The Pakistan Business Council

FOSTERING ECONOMIC GROWTH

(A Company set up under Section 42 of the Companies Ordinance 1984)

Pakistan's Aquaculture Sector

Opportunities, Challenges & Policy Recommendations for Improving Export Competitiveness









November 2026

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November 2026

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The Pakistan Business Council (PBC) is a research-based business advocacy platform established in 2005. It is now supported by over 100 private sector local and multinational businesses with significant investment in, and long-term commitment to sustainable growth of the country. They come from 14 countries, have leading roles in 17 major sectors of the formal economy, generate 40% of annual exports, contribute a third of Pakistan's total tax revenues and employ three million. Their combined sales represent every 6th Rupee of Pakistan's GDP.

PBC's major objectives are to advocate polices that lead to creation of jobs, value-added exports and reduction in import reliance through improved competitiveness of manufacturing, services and the agriculture sectors. It also promotes formalization of the economy.

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PBC is a pan-sectoral, not-for-profit, Section 42 entity. It is not a trade body; therefore, it does not advocate for any specific business sector. Rather, its key advocacy thrust is on easing barriers that thwart competitiveness of businesses in Pakistan. Further information on the PBC is available on: www.pbc.org.pk. The PBC's founding objectives are:

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- To conduct, organize, set up, administer and manage campaigns, surveys, focus groups, workshops, seminars and fieldwork for carrying out research and raising awareness in regard to matters affecting businesses in Pakistan.
- To acquire, collect, compile, analyze, publish and provide statistics, data analysis and other information relating to businesses of any kind, nature or description and on opportunities for such businesses within and outside Pakistan.
- To promote and facilitate the integration of businesses in Pakistan into the World economy and to encourage in the development and growth of Pakistani multinationals.
- To interact with governments in the economic development of Pakistan and to facilitate, foster and further the economic, social and human resource development of Pakistan.

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List of Acronyms

ASC	Aquaculture Stewardship Council
BAP	Best Aquaculture Practice
BFT	Biofloc Technology
CPEC	China–Pakistan Economic Corridor
DLTL	Drawback of Local Taxes and Levies
EMS	Early Mortality Syndrome
EU	European Union
FAO	Food and Agriculture Organization
GAP	Good Agricultural Practices
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
HACCP	Hazard Analysis Critical Control Point
MFD	Marine Fisheries Department
MPEDA	Marine Products Export Development Authority
RAS	Recirculating Aquaculture Systems
VASEP	Vietnam Association of Seafood Exporters and Producers

Executive Summary



Executive Summary

Aquaculture, the controlled farming of aquatic organisms, including fish, molluscs, crustaceans, and aquatic plants is becoming an increasingly important component of the global food system. In 2022, aquaculture surpassed capture fisheries in global aquatic animal production, reflecting the growing importance of controlled aquatic production in meeting rising demand for food and protein.

Pakistan's aquaculture production increased by 22.8% between 2011 and 2024, reaching approximately 174,338 MT in 2024, this was in comparison to the output of 2.85 million MT in Bangladesh, 11.32 million MT in India and 5.38 million MT in Vietnam.

Sector Significance and Market Opportunity

Pakistan's per-capita fish consumption is approximately 1.35 kg per year, compared with a global average of 19.93 kg. This large consumption gap indicates substantial room for future domestic demand growth.

The global seafood trade, valued at USD 184 billion[1], presents significant export opportunities for Pakistan. Although Pakistan is an established seafood exporter to China, its presence in several other major seafood-importing markets remains limited. The United States, Japan, Spain, Italy, France, South Korea, and Germany offer opportunities to diversify export destinations and increase export earnings.

Production Structure and Provincial Differences

Pakistan's aquaculture sector remains dominated by pond-based freshwater production, particularly common carp and tilapia. Production systems range from traditional extensive ponds to semi-intensive and intensive farms, alongside specialized systems including trout raceways, cage culture, coastal shrimp, biofloc and RAS.

- Punjab has the largest aquaculture production base and the highest concentration of progressive and semi-intensive farms.
- Sindh has substantial aquaculture resources but comparatively low productivity.
- KP has a smaller aquaculture sector but a significant unmet market demand. In KP trout provides a specialized high-value opportunity.

Inland Shrimp Farming: A High-Potential Commercial Segment

Inland shrimp farming provides an avenue for converting saline groundwater and marginal agricultural land into productive assets while diversifying agricultural production and expanding seafood exports.

The report's economic assessment indicates substantially higher potential returns from vannamei shrimp farming than conventional carp production. However, shrimp development remains at an early stage.

Productivity is the Central Constraint

The report's comparative analysis indicates that Pakistan's principal gap is productivity rather than simply farmed area. Pakistan's average aquaculture yield is estimated at approximately 3–5 MT/ha/year, compared with 5–7 MT/ha in Bangladesh, 6–9 MT/ha in India and 10–15 MT/ha in Vietnam.

1 https://openknowledge.fao.org/server/api/core/bitstreams/12715642-41ce-4b25-b1ed-2aa503fba80d/content

The transition towards higher productivity requires improvements in the entire production package: genetically improved seed, feed quality, stocking practices, water-quality management, disease control, technical knowledge and farm-level management.

Seed[2] and Feed Constraints

Seed availability is not uniformly constrained by quantity. The more important constraint is the availability of high-quality and genetically improved seed.

Feed represents a second major productivity constraint. The domestic aquafeed industry represents both a constraint and an investment opportunity.

Disease, Water and Technical Capacity

Disease risks are currently moderated to some extent by the predominance of extensive production, which provides farmers with more time to respond to production problems.

Stakeholders identified oxygen depletion, parasitic, bacterial and fungal infections as major production challenges, alongside limited diagnostic and post-mortem facilities.

Experienced farmers possess substantial traditional knowledge, but modern aquaculture practices, equipment, water-quality management and intensive production skills remain less widespread.

Weak Value-Chain Integration Limits Farmer Returns

Limited cold-chain and processing infrastructure reduces product shelf life, contributes to post-harvest losses and restricts access to higher-value domestic and export markets. This creates an important opportunity for investment in cold storage, refrigerated logistics, processing, grading, packaging and traceability.

Financial and Institutional Constraints

Access to appropriately structured finance remains limited. Financial institutions perceive aquaculture as relatively risky, while conventional land-backed borrowing can be expensive relative to farm returns.

Institutionally, provincial fisheries departments perform important regulatory, hatchery, training and extension functions, but the field assessment identifies a mandate–outcome gap.

A coordinated national development framework, combined with stronger provincial implementation, is therefore required to provide greater policy consistency and investment certainty.

Lessons from Regional Competitors

Vietnam provides a model for export-oriented production, processing, certification, traceability and integrated value chains. Bangladesh demonstrates how smallholder farmers can generate substantial production growth through improved seed, extension, inputs and market linkages. India demonstrates the importance of technology adoption, specialized institutions, domestic hatchery capacity and shrimp-export development.

Investment Outlook

The most attractive segments include pangasius and tilapia production, inland shrimp farming, vannamei hatcheries, cold-chain infrastructure, certified processing, trout farming and aquatic health and diagnostic services. Technology-driven production systems also offer opportunities. The private sector should remain the principal source of

2 **seed** refers to the young, juvenile life stages of aquatic organisms (such as fish, shrimp, or molluscs) that are collected or hatched to be stocked into ponds, tanks, or enclosures for grow-out

commercial investment, with government focused on policy certainty, infrastructure, standards, certification, research, extension and risk-sharing mechanisms.

Policy Priorities

The report recommends a shift towards a coordinated, productivity-led development strategy centered on the following priorities:

1. Establish a coordinated national aquaculture development framework
2. Improve seed quality
3. Develop appropriate aquaculture finance and insurance
4. Improve aquaculture data systems and water-resource management
5. Increase public awareness and promote year-round fish consumption

Chapter 1

Introduction to Aquaculture in Pakistan



Chapter 1

Introduction to Aquaculture in Pakistan

Aquaculture is defined as "the farming of aquatic organisms, including fish, molluscs, crustaceans, and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms which are harvested by an individual or corporate body which has owned them throughout their rearing period contribute to aquaculture, while aquatic organisms which are exploitable by the public as a common property resource, with or without appropriate licenses, are the harvest of fisheries."[3]

Unlike capture fisheries, which depend on the harvesting of wild stocks from oceans, rivers and lakes, aquaculture involves deliberate human intervention in the rearing process, including feeding, health management, genetic selection and water quality control.

Over the past three decades, aquaculture has emerged as the fastest-growing food production sector globally. Driven by the convergence of rising global protein demand, progressive depletion of wild fish stocks and escalating pressure on food security systems, particularly in populous developing nations.

The sector has transformed from a niche activity into a critical pillar of the global food economy. In 2022, aquaculture (excluding algae and seaweeds) surpassed wild capture fisheries for the first time in recorded history, accounting for 51 percent of global aquatic animal production[4].

For Pakistan, the implications of this global transition are profound. The country possesses a diverse and significant natural resource base for aquaculture: extensive inland water bodies spanning rivers, canals and reservoirs, vast saline groundwater reserves across arid and semi-arid zones of Punjab and Sindh, a 1,050 km coastline and a large, low-cost rural labor force. Yet despite these endowments, Pakistan's aquaculture sector remains severely underdeveloped relative to regional peers, contributing only approximately 0.17 million tons to annual production, compared to India's 11.3 million tons, Bangladesh's 2.85 million tons, and Vietnam's 5.37 million tons in 2024.

The contrast between Pakistan's substantial resource endowment and its relatively modest aquaculture output raises important questions regarding the structural, institutional, and market factors constraining the sector's development. Understanding these challenges is particularly important as global seafood demand continues to expand and aquaculture increasingly becomes a strategic component of food security, rural development, and export diversification. This study therefore examines the current status, growth potential, constraints, and investment opportunities within Pakistan's aquaculture sector, with particular emphasis on emerging inland shrimp farming systems.

3 https://www.fao.org/4/t0697e/t0697e02.htm

4 https://openknowledge.fao.org/server/api/core/bitstreams/12715642-41ce-4b25-b1ed-2aa503fba80d/content

1.1 Overview of Global Aquaculture Growth and its Importance

With global population continuing to grow, the demand for nutritious and affordable food is increasing rapidly. Seafood plays a vital role in meeting this rising demand due to its high nutritional value and contribution to food security.

The global aquaculture industry has undergone a significant structural transformation over the past two decades. Total global fisheries and aquaculture production reached 224.2 million tons in 2022, representing an increase of 24.8 percent compared to 2012. This growth was primarily driven by the expansion of aquaculture. The total economic value of global fisheries and aquaculture production in 2022 was estimated at USD 452 billion, of which USD 296 billion came from aquaculture.[5]

Table 1-1 World Fisheries & Aquaculture Growth from 2012 to 2022[6]

Indicator	Year 2012 (million ton)	Year 2022 (million ton)	Increase in production (million ton)	Percentage increase in production
World total fisheries & aquaculture production	179.6 Mt	224.2 Mt	44.6 Mt	24.8%
World total aquaculture production	88.2 Mt	131 Mt	42.8 Mt	48.5%
Capture Fisheries production	91.4 Mt	93.2 Mt	1.8 Mt	1.96%

1.1.1 The Transition from Capture Fisheries to Aquaculture

The rise of aquaculture has been particularly dramatic. From a global production base of 43 million tons in 2000, aquaculture output grew to 131 million tons in 2022. This growth has been driven primarily by Asian economies, with China alone accounting for approximately 57 percent of global aquaculture output. The key insight for Pakistan is that the structural demand shift toward farmed seafood is not cyclical, it is a permanent feature of the global food economy.

1.2 Strategic Importance of Aquaculture for Pakistan

1.2.1 Contribution of Aquaculture to Export Diversification

Pakistan's export base has historically been concentrated in textiles, representing approximately 60 percent of total export earnings. This structural concentration exposes the country to significant vulnerability from global textile demand cycles, competition from lower-cost producers such as Bangladesh, Vietnam and Cambodia and increasing environmental and social compliance costs in export markets. Aquaculture offers a high-value, employment-intensive alternative that can substantially diversify Pakistan's export portfolio.

1.2.2 Contribution of Aquaculture to Food Security and Nutrition

Pakistan's per capita fish consumption stands at approximately 1.35 kg per year, among the lowest in the region and well below the world average of 19.90 kg. The consumption pattern of animal protein in Pakistan reveals a strong preference for red meat and poultry, while fish and seafood remain a very small component of the national diet.

Seafood consumption has shown a gradual decline from 1.45 kg per person in 2019 to 1.35 kg in 2023, a reduction of approximately 6.9 percent. This trend is particularly noteworthy given the global shift toward seafood consumption due to its recognized nutritional and health benefits.

5 https://openknowledge.fao.org/server/api/core/bitstreams/a10e81b3-3fbd-4393-b7b6-6a926915a19a/content
6 https://ourworldindata.org/grapher/capture-fisheries-vs-aquaculture

From an aquaculture development perspective, these consumption patterns present a significant opportunity. Even a modest increase in annual fish consumption from the current level of 1.35 kg to 3–5 kg per person would generate substantial additional demand, requiring a major expansion in domestic fish production.

Table 1-2 Trends in Per Capita Meat & Fish Consumption in Pakistan (2019–2023)[7]

Trends in Per Capita Meat & Fish Consumption in Pakistan 2019–2023					
Type of Meat	Per Capita Consumption (kg) 2019	Per Capita Consumption (kg) 2020	Per Capita Consumption (kg) 2021	Per Capita Consumption (kg) 2022	Per Capita Consumption (kg) 2023
Beef & Buffalo	9.33	9.47	9.63	9.14	9.22
Poultry	6.58	7.04	7.55	8.13	8.72
Sheep & Goat	3.14	3.14	3.17	3.18	3.18
Fish & Seafood	1.45	1.42	1.39	1.37	1.35
Other Meats	0.13	0.12	0.12	0.12	0.12

1.2.3 Contribution of Aquaculture to Rural Employment and Livelihood Generation

Aquaculture is one of the labor-intensive food production sectors and generates employment throughout its value chain. In addition to fish farming, jobs are created in hatchery[8] operations, seed production, feed manufacturing, pond construction and maintenance, harvesting, processing, cold storage, transportation, marketing, and export logistics. A, growth in aquaculture stimulates economic activity across multiple upstream and downstream industries. For Pakistan, aquaculture thus presents a valuable opportunity to create sustainable rural livelihoods.

1.3 Major Objectives of the Study

- Assess the current state, production structure and growth trajectory of inland aquaculture[9] in Pakistan.
- Analyze the emerging inland shrimp farming industry in Pakistan, including its economic viability, geographic concentration and export potential.
- Compare Pakistan's aquaculture sector's performance against the regional benchmarks of Bangladesh, India and Vietnam across key dimensions of production, productivity, policy and export competitiveness.
- Identify and quantify the structural constraints and bottlenecks preventing Pakistan from realizing its aquaculture potential.
- Present a prioritized set of policy recommendations and investment opportunities for government, private sector and development finance stakeholders.

7 https://ourworldindata.org/grapher/per-capita-meat-type?time=latest&country=~PAK

8 A facility where aquatic species are bred, eggs are incubated, and larvae or early-stage seed are produced under controlled conditions for aquaculture.

