians' daily life and Lao livelihood and culture [53]. In this chapter, cultural, linguistic and religious factors of this phenomenon are being discussed.

The word *fish* is translated as **ປາ**/bpaa/in the Lao language and appears in several expressions denoting species of fish and other aquatic animals, as well as Lao national dishes, and types of fish of different processing methods in Laos (Table 3).

Table 3. Lao words originating from the word **ປາ** (*fish*) denoting species of fish and other aquatic animals, Lao national dishes, and types of fish of different processing methods in Laos.

	Lao Word	Pronunciation of Lao Word	English Translation	Category
1.	ປາ	/bpaa/	*fish*	species of fish and other aquatic animals
2.	ປານິນ	/bpaa nin/	*tilapia*	
3.	ປາໄນ	/bpaa nai/	*carp*	
4.	ປາກົດ	/bpaa got/	*catfish*	
5.	ປາທູ	/bpaa tu/	*mackerel*	
6.	ປາໄຫລ	/bpaa lai/	*eel*	
7.	ປາມຶກ	/bpaa muek/	*squid*	
8.	ປາມຶກຍັກ	/bpaa meauk nyok/	*octopus*	
9.	ລາບປາ	/laap bpaa/	*spicy fish salad*	Lao national dishes
10.	ກ້ອຍປາ	/ghoi bpaa/	*raw fish salad*	
11.	ແກງປາ	/keng bpaa/	*fish soup*	
12.	ໝົກປາ	/mok bpaa/	*steamed fish in banana leaves*	
13.	ປາແຮ້ງ	/bpaa haaeng/	*fish dried on the sun*	types of fish of different processing methods in Laos
14.	ປາແດກ	/bpaa daek/	*fermented fish sauce*	

Original linguistic data, their English translation in Table 3 and throughout the text are italicized.

The Lao word **ປາ** (*fish*) is the 129th most frequently used noun of the Lao language [34]. The most typical co-occurrences (words appearing in its vicinity) of the Lao word **ປາ** (*fish*) refer to activities connected to fish, including **ກິນ** (*eat*), **ຮັບປະທານ** (*eat/consume*), **ໄປຫາປາ** (*go to fish*), and **ຂາຍ** (*sell*). More specific activities appear in the vicinity of the word **ປາ** (*fish*), such as **ປ່ອຍປາ** (*release fish*), which is without doubt in connection with the Buddhist religious habit of releasing fish fingerlings to the rivers and lakes during more important

religious festivities as well as on 13 July of each year on the occasion of the National Fish Release Day. The verb ເພິ່ງ (*depend on/rely on*) also highlights the utmost importance of fish as a staple food in the Lao PDR. Besides activities, highly relevant nouns co-occurring with ປາ (*fish*) include those connected to fish dishes: ຕັບປາ (*fish liver*) and ສົ້ມປາ (*sour fish*). The importance of raising fish as an agricultural activity is reflected in such collocations as ໜອງປາ (*fish pond*) and ຕູ້ປາ (*fish tank*) (Table 4).

Table 4. Most frequent collocations of the word ປາ (*fish*) in the Lao language. The analysis was performed with the online corpus linguistic tool Sketch Engine [8].

	Lao Word	English Translation	Word Class
1.	ກິນ	*eat*	verbs
2.	ຮັ ບປະທານ	*eat/consume*	
3.	ໄປຫາປາ	*go to fish*	
4.	ຂາຍ	*sell*	
5.	ປ່ ອຍປາ	*release*	
6.	ເພິ່ງ	*depend on/rely on*	
7.	ຕັ ບປາ	*fish liver*	nouns
8.	ສົ້ ມປາ	*sour fish*	
9.	ໜອງປາ	*fish pond*	
10.	ຕູ້ ປາ	*fish tank*	

Original linguistic data, their English translation in Table 4 and throughout the text are italicized.

Lao proverbs, sayings, and idiomatic expressions are also primordial sources of wisdom and knowledge accumulated by the Lao people that reflect cultural values, norms, and beliefs [9,10]. Table 5 summarizes some essential Lao proverbs and sayings connected to fish.

Fish as a staple food, a main protein source and a foundational element of the Lao diet appears in such proverbs as *Ten dishes of meat cannot be compared to a fish meal (ສິບຊີ້ນບໍ່ປານປາ)* or *In the rivers there is fish, in the fields there is rice (ຢູ່ນ້ຳມີປາ ຢູ່ນາມີເຂົ້າ)*. Further essential Lao values can be grasped including the value of persistence and thrift: *When the water rises, the fish eat the ants; when the water falls, the ants eat the fish (ເມື່ອນ້ຳ ຂຶ້ນ, ປາກິນ ມົດ; ເມື່ອນ້ຳ ຕົກ, ມົດ ຈະກິນ ປາ)*, or *Small fish, but hard to catch (ປານ້ອຍ ແຕ່ເປັນ ປາ ຫາຍາກ)*, or *When you eat fish, don't forget to dry some on the sun (ຄົນໃດກິນປາແລ້ວ ຢ່າລືມເອົາຕົກແດດ)*. The strong communitarian trait and the utmost importance of interdependence and solidarity can be observed in proverbs including *Do good and you'll have food; do evil and you'll have fish scales (ເຮັດດີ ມີກິນ ເຮັດ ຊົ່ວ ມີ ເປືອກປາ)*, and *A single rotten fish makes a basketful turn bad (ປາທີ່ເນົ່າເປື່ອຍ ໂຕດຽວ ເຮັດໃຫ້ກະຕ່າ ເປື່ອຍ ບໍ່ດີ)* (Table 5).

