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STATUS AND DEVELOPMENT TREND OF AQUACULTURE AND FISHERIES IN NEPAL

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ABSTRACT
Nepal's fisheries sector, deeply rooted in historical practices, constitutes crucial component of the nation's natural wealth, buoyed by its diverse geographical features and ample water resources. While traditional capture fisheries have historically played a significant role in fish production and employment, maintaining production levels presents challenges necessitating thorough reassessment. The landlocked geography compels a focus on inland finfish farming in the aquaculture subsector, supported by governmental initiatives such as the Fish Mission and Prime Minister Agriculture Modernization Project. The Terai belt, with its favorable climate, serves as a pivotal area for fish production, covering 89% of the total pond area. Nepal's total fish production stands at 113,736 mt, with capture fisheries contributing 18% and aquaculture 82%, collectively employing around 0.52 million individuals. Fish consumption in Nepal is on the rise, with per capita availability increasing from 330 g to 3.92 kg between 1981/82 and 2022/23. Efforts from both the government and private sector aim to commercialize the sector, addressing issues of food security, poverty reduction, and creation of income and employment opportunities. Despite challenges, targeted endeavors through governmental initiatives, private sector involvement, and sustainable practices are vital to unlocking the full economic, employment, and food security potential of fisheries sector.

Key words: Productivity, Production, Capture fishery, Aquaculture, Fish seed

INTRODUCTION
Nepal boasts rich geographical diversity and abundant water resources, making it a land of significant natural wealth. In addition to its diverse geography, Nepal boasts a substantial biodiversity profile, particularly in the realm of fish, harboring a total of 252 fish species (Shrestha 2019), constituting approximately 1.6% of the global freshwater aquaculture diversity. Within this diverse array, Nepal is home to 16 endemic fish species. Concurrently, the inhabitants of Nepal have an enduring engagement in capture fisheries, a historical practice deeply rooted in ancient times. This historical significance of fish in Nepal's diverse cultures and traditions is substantiated by archeological evidence and documentation, which underscore the presence of fishing gear and the cohabitation of indigenous communities (such as Majhi, Malah, Bote, Danuwar, etc.) in proximity to natural water bodies (Adhikari and Thapa 2016). Despite the historical significance of fish in Nepal, the modern era of fish farming commenced with the establishment of the Fisheries section under the Agriculture Council in 1956 AD.

Aquaculture has emerged as a rapidly advancing agricultural subsector in Nepal, driven by its landlocked geography, necessitating exclusive reliance on inland finfish farming. The diverse climatic conditions in Nepal allow for the cultivation of both warm and cold-water species, including indigenous and exotic carps, pangasius, tilapia, catfish, and rainbow trout. Despite the slow progress in institutional aquaculture development over the past seven decades, the sector witnessed significant growth in the previous decade (Kunwar and Adhikari 2017). Government initiatives such as the Fish Mission, One Village One Product, resource center establishment, and the Prime Minister Agriculture

Modernization Project (PMAMP) played a crucial role in this advancement (Chaudhary and Jha 2018).The Terai belt of Nepal holds a prominent position in fish production, accounting for 88% of the overall pond area(Zhuang and Ghimire 2017). The leading districts in terms of fish production are Bara, Dhanusha, Saptari, Rupandehi, Siraha, Morang, Parsa, Rautahat, Sarlahi, and Chitwan (CFPCC 2019).

The primary objective of Nepal's fisheries development program is to enhance the production and productivity of fish by utilizing the diverse water resources available in the country. The program aims to commercialize the fisheries sector, contributing to food and nutrition security, poverty reduction, and increased income and employment opportunities. Private sector involvement, along with technical support for the conservation of fishery resources and the development of an eco-friendly fisheries sector, is crucial for the success of these initiatives. These programs operate within the framework defined by the Constitution of Nepal, which delegates responsibilities to local, provincial, and federal levels. There exist diverse institutional frameworks dedicated to advancing fisheries. The Central Fisheries Promotion and Conservation Center (CFPCC), along with its three subordinate offices under the central government, each equipped with specific mandates play a pivotal role in this regard. Additionally, fish development centers, Veterinary Hospitals, and Animal Service Expert Centers operate under provincial government jurisdiction, while livestock section under local government, contribute significantly to the execution of fisheries development programs. Fishery extension is mostly carried out by local government. Development of fish market and large investment is done by provincial government and Central government mostly works on policy, quarantine issue and is responsible for coordination with national and international organization. To bolster research initiatives in fisheries development, institutions like the Nepal Agricultural Research Council are actively engaged in overseeing various fisheries research activities. Furthermore, the human resources involved in fisheries activities are nurtured and developed through academic institutions such as the Agriculture and Forestry University (AFU) and Tribhuvan University (TU). These universities play a key role in shaping the skill sets and knowledge base of individuals contributing to the fisheries sector in Nepal.