9 the farming of aquatic organisms—such as fish, crustaceans, molluscs, and aquatic plants—in land-based, non-coastal areas rather than in the open ocean or marine environments

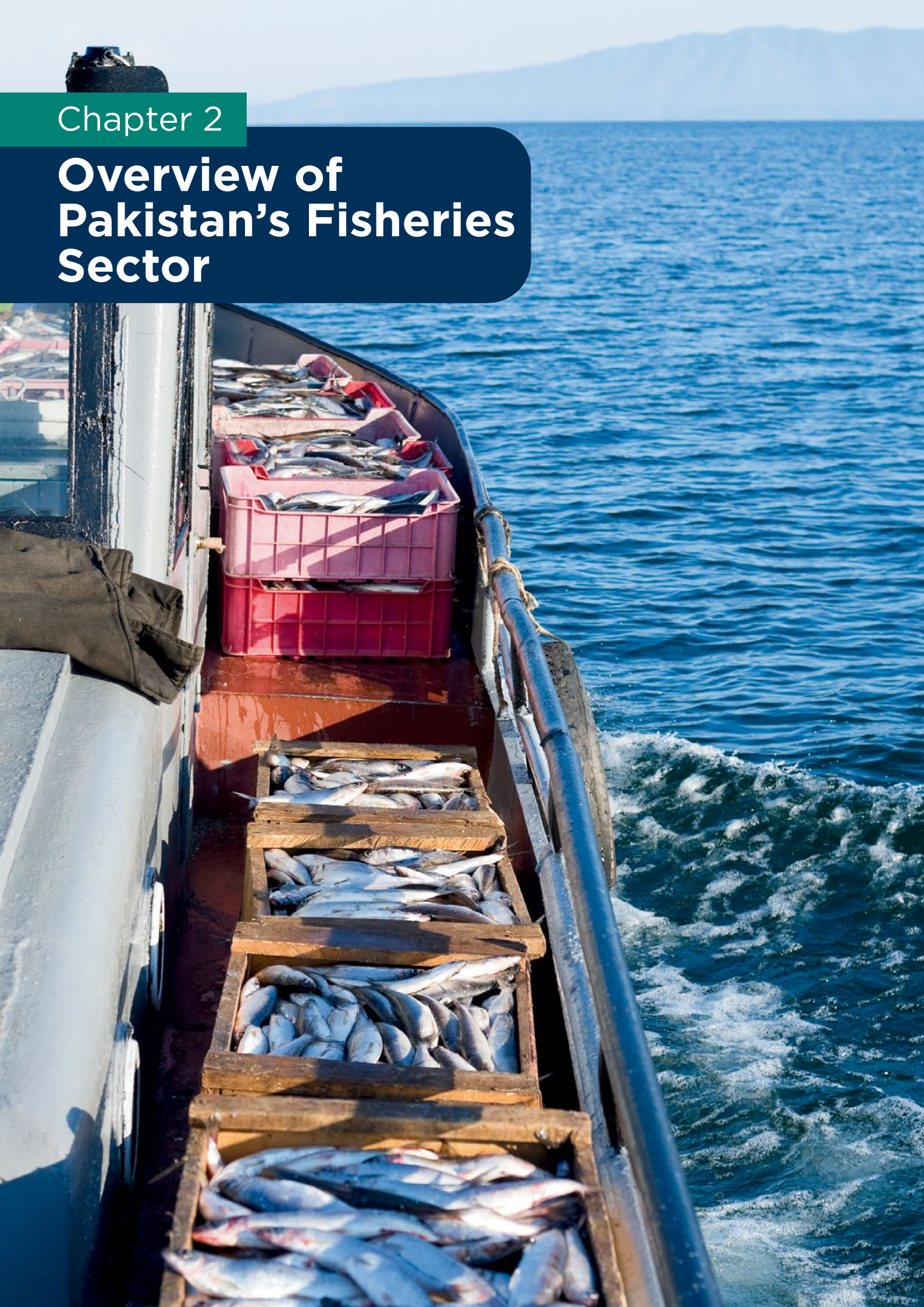
1.4 Scope and Methodology of the Study

Intensive fieldwork in three major provinces supplements the secondary data obtained from the Food and Agriculture Organization (FAO), World Bank, Our World in Data, Trade Map, Government of Pakistan publications, provincial fisheries departments, and relevant academic literature.

Comparative analysis is undertaken using Bangladesh, India, and Vietnam as regional benchmarks due to their demonstrated success in aquaculture development and seafood exports. Quantitative indicators relating to production, trade, productivity, consumption, and employment are analyzed to assess Pakistan's current position and future growth potential.

Chapter 2

Overview of Pakistan's Fisheries Sector



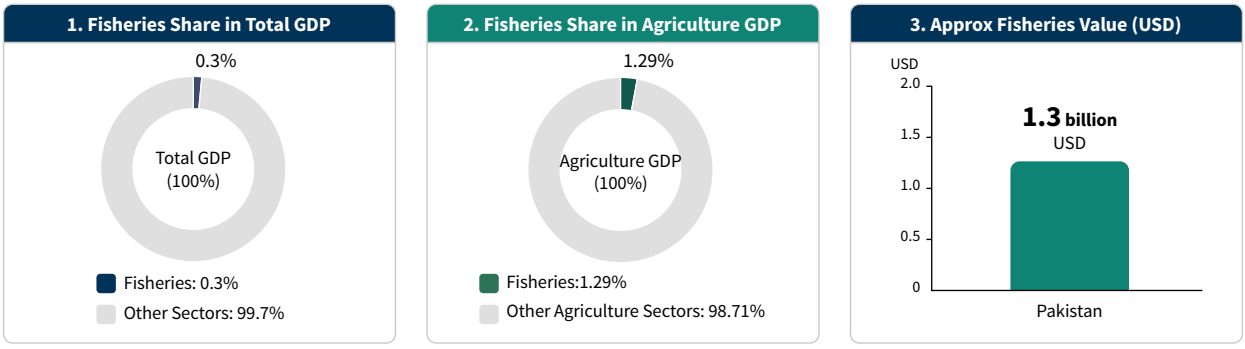
Chapter 2

Overview of Pakistan's Fisheries Sector

In Pakistan, the fisheries sector comprises three distinct sub-sectors: marine capture fisheries operating along Pakistan's 1,050 km coastline in the Arabian Sea; inland capture fisheries based on rivers, lakes, canals, reservoirs, and floodplains; and aquaculture, which involves the controlled farming of aquatic organisms, predominantly in freshwater environments.

Historically, marine fisheries have dominated national fish production and export activity. However, increasing pressure on wild fish stocks, resource limitations, and growing demand for seafood have elevated the importance of aquaculture as a key driver of future sector growth.

Figure 2-1 Contribution of Fisheries to Pakistan's Economy 2025[10]



2.1 Structure of Pakistan's Fisheries Sector

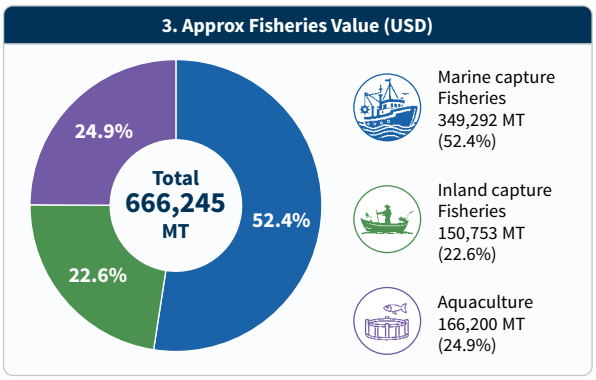
The sector's structure reflects Pakistan's geographic diversity.

Marine fisheries dominate in production volume terms, accounting for around 52 percent of total national fish production, primarily from demersal and pelagic species caught by artisanal and semi-industrial fleets operating from ports in Karachi and Gwadar.

Inland fisheries contribute approximately 23 percent, drawing on Pakistan's extensive river systems. Aquaculture, despite its significant untapped potential, currently represents approximately 25 percent of total production.

10 https://www.finance.gov.pk/survey/chapter_26/Highlights_of_the_PES_2026.pdf

Figure 2-2 Fisheries production by segment 2022[11]



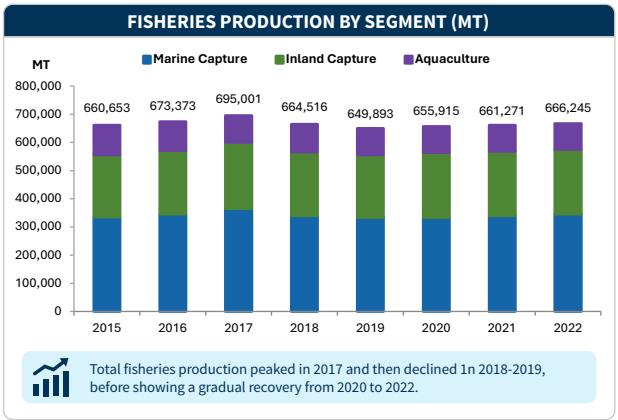
2.2 Trends in Fisheries Production in Pakistan

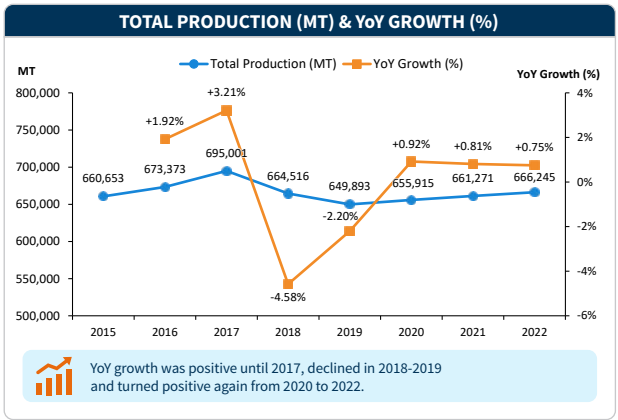
Total fish production in Pakistan has shown a broadly positive trend over the past two decades, driven primarily by growth in inland capture and aquaculture and modest expansion of the marine fleet. However, marine capture fisheries, the dominant segment, have displayed stagnation and in some years decline, reflecting the progressive over-exploitation of near-shore fishery resources and the limited adoption of sustainable fishing practice.

Figure 2-3 Fisheries Production in Pakistan 2015-22[12]

FISHERIES PRODUCTION OVER TIME (2015-2022)

Year	Marine Capture (MT)	Inland Capture (MT)	Aquaculture (MT)	Total (MT)	YoY Growth
2015	377,141	132,365	151,147	660,653	—
2016	379,716	136,640	157,017	673,373	+1.92%
2017	397,968	138,958	158,075	695,001	+3.21%
2018	363,840	140,970	159,706	664,516	-4.58%
2019	344,653	144,108	161,390	649,893	-2.20%
2020	344,827	147,956	163,132	655,915	+0.92%
2021	346,490	149,569	165,212	661,271	+0.81%
2022	349,292	150,753	166,200	666,245	+0.75%





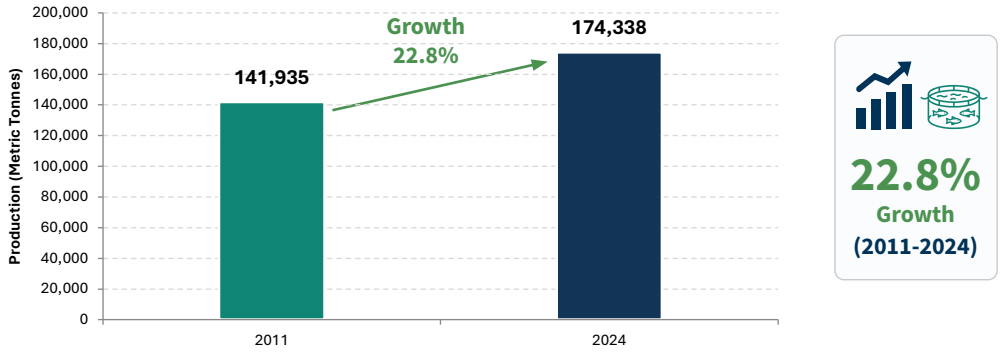
While capture fisheries continue to account for a majority of Pakistan's fish production, their long-term growth prospects are constrained by resource limitations, overfishing pressures and environmental challenges.

11 https://www.fao.org/fishery/statistics/software/fishstatj/en
12 https://www.fao.org/fishery/statistics/software/fishstatj/en

Aquaculture Growth (2011–2024)

Pakistan's aquaculture sector has recorded a growth of 22.8% between 2011 and 2024. This indicates a steady expansion of fish farming activities supported by an increasing demand for fish, better utilization of freshwater resources and gradual improvements in farming practices and infrastructure. Despite this positive growth, there remains significant potential for future expansion through investment, technology adoption and supportive policies.

Figure 2-4 Aquaculture production and growth in Pakistan 2011-24[13]

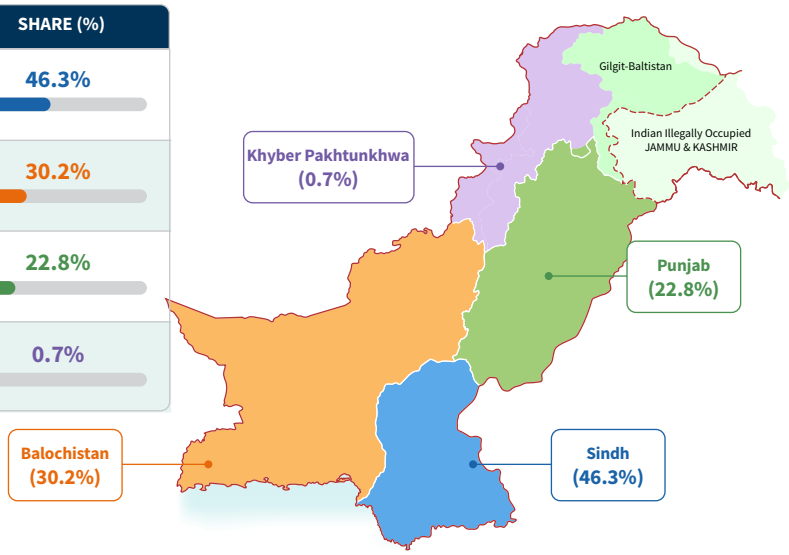


2.3 Distribution of Fisheries Production Across Provinces

Fisheries activity in Pakistan is geographically concentrated, with significant variation in the nature and scale of operations across provinces. Sindh and Balochistan dominate marine fishing by virtue of their coastal access. Punjab, despite being landlocked, is the largest contributor to inland aquaculture by virtue of its extensive canal irrigation networks and the availability of productive agricultural land suitable for fish pond development. Khyber Pakhtunkhwa contributes primarily through trout farming in cold-water mountain streams, a niche but high value segment.

Figure 2-5 Fisheries and aquaculture production by province[14]

PROVINCE	PRIMARY ACTIVITY	SHARE (%)
Sindh	Marine + Inland Capture + Aquaculture	46.3%
Balochistan	Marine Capture (Deep-sea, Artisanal)	30.2%
Punjab	Inland Aquaculture (Carp, Tilapia, Shrimp)	22.8%
Khyber Pakhtunkhwa	Trout Farming + Inland Capture	0.7%



13 https://www.fao.org/fishery/statistics/software/fishstatj/en

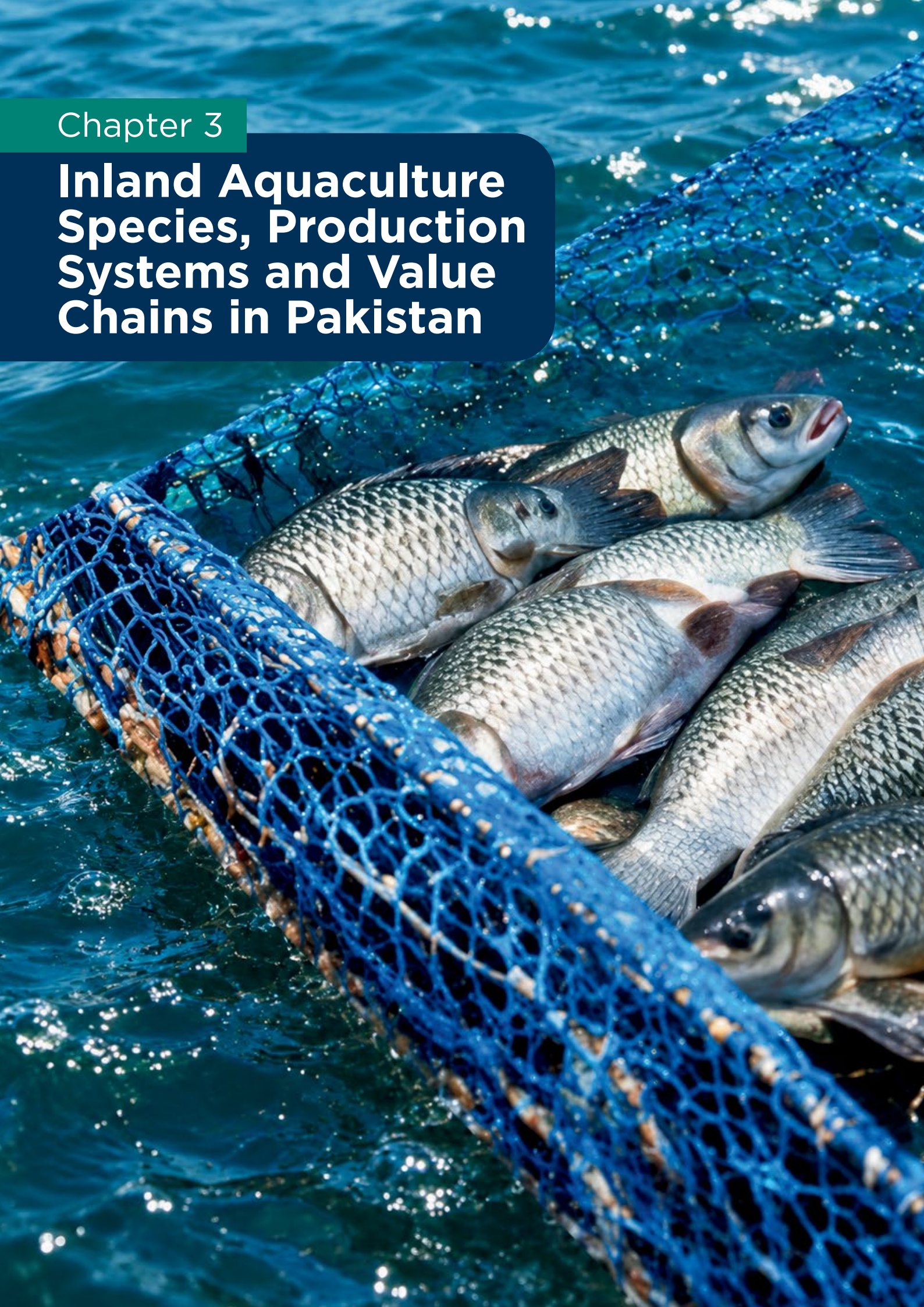
14 https://bos.punjab.gov.pk/system/files/PDS_2024_Final_r.pdf , https://sbos.sindh.gov.pk/files/SBOS/Development%20Statistics/SINDH%20STATISTIC%202023.pdf , https://kpbos.gov.pk/search/indicator-detail?id=712

2.4 Implications of Fisheries Sector Performance for Aquaculture Development

The analysis presented in this chapter highlights three important implications for the future development of Pakistan's aquaculture sector. First, the stagnation of capture fisheries suggests that future growth in fish production will increasingly depend on aquaculture expansion. Second, low domestic fish consumption presents both a challenge and an opportunity, improvements in supply chains, product availability, and consumer awareness could stimulate significant demand growth. Third, the concentration of aquaculture activity in Punjab and parts of Sindh indicates that substantial opportunities remain to expand production through improved resource utilization, technology adoption, and investment.