Besides language, fish appears to be very deeply embedded in Lao culture, customs, and habits. In many Lao households, fish is the traditional dish of family gatherings and celebrations. There is also a common belief that eating fish makes children not only healthier but smarter too. Parents usually prioritize serving fish over processed foods, aligning with a broader goal of instilling healthy eating habits in their children from a young age. These preferences reflect the combination of nutritional knowledge, cultural traditions, and beliefs that influence food choices in Lao households, especially concerning the well-being and future success of Lao children.

Cultural and religious rituals and beliefs connected to rivers and lakes are also visible in the various legends and imaginary figures connected to waters [11]. Many of the Lao elderly do not allow their children to be or to play near the rivers because they believe that a soul or water spirit—the Ngeuak (ເງືອກ) and the Naga (ພະຍານາກ)—may prey on

them [12]. These mythical creatures are believed to dwell in rivers, lakes, and other waters and are considered to be dangerous for all, especially children. Lao beliefs connected to the Naga and the Ngeuak, as well as Lao rituals during the Rocket Festival, the Fish Release Day and during various family festivities, confirm the strong embeddedness and impact of the culture of rivers, waters, and fish on Lao culture and everyday life.

Table 5. Lao proverbs about *fish*, their meaning and their underlying societal values.

	Lao Proverbs/Sayings Connected to *Fish*	Literal Meaning	Abstract Meaning	Underlying Value
1.	*ເມືອນ້ຳຂຶ້ນ, ປາກິນມົດ; ເມືອນ້ຳຕົກ, ມົດຈະກິນປາ*	*When the water rises, the fish eat the ants; when the water falls, the ants eat the fish.*	Luck is fickle. You need to be patient and persistent in life.	Patience, persistence.
2.	*ປາຫື ເນົ່າເປື່ອຍ ໂຕດຽວ ເຮັດໃຫ້ກະຕ່າ ເປື່ອຍ ບໍ່ດີ*	*A single rotten fish makes a basketful turn bad.*	One single person's mistake can harm the whole group's well-being.	Solidarity, importance of the community.
3.	*ຢູ່ນ້ຳມີປາ ຢູ່ນາມີເຂົ້າ*	*In the rivers there is fish, in the fields there is rice.*	You can earn your living and maintain a happy life even in simple conditions.	Dependence on and respect of nature.
4.	*ປາໃຫຍ່ກິນປານ້ອຍ*	*Big fish eat little fish.*	The more powerful dominates the less powerful in society.	Inequity of society.
5.	*ປານ້ອຍ ແຕ່ເປັນ ປາ ຫາຍາກ*	*Small fish, but hard to catch.*	Sometimes seemingly insignificant things can be difficult to obtain.	Persistence and effort.
6.	*ກິນປາ ກ້າ ແລ້ວ ແຕ່ ດອກໄມ້ ສູງ*	*Eating fish, but the trees are tall.*	Even if you are lucky at the moment, you might face challenges in the future.	Modesty, avoidance of being over-confident.
7.	*ປາ ທີ່ບໍ່ມີ ນ້ຳ ກໍເຮັດ ຫຍັງບໍ່ ໄດ້*	*A fish without water cannot do anything.*	Being prepared for changing or unfavorable conditions in life.	Adaptation to the environment.
8.	*ເຮັດດີ ມີກິນ ເຮັດ ຊົ່ວ ມີ ເປືອກປາ*	*Do good and you'll have food; do evil and you'll have fish scales.*	For good deeds you will be rewarded; for wrongdoing your karma will bring undesirable results.	Solidarity, helping one another.
9.	*ເປັນ ເປັນ ປາ ກໍໄປ ຄົນຈັບ*	*Even a live fish can be caught.*	Even smart and strong individuals can face problems and challenges.	Modesty, being humble.
10.	*ຄົນໃດກິນປາແລ້ວ ຢ່າລືມເອົາຕາກແດດ*	*When you eat fish, don't forget to dry some in the sun.*	Think of tomorrow rather than just enjoying the present day.	Thrift, frugality.
11.	*ສິບຊີ້ນບໍ່ຢາມປາ*	*Ten dishes of meat cannot be compared to a fish meal.*	Fish consumption is favorable for health.	High nutritional value of fish.

Original linguistic data, their English translation in Table 5 and throughout the text are italicized.