While fish consumption in Nepal lags behind poultry, pork, buffalo, and mutton, a growing awareness of the health benefits associated with fish consumption has fueled increased demand for aquaculture products (Rijal and Jha 2020). The government actively supports the establishment of commercial fish farms to boost employment and income in rural areas. Notably, many of these newly established farms are managed by returning youths with experience abroad, contributing to a reduction in youth migration and aligning with the broader goal of promoting economic development and sustainability in Nepal's aquaculture sector (Rijal and Jha 2020).

PRODUCTION AND PRODUCTIVITY TREND

Capture Fisheries

Nepal is rich in natural water resources, with rivers, lakes, reservoirs, swamps, and lowland irrigated paddy fields standing out as significant sources of fresh water (Figure 1). Rivers and lowland irrigated paddy fields emerge as the primary and most influential natural water resources. Moreover, lakes marginal swamps and reservoirs cover a smaller water surface area compared to other natural water resources. In addition to these water bodies, there are extensive network of 7,900 kilometers of irrigation canals throughout the country (Gurung2014).

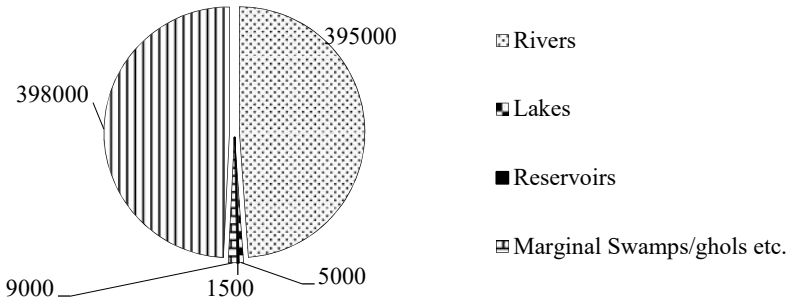

Figure 1: Natural water resources (ha) in Nepal

The capture fisheries sector is vital for its dual role in fish production and employment generation. Fish production from capture fisheries has remained stable at 21,000 tons over recent years. Noteworthy contributors to capture fish production include irrigated paddy fields, rivers, and swamps, while lakes and reservoirs play a minimal role (Figure 2). The preeminent contributors to the natural water area in Nepal are rivers and lowland irrigated paddy fields, collectively constituting 98% of the total natural water surface. Despite their expansive coverage, these areas demonstrate comparatively low productivity, yielding 18 kg of fish per hectare. In contrast, lakes and reservoirs, encompassing a smaller portion of the natural water landscape, exhibit higher productivity at 200 kg and 350 kg per hectare, respectively. Notably, marginal swamps, constituting a mere 1.1% of the total natural water body, stand out for their remarkably elevated productivity, producing 577 kg of fish per hectare. This datahighlights the complex interplay between the extent of natural water areas and their corresponding productivity levels, providing valuable insights for fisheries management strategies in Nepal.

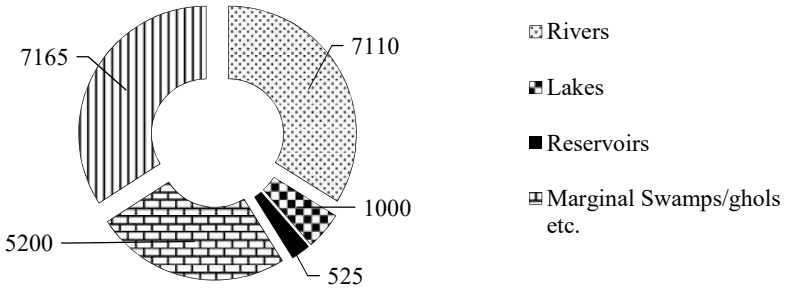

Figure 2: Fish capture (mt) from diverse natural aquatic sources.

While capture fisheries initially exhibited an increasing trend, it has remained almost constant since the year 2000, posing a significant challenge to maintain this capture at a standstill. Therefore, there is a need for a comprehensive reevaluation of the status and potential of capture fisheries, including an assessment of freshwater snail, crab, shrimp, water chestnut, and makhana collection and yield. It is also essential to estimate the communities and population that consume these products, along with assessing the farming perspectives of these fisheries commodities.

Aquaculture

Pond fish culture emerges as the predominant practice among various fish culture methods, experiencing rapid growth while other aquaculture activities have largely remained stagnant over the past decades. Since the inception of aquaculture development in Nepal, finfish culture has been a major focus, with a significant portion dedicated to major carps, particularly common carp and

Chinese carps, utilized in carp poly-culture. This approach has made substantial contributions to aquaculture production in Nepal. The introduction of new technologies and species has seemingly led to an increase in aquaculture production in the country.