Chapter 3

Inland Aquaculture Species, Production Systems and Value Chains in Pakistan



Chapter 3

Inland Aquaculture Species, Production Systems and Value Chains in Pakistan

Inland aquaculture constitutes the growth engine for Pakistan's fisheries sector. Understanding the structure, species composition, geographic distribution, production systems, and value chains of inland aquaculture is essential for identifying the most effective pathways for sector expansion.

This chapter examines the key farmed species, recent production trends, regional production clusters, the major aquaculture production systems operating in Pakistan, and the structure of the aquaculture value chain. Together, these elements provide the foundation for assessing future growth opportunities and investment priorities.

3.1 Overview of Major Farmed Species

Pakistan's inland aquaculture is dominated by major carp[15] species, which together account for an estimated 85 percent of total production. This species concentration reflects historical hatchery programs that focused on carp broodstock[16] development, the dietary preference of domestic consumers and the suitability of carp polyculture to low-input farming systems. However, the species mix is diversifying as commercial operators seek higher-value export-oriented species, particularly Tilapia and shrimp.

Figure 3-1 Major aquaculture species in Pakistan[17]

SPECIES	EST. PRODUCTION SHARE	PRIMARY MARKET	EXPORT POTENTIAL
Rohu labeo	35%	Domestic	LOW
Silver carp	15%	Domestic	LOW
Grass carp (White amur)	11%	Domestic	LOW
Catla	11%	Domestic	LOW
Nile tilapia	10%	Domestic	LOW
Mrigal carp	10%	Domestic	LOW
Inland Shrimp (L. vannamei)	<2% (emerging)	Export Priority	VERY HIGH

While traditional carp species continue to dominate aquaculture production, the sector is gradually diversifying toward higher-value species such as tilapia, trout, and vannamei shrimp. This diversification reflects changing market demand, technological improvements, and growing interest in export-oriented aquaculture. The transition toward higher-value species is likely to play an important role in improving farm profitability and increasing sector competitiveness in the coming years.

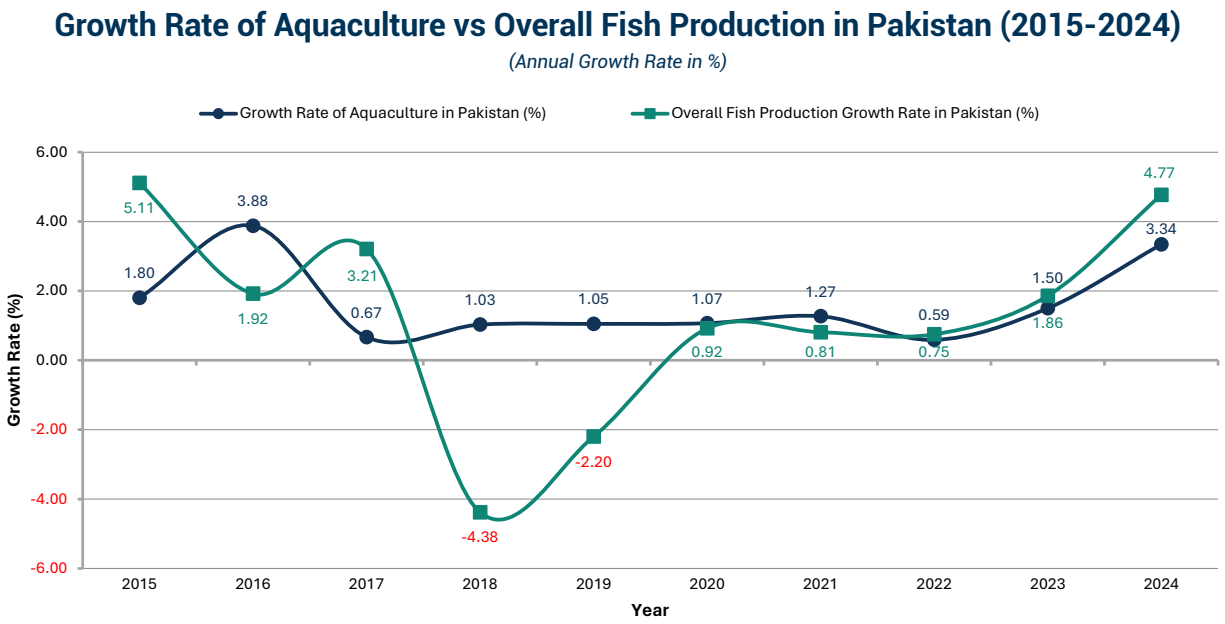
15 A group of freshwater fish species commonly farmed in aquaculture, including species such as rohu, catla and common carp.
16 Mature fish or other aquatic animals selected and maintained for breeding and the production of eggs, larvae or seed for aquaculture.
17 https://www.fao.org/fishery/statistics/software/fishstatj/en

3.2 Trends in Inland Aquaculture Production

Pakistan's inland aquaculture sector recorded an average annual growth rate of 1.7 percent during the 2015–2024 period, while overall fish production grew at an average of 1.3 percent over the same timeframe. These figures indicate a persistently sluggish pace of development in the fisheries sector.

When benchmarked against regional peers India, Bangladesh, and Vietnam, Pakistan's growth trajectory appears markedly inadequate, as these countries have achieved significantly higher rates of expansion in their aquaculture and fish production sectors during the same period, underscoring the urgent need for structural reforms and targeted investment in Pakistan's fisheries value chain.

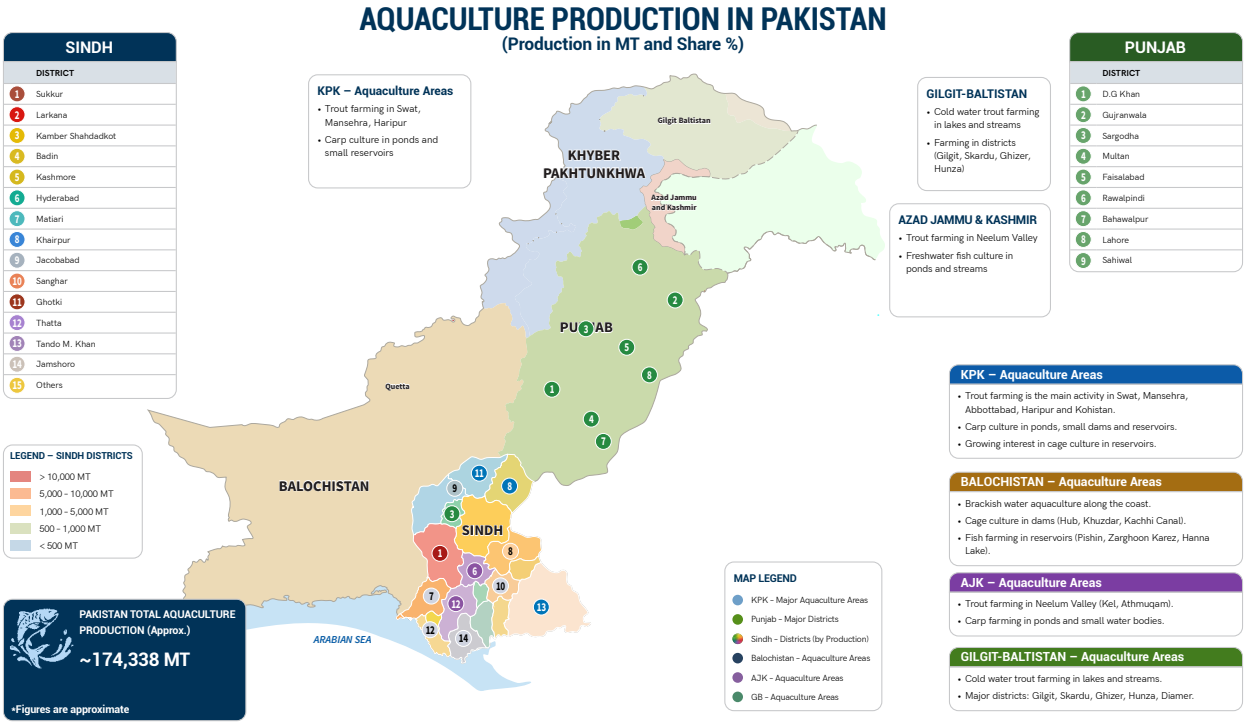
Figure 3-2 Growth rate of aquaculture vs overall fish production in Pakistan 2015-24[18]



18 https://www.fao.org/fishery/statistics/software/fishstatj/en

3.3 Geographic Distribution of Inland Aquaculture in Pakistan

Figure 3-3 Aquaculture production in Pakistan 2024[19]



Pakistan's inland fisheries and aquaculture production is concentrated in Punjab and Sindh, with Punjab producing approximately 123,000 MT and Sindh 39,396 MT in 2022.

In Punjab, six districts account for over two-thirds of aquaculture area, highlighting the role of canal irrigation and reliable water access in fish farming.

Table 3-1 Aquaculture in Punjab 2022[20]

Region	Percentage
Punjab	**100%**
D.G Khan	19.4%
Gujranwala	12.9%
Sargodha	12.3%
Multan	11 %
Faisalabad	10.8%
Rawalpindi	10%
Bahawalpur	9 %
Lahore	7.4%
Sahiwal	6.8%

19 https://bos.punjab.gov.pk/system/files/PDS_2024_Final_r.pdf
20 https://bos.punjab.gov.pk/system/files/PDS_2024_Final_r.pdf

Table 3-2 Aquaculture in Sindh 2022[21]

Region	Percentage
Sindh	**100%**
Sukkur	45.1%
Larkana	25.1%
Kamber Shahdadkot	7.4%
Badin	5.4%
Kashmore	4.2%
Hyderabad	3.4%
Others	9.5

Table 3-3 Aquaculture in KP 2022[22]

Region	Percentage
KP	**100%**
Swat	24.6%
Charsadda	22.5%
D.I.Khan	12.2%
Dir Lower	6.1%
Haripur	5%
Swabi	4.6%
Mansehra	4.3%
Mardan	3.2%
Nowshera	3.1%
Kohat	2.8%
Others	11.4%

3.4 Overview of Inland Aquaculture Production Systems

Inland aquaculture in Pakistan operates across several distinct production systems, each with different capital requirements, productivity levels and target markets:

3.4.1 Pond Farming Systems

Pond farming is Pakistan's dominant aquaculture system, concentrated mainly in Punjab and Sindh. Farms range from small household ponds to large commercial operations and these primarily use polyculture[23] of Indian and Chinese major carps, while Nile Tilapia is gaining importance due to its growth rate, market demand, and export potential.

Key constraints include limited access to quality seed, water supply, feed efficiency, disease management, and modern technology. Despite these challenges, pond culture remains the most scalable pathway for increasing domestic fish production.

21 https://sbos.sindh.gov.pk/files/SBOS/Development%20Statistics/SINDH%20STATISTIC%202023.pdf

22 https://kpbos.gov.pk/search/indicator-detail?id=712

23 An aquaculture system in which two or more compatible aquatic species are raised together in the same production system to make more efficient use of available resources and improve overall productivity.

Figure 3-4 Pond Farm



3.4.2 Cage Culture Systems

Cage culture involves raising fish in floating net enclosures in reservoirs, lakes, and dams. Pakistan has significant potential in water bodies such as Tarbela, Mangla, Khanpur, Rawal, and Hub dams. Tilapia and carp are well suited to this system, which can increase production without additional land.

Expansion however is constrained by regulatory gaps, limited financing, technical capacity, and undeveloped value chains. With appropriate policy support, cage culture could contribute significantly to future aquaculture growth.

Figure 3-5 Cage farm



3.4.3 Raceway Trout Farming Systems

Raceway farming is a specialized cold-water aquaculture system concentrated in Khyber Pakhtunkhwa, Gilgit-Baltistan, and Azad Jammu & Kashmir. It primarily produces premium-priced rainbow trout using continuous flows of cold, oxygen-rich water from streams and springs. Although production remains small, trout farming supports rural incomes and tourism, with expansion potential through improved hatcheries, feed supply, cold chains, and processing.

Figure 3-6 Raceway trout farm



3.4.4 Coastal Shrimp Farming Systems

Coastal shrimp farming is an emerging, export-oriented segment concentrated in Sindh and Balochistan, driven by the introduction of Pacific White Shrimp (*Litopenaeus vannamei*). While Pakistan has substantial coastal potential, commercial development remains limited by hatchery capacity, import dependence, cold-chain gaps, biosecurity risks, and limited technical expertise. With targeted investment, regulatory support, and stronger value-chain integration, shrimp farming could become a high-value contributor to aquaculture exports and employment.

Figure 3-7 Coastal shrimp farm



3.4.5 Biofloc Production Systems

Biofloc Technology (BFT) is an intensive aquaculture system[24] that uses beneficial microbes to convert organic waste into microbial biomass, improving water quality and providing supplementary nutrition. It requires minimal water exchange and supports high stocking densities, making it suitable for water-scarce areas.

In Pakistan, BFT is increasingly used for Nile Tilapia, catfish, and Pacific White Shrimp, but adoption is constrained by high investment and energy costs, technical complexity, and skilled management requirements.

24 The system characterized by high stocking densities and substantial use of formulated feed, aeration, water management and other inputs to achieve high production per unit area.

Figure 3-8 Biofloc system



3.4.6 Recirculating Aquaculture Systems (RAS)

Recirculating Aquaculture Systems (RAS) are controlled, land-based systems that treat and reuse water through filtration. Although still emerging in Pakistan, RAS offers year-round production, improved biosecurity, and proximity to urban markets, particularly for high-value species such as trout, ornamental fish, pangasius, and shrimp. Adoption remains constrained by high capital costs, unreliable electricity, technical requirements, and continuous monitoring needs.

Figure 3-9 Recirculating aquaculture system



While production systems determine the technological and operational characteristics of aquaculture, the species being cultivated largely determine profitability, market orientation, productivity levels and export potential.

3.5 Key Findings and Implications for Sector Development

Pakistan's inland aquaculture sector offers significant growth potential as capture fisheries face increasing constraints. Pond-based carp farming remains dominant, while diversification into tilapia, pangasius, trout, and vannamei shrimp is gradually expanding. Production is concentrated in Punjab and parts of Sindh, supported by water availability, infrastructure, and market access.