6. Fish Trade, Markets, Processing and Consumption

6.1. Fish Trade

Since most of the fish and other aquatic animals in Laos are produced by small farms or caught by artisanal fisheries which do not possess storage and transport facilities and lack appropriate market information, middlemen provide the link between the producers and the market. Few studies have been carried out regarding fish trade, and no official statistical information is available on this subject; however, it is assumed that less than 25% of the total household fish catch and production was traded locally, and this ratio is even lower in remote rural areas [52].

Significant regional differences can be observed in fish trading, including the growing presence of Chinese fish farmers on the Nam Ngum River that has led many Lao fish breeders to give up the business, as the Chinese traders have more favorable financial resources to finance their operation. Some larger farms operated by advanced farmers run storage facilities, local fish shops, and even transport trucks to supply fish to consumers [4].

Further to the above, there are also rural communities close to larger water bodies that process fish products and operate fish restaurants, purchasing the fish directly from fishermen without the assistance of middlemen [54]. In some rare examples, export activities can also be observed, in case the relevant documents submitted to the Department of Livestock and Fisheries at the District or Provincial Agriculture and Forestry Office are approved at the National office. Subsequently, the fish and fishery products are quarantined at laboratories and cleared at border checkpoints before reaching the international markets [52].

The commercialization of fish farming is still a great challenge in fish trading. One of the priorities of current national agricultural and fisheries development policies is to ensure the provision of fishery products as commercial commodities for local markets and for future export [52]. Through DLF, the country aims to enhance fisheries trade by improving fisheries management and production, international border checkpoints, fisheries quarantine, and fisheries marketing strategies in collaboration with neighboring countries along the Mekong River [54]. However, significant further efforts are needed to achieve the above goals.

6.2. Fish Markets

Fish markets in Laos exhibit a very diverse and colorful picture. Traditional, rural markets and street vendors are still common in many regions and also exist in larger towns including Vientiane, the capital city. The growing number of small, modern shops (e.g., Little Big C, Seven Eleven) sell processed fish products, mainly imported canned fish. Food delivery services (e.g., Foodpanda) are becoming increasingly popular in larger cities, often delivering fish dishes to customers. Modern supermarkets are also appearing in increasing numbers in larger cities. Those typically sell high-quality imported fish products (e.g., salmon, oysters) and delicate fish products that are also commonly available on the menu of high-class restaurants and hotels.

Despite the above, most of the fish and fishery products are sold at local markets situated near the landing sites along the Mekong River and its tributaries, including the Ou, Xieung, and Khan Rivers. In many rural markets, sellers commonly communicate with the consumers by phone, and payment with a mobile phone application is also common. The market operations at certain landing sites are seasonal, and as a result, fish and fishery products are often sold directly to restaurants [55,56]. Market hygiene conditions vary greatly, generally displaying an improving trend, but in remote areas, they do not meet international food safety standards. As far as the general market situation of fish supply is concerned, it can be concluded that market traditions, market culture, the large number of markets and the high variety of products accessible at markets contribute to the population having access to fish and fish products even in remote regions.

6.3. Fish Processing

Artisanal fish processing has a long tradition in Laos. Apart from the consumption of fresh fish, almost 50 percent of fish and other aquatic animals are transformed into preserved fish products such as salted and dried fish, smoked fish, fish paste and other kinds of fermented fish and fish sauce [57]. Fish processing communities can also be found close to landing sites at large water reservoirs (e.g., Nam Xouang) where mainly women produce various local products, namely fermented sour fish wrapped in banana leaves, fermented

fish dip, dried fish, and fermented salted fish [39,58]. The first modern fish processing plant of the Lao PDR has recently been built in the frame of a Hungarian development project in Tha Ngon village 25 km from Vientiane on the side of Nam Ngum River. The plant is operated by the Vernkham Agricultural Cooperative that also produces fish and high-value aquatic animals including softshell turtles and frogs. Relying on a modern production line, the plant produces fish filets, fish balls, and smoked fish with a total capacity of 20 tons per month [54].

6.4. Fish Consumption and Consumer Preferences

Because of limited production levels and a low level of purchasing power, the daily diets of a large segment of the rural population depend mainly on foraged foods including mushrooms, bamboo shoots, wild plants, insects, wild meat, and wild fish. Wild fish is a key source of protein, accounting for over half of the total fish consumption in Laos in 2019 [59,60]. However, volume, structure and trends of fish consumption show a different picture in larger settlements and urban areas. While fish consumption remains high in rural communities, there are emerging trends that reflect changes in the diet of urban populations. With increased access to processed foods and greater availability of imported meat products, fish in urban centers remains a staple food. Additionally, the expansion of the aquaculture industry is contributing to a steady supply of farmed fish, which has impacted both the affordability and availability of fish. Fish caught in reservoirs and natural waters have secondary importance since 1997, when supply from aquaculture exceeded the production of capture fisheries [2]. The share of imported aquatic products is only about 5 percent of the total consumption of aquatic animals [3].

In Laos, there is a growing number of consumers who are ready to buy more modern, processed, packed, high-quality fish products from fish processing plants. It is important to examine which values are important to Lao consumers, especially for the young generation (18–25), and which final products of the value chain they are interested in the most. Understanding the values and preferences of this societal group is crucial for the successful introduction of new fish products in Laos. These consumers are not only concerned with product quality but also show a strong inclination towards the convenience of modern, processed goods. This transition reflects broader global trends where young consumers are more likely to prioritize product quality, packaging, and the overall purchasing experience [61].