The introduction of rainbow trout has brought a fresh perspective to cold-water aquaculture, marking a paradigm shift in Nepal's aquaculture landscape. Similarly, the introduction of tilapia and pangasius has opened up new avenues for promoting monoculture systems, offering significant production potential for aquaculture in Nepal. The innovation of the 'chhadi fish' pond aquaculture technology has proven to be a lucrative investment for fish farmers, enabling faster returns and increasing national production. In this technology, fry/hatchlings are densely stocked in ponds, and multiple harvests (at least 3-4 times a year) is done to capture fish that have reached sizes less than 50 gcontributing 35% of total fish production (Pathak et al. 2023). Local consumers show a preference for smaller, single-piece fish from head to tail, referred to as 'chhadi' fish (Rijal and Jha 2020). The national fish production has witnessed a remarkable increase, surging more than four fold over the last 20 years, from 17,665 mt in 2002/03 to 97,385 mt in 2021/22 (Figure 3).

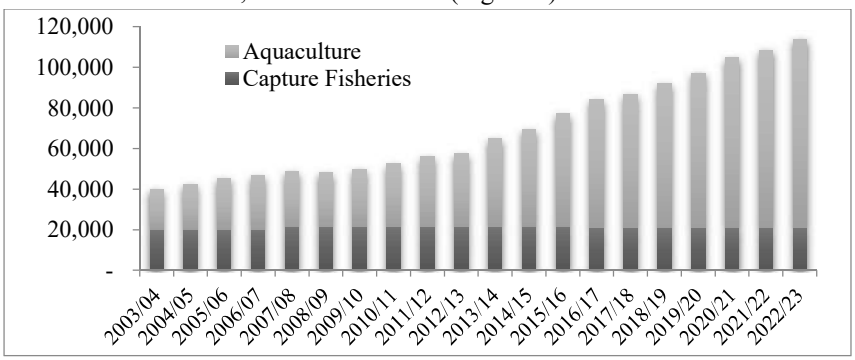

Figure 3: Fish production trend capture fisheries and aquaculture.

The state of aquaculture in Nepal is currently in a phase of growth, and although the fish production levels are comparatively lower than those of larger countries worldwide, recent advancements in the sector are highly promising. Pond aquaculture, particularly with common carps, Chinese, and Indigenous Major Carps, significantly dominates the overall fish production, boasting an average productivity of 5.41mt per hectare. Monoculture of common carp, tilapia, and especially catfish is also practiced in various locations across the country. The interest in aquaculture is growing swiftly among young farmers, reaching 55 districts out of 75 in 2017, a significant jump from 30 districts a decade ago (Chaudhary and Jha 2018). Remarkably, fish farming has expanded to 76 districts out of 77 in the current scenario. This surge in interest is especially notable following the successful implementation of rainbow trout farming technologies in the colder regions of hills and mountains.

Currently, the poly-culture technology of carp fish farming in ponds has been widely disseminated in the southern plain areas and mid-hill regions of the country, emerging as a viable and common aquaculture activity. However, monoculture of pangasius and tilapia are also gaining popularity contributing about 10% of fish production from pond. Pond culture alone contributed to 72.23% (82,161 mt) of the total fish production in 2022/23 (CFPCC 2022/23) (Table 1).

Following pond aquaculture, swamps represent the second-largest contributor to fish production, encompassing an area of 3,670 ha and yielding 9,125 mt of fish in 2022/23. These swamps are predominantly concentrated in the mid-western and far-western Terai region of Nepal. To enhance

the productivity of these swamps for various purposes, their restoration, maintenance, and management are imperative for the sustainability of natural resources and the well-being of marginalized communities relying on them for food, nutrition, livelihood, and employment opportunities.

Cage culture practices in lakes and reservoirs contributed approximately 370 mt of fish in the fiscal year 2022/23. The introduction of cage fish culture technology in Nepal dates back to 1972 in Lake Phewa, initially used for raising brood fish of common carp. Presently, the estimated fish culture coverage area has reached nearly 71,205 m^3 with an average fish productivity of 5.19 kg/m^3. Cage fish cultivation primarily involves plankton-feeding fish, relying on naturally available phytoplankton, zooplankton, detritus, and some aquatic vegetation for growth. While external feed is generally not applied, there is a possibility that this practice may evolve in the future due to the potentially increased profitability of adopting feeding practices in cages.

Rice cum fish culture, a successful farming technique in countries like India, Indonesia, China, and Bangladesh, has gained limited attention in Nepal.The extent of land dedicated to rice cum fish farming has experienced a substantial reduction, declining from 300 ha in the fiscal year 2007/08 to a mere 49 ha in 2022/23, accompanied by a decline in productivity as well. The notable reduction in area can be attributed to limited availability of fish seed in mid hills and increased pesticide usage in rice fields. However, to promote this integrated farming system, especially in the Terai and lower mid-hill regions, special long-term projects should be prioritized in the future.