Although diverse production systems offer opportunities for expansion, weaknesses in seed quality, feed supply, cold-chain infrastructure, processing, and certification constrain development.

Unlocking this potential requires improving productivity, strengthening value chains, and expanding market integration to enhance food security, rural employment, and export competitiveness. The following chapter examines inland shrimp farming as an emerging opportunity.

Chapter 4

Inland Shrimp Farming in Pakistan



Chapter 4

Inland Shrimp Farming in Pakistan

Having examined the structure, species composition and value chain of Pakistan's broader inland aquaculture sector, this chapter turns to its most dynamic emerging segment. Inland shrimp farming using saline groundwater. This is one of the most significant structural developments in Pakistan's aquaculture sector in recent years. Pioneered by a small number of commercial operators in Pakistan, it represents a shift from subsistence-oriented carp pond farming for domestic consumption to high-value, export-oriented production targeting international markets.

The sector's emergence deserves detailed analysis as it constitutes one of the highest potential investment opportunities in Pakistan's agricultural economy.

4.1 Overview of Inland Shrimp Farming

Farmed shrimp accounts for approximately 55% of global shrimp production, supporting incomes, exports, and growing consumer demand. Pacific White Shrimp (Litopenaeus vannamei), the leading farmed species, represents around 70% of global shrimp aquaculture output and is widely cultivated across Asia for export markets.

Its broad salinity tolerance (0.5–35 ppt, with proper acclimation) enables inland farming using brackish groundwater in southern Punjab, Sindh, and Balochistan. Pakistan's commercial model involves extracting saline groundwater, cultivating imported post-larvae[25] in grow-out ponds, and harvesting shrimp after 90–120 days for export processing. Advanced biofloc systems may support two to three production cycles annually, improving production efficiency.

4.2 Drivers of Inland Shrimp Farming Growth in Pakistan

Saline Groundwater Availability

Saline groundwater and salt-affected lands in Pakistan, which limit conventional agriculture, offer potential for inland shrimp farming. Pacific White Shrimp (*Litopenaeus vannamei*) can thrive in brackish water, enabling underutilized resources to be converted into high-value aquaculture assets. This presents opportunities to improve land-use efficiency, generate rural employment, and diversify exports.

Modern Farming Systems Viability

Modern aquaculture technologies have demonstrated the feasibility of inland shrimp farming under Pakistan's conditions. Commercial operations in Thatta, Sindh, and southern Punjab have validated semi-intensive systems[26] using improved aeration, water quality management, formulated feeds, and biosecurity. These advances have reduced technical uncertainty, strengthened investor confidence, and created opportunities to improve productivity and competitiveness.

25 The early juvenile stage of shrimp following the larval stage, when the shrimp begins to resemble a miniature adult and is suitable for stocking in nursery or grow-out systems.

26 An aquaculture system that combines natural food production with supplementary feed and moderate levels of stocking, management and other inputs.

Investor Interest

Growing investor interest is driving inland shrimp farming in Pakistan, attracted by its potential for higher returns per unit of land and water, strong global seafood demand, and export opportunities. Domestic entrepreneurs, corporate agribusinesses, and overseas investors are increasingly entering the sector, supporting investment in modern technologies, professional farm management, and value-chain development.

International shrimp businesses are also showing interest in partnerships and collaborations with local businesses in Pakistan, creating opportunities for foreign expertise, technology transfer and investment in the sector.

Government Support

At the provincial level, particularly in Punjab, fisheries departments have supported inland shrimp farming through extension services, farmer training, and technical assistance, while collaboration with universities and private operators has helped adapt technologies to local conditions. Further growth requires dedicated hatcheries, streamlined licensing, disease surveillance, export certification, concessional financing, and targeted investment incentives.

4.3 Geographic Potential for Inland Shrimp Farming

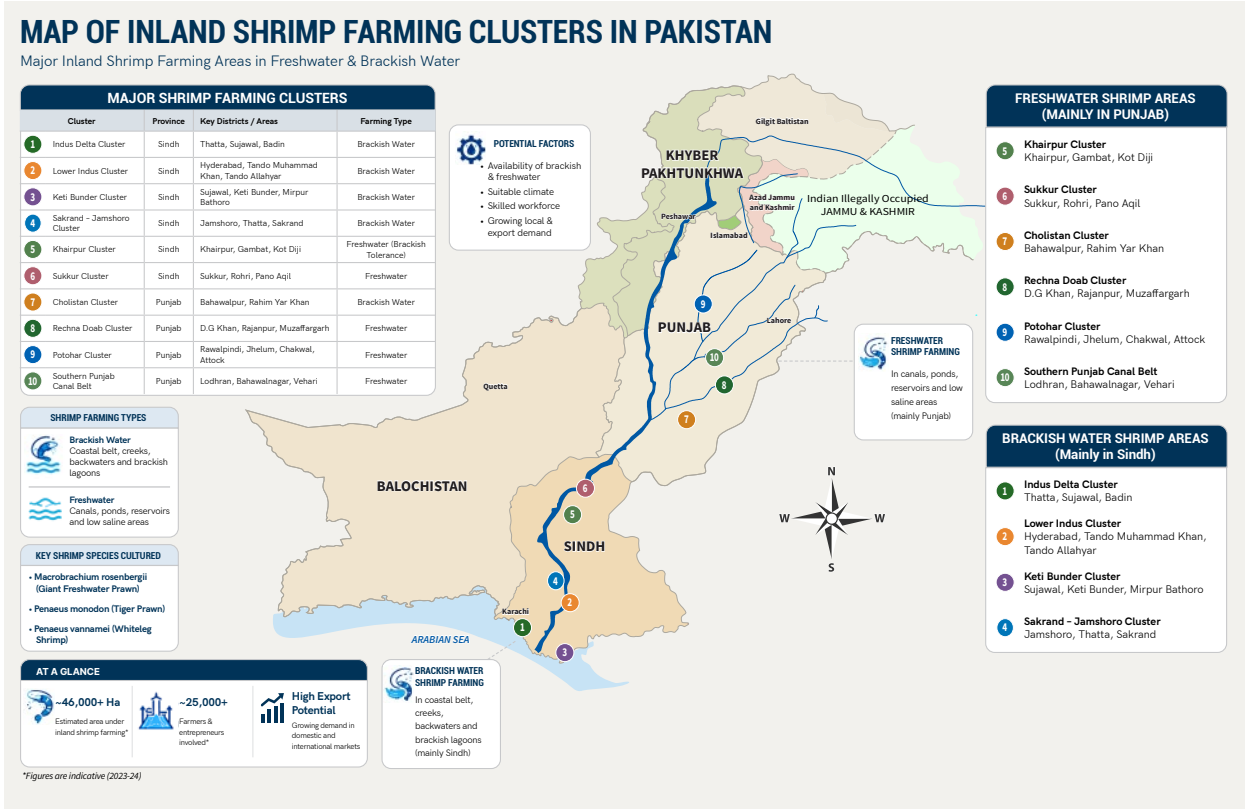
Inland shrimp farming in Pakistan has potential to expand into areas where saline groundwater, salt-affected land and suitable climatic conditions create favorable environments for commercial aquaculture. While shrimp production in Pakistan has historically been concentrated in coastal areas of Sindh and Balochistan, the introduction of Pacific White Shrimp (Litopenaeus vannamei) has created opportunities to explore inland production using brackish groundwater resources. However, the identification of suitable locations should be distinguished from the establishment of operational commercial shrimp farms.

In Sindh, coastal and adjoining districts, including Thatta, Sujawal and Badin, offer potential for shrimp aquaculture due to their geographic conditions and proximity to existing fisheries infrastructure. Hyderabad and Jamshoro may also offer opportunities in suitable locations, subject to groundwater salinity, water quality and site-specific feasibility assessments. These areas represent potential investment locations rather than established inland shrimp-producing clusters.

In Punjab, districts such as Bahawalpur, Rahim Yar Khan, Muzaffargarh and Dera Ghazi Khan have been identified as potential locations for inland shrimp farming. The availability of saline groundwater and salt-affected land, some of which may be less suitable for conventional agriculture, could provide opportunities for aquaculture diversification. However, the commercial viability of shrimp farming in these districts depends on water quality, farm-level infrastructure, seed and feed availability, technical capacity, disease management and access to processing and marketing facilities.

Overall, the geographic distribution of inland shrimp farming in Pakistan should be understood in terms of its development potential rather than an established pattern of commercial production. Site-specific assessments, pilot projects and investment feasibility studies are required to determine which locations can support commercially viable and sustainable shrimp farming.

Figure 4-1 Geographic Potential for Inland Shrimp Farming



4.4 Current Status of Inland Shrimp Farming in Pakistan

Inland shrimp farming remains at an early stage in Pakistan, with commercial production still limited, but with growing interest from private investors, policymakers, and export-oriented agribusinesses. Its high-value and export potential provides a strong base for future expansion.

Key constraints include limited domestic hatchery capacity for Pacific White Shrimp, dependence on imported post-larvae and technical services, limited disease diagnostics, and shortages of trained professionals. These gaps increase production costs and operational risks.

The sector can leverage Pakistan's existing seafood processing and export infrastructure to access international markets and generate foreign exchange. However, establishing a commercially viable and scalable industry will require investment in hatcheries, technical capacity, input supply, farm management, disease control, and supporting infrastructure.

Table 4-1 Current Status of Inland Shrimp Farming

Indicator	Current Status
Primary Species	Pacific White Shrimp (*Litopenaeus vannamei*)
Development Stage	Emerging commercial industry
Main Production Areas	Southern Punjab and Sindh
Key Districts	Bahawalpur, Rahim Yar Khan, Muzaffargarh, D.G. Khan, Thatta, Badin
Production Systems	Semi-intensive ponds, intensive ponds, biofloc systems
Production Cycle	Approximately 90–120 days
Annual Cycles	2–3 cycles (depending on management system)
Seed Source	Primarily imported post-larvae
Market Orientation	Predominantly export-oriented
Growth Outlook	High growth potential with increasing private investment

4.5 Economic Analysis of Inland Shrimp Farming

The economics of the two systems currently in vogue in Pakistan differ by an order of magnitude. The table below compares representative per-hectare costs and returns for conventional carp pond farming against inland vannamei shrimp farming, the two dominant production models competing for land and capital in Punjab and Sindh today.

Table 4-2 Economics of Shrimp Farming

Parameter	Conventional Carp Farming	Inland Shrimp Farming (Vannamei)
Capital Investment (RS/ha)	500,000 – 1,100,000	2,800,000 – 7,000,000
Annual Production (MT/ha)	3 – 5	8 – 20 (2 cycles)
Farm-Gate Price (RS/kg)	250 – 350	900 – 1400 (export grade)
Gross Revenue (RS/ha/year)	900,000 – 1,600,000	9,000,000 – 28,000,000
Operating Cost (RS/ha/year)	400,000 – 800,000	5,000,000 – 15,000,000
Net Profit (RS/ha/year)	500,000 – 800,000	4,200,000 – 11,000,000
Export Suitability	Low (primarily domestic)	High (direct export)

Net profit per hectare from inland shrimp farming ranges from approximately five to more than twenty times that of conventional carp farming and is around twelve times higher at the midpoint of the respective ranges, despite requiring only three to six times greater initial capital investment. This substantial profitability advantage is driven by a combination of higher market prices, superior productivity, and export orientation.

Unlike freshwater fish species that are largely dependent on domestic markets, Pacific White Shrimp commands premium prices due to strong and sustained international demand. In addition, intensive shrimp production systems can achieve significantly higher yields per hectare than traditional carp ponds, allowing producers to generate greater output from the same land and water resources.

The combination of higher prices and greater productivity results in substantially higher returns on land, water, and capital, inland shrimp farming in Pakistan and reinforcing its position as one of the most attractive investment opportunities within Pakistan's aquaculture sector.

4.6 Export Potential of Inland Farmed Shrimps

Global shrimp demand has grown steadily, with major markets including the United States, China, the European Union, Japan, and Gulf countries. With global shrimp trade exceeding USD 32 billion annually and expanding demand provides opportunities for new exporting countries.

Pakistan can leverage its established seafood export ecosystem, including processing facilities, cold-chain infrastructure, quality assurance systems, and trade relationships with international markets. This provides a foundation for scaling shrimp exports without developing an entirely new export network.

In contrast, Pakistan's traditional aquaculture species, including Rohu, Catla, Mrigal, Silver Carp, Grass Carp, and Tilapia, are largely consumed domestically and have relatively limited export potential. Shrimp offers a higher-value export pathway, allowing Pakistan to target premium international markets. Although inland shrimp currently accounts for less than 2% of aquaculture production, its higher value per unit means that even modest production growth could generate substantial export revenues.

Table 4-3 Export Potential of Shrimp Farming

Indicator	Global Shrimp Market
Global Trade Value	USD 32+ Billion
Largest Importers	USA, China, EU, Japan
Most Farmed Species	Vannamei
Share of Global Farmed Shrimp	~70%
Pakistan Position	Emerging Producer

4.7 Constraints to Inland Shrimp Farming

Despite its strong commercial potential, inland shrimp farming remains at an early stage of development and faces several structural constraints. These challenges increase production costs, limit productivity, and reduce international competitiveness. Addressing these bottlenecks will be essential if Pakistan is to scale inland shrimp farming into a major export industry.

Table 4-4 Constraints on Inland Shrimp Development

Constraint	Specific Impact	Severity
Seed Import Dependency	Limited domestic hatchery capacity; reliance on imported post-larvae from Thailand and Vietnam increases costs and disease risks	Critical
Disease Management	EMS (Early Mortality Syndrome), White Spot Syndrome — limited diagnostic labs and biosecurity protocols	High
Processing & Certification	Few export processors with international certifications (GlobalG.A.P., BAP, EU market access)	High
Cold Chain Gaps	Shortage of refrigerated logistics from South Punjab farms to Karachi processing/ export hubs	High
Technical Expertise	Shortage of trained farm managers with shrimp culture experience; reliance on foreign consultants	Medium

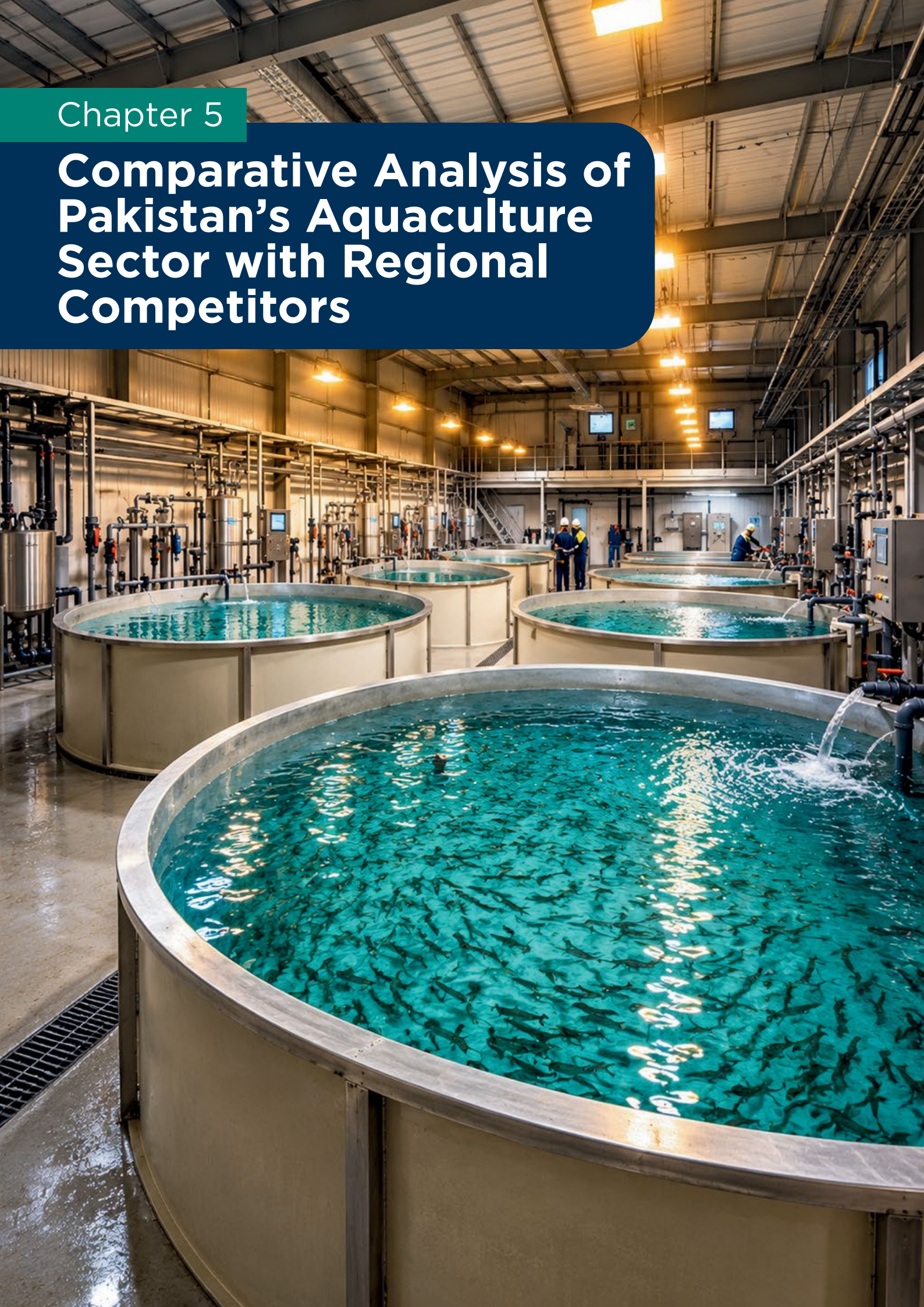
4.8 Key Findings and Implications for Sector Development

Inland shrimp farming represents the most commercially attractive segment of Pakistan's aquaculture sector. By converting saline groundwater and marginal agricultural land into productive aquaculture assets, the industry offers a unique opportunity to expand exports, increase rural incomes, and diversify agricultural production.