Considering the socio-economic changes in Laos, a study (online questionnaire survey) was carried out recently to evaluate the motivation and preferences of young consumers when buying fish and fish products [54]. The results of a local survey on processed fish product preferences were taken into account when the possible selection of fish products was listed in the questionnaire [54]. It should be noted that besides fish fillet, traditional fish products were dominant in the list of preferred processed fish products such as fish ball, dried and fermented fish, fish sausage and fish sauce. The responses of the young customers confirmed the positive consumer attitude towards traditional products since 61% and 50% of the respondents would willingly buy fillet and fish ball, respectively. The preference for local products was also clearly indicated by the results since 68.5% of the respondents would like to buy mainly Lao fish and fish products, while 21.8% would buy from other Asian countries, and 9.7% would also buy from European countries and the United States.

The findings reveal a significant openness among the young generation towards new fish products, especially processed and packaged fish items that meet both their quality expectations and lifestyle needs. Food safety concerns are increasing not only among younger consumer groups but in the case of all fish consumers, even in rural areas. It is a

great challenge for the whole Lao aquaculture sector to improve product quality as well as food safety [62,63]. The first modern fish processing plant can be a good reference for the application of appropriate processing technology and a reliable certification system. However, there is a need for the development of relevant regulations, the training of the actors along the whole fish value chain, and improved communication with the consumers.

6.5. Export and Import of Fish and Fishery Products

The import of fish and fish products, including aquatic animals in Laos, has been less than 5% of the total fish supply in the past decade. Local aquaculture production and fisheries catches are the major source of fish supply. The volume of imports of fish and fishery products reached 14,887 tons in 2021, about 4.6% of the total fish supply. Even though the volume of imports is increasing and was 2.5 times higher than three years ago, the major source of fish supply will remain local production. Imported products predominantly originate from neighboring countries, including Thailand, Vietnam, Cambodia, Myanmar, and China [13,55]. In 2021, 61% of the imports originated from Thailand and included mainly high-value fish (e.g., salmon and tuna) and processed products [2]. In some landlocked developing countries where fish consumption is relatively high, such as Mali and Zambia, the share of imports was 43% and 56%, respectively, in 2021.

Some landlocked developing countries import fish and fishery products not only from neighboring countries but also from distant developed countries. In the past decade, Laos has exported approximately 10 to 50 tons of fish and crustaceans annually in both fresh and processed forms [2,12]. There is no clear trend in exports, and it includes mainly occasional supplies of some special products like fish heads to China or freshwater algae to Thailand. Exports of aquatic products do not have any noteworthy effect on local fish supply. The fact that fish consumption in Laos is based on local supply has significant advantages. Fish consumption has not been significantly affected by the recent economic difficulties and the devaluation of the local currency, the kip. Restrictions on imports of fish and fishery products during the COVID-19 epidemic and the recent economic recession indicated that even the most demanding local consumers are interested in domestic premium fish products. The processing of domestic fish can therefore play a major role in maintaining the level of fish consumption.

6.6. Threats to Maintaining Current Fish Consumption Level

Maintaining current levels of fish consumption requires different measures for rural and urban populations. In rural areas, fish consumption patterns among the poorer and more vulnerable populations—who are exposed to the impacts of climate change—may shift, whereas in cities, the challenge lies in meeting the demand for higher-quality processed fish products.

The commercialization of fish farming can also give rise to problems observed in other developing countries—specifically, that due to profit-oriented operations, the farmer's family consumes purchased food rather than the fish they have produced themselves. There is no concrete or reliable information on this yet, but it is worth investigating.

Since fish consumption in Laos is strongly tied to tradition, this represents resistance to challenges that could cause fish consumption to decline.

7. Conclusions

Aquaculture and fisheries are crucial to the Lao economy and culture, with a significant portion of the population dependent on these sectors for livelihood and food security. Fish is deeply embedded in the Lao diet-related and religious habits and customs, for instance in the form of annual and religious fish release activities. This strong intercon-

nectedness is also mirrored linguistically, including the most frequent collocations of the word *fish* (*eat/consume; go fishing; sell; release; depend on; fish pond; fish tank*), as well as in numerous proverbs emphasizing the importance of fish in daily life and displaying clearly the connected values of the community (patience, solidarity, modesty, adaptation, thrift).

Among the limitations of the study, it needs to be mentioned that not only is relevant literature missing, but reliable statistics are very scarce or sometimes contradictory. The key quantitative claims about markets and consumer preferences are based on unpublished and self-authored consulting reports. Furthermore, a subjective element of the analysis is the authors' reliance on their decades-long expertise in the target country. In the case of the correlation analysis in Section 3, generalizability is limited due to a small sample size as well as the potential distortion effect of the two countries with markedly higher values (Laos and Uganda).