The introduction of rainbow trout, a cold-water species, began in 1969 from India and later from England and Japan in 1988 (Rai 2010). After the successful breeding program of trout commercial trout farming initiated in Rasuwa and Nuwakot districts under collaborative efforts of Nepal Agricultural Research Council, Japan International Cooperative Agency, and the Directorate of Fisheries Development Program contributing a significant growth of trout farming in Nepal. Then, trout has become a distinctive and valuable fish species in the Nepali market, known for its taste and high nutritional value. The production of trout has gained popularity and witnessed a substantial increase, reaching 1007 mt tons in the fiscal year 2022/23. This is a remarkable surge from a mere 192 mt a decade ago. Furthermore, integrating trout farms with restaurants has become a successful practice, particularly beneficial for small-scale farmers to sustain their businesses.

Table 1: Status of aquaculture production in 2022/23 (CFPCC 2022/23)

Particulars	Pond (Nos.)	Total Area (ha)	Fish Production (mt)	Productivity kg/ha
1. Aquaculture production			**92,736**	
1.1 Pond culture	49,862	14,745	82,161	5,572
1.1.1 Mountain	670	48.96	82	1,674
1.1.2 Hill	8,874	1,452.85	6,787	4,671
1.1.3 Terai	40,318	12,635.2	75,292	5,958
1.2 Marginal Swamps (ghols)		3,670	9,125	2,486
1.3 Rice cum fish culture		49	17	346
1.4 Cage culture (m^3)		71,205	370	
1.5 Enclosure (Pen) culture		35	48	1,371
1.6 Trout culture in Raceway		6.8	1,007	148,088
1.7 Fish Production in Public Sector			8	
2. Capture Fisheries production			**21,000**	
3. Total Fish Production			**113,736**	

The productivity of pond fish was only 0.8 mt/ha in 1981/82 but has seen a significant increase, reaching 5.57 mt/ha by 2022/23. This notable increase in pond fish productivity is attributed by various factors, including improved availability of fry, effective fertilization practices, strategic feeding regimes, and enhanced management practices such as the introduction of aeration technology, effective control measures for fish diseases, comprehensive training programs, and adherence to Good Management Practices (GMP). Furthermore, the Government of Nepal consistently underscores the importance use of improved technology, advocating for the utilization of pellet machines to produce cost-effective, high-quality feed on farms and the incorporation of aerators to enhance water quality. These measures are intended to achieve higher productivity in pond fish culture.

The prevalent fish culture technique, carp poly-culture, is predominantly characterized by the dominance of Chinese carps, Indian carps, and common carps in production. Within this context, silver carp holds the highest contribution to production, accounting for 20% of the total, followed by common carp at 18% and naini at 16%. In contrast, rainbow trout and tilapia exhibit minimal contributions, each making up around 10 of the overall production.