The economic returns from shrimp farming substantially exceed those of conventional carp culture, while Pakistan's existing seafood export infrastructure provides a strong platform for future growth. However, scaling the industry will require investment in hatcheries, feed manufacturing, biosecurity systems, cold-chain infrastructure, and export certification.

Chapter 5

Comparative Analysis of Pakistan's Aquaculture Sector with Regional Competitors



Chapter 5

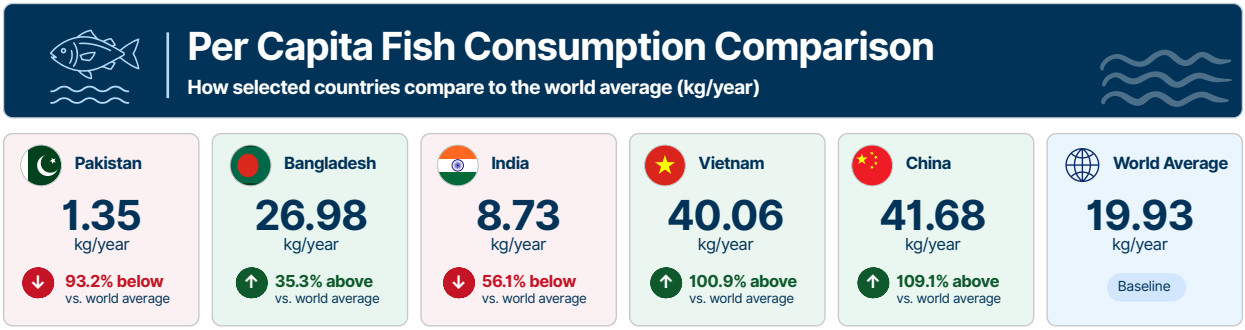
Comparative Analysis of Pakistan's Aquaculture Sector with Regional Competitors

This chapter benchmarks Pakistan's aquaculture performance against Bangladesh, India and Vietnam — three economies with comparable or inferior natural resource endowments that have nonetheless built aquaculture sectors many times larger than Pakistan's.

The comparison proceeds across four dimensions: fisheries' contribution to GDP and agriculture, aquaculture production and productivity, export competitiveness, and policy frameworks.

As a starting point, the following table places Pakistan's very low per-capita fish consumption in regional and global context.

Figure 5-1 Per Capita Fish Consumption Comparison, 2023[27]

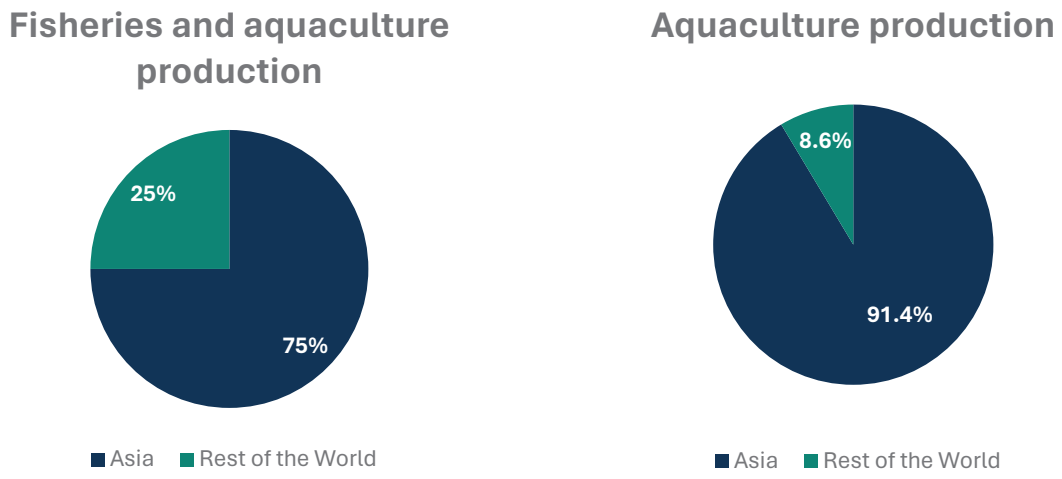


Pakistan's per-capita fish consumption is not only far below the global average but also an order of magnitude below Bangladesh's, despite comparable population pressures on food security — a gap that reflects supply-side constraints as much as consumer preference.

The pie chart below illustrates the regional distribution of global fisheries and aquaculture production, highlighting Asia's overwhelming dominance in the sector.[28]

27 https://ourworldindata.org/grapher/per-capita-meat-type?time=latest&country=OWID_WRL~PAK~BGD~IND~VNM~CHN
28 https://openknowledge.fao.org/server/api/core/bitstreams/12715642-41ce-4b25-b1ed-2aa503fba80d/content

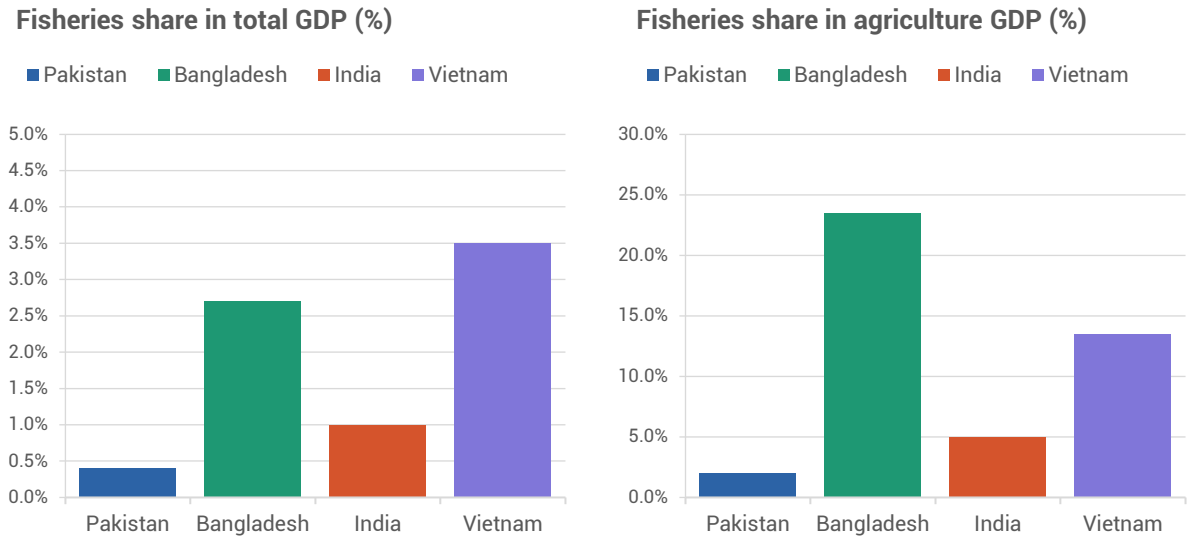
Figure 5-2 Fisheries and Aquaculture Production in Asia and Rest of the World 2024[29]



5.1 Comparison of Fisheries Sector Contribution to GDP and Agriculture

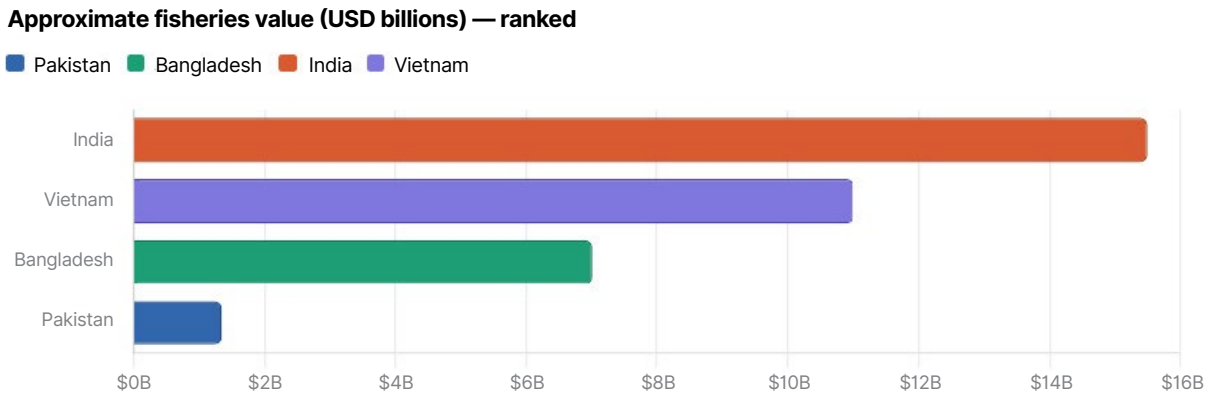
The following table compares fisheries' contribution to GDP and to agricultural GDP across Pakistan and its regional comparators, underscoring how much smaller a role the sector plays in Pakistan's economy relative to Bangladesh, India, and Vietnam.

Figure 5-3 Fisheries Sector Contribution Comparison 2025



29 https://openknowledge.fao.org/server/api/core/bitstreams/12715642-41ce-4b25-b1ed-2aa503fba80d/content

Figure 5-4 Fisheries Value Comparison



5.2 Comparison of Aquaculture Production Growth and Scale

Aquaculture growth rates indicate the pace of sector expansion, while total production volumes reflect the scale achieved through long-term investment and technological development. Pakistan performs poorly on both indicators compared with regional competitors.

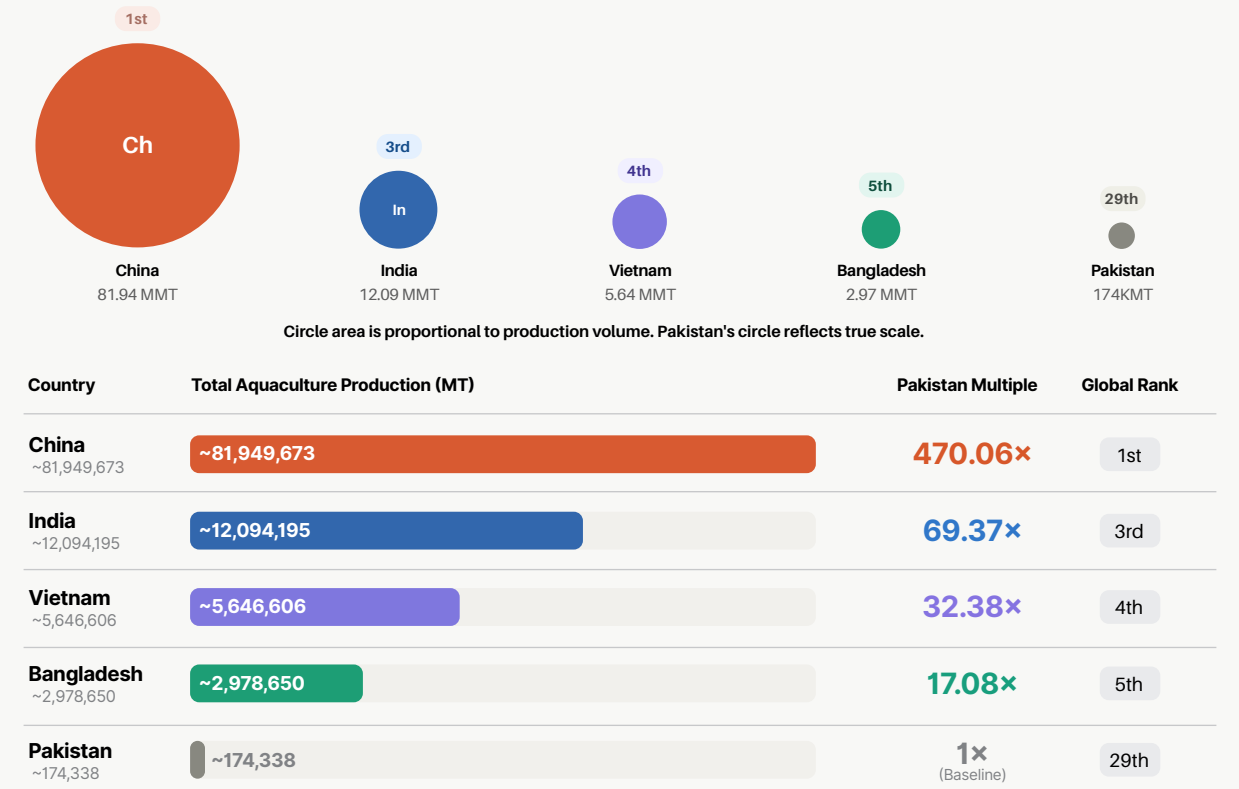
Figure 5-5 Aquaculture Growth Comparison from 2011 to 2024[30]

Country	Growth (%)
Pakistan	22.8%
Bangladesh	95.4%
Vietnam	97.3%
India	228.5%

The disparity in production volumes is striking. Bangladesh produces more than seventeen times, Vietnam more than thirty two times, and India nearly seventy times Pakistan's aquaculture output. These differences reflect decades of investment in hatcheries, feed industries, farmer training, and supportive policy frameworks rather than differences in natural resource availability alone.

30 https://www.fao.org/fishery/statistics/software/fishstatj/en

Figure 5-6 Aquaculture Global Ranking Comparison - 2024[31]



5.3 Comparison of Aquaculture Productivity Performance

The production gap between Pakistan and its regional peers is not explained by geography or natural resource limitation alone. A large portion of the differential is attributable to a productivity gap: Pakistan produces significantly less per unit of farming area. Closing even half the yield gap with Bangladesh would effectively double Pakistan's aquaculture output without requiring any expansion of farmed area.

Table 5-1 Aquaculture Productivity Comparison

Country	Average Yield (MT/ ha/year)	Primary Driver of Productivity	Technology Adoption Level
Pakistan	3 – 5	Low stocking density, poor feed management	Low
Bangladesh	5 – 7	Improved feeds, government extension	Medium
India	6 – 9	Biofloc adoption in shrimp, certified feeds	Medium-High
Vietnam	10 – 15	Intensive culture, certified hatcheries, traceability	High

5.4 Comparison of Export Competitiveness and Seafood Trade Performance

Export performance provides perhaps the clearest indication of the commercial maturity and international competitiveness of a country's aquaculture sector.

Vietnam's seafood exports exceeded USD 6.9 billion in 2025, Bangladesh's shrimp export alone generates approximately USD 300 million annually while India's seafood exports reached USD 6.9 billion. Pakistan by contrast generated approximately USD 450 million in total fish and seafood exports, a fraction of its potential given comparable or superior natural resource endowments.