Regarding the investigated phenomenon of an outstandingly high per capita fish consumption in Laos, it was concluded that freshwater aquaculture production and fish consumption are not highly correlated with the availability of renewable freshwater resources. A more determining factor is the proximity of rural settlements and homesteads to water areas, which affects knowledge of fish and its consumption. Taking into account that Laos possesses abundant freshwater resources, the application of water-efficient and sustainable aquaculture systems and technology will be a key issue in future aquaculture development.

Based on the comparative correlation calculation of 15 LLDCs' variables, it was pointed out that no or weak correlation was found between AIRWR and the other variables (AFR, aquaculture production, and GDP/capita), while AFR showed a strong positive correlation with aquaculture production and GDP/capita displayed a moderate positive correlation with both AFR and aquaculture production.

In Lao PDR, the fishery and aquaculture sector provides employment and protein and contributes to GDP. Transitioning from subsistence farming to market production in Laos causes various challenges, but with improved governance, sustainable practices, and commercialization, it can support economic growth and can improve habits and traditions connected to food safety. The deep cultural and religious ties to fish further emphasize its role in Lao society. Strengthening the aquaculture sector offers significant potential for socioeconomic development and alignment with national and regional sustainability goals.

Laos has appropriate agricultural and food policies in line with international and regional strategies and standards for the sustainable use of natural resources by fisheries and aquaculture, which are also consistent with the Least Developed Country graduation process. Besides the relevant basic regulations (Agriculture Law; Law on Aquatic Animals and Fisheries; Law on Water Resources), there are specific initiatives such as the National Action Plan on Transition toward Sustainable Food Systems Transformation (2025–2030) and the Country Programming Framework (CPF) for 2027–2031 to guide cooperation on agriculture, rural development and environmental sustainability.

Regarding fisheries and aquaculture, a new law, the Law on Aquatic Animals and Fisheries, came into force in 2023. However, the enforcement and implementation of laws and regulations is a major challenge. In the future, the participation of local communities will be essential in this work; thus, it is necessary to motivate the local population and support training and community actions. It is also crucial to harness the power of culture, religion and tradition throughout the process.

Author Contributions: Conceptualization, E.B.B., I.L., I.M., Z.B.-M., G.G., G.K., D.S., A.K. and L.V.; methodology, E.B.B., I.L., I.M., Z.B.-M., G.G., G.K., D.S., A.K. and L.V.; software, E.B.B., I.L., G.K., D.S., A.K. and L.V.; validation, E.B.B., I.L., G.K., D.S., A.K. and L.V.; formal analysis, E.B.B., I.L., I.M., Z.B.-M., G.G., G.K., D.S., A.K. and L.V.; investigation, E.B.B., I.L., I.M., Z.B.-M., G.G., G.K., D.S., A.K.

and L.V.; resources, E.B.B., I.L., I.M., G.K., D.S., A.K. and L.V.; data curation, E.B.B., I.L., I.M., Z.B.-M., G.G., G.K., D.S., A.K. and L.V.; writing—original draft preparation, E.B.B., I.L., I.M., Z.B.-M., G.G., G.K., D.S., A.K. and L.V.; writing—review and editing, E.B.B., I.L. and L.V.; visualization, E.B.B., I.L., I.M., Z.B.-M., G.G., G.K., D.S., A.K. and L.V.; supervision, E.B.B., I.L., I.M., Z.B.-M., G.G., G.K., D.S., A.K. and L.V.; project administration, E.B.B., I.L., I.M., G.K., D.S., A.K. and L.V.; funding acquisition, no funding. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: As this manuscript is a review and does not involve any research on animals or human subjects, ethical approval from an Institutional Review Board was not required.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data supporting the results of this study are publicly available and are cited within the References section of this article.