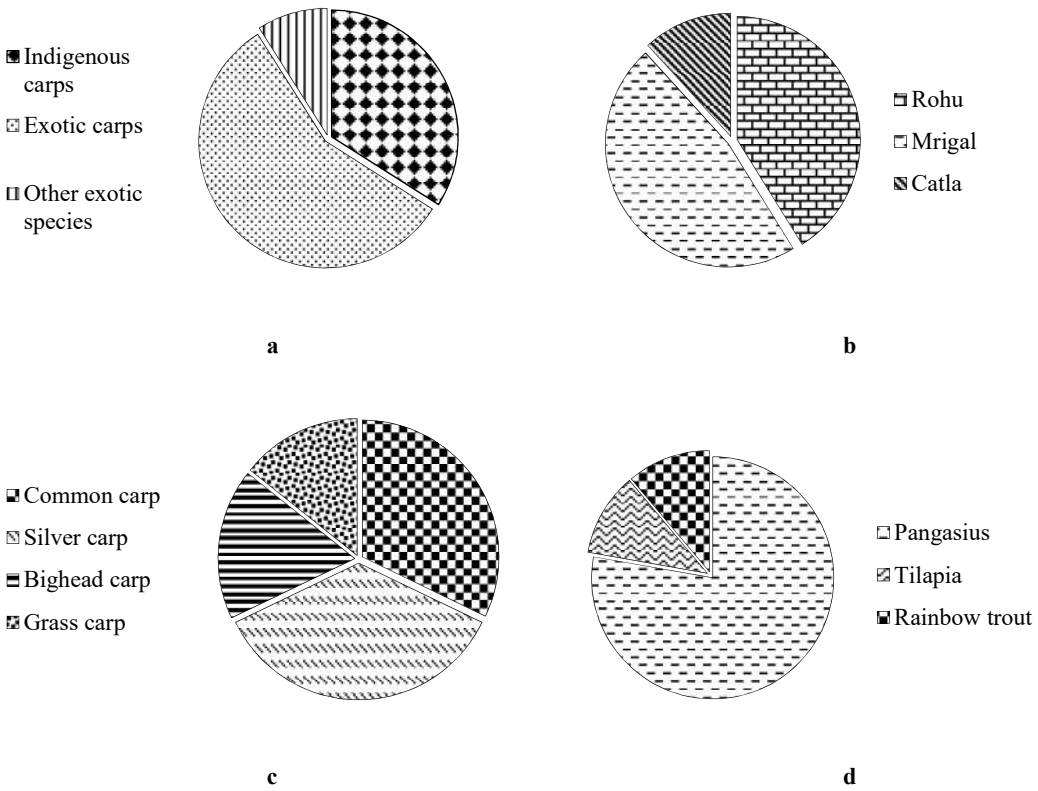

Figure 4: Species wise contribution in aquaculture production (**a.** Group wise contribution; **b.** Contribution of indigenous carps; **c.** Contribution of exotic carps; **d.** Contribution of other exotic species)

FISH SEED PRODUCTION

Seed is a critical input for aquaculture production, and ensuring the quality of seed is essential for enhancing the productivity of aqua farms (Kunwar and Adhikari 2017). In Nepal, fish seed is distributed in three forms: hatchlings (4-5 days old), fry (2-3 cm or more than 1 g), and fingerlings (more than 5 g body weight on average).

Table 2: Status of fish seed production in 2021/22 (CFPCC 2021/22)

A. Fish seed(Fry) Production/Distribution (No. in '000)	569,070
A[1] Public Sector	131,239
a. Hatchling*	335,600
b. Fry	17,158
c. Fingerling	16,869
A[2] Private Sector (Fry)	437,831

*Hatchling of public sector is distributed for fry production in private sector

In the context of Nepal, while self-sufficiency has been attained in the production of fish seed of carp species and rainbow trout, there persists a requirement for importing (around 90% of total demand) of pangasius fingerling to sustain pangasius production. The fish seed sector in the country involves the participation of seven government institution and five research centers, 99 private hatcheries and 232 nurseries. The aggregate fish seed production in Nepal has reached 569 million, with private sector contributing around 77%, and public sector contributing the remaining 23%.

Over the past decade, seed supply by both private and public sector has experienced a substantial increase producing 5.7 million in 2001/02 to 569 million in 2022/23 (Table 3). This growth can be attributed to the government's emphasis on encouraging private sector participation in seed supply. Various supportive programs have been initiated to empower the private sector, including the establishment of fish seed resource centers under private ownership.

AQUACULTURE EXPANSION

The aquaculture sector in Nepal has evolved into a lucrative sub-sector of agriculture, providing favorable returns on investment. In the Terai region of Nepal, the consumer base for fish is expanding, driven by increased availability in the market. Aquaculture practices in the country encompass diverse areas, including pond culture, rainbow trout culture in raceways, rice-fish farming, fish culture in swamps and enclosure, cage culture with innovative and modern techniques like aquaponic, re-circulating aquaculture.

Despite the diverse array of aquaculture practices, pond culture has gained the highest popularity, witnessing substantial growth from 6,093 ha in 2003/04 to 14,756 ha in 2022/23.This is closely followed by trout culture in raceways and cage culture, while rice-fish farming and enclosure fish farming are on a declining trend. Initially, the adoption of pond aquaculture was limited due to high initial investments and insufficient technologies and expertise, coupled with infrastructural challenges. However, the scenario changed with the initiation of a government subsidy program for pond construction, leading to a notable increase in the popularity of pond fish farming.

The Government of Nepal has continued its support for aquaculture businesses through various subsidy programs, contributing to the widespread adoption of pond fish aquaculture. The number and water surface area of fish cultivating ponds have seen a marked increase (Figure 4). The fiscal year 2015/16 witnessed the highest achievement in pond construction, reaching 734 ha (CFPCC 2017).

While pond fish culture remains dominant in the Terai belt, its expansion into hill regions has gained momentum, particularly after the government implemented a pond expansion program in mid-hill districts starting from the fiscal year 2011/12.

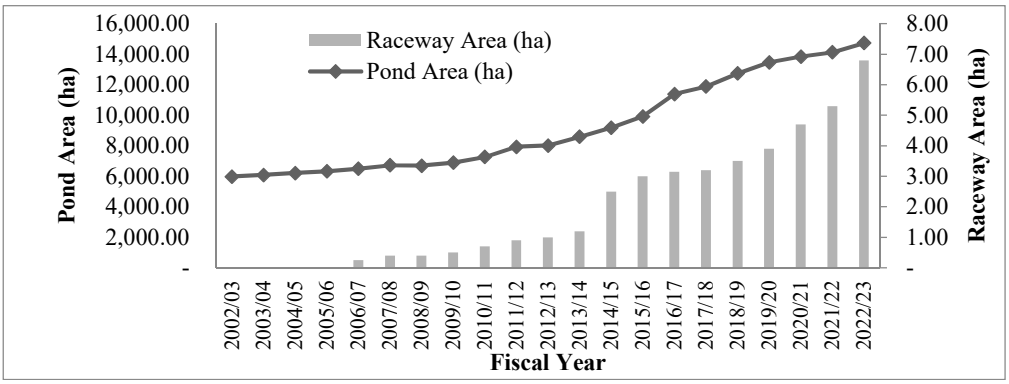

Figure 5: Pond and raceway area expansion trend.