31 https://data.worldbank.org/indicator/ER.FSH.AQUA.MT?most_recent_value_desc=true

Figure 5-7 Export Value Comparison 2025 [32]

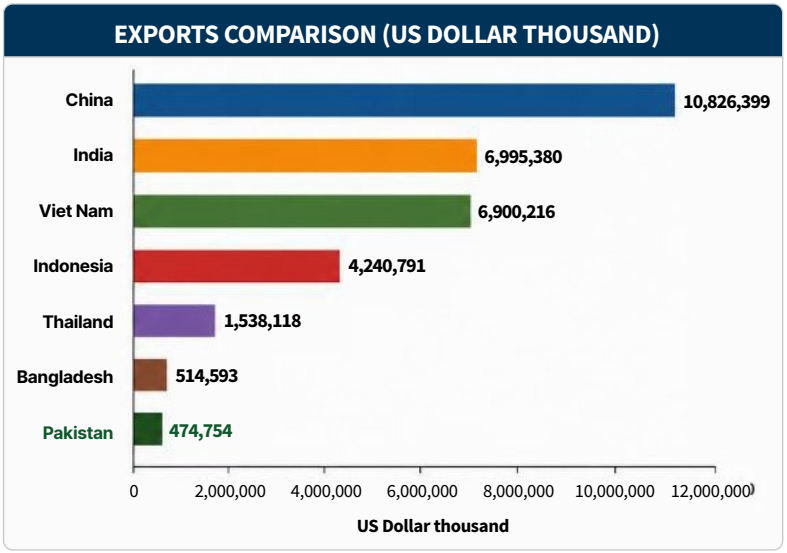
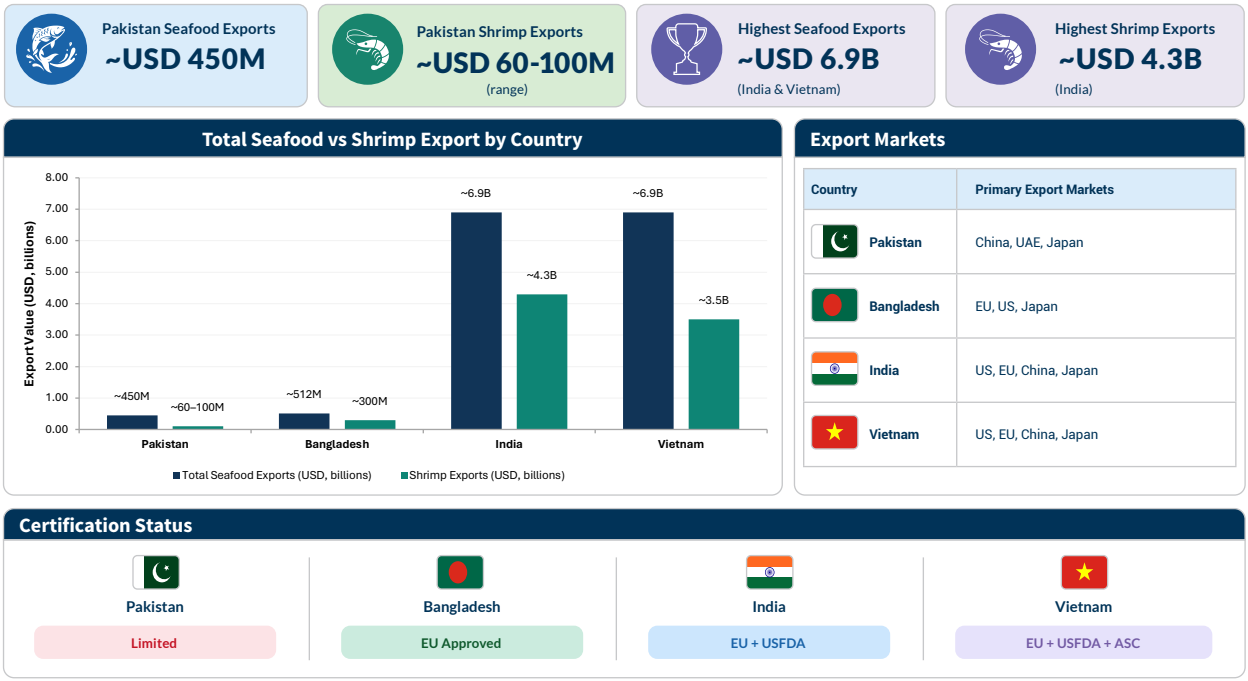


Figure 5-8 Seafood and Shrimp Export Comparison 2025[33]



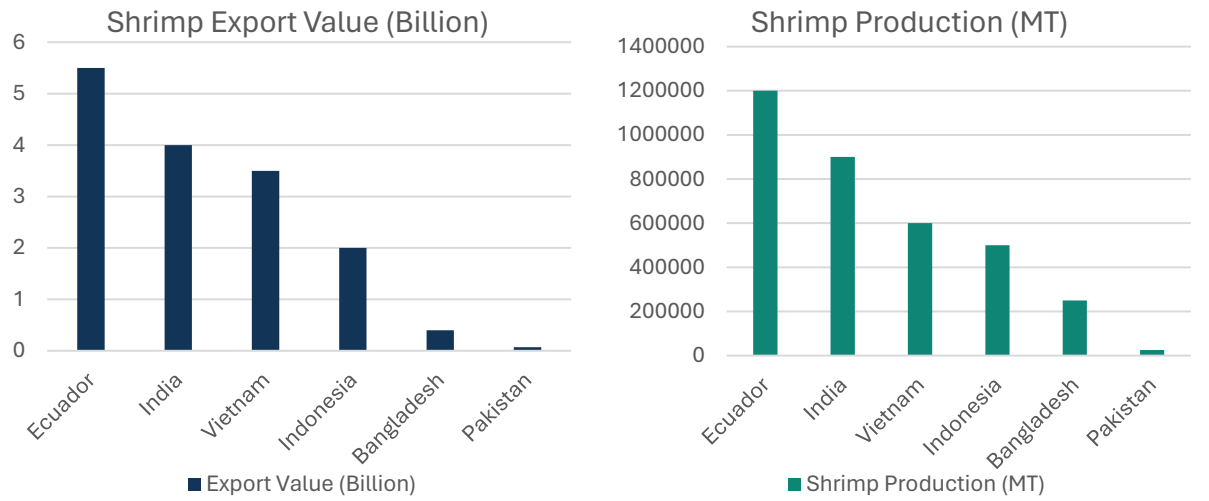
Although overall seafood exports remain an important indicator of sector performance, shrimp exports are particularly relevant because shrimp is the highest-value aquaculture commodity traded internationally.

5.4.1 Assessment of Global Shrimp Trade Opportunities

Global shrimp trade represents one of the most valuable categories in international seafood commerce, with annual trade value exceeding USD 32 billion. The market is structurally growing, driven by increasing shrimp consumption globally. Pakistan's competitive cost position, with land, water, and labor costs, positions it well to capture additional market share provided quality, traceability, and certification requirements can be met.

32 https://www.trademap.org/Product_SelCountry_TS
33 https://www.trademap.org/Product_SelCountry_TS

Figure 5-9 Global Shrimp Exports 2025



5.5 Comparison of Policy and Institutional Frameworks

Policy Area	Pakistan	Bangladesh	Vietnam
National Aquaculture Policy	Draft policy; no dedicated act	National Fisheries Policy 2006; regular updates	Law on Fisheries 2017; dedicated aquaculture decree
Subsidies / Input Support	Very limited; ad hoc provincial programs	Subsidized feeds, fingerlings for small farmers	Subsidized credit, insurance, extension services
Hatchery Regulation	Government hatcheries, no private sector licensing framework	Registered private hatcheries with quality control	Certified national broodstock centers + private hatcheries
Export Incentives	DLTL scheme (limited seafood coverage)	Cash incentives, export processing zones	Tax breaks, dedicated export zones, VASEP support
Quality / Certification	PSQCA; no EU approval for most facilities	EU approved; HACCP mandatory for exporters	EU + US FDA approved; national traceability system

The comparison suggests that policy and institutional support have played a central role in the development of successful aquaculture sectors across the region, particularly in relation to hatchery development, export promotion, certification systems, and farmer support services. The experiences of Bangladesh, India, and Vietnam indicate that policy consistency and institutional coordination are often as important as natural resource endowments in determining aquaculture success.

5.6 Lessons from Regional Competitors

5.6.1 Vietnam: The Scale, Export and Certification Model

Vietnam has transformed itself into one of the world's leading aquaculture exporters through a highly coordinated approach that combines large-scale production, strong government support, modern processing infrastructure, and strict compliance with international standards.

The country's success is built on extensive hatchery networks, continuous investment in research and technology, integrated value chains, and widespread adoption of certifications such as GlobalG.A.P., ASC, and European Union standards. Equally important is Vietnam's sophisticated seafood processing industry, supported by cold-chain logistics and export-oriented industrial clusters that enable producers to access premium international markets.

The key lesson for Pakistan is that production growth alone is insufficient to achieve export competitiveness. Pakistan must simultaneously invest in hatchery infrastructure, quality certification systems, processing facilities,

and cold-chain networks. Adopting internationally recognized standards and traceability systems will be essential for accessing high-value markets in Europe, North America, and East Asia.

Vietnam demonstrates that a well-organized value chain can transform aquaculture from a domestic food production activity into a major source of foreign exchange earnings.

5.6.2 Bangladesh: The Smallholder-Led Growth Model

Bangladesh has emerged as one of the fastest-growing aquaculture producers in the world despite having limited land resources and a predominantly smallholder farming structure. Rather than relying solely on large commercial farms, Bangladesh expanded aquaculture by integrating fish farming into existing agricultural systems, particularly through pond aquaculture and rice-fish farming.

Government extension services played a critical role by providing technical training, improved seed, access to inputs, and market support to rural households. This approach enabled millions of small-scale farmers to participate in aquaculture production while simultaneously improving food security and household incomes.

For Pakistan, the principal lesson is that aquaculture expansion does not necessarily require large-scale corporate investment. Significant production gains can be achieved by integrating fish farming into existing farming systems and supporting small and medium-sized farmers through extension services, quality seed distribution, affordable financing, and market linkages.

5.6.3 India: The Technology, Institutional and Shrimp Export Model

India's aquaculture transformation has been driven by technological innovation, strong institutional support, and a highly successful export-oriented shrimp industry. The introduction of Pacific White Shrimp (Vannamei), combined with the development of domestic hatchery capacity, modern farming practices, and disease management systems, enabled India to become one of the world's largest seafood exporters within a relatively short period.

The country's success was further supported by strong institutions, particularly the Marine Products Export Development Authority (MPEDA), which coordinated research, farmer training, export promotion, certifications, and international market access initiatives.

The lesson for Pakistan is the importance of establishing dedicated institutions capable of coordinating aquaculture development across the entire value chain. Pakistan possesses significant potential for both coastal and inland shrimp farming but lacks the institutional framework necessary to support rapid industry expansion.

5.6.4 Implications for Pakistan

Taken together, the experiences of Vietnam, Bangladesh, and India suggest that Pakistan's aquaculture strategy could combine the strengths of all three models: Vietnam's focus on certification, processing, and export competitiveness; Bangladesh's emphasis on smallholder participation and rural development; and India's commitment to technology adoption, institutional coordination, and export-oriented shrimp farming. By integrating these approaches, Pakistan can simultaneously increase domestic fish production, improve nutrition and food security, generate rural employment, and expand seafood exports.

5.7 Key Findings and Strategic Implications

The comparison with Bangladesh, India, and Vietnam demonstrates that sustained investment in technology, hatchery development, extension services, processing infrastructure, certification systems, and export-oriented value chains can transform aquaculture into a major contributor to economic growth and export earnings. Pakistan's challenge is not resource scarcity but the need for stronger institutions, higher productivity, and greater market integration.

Chapter 6

Stakeholder Inputs - Aquaculture Sector Constraints



Chapter 6

Stakeholder Inputs - Aquaculture Sector Constraints

6.1 Overview of Stakeholder Inputs on Sector Constraints

The constraints affecting aquaculture development are interconnected. Low productivity limits farm profitability, which in turn reduces farmers' willingness to invest in quality inputs and technology. Weak market and post-harvest systems constrain returns, while limited access to finance restricts investment in farm improvement. At the same time, gaps in data, technical extension, disease management and institutional coordination limit the sector's ability to transition towards more commercially oriented production.

Field consultations conducted across Punjab, Sindh and Khyber Pakhtunkhwa broadly support these findings, while also highlighting important differences across provinces and along the aquaculture value chain.

6.2 Provincial Production Landscape

Pakistan's aquaculture sector varies considerably across provinces in terms of production systems, species, resource availability, market conditions and technology adoption. Field consultations highlighted three distinct provincial production landscapes.

6.2.1 Punjab: Largest Production Base with Greater Technology Adoption

Punjab represents the largest production base for inland aquaculture and has a relatively developed network of fish farms, hatcheries and input suppliers. Common carp remains the dominant species, while tilapia and catfish are also increasingly farmed.

Most farms continue to operate under extensive or traditional production systems. However, field consultations identified a growing group of progressive farmers adopting semi-intensive and, in some cases, more intensive production practices. Stakeholders estimated that fewer than one-fifth of farmers currently operate under progressive, semi-intensive systems, indicating substantial scope for productivity improvements.

Inland shrimp farming is also emerging in Punjab, particularly in saline areas. Its future development will depend on production costs, technical capacity, reliable seed and feed supply, farm management and market viability.

6.2.2 Sindh: Resource Availability but Predominantly Extensive Production

Sindh possesses substantial land and water resources for aquaculture, including areas with potential for freshwater and saline-water production. Despite this resource base, production remains largely extensive and below its potential.

Freshwater farming is dominated by traditional carp production, while marine and brackish-water aquaculture remains untapped. However, shrimp farming is also being explored by private businesses in Sindh, including larger-scale operations located near coastal creeks that utilize creek water for production. These emerging initiatives demonstrate the potential to diversify aquaculture beyond traditional freshwater carp farming and make greater use of Sindh's saline and brackish-water resources. Stakeholders identified water availability and reliability, feed and seed costs, limited technical knowledge and access to finance as important constraints.

Field consultations also highlighted seasonal interruptions in canal and other surface-water supplies in some areas. During periods of high temperature, farmers may face additional production stress through changes in water quality, temperature and dissolved oxygen.

6.2.3 Khyber Pakhtunkhwa: High Demand, Limited Production and Trout Potential

Khyber Pakhtunkhwa has a smaller aquaculture production base but significant potential for both warm-water and cold-water species. Field consultations indicated that local fish production remains below demand in several areas, with part of the market supplied from Punjab.

Carp and tilapia are commonly produced under traditional systems, with farmers often relying on fertilizers, crop residues and manure rather than formulated feed. Some farmers expressed concerns that greater reliance on commercial feed could increase production costs or disease risks.

Trout represents a specialized opportunity for Khyber Pakhtunkhwa. Stakeholders reported strong market demand and noted that trout production had expanded significantly before the 2022 floods to supply markets outside the province. However, damage to farms, infrastructure and supply chains slowed recovery. Trout production also faces specific challenges related to climate change, water temperature, flood exposure, feed quality and cold-chain and processing facilities.

Other cold-water species and technologies such as recirculating aquaculture systems (RAS) may offer opportunities for diversification, although their commercial application would require careful consideration of capital and operating costs.

6.3 Production, Productivity and Technology Constraints

The predominant production model in Pakistan remains extensive, characterized by relatively low stocking densities, limited use of formulated feed and reliance on traditional farm management practices. While these systems require lower levels of investment, they also generally generate lower yields and limit the sector's ability to achieve consistent commercial returns.

Field consultations indicate that many farmers possess substantial practical knowledge of traditional fish farming but have limited exposure to modern water-quality monitoring, aeration, feed management, stocking practices and intensive production technologies. Adoption of technologies such as biofloc remains limited, partly because of their technical requirements, energy costs and higher management complexity.

The transition towards semi-intensive and intensive systems therefore requires more than access to technology. Farmers need commercially viable production models, technical support, reliable inputs and sufficient market returns to justify additional investment.

6.4 Seed Supply and Quality

The availability of fish seed is an important component of aquaculture productivity. However, field consultations suggest that seed availability is not a uniform supply constraint across Pakistan. For commonly farmed species such as carp, farmers can generally obtain seed in the required quantities.

The more significant concern is seed quality, affordability and genetic performance. Stakeholders reported weaknesses in broodstock management and genetic selection, with conventional and relatively unselected strains[34]

34 Distinct populations within the same aquatic species that have particular genetic characteristics or traits, such as growth rate, disease resistance or environmental tolerance.

remaining common in some production systems. Poor-quality seed can increase production cycles, reduce growth rates and ultimately lower farm profitability.

The availability of improved tilapia strains and monosex seed have increased, while pangasius seed is increasingly produced locally following earlier reliance on imports. Continued improvement in hatchery standards, broodstock management and genetic selection could improve productivity without requiring substantial expansion of farm area.