Acknowledgments: The authors would like to express their sincere gratitude to Philavong Santisouk (Dunaújváros University) for his invaluable assistance with native-language proofreading and editing of the manuscript, particularly the cultural–linguistic section, as well as for his substantial contributions to the chapter on cultural context.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Encyclopaedia Britannica. Laos. 2024. Available online: https://www.britannica.com/place/Laos (accessed on 21 December 2024).
2. Food and Agriculture Organization of the United Nations. Aquaculture Growth Potential in Landlocked Developing Countries: WAPI Factsheet to Facilitate Evidence-Based Policy Making and Sector Management in Aquaculture. March 2021. Available online: https://openknowledge.fao.org/server/api/core/bitstreams/e6a6f758-66e8-43b1-b33d-2d45f00d58ce/content (accessed on 19 December 2024).
3. FAO Food Balance Sheet. 2010. Available online: https://www.fao.org/faostat/en/#data/FBS (accessed on 12 July 2026).
4. Bozánné Békefi, E. Market Infrastructure Development. Consultancy Work in the Frame of Lao Hungarian 3rd Agricultural Tied Aid Loan Program. 2021. Available online: https://vitafortasia.com/wp-content/uploads/2025/02/Bekefi-E.-Consultancy-Report-30-July-13-September-2021.pdf (accessed on 6 June 2026).
5. Sajtos, L.; Mitev, A. *SPSS kutatási és Adatelemzési Kézikönyv*; [SPSS Research and Data Analysis Handbook]; Alinea Publishing House: København K, Denmark, 2007.
6. Huzsvai, L.; Vincze, S. *SPSS-Könyv*; [The SPSS Book]; Seneca Books: North York, ON, Canada, 2012.
7. Jánosa, A. *PSPP Programismertető és Felhasználói Kézikönyv*; [PSPP Program Description and User Handbook]; Statisztikai Szoftverek Műhelye: Budapest, Hungary, 2007.
8. Kilgarriff, A.; Baisa, V.; Bušta, J.; Jakubíček, M.; Kovář, K.; Michelfeit, J.; Rychlý, R.; Suchomel, V. The Sketch Engine: Ten years on. *Lexicography* **2014**, *1*, 7–36.
9. Mipun, J. 10+ Amazing Lao Proverbs To Know. 2022. Available online: https://ling-app.com/lo/lao-proverbs-to-know (accessed on 16 February 2025).
10. Proverbicals.com. Laotian Proverbs. 2025. Available online: https://proverbicals.com/laotian (accessed on 16 February 2025).
11. Cranmer, J.; Martin, S.; Coxon, K. *The Rough Guide to Laos*; Rough Guides: London, UK, 2002.
12. Badenoch, N. Crocodiles and Dragons: Fauna and Folklore in the Forests of Northern Laos. *J. Res. Inst. Kobe City Univ. Foreign Stud.* **2022**, *63*, 37.
13. Thongsamouth, K. Sustainable Aquaculture and Resource Enhancement in Lao PDR. In Proceedings of the International Workshop on Fish Health and Sustainable Aquaculture: Promotion of Sustainable Aquaculture, Aquatic Animal Health, and Resource Enhancement in Southeast Asia, Iloilo City, Philippines, 25–27 June 2019. Available online: https://repository.seafdec.org.ph/bitstream/handle/10862/6252/ThongsamouthK2021.pdf (accessed on 11 December 2024).
14. Friend, R. *Aquatic Resources in the Lao PDR: A Review of Current Knowledge*; MRC Technical Review: Vientiane, Laos, 2001.
15. Open Development Laos. Fisheries and Aquaculture Production in Reservoirs in Lao PDR. 2014. Available online: https://laos.opendevelopmentmekong.net (accessed on 26 July 2026).