The expansion of areas was primarily concentrated in the Terai region of Nepal, attributed to its favorable climate for warm water fish culture. Conversely, significant growth in raceway areas was observed in the middle hills of the central part of the country. Considering that the Terai region was a major production area, Madhesh province exhibits the highest number of ponds and water areas, followed by the Lumbini province. In contrast, Karnali Province demonstrates the least contribution to the aquaculture sector, contributing less than 1% in both pond area and raceways.

Table 3: Contribution of different province in pond water surface area.

S.N.	Province	Pond Water Surface Area (ha)
1.	Koshi	2,019
2.	Madesh	7,745
3.	Bagmati	1,263
4.	Gandaki	391
5.	Lumbini	2,866
6.	Karnali	32
7.	Sudur Paschim	429
	Total	14,745

ECONOMIC CONTRIBUTIONAND EMPLOYMENT GENERATION

In Nepal, the pervasive issue of unemployment, driving a significant annual migration of youths in search of jobs, poses a serious challenge and heavy reliance on remittance in the Nepali economy makes it vulnerable and unstable (ILO 2015). To address the outmigration problem and foster national development, the expansion of aquaculture emerges as a viable option to create jobs domestically and attract young talent within the nation. Given this context, the fisheries sub-sector holds potential as an alternative, offering employment opportunities in various fisheries and aquaculture-related activities.

The combined efforts of capture fisheries and aquaculture, including related activities such as harvesting, processing, marketing, and other industries associated with aquaculture, are generating substantial employment opportunities for a significant portion of the population. Currently, the aquaculture and fisheries sector contribute 0.44% to GDP and 1.83% to AGDP. Notably, the sector's contribution to the economy is on a consistent upward trajectory.

Capture fisheries contribution in employment generation

Natural water bodies, particularly rivers, swamps, and lakes, play a vital role in sustaining the economy of numerous fishing communities. Approximately twelve distinct ethnic communitiesare directly or indirectly involved in fisheries (Gurung 2005). These communities reside in close proximity to water resources, relying on fisheries and aquatic resources for their livelihoods across generations. Engaging around 362,000 individuals in capture fisheries (CFPCC 2023) with 60% being female, these communities actively participate in various aspects of the fishing industry (Rijal and Jha 2020). Female members contribute not only to the fishing activities but also play roles in the preparation of fishing gears, nets, and other equipment, as well as in the selling of fish in the market.While capture fisheries have been a traditional source of livelihood for many, the number of individuals relying on natural water bodies for their livelihoods through capture fisheries is gradually diminishing. This decline is attributed to the comparatively low income generated from capture fisheries, prompting individuals to seek alternative and more lucrative income-generating opportunities.

Aquaculture contribution in employment generation

Over the past few decades, aquaculture has evolved into a more intensive and diversified practice, offering faster returns on investment. Consequently, there has been a substantial increase in the participation of individuals in the aquaculture business, and the number of households engaged in the aquaculture sector has witnessed significant growth. In the last 20 years, these figures have doubled, with the number of people involved reaching 158,000, and the number of households engaged in aquaculture rising to 62,000. In the realm of aquaculture and related businesses, there is a predominant male presence, making up 68% of the workforce (Rijal and Jha 2020). This stands in contrast to the opposite scenario observed in capture fisheries.