There is also scope to diversify hatchery production towards higher-value and locally suitable species, including sea bass, snakehead and mahseer, where technical and market conditions permit.

6.5 Feed and Input Constraints

Feed is an important component of aquaculture production costs, particularly in commercial and semi-intensive farming systems. However, field findings indicate that the main challenge for Pakistan's aquaculture feed industry is low and fragmented demand for commercial feed. The predominantly small-scale and extensive nature of fish farming limits feed consumption and reduces the incentive for producers to expand dedicated aquaculture feed production.

Feed producers also face high production costs, particularly electricity and raw material costs, which increase the price of commercial feed. The price farmers are willing or able to pay remains a major constraint, especially where farm-level returns are low. In addition, the reliability of credit and payment arrangements with farmers creates working-capital challenges for feed producers.

Field consultations indicated that a relatively small share of farmers currently use formulated feed, with stakeholders estimating that no more than around one-quarter of farmers rely on commercial formulations. Traditional feeding practices remain widespread, particularly in extensive systems.

Trout farming is an important exception because formulated feed is essential for commercial production. However, stakeholders also raised concerns regarding the quality and performance of locally available trout feed.

Shrimp feed is locally available and is generally considered suitable by farmers. As shrimp farming expands, demand for shrimp-specific feed is expected to increase gradually.

These findings suggest that strengthening the feed industry requires simultaneous expansion of commercial aquaculture production and improvement in farm-level profitability. As production systems intensify, demand for reliable, species-specific and cost-effective feed is likely to increase.

6.6 Disease, Water and Production Risks

Disease management remains an important production challenge, particularly as farming systems become more intensive. Farmers reported parasitic, bacterial and fungal problems as well as production losses associated with low dissolved oxygen and poor water quality.

Access to rapid diagnostics, post-mortem services and professional technical advice remains limited in production areas. In the absence of standardized disease-management protocols, farmers may respond through water replacement or chemical treatments without clear diagnosis, potentially increasing production costs and reducing effectiveness.

Water availability and quality also vary considerably by location. In parts of Sindh, interruptions in canal and surface-water supply during summer can affect production. Groundwater may provide an alternative in some areas, but its suitability varies and pumping can increase costs.

Temperature extremes can also affect growth, water quality and disease risk. These conditions are particularly important for trout, which requires relatively cold and well-oxygenated water. Flooding represents an additional production risk in vulnerable areas.

At the same time, suitable underutilized, fallow and waterlogged land in some areas could provide opportunities for aquaculture development where water quality and farm economics are favorable.

6.7 Infrastructure, Markets and Post-Harvest Constraints

Weak market infrastructure limits the returns available to fish farmers and reduces incentives for investment in productivity improvements. Many farmers sell their harvest in nearby wholesale markets because access to refrigerated transport, organized collection systems and processing facilities remains limited.

Field consultations indicated that intermediaries play an important role in connecting farmers with markets, particularly where farmers lack direct access to buyers. Stakeholders estimated intermediary margins at around 6–7 percent, while harvesting-day labor and transport expenses were estimated at approximately 10–12 percent of total production costs in some cases.

Demand is also seasonal, with stronger consumption generally reported during winter months. Farmers may therefore face weaker prices during other periods, particularly where harvesting cannot be postponed because of production or market conditions.

For export-oriented aquaculture, stronger linkages between farms, processors, exporters and international buyers are required. At present, exporters frequently depend on intermediary networks for procurement, limiting direct integration between producers and export markets.

Investment in cold storage, refrigerated transport, collection centers, processing and quality management could improve market efficiency and reduce post-harvest losses while creating opportunities for value-added products.

6.8 Access to Finance and Insurance

Limited access to suitable finance remains a major constraint to aquaculture investment. Financial institutions generally face difficulty in assessing aquaculture-related risks because farm performance varies by species, production system, water availability and management practices.

Farmers also often lack acceptable collateral or prefer to avoid formal borrowing because of financing costs and repayment requirements. Where land-backed financing is available, it may not be accessible to smaller operators.

The transition from extensive to semi-intensive or intensive systems requires investment in ponds, aeration, water-management systems, improved seed, feed, equipment and other inputs. Without appropriate financing, many farmers remain locked into low-investment, low-productivity systems.

Insurance coverage for aquaculture is also limited. Fish farmers can face losses from disease, flooding, water-quality problems, extreme temperatures and mass mortality, yet dedicated insurance products covering fish stocks and production risks remain underdeveloped.

Developing financing and insurance products specifically suited to aquaculture could therefore support investment while reducing the financial risks associated with production expansion.

6.9 Research, Data, Extension and Institutional Capacity

Reliable sector information is essential for investment decisions and policy formulation. However, field consultations highlighted weaknesses in farm-level data on production, yields, farm size, species composition, input use, production costs and market performance. Inconsistent or outdated information makes it difficult to accurately assess productivity and commercial opportunities.

Technical extension is another important gap. Provincial fisheries departments undertake activities such as training, hatchery operations and farmer support, but stakeholders indicated that the scale and frequency of extension services remain below sector requirements. The quality and reach of institutional support also vary across provinces.

The findings suggest that the challenge is not necessarily an absence of institutional activity, but a mandate outcome gap. The effectiveness of public support should therefore be evaluated not only through the number of hatcheries, training programs or activities undertaken, but also through measurable improvements in farmer productivity, survival rates, technology adoption and farm profitability.

Research and innovation can further support sector development through improved genetics, feed formulation, disease diagnostics and species diversification. Selective breeding[35] of commonly farmed species could improve growth performance and shorten production cycles, while research into locally suitable species could expand the sector beyond its current concentration in carp, tilapia and pangasius.

6.10 Cross-Cutting Constraints and Sector Implications

The combined evidence from secondary analysis and field consultations points to four interconnected constraints underlying many of the sector's challenges:

- Low productivity and limited technology adoption, driven by extensive production systems, weak seed quality, limited feed use and inadequate technical capacity.
- Weak value-chain integration, reflected in fragmented input supply, limited processing and cold-chain infrastructure, dependence on intermediaries and weak linkages between farmers and export markets.
- Limited commercial incentives and access to finance, as low and variable farm returns reduce investment capacity while formal financing and insurance remain difficult to access.
- Fragmented institutional and knowledge systems, including weaknesses in farm-level data, research, extension, disease diagnostics and coordination between public institutions and private-sector participants.

These constraints reinforce one another. Low productivity reduces profitability; low profitability limits investment in improved inputs and technology; limited investment restricts productivity growth; and weak market infrastructure further reduces the returns available to farmers. Breaking this cycle requires interventions across the value chain rather than isolated measures focused only on production.

35 The controlled breeding of aquatic animals chosen for desirable characteristics, such as rapid growth, disease resistance or improved feed efficiency, to produce offspring with improved traits.

6.11 Climate Change Challenge

Climate change is emerging as an additional risk to aquaculture production in Pakistan. Increasing variability in temperature, rainfall and the frequency and intensity of extreme weather events can directly affect fish growth, survival and production cycles. Flooding can damage ponds, hatcheries and farm infrastructure, cause fish escape and mortality, and disrupt access to feed, seed and markets. Changes in water temperature can also affect feeding behavior, growth rates, breeding and disease susceptibility, while prolonged heat can reduce dissolved oxygen levels and increase stress on fish. In cold-water systems such as trout farming, rising water temperatures can further restrict suitable production conditions. These risks can increase production losses and operating costs and make farm planning more difficult, particularly for small-scale farmers with limited capacity to absorb unexpected losses.

6.12 Summary of Key Constraints

Constraint Area	Key Issue	Impact on Sector	Priority Intervention
Production & Productivity	Predominance of extensive systems and limited technology adoption	Low yields and farm profitability	Promote commercially viable semi-intensive and improved production models
Seed	Quality and genetic performance remain inconsistent	Slower growth and longer production cycles	Improve broodstock management, hatchery standards and selective breeding
Feed	Low commercial demand, high production costs and farmer price sensitivity	Limited feed-industry development and low productivity	Expand commercial aquaculture and improve feed affordability and quality
Disease	Limited diagnostics and standardized management	Mortality and higher production risk	Strengthen diagnostics, biosecurity and extension services
Water	Seasonal availability, quality variation and energy costs	Production interruptions and higher operating costs	Improve water management and promote location-specific production systems
Markets	Dependence on intermediaries and seasonal demand	Lower and more variable farmer returns	Strengthen market linkages, collection and direct buyer access
Post-Harvest	Limited cold chain, processing and storage	Quality deterioration and restricted value addition	Develop cold storage, refrigerated transport and processing capacity
Finance	Limited access to suitable aquaculture financing	Low investment in farm improvement	Develop tailored lending products and risk-sharing mechanisms
Insurance	Limited coverage of aquaculture production risks	High exposure to production losses	Develop appropriate fish-farm insurance products
Data	Weak farm-level production and market information	Poor investment and policy decisions	Establish a reliable aquaculture data system
Extension	Limited reach of modern technical knowledge	Slow technology adoption	Strengthen practical, field-based extension and demonstration farms
Research	Limited genetic improvement, feed research and diversification	Low productivity and narrow species base	Strengthen applied research and industry–research linkages
Institutional Capacity	Variation in resources and outcomes across provinces	Uneven sector development	Focus institutional support on measurable sector outcomes
Climate & Extreme Weather	Flooding, temperature variability and changing water availability	Fish mortality, disrupted production cycles, infrastructure damage and production losses	Strengthen farm resilience, water management and risk-management systems

The following chapter translates these findings into policy recommendations and an investment roadmap aimed at improving productivity, strengthening value-chain integration and creating conditions for commercially viable aquaculture expansion in Pakistan.

Chapter 7

Investment Opportunities and Future Growth Prospects for Aquaculture in Pakistan



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Investment Opportunities and Future Growth Prospects for Aquaculture in Pakistan

Despite its structural constraints, Pakistan's aquaculture sector presents a compelling investment case. The combination of a large domestic market, underutilized natural resources, a competitive cost structure and positioning relative to major seafood import markets creates conditions for rapid and profitable sector expansion. This chapter identifies and evaluates the most significant investment opportunities across the sector's value chain.

7.1 Demand Drivers and Future Market Growth

Pakistan's aquaculture sector benefits from long-term demand fundamentals. With a population exceeding 242 million and growing at approximately 2.55 percent annually, Pakistan represents one of the largest potential seafood markets in the region. Rising urbanization, increasing household incomes, changing dietary preferences, and growing awareness of the nutritional benefits of fish consumption are expected to drive sustained demand growth over the coming decades.

Despite these favorable trends, Pakistan's low per-capita fish consumption indicates substantial untapped domestic market potential. Even modest increases in per-capita fish consumption would generate significant additional demand for aquaculture products, creating opportunities for investment in fish production, processing, cold-chain infrastructure, and distribution networks. Consequently, domestic market growth represents an important complement to export-oriented aquaculture development and provides a strong foundation for long-term sector expansion.

7.2 Export Market Opportunities

Pakistan is a well-established exporter to only 3 of the world's top 10 seafood-importing markets, underscoring substantial untapped export potential in the remaining high-value destinations.

Table 7-1: Global Fishery Import Market (Top Importers)[36]

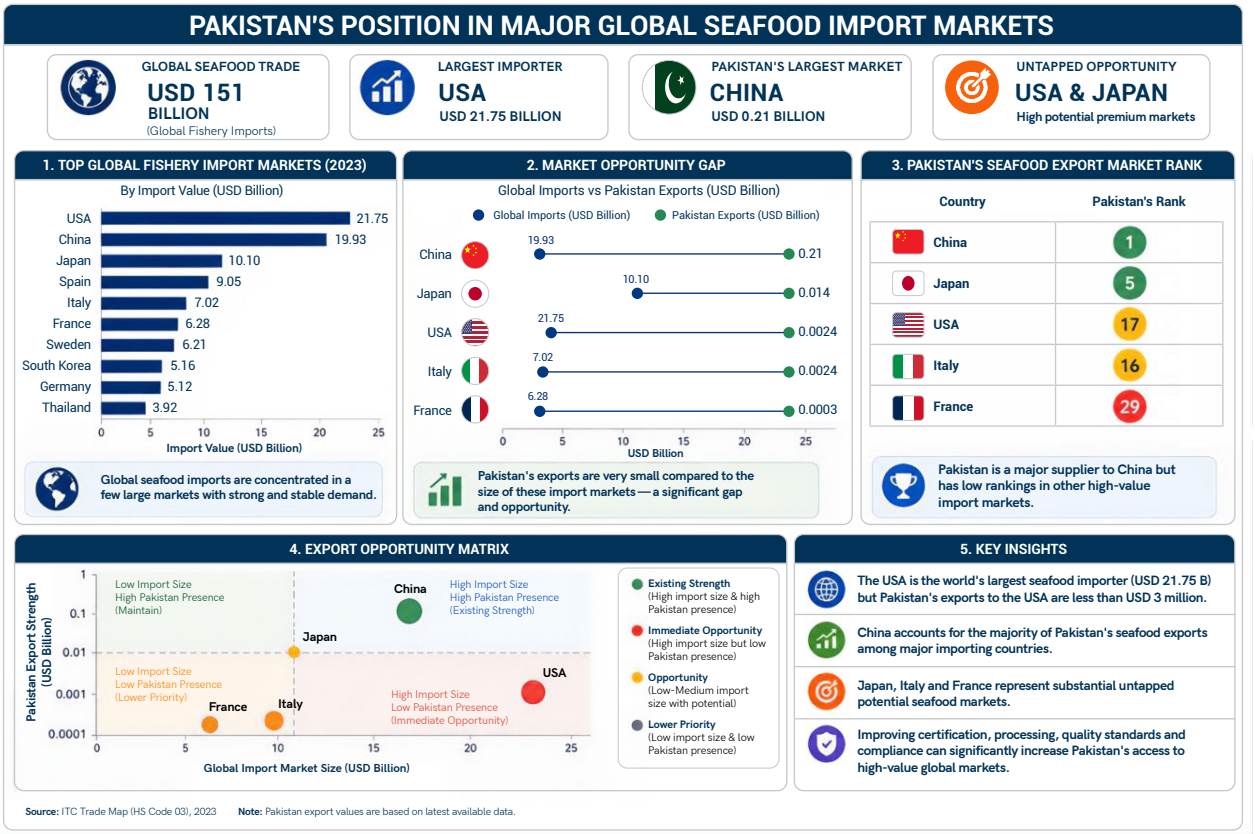
Rank	Country	Fishery Imports ($ Billion)	Share of Global Imports (%)	Key Insight
1	USA	21.75	14.40	Largest global importer
2	China	19.93	13.15	High demand + re-export hub
3	Japan	10.10	6.60	Premium seafood market
4	Spain	8.7	5.76	Major EU seafood hub
5	Italy	7.02	4.64	High per-capita consumption
6	France	6.31	4.17	Stable premium demand
7	Sweden	6.15	4.07	Nordic seafood consumption
8	South Korea	5.16	3.40	Strong domestic demand
9	Germany	5.12	3.38	Large EU import market
10	Thailand	3.92	2.58	Regional processing hub

36 https://legacy.trademap.org/Country_SelProduct_TS.aspx?nvpm=1%7c%7c%7c%7c%7c03%7c%7c%7c2%7c1%7c1%7c1%7c2%7c1%7c2%7c1%7c1%7c1

Table 7-2 Pakistan Fishery Export Performance Across Top Importing Countries[37]

Country	Pakistan Exports (US$ Million)	Share in Pakistan Fishery Exports (%)	Pakistan's Seafood Export Market Rank
China	218	High	1st
Japan	14.7	Low	5th
USA	2.4	Very low	17th
Italy	2.4	Very low	16th
France	0.3	Extremely low	29th

Figure 7-1 Pakistan's Position in Major Global Seafood Import Markets



These tables point to a clear prioritization logic. China is already Pakistan's anchor market and the relationship should be deepened and formalized particularly by using the CPEC framework to pursue preferential tariff treatment.

The GCC offers the closest thing to a quick win: proximity and an existing, if underpriced, market presence mean that quality and presentation upgrades alone could lift returns without new market entry.

The EU, by contrast, is a medium-term play that requires prior investment in certified processing capacity before it becomes accessible at all; it is included here not because it is easy, but because it is the single largest prize among Pakistan's realistic options.

The three profiles below set out the rationale, access conditions and near-term actions for each market.