16. Boyd, C.; Li, L.; Blummett, R. Relationship of Freshwater Aquaculture Production to Renewable Freshwater Resources. *J. Appl. Aquac.* **2012**, *24*, 99–106. [CrossRef]
17. Food and Agriculture Organization of the United Nations. Fisheries and Aquaculture–Global Statistical Collections. In *FishStatJ: Software for Fishery and Aquaculture Statistical Time Series (Computer Software)*; FAO: Rome, Italy, 2021. Available online: https://www.fao.org/fishery/en/statistics/software/fishstatj (accessed on 26 December 2024).
18. World Bank Group, Data Bank, World Development Indicators, Renewable Internal Freshwater Resources. Available online: https://databank.worldbank.org/reports.aspx?source=2&type=metadata&series=ER.H2O.INTR.K3# (accessed on 28 July 2026).
19. World Bank. GDP per Capita (Current US$) [Data Set]. World Development Indicators. 2024. Available online: https://data.worldbank.org/indicator/NY.GDP.PCAP.CD (accessed on 30 July 2026).
20. Inphonephong, S.; Mam, K.; Phounvisouk, L.; Dubois, M. *Introducing Integrated Rice–Fish Farming in Lao PDR: Policy Engagements*; CGIAR Technical Report; International Water Management Institute (IWMI): Colombo, Sri Lanka, 2024; 21p. Available online: https://hdl.handle.net/10568/151824 (accessed on 8 July 2026).
21. McCartney, M.; Brunner, J. Improved water management is central to solving the water-energy-food trilemma in Lao PDR. *Int. J. Water Resour. Dev.* **2021**, *37*, 619–639. [CrossRef]
22. UN WFP, World Food Programme. Food and Nutrition Security Atlas of Lao PDR. 2013. Available online: https://docs.wfp.org/stellent/groups/public/documents/ena/wfp260762.pdf (accessed on 24 July 2026).
23. Yoshida, Y.; Lee, Y.H.S.; Trung, B.H.; Tran, H.-D.; Lall, M.K.; Kakar, K.; Xuan, T.D. Impacts of mainstream hydropower dams on fisheries and agriculture in Lower Mekong Basin. *Sustainability* **2020**, *12*, 2408. [CrossRef]
24. Mingmeuangthong, A. Boosting Sustainable Development and Management of Inland Capture Fisheries and Aquaculture Toward Food Security in Lao PDR. In *Fish for the People*; SEAFDEC: Ottawa, ON, Canada, 2025; Volume 23. Available online: http://hdl.handle.net/20.500.12066/7648 (accessed on 14 September 2025).
25. Blackwell Carter. Hydropower's Mixed Impact on Laos. 2026. Available online: https://sites.uab.edu/humanrights/author/blackwec (accessed on 1 August 2026).
26. McCartney, M.; Whiting, L.; Makin, I.; Lankford, B.; Ringler, C. Rethinking irrigation modernization: Realizing multiple objectives through the integration of fisheries. *Mar. Freshw. Res.* **2019**, *70*, 1201–1210. [CrossRef]
27. Li, Y.; Phonexay, M.; Zhang, Z.; Li, C.; Li, J.; Zhang, W. Status of rice-fish farming and rice field fisheries in Northern Laos. *Front. Sustain. Food Syst.* **2023**, *7*, 1174172. [CrossRef]
28. World Bank. *Lao People's Democratic Republic Economic Monitor: October 2022*; International Bank for Reconstruction and Development/The World Bank: Washington, DC, USA, 2022.
29. Samaddar, A. *Integrated Rice–Fish Farming Gives Farmers in Laos' Sanamxay Region a New Lease on Life*; WorldFish Brief: Penang, Malaysia, 2024.
30. Phonvisay, A. *Developing a National Blue Economy Framework for Lao PDR*; Policy Brief No. 2023-08; Economic Research Institute for ASEAN and East Asia: Jakarta, Indonesia, 2023.
31. Baran, E.; Jantunen, T.; Chong, C.K. *Values of Inland Fisheries in the Mekong River Basin*; WorldFish Research Report; WorldFish Center: Phnom Penh, Cambodia, 2007. Available online: https://digitalarchive.worldfishcenter.org/server/api/core/bitstreams/59287a0a-27e9-40f2-9894-43ee40c43ffc/content (accessed on 14 February 2025).
32. Bozánné Békefi, E.; Tammajedy, V.; Varadi, L. Value chain analysis of the fisheries and aquaculture sector in Laos to contribute to the improvement of food security and food safety. In *Proceedings of the 1st International Conference on Agricultural and Food Chain Safety Development, online, 24 February 2022*; Sibounnavong, P., Máthé, L., Eds.; Embassy of Hungary in Bangkok: Bangkok, Thailand; Ministry of Agriculture and Forestry: Vientiane, Laos; NUOL: Vientiane, Laos, 24 February 2022; pp. 13–16.
33. Hortle, K.G. *Fisheries of the Mekong River Basin*; MRC Technical Paper; Academic Press: Cambridge, MA, USA, 2009.
34. FAO. FishStat: Global Aquaculture Production 1950–2024. In *FishStatJ*; Licence: CC-BY-4.0.; FAO: Rome, Italy, 2026. Available online: https://www.fao.org/fishery/en/statistics/software/fishstatj (accessed on 28 July 2026).
35. Baran, E.; Myschowoda, C. *Have Fish Catches Been Declining in the Mekong Basin?* MRC Technical Paper; Water & Development Publications, Helsinki University of Technology: Helsinki, Finland, 2009. Available online: https://www.mrcmekong.org/assets/Publications/technical/tech-No25-Have-Fish-Catches-Been-Declining-in-the-Mekong-Basin.pdf (accessed on 11 February 2025).
36. Phommavong, T. Country Report of Aquaculture Production in Lao PDR. ASEAN Training Course on Aquaculture Production. 2010. Available online: http://www.slideshare.net/ridzaludin/country-report-of-aquaculture-production-in-lao-pdr (accessed on 1 August 2026).
37. Phonvisay, S. *An Introduction to the Fisheries of Lao PDR*; Mekong Development Series No. 6; Mekong River Commission: Phnom Penh, Cambodia, 2013.
38. Rattana, T.; Thanyalak, S.; Jariya, S. Promoting CBRM and co-management: Empowering women in fish processing group in the Nam Xouang Reservoir, Lao PDR. *Fish People* **2023**, *21*, 21–24.