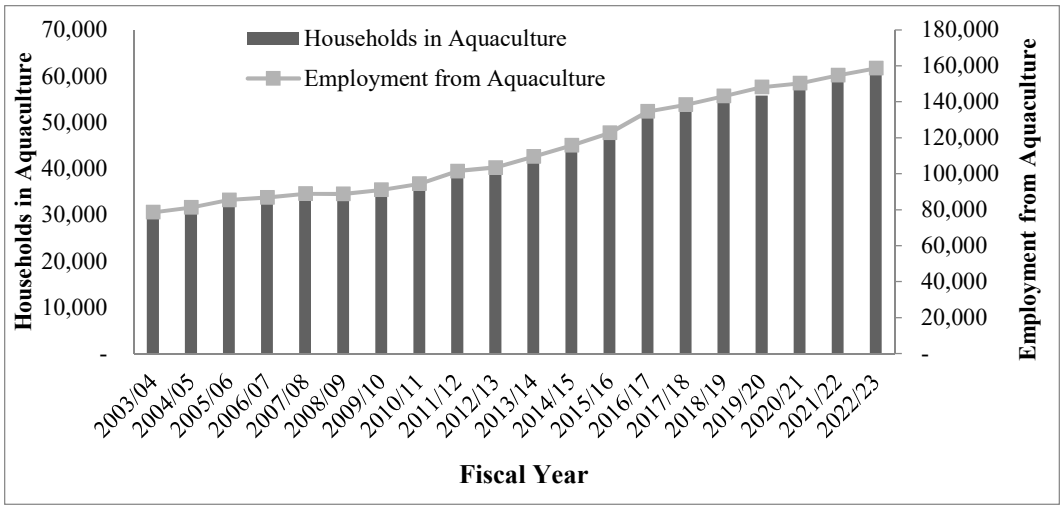

Figure 6: Trend of employment (no) from aquaculture and household (no) in aquaculture.

FISH MARKET AND MARKETING SYSTEM

Fish marketing system in Nepal is not well developed andmarketing strategies exhibit variability across regions, lacking a singular approach. The various functions or services within fish marketing encompass collecting small quantities from numerous producers, grading, packing, transporting to distant city-based wholesale markets, and distributing to retailers. Small produce is directly dispatch to local markets by farmers themselves andfor substantial productions, contractors typically handle marketing activities. Farmer organizations often operate through cooperatives, exemplified by the success of Harpan Phewa Matsya Sahakari in Kaski district and similar cooperatives in Nawalparasi, Rupandehi, and Kanchanpur districts (KBNPK 2010).

A recent trend in the emergence of live fish marketing systems is observed, reflected in the increasing number of live fish shops. The government supports this by providing financial assistance to establish fish marketing stalls and collection centers. Concentrated mainly in the capital and other major cities where demand is high, there are currently stalls in Nepal. Over the last decade, the prices of agricultural commodities, including fish, have seen a substantial increase. In 2001/02, fresh fish was priced at NRs 100 per kg, and was 300 per kg in 2018 (Chaudhary and Jha 2020) which has now reached an average of NRs 350 per kg. Despite the rise in price, fish remains a more affordable source of animal protein for lower and middle-class citizens compared to other meat products.

Fish prices vary across locations, with metropolitan and capital cities experiencing higher costs. The demand for fish fluctuates monthly, with a study revealing increased fish demand during winter and lower consumption reported in Asadh, Shrawan, and Bhadra (KBNPK 2010). While national production falls short of meeting the entire demand, Nepal imports a certain quantity of fish. India stands as the major fish exporter, followed by Vietnam, China, and Bangladesh, contributing to fish imports in Nepal.

Table 4: Price of fish in Kalimati market (Source: Kalimati Fruit and Vegetable Market Development Board. November 13, 2023)

Fish Species	Minimum Price	Maximum Price	Average Price
Fresh Rohu	360	370	365
Fresh Pangasius	260	270	265
Fresh Chhadi	240	280	260

Table 5: Price of farm gate and consumer price in Chitwan (Source: Fishermen's Association Nepal, Chitwan. November 13, 2023)

Fish Species	Farm gate price	Consumers price in market
Silver carp, Tilapia	300	400
Other carps	350	450
Pangasius, Chhadi	280	350-400

Most fish markets in Nepal portray local, unregistered, and unmanaged characteristics, frequently lacking adequate sanitary maintenance.However, in urban areas, a few well-managed markets stand out. The principal challenges faced by fish markets in Nepal include issues related to the preservation of fish quality, inadequate waste management practices, lack of market accessories like collection center, chilling center, road connectivity to the production site and the use of unscientific and unsophisticated methods for fish transportation, and a limited emphasis on product diversification and value addition.

Post-harvest management

Post-harvest loss in the fish industry pertains to the disposal or sale of fish at a reduced value due to either a decline in quality or market-related factors (Dhakal et al. 2020).Fish, being a highly perishable agricultural commodity, should be preserved promptly following harvest.However, Nepal is at an early stage in post-harvest management and most of the harvested fish are sold within a day in local market witha significantly low amount of post-harvest loss accounting only 3-5%.

In Nepal, typical post-harvest management practices include grading of fish based on size and species at the harvest site. These graded fish are then transferred to local markets by local vendors. For those fish destined for distant markets, middleman collect them at a centralized collection center. Subsequently, the fish are graded and packed in styrofoam with a 2:1 ratio of fish to ice. Various types of vehicles are employed to transport the packaged fish to distant markets. Additionally, given the popularity of selling live fish in the country, live fish are collected and transported to distant markets in tanks equipped with aeration facilities.The primary obstacles in post-harvest management include insufficient awareness regarding its significance, a dearth of resources and infrastructure, elevated costs associated with post-harvest management, insufficient training, and gaps in existing policies.

Value addition of fishery products is gaining popularity in Nepal. The primary motivation behind this shift towards value-added products is to enhance the product's price, make it convenient or ready-to-consume, and secure better prices during periods of surplus production. The predominant methods of value addition in Nepal have traditionally been drying and smoking. However, contemporary techniques such as freezing and vacuum packaging, pickling, and filleting are becoming increasingly popular in the current scenario.

Import and export of fish and fishery products

Nepal is at an early stage in post-harvest management, resulting in approximately a 3-5% loss. Typical post-harvest management practices in Nepal involve grading based on fish size and species, followed by preservation in a ratio of 2:1 for fish and ice. Post-harvest loss in fish refers to fish that is either discarded or sold at a relatively low price because of quality deterioration or owing to market dynamics.

The import of fish in Nepal shows decreasing trend, with less than 3% of the total fish consumption in the fiscal year 2022/23 attributed to imports from various countries. This marks a substantial decline from the approximately 20% observed a decade ago. The primary contributors to the import volume are fresh rohu and pangasius, followed by notable quantities of dried fish and pangasius fillets. The import portfolio also encompasses comparatively smaller quantities of species such as salmon, shrimp, scallops, mussels, octopus, and marine arachnids.The export value is notably lower compared to the import figures in Nepal's fishery trade. A substantial portion of the exports is directed towards India, primarily comprising fresh fish sourced from ponds located in close proximity to the border.

Table 6: Import and Export value of fish and fishery product in Nepal (Source: Costume Department)

Fiscal Year	Import (thousand, NRs)	Export (thousand, NRs)
2017/18	1,853,570	1,911
2018/19	1,894,018	1,459
2019/20	1,765,136	334
2020/21	1,698,061	0
2021/22	1,346,580	1
2022/23	1,030,417	449

MAJOR ISSUES OF THE SECTOR

Despite its vast scope and potential, the sector has not experienced the anticipated growth due to various challenges. Issues related to policies, technical aspects, human resources, and organizational matters persist. Essential institutions such as Central and provincial Fish labs, Rainbow Trout and Aquarium Fish Development Centers are notably absent. Additionally, Karnali province lacks a dedicated Fish Research and Development Center.

The absence of a specific Aquaculture and Fisheries Act to regulate the sector is a significant drawback. The current regulation under the Animal Health and Livestock Service Act 2055 does not adequately address the concerns of the fishery sector. The sector also grapples with the unavailability of sufficient and quality inputs such as seeds, feed, and machinery. The lack of a well-established marketing system contributes to high losses and safety issues.

Furthermore, fish farmers face challenges, including high electricity charges and the unmet demand for Krishi Meters in Aquaculture. Access to insurance and concessional loans is limited, and the sector remains highly vulnerable to climate change. Nevertheless, the most pressing challenge remains the scarcity of human resources, as only 312 technicians cater to the sector under central, provincial, and local government jurisdictions. This shortage of personnel makes it difficult for farmers to access technical services, compounded by a low ratio of extension workers to farmers, standing at approximately 1:192.

CONCLUSION AND RECOMMENDATION

Aquaculture stands as a thriving sector within Nepal's food industry, boasting an annual growth rate of approximately 10% in recent decade, the highest among SAARC nations. Recognizing its significance and potential, both federal and provincial governments are increasingly directing attention towards aquaculture. This focus suggests a potential substantial increase in fish production within the country. The escalating demand for fish has created market opportunities, attracting investments in commercial fish farms. However, newly established farms require technical support to enhance competitiveness in local, regional, and global markets.

The current state of technical expertise among human resources in aquaculture is insufficient to represent the advancements of the 21st century due to limited exposure to study and training programs. Specialized hands-on training and studies in fields such as fish breeding, disease management, nutrition, genetics, and water quality are essential aspects that need attention from relevant authorities in the near future. Establishing a robust coordination mechanism among development, research, and educational institutions is imperative for effective and efficient implementation of aquaculture and fisheries programs.

Pond aquaculture currently dominates the fish farming landscape and is a prioritized practice. However, marginal swamps, covering an area of 12,500 ha, should not be neglected. Only 30% of these swamps are currently utilized for aquaculture, highlighting the need for proper planning and management to optimize fish production. This will not only generate employment opportunities but also provide income to many landless individuals. Nepal's abundant natural water resources, including lakes, reservoirs, and swamps, make the nation highly potential for culture-based fisheries, an area that is still underutilized for fish production.

The favorable water resources and climatic conditions in Nepal also support cold-water fisheries, particularly in trout farming. Promoting trout culture requires minimizing production costs to attract

more farmers in the future, making trout accessible to middle-class consumers. Similarly, for sustainable development of fishery sector, our indigenous fish breed should be conserved and promoted. Fish like Asala, Sahar, Katle having unique taste and features should be promoted for commercial culture developing package of production. For sustainable utilization and promotion of the sector, effective implementation of Fishery Development Policy, 2079 is crucial. All the institution involved in the development of this sector, should plan and implement program according to the objective envisioned by Policy.

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