39. Phouthavong, K.; Viengsombath, B.; Singhanouvong, D.; Chanthavong, S.; Philavong, S.; Vonvichith, B.; Boualaphanh, V. *Sustainable Capture Fisheries and Aquaculture for Food and Nutrition Security in Lao PDR*; FAO Regional Office and LARReC: Bangkok, Thailand, 2014.
40. Government of Lao PDR. *9th Five-Year National Socio-Economic Development Plan (2021–2025)*; Government of Lao PDR: Vientiane, Laos, 2021.
41. Kommadam, S.; Saikia, U.; Satdichanh, M.; Latthachack, P.; Thongmanyvong, S.; Phompila, C.; Chansomphou, V.; Thongphan, D.; Phengvichith, V. Measuring Climate Change Vulnerability in Rural Northern Laos. *Am. J. Clim. Change* **2025**, *14*, 374–392.
42. Appelt, J.L.; Saphangthong, T.; Verburg, P.H.; van Vliet, J. Climate change impacts on the suitability of lowland and upland crop systems in Lao PDR. *Agric. Syst.* **2025**, *226*, 104316. [CrossRef]
43. Thammavong, S. Investment Climate Statements: Laos. 2022. Available online: https://www.state.gov/reports/2022-investment-climate-statements/laos/ (accessed on 4 August 2026).
44. Rasal, A.; Patnaik, M.; Murmu, K.; Mohanty, R.K.; Sundaray, J.K.; Swain, J.K.; Mahapatra, K.D. Climate smart carp hatchery: Bringing resilience to sustainable fish seed production. *Aquaculture* **2023**, *571*, 739476. [CrossRef]
45. SEAFDEC. Fisheries Country Profile: Lao PDR 2025. 2025. Available online: https://www.seafdec.org/fisheries-country-profile-lao-pdr (accessed on 8 July 2026).
46. National Assembly of Lao PDR. *Law on Aquatic Animals, Fisheries and Aquaculture (Amended)*; No. 41/NA; National Assembly of Lao PDR: Vientiane, Laos, 2023.
47. Sapakhdy, M.B.; Funge-Smith, S. *Provincial Aquaculture Development Project, Lao*; FAO: Rome, Italy, 1997.
48. Dubois, M.; Inphonephong, S. *Food, Land, and Water (FLW) Policies and Institutions in Lao PDR*; International Water Management Institute (IWMI), CGIAR: Battaramulla, Sri Lanka, 2023.
49. Government of Lao PDR. *National Green Growth Strategy of the Lao PDR Till 2030*; Government of Lao PDR: Vientiane, Laos, 2019.
50. UNEP. Advancing the Sustainable Blue Economy in ASEAN Region. *Webinar*. 30 June 2022. Available online: https://www.unep.org/events/webinar/advancing-sustainable-blue-economy-asean-region (accessed on 12 June 2026).
51. Hortle, K.G. *Consumption and the Yield of Fish and Other Aquatic Animals from the Lower Mekong Basin*; MRC Technical Paper 16; Mekong River Commission: Vientiane, Laos, 2007. Available online: https://archive.iwlearn.net/mrcmekong.org/download/free_download/Technical_paper16.pdf (accessed on 21 January 2025).
52. Souliphone, K. Country Fisheries Trade: Lao PDR. Regional Fisheries Policy Network (RFPN). 2019. Available online: http://www.seafdec.org/country-fisheries-trade-lao-pdr (accessed on 11 July 2026).
53. La, A. *Simple Dishes*; Lao Uniprint–Dokked Publishing, APPAL: Vientiane, Laos, 2023.
54. Bozánné Békefi, E. Survey Existing Artisanal Fish Processing Activities in Vang Vien. Consultancy Work in the Frame of Lao Hungarian 3rd Agricultural Tied Aid Loan Program. 2022. Available online: https://vitafortasia.com/wp-content/uploads/2025/02/Bekefi-E.-Consultancy-Report-01-November-10-December-2022.pdf (accessed on 2 August 2026).
55. Department of Livestock and Fisheries. *Statistics of Fisheries in Lao PDR*; Department of Livestock and Fisheries, Lao PDR: Vientiane, Laos, 2019.
56. LARReC. *The Study of Fish Market Channels in Luang Prabang and Oudomxay*; LARReC: Vientiane, Laos, 2019.
57. SEAFDEC. Fishery Statistical Bulletin of South Asia 2021. SEC/ST/57 (January 2024). 2024. Available online: http://repository.seafdec.org (accessed on 22 July 2026).
58. Dixon, P.-J.; Sultana, P.; Thompson, P.; Ahmed, M.; Halls, A.S.; Lorenzen, K. *Understanding Livelihoods Dependent on Inland Fisheries in Bangladesh and Southeast Asia—Synthesis Report*; DFID Fisheries Management Science Programme (FMSP), Project R8118; WorldFish Center: Penang, Malaysia, 2003.
59. FAO; European Union; CIRAD. *Food Systems Profile—The Lao People's Democratic Republic*; FAO: Rome, Italy; European Union: Brussels, Belgium; CIRAD: Montpellier, France, 2022. [CrossRef]
60. Freed, S.; Kura, Y.; Sean, V.; Mith, S.; Cohen, P.; Kim, M.; Thay, S.; Chhy, S. Rice field fisheries: Wild aquatic species diversity, food provision services and contribution to inland fisheries. *Fish. Res.* **2020**, *229*, 105615. [CrossRef]
61. Krešić, G.; Dujmić, E.; Lončarić, D.; Buneta, A.; Liović, N.; Zrnčić, S.; Pleadin, J. Factors affecting consumers' preferences for products from aquaculture. *Croat. J. Food Sci. Technol.* **2020**, *12*, 287–295. [CrossRef]
62. Kasza, G.; Izsó, T.; Kunszabó, A.; Szakos, D.; Lénárt, I.; Bozánné Békefi, E.; Vongxay, K.; Popp, J.; Oláh, J.; Lakner, Z.; et al. Consumer knowledge, attitudes, and behaviour regarding food safety—A perspective from Laos. *Heliyon* **2024**, *10*, e29725. [CrossRef] [PubMed]
63. Oyebamiji, O.A.; Türkekul, B. Beyond income: Governance and protein supply drive global food security. *Front. Sustain. Food Syst.* **2026**, *10*, 1726650. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.