37 https://legacy.trademap.org/Country_SelProductCountry_TS.aspx?nvpm=1%7c586%7c%7c%7c%7c03%7c%7c%7c2%7c1%7c1%7c2%7c2%7c1%7c2%7c1%7c1%7c1

7.2.1 China: Priority Export Market

China is the world's largest seafood importer and Pakistan's most significant trading partner. China's growing middle class, with increasing seafood consumption preference and a structural deficit in domestic supply, creates a large and expanding market for Pakistani products.

Pakistan has a geographic and logistics advantage over competing suppliers in South America and Europe. The CPEC framework provides an opportunity to negotiate preferential tariff treatment for Pakistani seafood exports to China, which currently face tariffs of 5-15 percent.

7.2.2 Gulf Cooperation Council (GCC): Priority Export Market

The UAE, Saudi Arabia, Qatar and Kuwait collectively import substantial volumes of frozen and fresh seafood, with demand growing alongside a rapidly expanding expatriate population and tourism sectors. Pakistan's geographic proximity to the Gulf markets — 2–3 days by sea freight compared with 10–20 days for Asian competitors — provides a material logistics cost advantage. Pakistani seafood is already present in Gulf markets but commands lower prices due to quality and presentation deficiencies.

7.2.3 European Union: Priority Export Market

The European Union represents one of the world's largest and highest-value seafood import markets. Pakistan currently has very limited access to premium EU seafood markets due to certification, traceability, processing, and regulatory compliance constraints. However, achieving EU market access through HACCP-compliant processing facilities, residue monitoring systems, and internationally recognized quality assurance mechanisms would significantly increase export earnings while strengthening Pakistan's credibility and competitiveness across other international markets.

Figure 7-2 Export Market Opportunity for Pakistani Seafood

Market	Current Access	Market Size (USD)	Pakistan's Cost Advantage	Certification Required	Priority
China	Moderate	USD 12B+ imports (0, 5, 10, 15 USD Billion)	High	GACC registration	IMMEDIATE
GCC / UAE (UAE, Saudi Arabia, Qatar, Kuwait)	Moderate	USD 3B+ imports (0, 2, 4, 6 USD Billion)	Very High (proximity)	Halal + basic HACCP	IMMEDIATE
Japan / S. Korea	Limited	USD 4B+ imports (0, 2, 4, 6, 8 USD Billion)	Medium	HACCP + traceability	SHORT-TERM
European Union	Very Limited	USD 25B+ imports (0, 10, 20, 30 USD Billion)	High	EU Approved establishment	MEDIUM-TERM
United States	Minimal	USD 22B+ imports (0, 10, 20, 30 USD Billion)	High	USFDA SIMP + HACCP	MEDIUM-TERM

Pakistan has strong cost and logistics advantages in key markets.
Upgrading certifications and compliance will unlock higher-value export opportunities.

7.3 Investment Opportunities Across Aquaculture Segments

Not all investment opportunities offer the same strategic value. Some investments generate direct commercial returns through production and exports, while others act as enabling investments that remove critical bottlenecks within the value chain. The opportunities identified below are prioritized according to their commercial viability, contribution to sector growth, export potential, and ability to strengthen Pakistan's overall aquaculture competitiveness.

Based on the demand, export, and competitiveness analysis presented above, several investment opportunities emerge as particularly attractive due to their profitability, scalability, and strategic importance for sector development.

Figure 7-3 Potential Investment Areas in Pakistan's Seafood & Aquaculture Sector

Investment Area	Estimated Investment Required	Return Potential	Strategic Importance
Inland Shrimp Farming (vannamei)	USD 10,000–25,000/ha	Net profit: USD 15,000–40,000/ha/year	Transformation
Vannamei Hatchery (domestic)	USD 2–5 million (commercial scale)	High — strong import substitution potential & monopoly position initially	Critical enabler
Aquafeed Manufacturing	USD 3–8 million (certified plant)	High — import substitution	Critical enabler
Cold Chain Infrastructure	USD 5–15 million (regional hub)	Medium (enables value addition and reduces post-harvest losses)	Essential
Certified Processing Plants	USD 3–10 million (EU-grade)	High (improves access to premium export markets)	Essential
Tilapia Export Farming	USD 5,000–12,000/ha	Medium-High	Near-term opportunity
Trout Farming (KPK)	USD 3,000–8,000/ha	Medium (premium domestic and tourism markets)	Niche
Aquaculture Health & Diagnostic Services	USD 0.5–2 million	Medium-High (growing demand for aquatic animal health services)	Disease prevention and productivity enhancement

Strategic investments in these areas will strengthen the aquaculture value chain, enhance exports, create jobs, and drive sustainable growth.

7.4 Opportunities for Technology Adoption in Aquaculture

Several of the technologies referenced earlier in this report warrant deliberate, sector-wide adoption strategies rather than the ad hoc uptake seen to date. Biofloc technology and recirculating aquaculture systems (RAS), both discussed in Chapter 3, offer the clearest path to raising yields per unit of water and land without new land conversion, and are best suited to peri-urban sites close to major consumption markets.

Certified domestic hatchery and broodstock development — particularly for vannamei shrimp and Nile tilapia — would directly address the seed-import dependency identified as a critical constraint identified in Chapter 6, and is a natural candidate for public-private co-investment given its public-good characteristics.

Digital trade and traceability platforms, already emerging in wholesale trading (Chapter 3.5), could be extended into export documentation and cold-chain monitoring, directly supporting the certification upgrades required for EU and US market access discussed in Chapter 7.2. None of these technologies requires unproven innovation; each has already been demonstrated at commercial scale elsewhere in Asia.

7.5 Role of the Private Sector in Aquaculture Development

Sustainable expansion of Pakistan's aquaculture sector will depend primarily on private-sector investment, entrepreneurship, and value-chain development, supported by an enabling policy and regulatory environment. The role of government should focus on establishing policy certainty, strengthening certification systems, improving infrastructure, facilitating research and extension services, and expanding access to finance, while private investors provide capital, operational expertise, innovation, and market linkages.

Several categories of private sector actors are particularly well-positioned to drive sector growth. Large agribusiness conglomerates with existing rural supply chain infrastructure, feed companies, cold chain operators and agriculture input distributors can leverage existing assets and relationships to enter aquaculture rapidly.

7.6 Strategic Outlook for Aquaculture Sector Expansion

Pakistan's aquaculture sector presents significant opportunities for investment across production, processing, input supply, logistics, and export-oriented value chains. The analysis identifies inland shrimp farming, hatchery development, aquafeed formulation, cold-chain infrastructure, certified seafood processing facilities, and technology-driven production systems as the most attractive investment areas.

The sector's future growth will be supported by rising domestic demand, favorable demographic trends, expanding export opportunities, and increasing interest from private investors. However, realizing this potential will require coordinated action to address key constraints related to seed availability, feed quality, disease management, certification, processing capacity, and market access.

Chapter 8

Policy Recommendations for Aquaculture Development in Pakistan



Chapter 8

Policy Recommendations for Aquaculture Development in Pakistan

Pakistan's aquaculture sector has substantial potential for expansion, but unlocking this potential requires coordinated action across production, inputs, finance, infrastructure, markets and institutional support. The field findings presented in Chapter 6 provide the basis for the following recommendations, which focus on improving productivity, strengthening value-chain integration, mobilizing private investment and building export competitiveness.

The recommendations below are prioritized according to their potential contribution to productivity, investment, value-chain development and export competitiveness.

8.1 Establish a Coordinated National Aquaculture Development Framework

Pakistan requires a common national direction for aquaculture development while retaining provincial responsibility for implementation. A national aquaculture development framework should establish common objectives, production and quality standards, investment priorities, data requirements and coordination mechanisms.

The framework should cover inland fish farming, trout, shrimp, hatchery development, aquafeed, processing and export development. It should also provide a mechanism for coordination between federal and provincial institutions and greater consistency in standards and investment facilitation.

The objective should not be to centralize provincial fisheries administration, but to provide a consistent policy environment within which provinces can pursue their respective comparative advantages and private investors can operate with greater policy certainty.

Priority: Critical | Time horizon: Short term

8.2 Upgrade Seed Quality Through Broodstock and Hatchery Reform

Field findings indicate that the principal seed constraint is increasingly quality rather than aggregate availability. Common carp seed is generally available, but high-quality seed remains less accessible, while genetic selection and broodstock management require improvement.

A national seed-quality programs should therefore focus on:

- establishing and maintaining genetically improved broodstock;
- developing certification and quality standards for hatcheries;
- improving monitoring of hatchery performance and seed quality;
- expanding availability of improved seed for common carp, tilapia, pangasius and other commercially viable species; and
- strengthening domestic hatchery capacity for high-value species, particularly vannamei shrimp.

The objective should be to move from a system focused on quantity of seed supplied towards one focused on quality, genetic performance and consistency.

Priority: Critical | Time horizon: Short term

8.3 Establish an Export Competitiveness and Certification Program

Export development should focus first on market readiness and compliance, followed by broader market expansion. Pakistan's ability to compete in international markets will depend on consistent product quality, food safety, traceability, processing standards and compliance with destination-market requirements.

The program should support:

- internationally recognized food-safety and aquaculture standards;
- stronger laboratory testing capacity;
- farm and product traceability systems;
- certification support for eligible farms and processing facilities;
- assistance in meeting destination-market requirements;
- export-oriented processing facilities; and
- targeted trade promotion and buyer linkages.

Established markets in China and the GCC can be developed alongside longer-term efforts to strengthen access to more demanding markets in the EU, US, Japan and South Korea.

For shrimp and other high-value products, certification, biosecurity and traceability will be particularly important for establishing reliable export channels.

Priority: Critical | Time horizon: Short to medium term

8.4 Strengthen Farmer Extension and Technology Adoption

Extension services should move towards a demonstration-based and commercially oriented model. Many farmers possess strong practical knowledge of traditional production systems but have limited exposure to modern water-quality management, improved feeding, stocking practices, aeration and semi-intensive production.

Demonstration farms should be established in major aquaculture clusters to allow farmers to compare traditional and improved production systems under local conditions. Demonstrations should provide evidence on yields, production cycles, input requirements and profitability.

Extension programs should focus on:

- improved stocking and feeding practices;
- water-quality and oxygen management;
- disease prevention and biosecurity;
- improved seed selection;
- farm financial management;
- harvesting and post-harvest handling; and
- economically appropriate semi-intensive technologies.

Technology should be promoted according to farm economics rather than as an objective in itself. Biofloc, RAS and other intensive systems may be suitable for selected business models, but their adoption should consider capital requirements, energy costs, technical expertise and management complexity.

Priority: High | Time horizon: Short term

8.5 Develop Aquaculture Finance, Insurance and Risk-Sharing Mechanisms

Appropriately structured finance is required to support farm expansion, technology adoption and investment across the aquaculture value chain. Financing products should reflect the production cycles and cash-flow characteristics of aquaculture rather than applying conventional agricultural lending structures without adaptation.

Potential instruments include:

- seasonal working-capital facilities;
- medium-term loans for pond and farm infrastructure;
- financing for aeration, water-management and other production equipment;
- financing for hatchery and aquafeed investments;
- credit guarantees or risk-sharing mechanisms for eligible borrowers; and
- dedicated financing windows for small and medium-sized aquaculture enterprises.

Insurance should develop alongside credit. Dedicated products covering fish stocks and major production risks could reduce farmer exposure and improve lender confidence. Disease, flooding, water-quality problems and mass mortality should be considered within appropriate aquaculture risk-management products.

Priority: High | Time horizon: Medium term

8.6 Build Cold-Chain, Processing and Domestic Market Infrastructure

Higher farm productivity will generate limited additional value if fish cannot be efficiently transported, processed, stored and marketed. Investment should therefore focus on aquaculture clusters with sufficient production volumes to support commercially viable infrastructure.

Priority investments include:

- regional cold-storage facilities;
- refrigerated transport;
- modern landing and handling facilities;
- processing and value-addition units;
- grading, sorting and packaging infrastructure; and
- stronger linkages between producers, wholesalers, retailers and processors.

The objective should be to reduce dependence on a predominantly farm-to-wholesale model and develop more efficient domestic value chains capable of supplying organised retail, food-service and processing markets.

Priority: High | Time horizon: Medium term

8.7 Develop Aquaculture Around Provincial Comparative Advantages

A uniform national production model is unlikely to be appropriate given substantial differences in resources, production systems, market conditions and technical capacity across provinces.

Punjab should remain a major center for commercial freshwater aquaculture, improved seed, feed manufacturing, technology adoption and inland shrimp development. Its larger production base and relatively greater presence of progressive farms provide a foundation for commercial expansion.

Sindh should focus on improving productivity in existing extensive systems while developing opportunities in marine aquaculture and higher-value species. Water availability and reliability should be integrated into production planning.

Khyber Pakhtunkhwa should focus on trout and other cold-water aquaculture alongside commercially viable warm-water production. Its demand-supply gap and trout's linkages with tourism provide a basis for targeted development.

A cluster-based approach should be used to concentrate public and private investment where production, infrastructure, skills, input supply and market linkages can reinforce one another.

Priority: High | Time horizon: Short to medium term

8.8 Strengthen Aquaculture Data and Sector Monitoring

Reliable sector information is essential for effective policy formulation and investment decisions. A national aquaculture information system should progressively establish a reliable database covering:

- registered farms and farm area;
- production by species and production system;
- seed sources and hatchery capacity;
- feed use and production;
- farm-level yields and production costs;
- disease incidence;
- domestic prices and market flows;
- processing and cold-chain capacity; and
- export volumes and destinations.

Digital farmer registration should be linked with provincial fisheries departments and periodically updated. Improved data would allow policymakers and investors to distinguish between resource potential, installed capacity and actual productive performance.

The system should also support regular monitoring of productivity, technology adoption, farm profitability and sector investment

Priority: High | Time horizon: Short to medium Term

8.9 Promote Year-Round Fish Consumption and Consumer Awareness

Sustained growth in domestic aquaculture requires a growing domestic market. Per-capita fish consumption in Pakistan is approximately 1.35 kg per year, well below the global average of 19.93 kg, and has declined in recent years while poultry consumption has increased. Field consultations also indicate that demand is concentrated in the winter months, leaving farmers with weaker prices outside this period.

A national consumer awareness and consumption promotion program should therefore be developed in coordination with health, nutrition, food-safety and fisheries authorities. The program should focus on:

- communicating the nutritional and health benefits of fish, including its role as an affordable source of high-quality protein and omega-3 fatty acids;
- promoting year-round consumption, including through seasonal promotions, product forms and pricing that reduce dependence on winter demand;
- addressing consumer concerns and misconceptions regarding seasonal suitability, freshness, hygiene and food safety, based on evidence from consumer surveys;
- promoting safe handling, storage and preparation practices, and developing easy-to-cook and value-added fish products suited to urban and rural households;
- integrating fish into public nutrition, school-feeding and health-education programs where feasible; and
- supporting branding, labelling and freshness standards so that consumer messaging is backed by verifiable quality.

Awareness measures should be sequenced with the cold-chain, quality and market infrastructure investments described in Section 8.7, so that increased demand can be met with safe, fresh and reasonably priced products. Success should be measured through changes in per-capita consumption, off-season sales volumes, farm-gate price stability and consumer perceptions.

Priority: High | Time horizon: Short to medium term

8.10 Ensure Sustainable Water and Resource Management

Water availability and quality should be incorporated into aquaculture investment and production planning, particularly in regions where seasonal shortages, groundwater dependence or water-quality variation constrain production.

Water-management priorities should include:

- monitoring of groundwater extraction;
- assessment of water quality before farm development;
- efficient pond-water management and recycling;
- improved drainage in suitable aquaculture areas;
- site-specific planning for water-intensive production; and
- greater use of water-efficient systems where economically viable.

For inland shrimp, long-term management of saline groundwater is particularly important because the resource provides a production opportunity but may also become a constraint if extraction is not appropriately managed.

Climate-related risks should also be incorporated into farm planning. Flooding, extreme temperatures and changing rainfall patterns can damage ponds and infrastructure, cause fish escape or mortality and disrupt production cycles.

Strengthening drainage, farm design, emergency response and risk-management mechanisms can reduce exposure to these losses.

Priority: Medium to High | Time horizon: Medium to long term

8.11 Develop a Competitive Domestic Aquafeed Industry

Policy should support the development of a competitive aquafeed industry capable of supplying species-specific, reliable and affordable formulations. The focus should be on addressing both supply-side costs and the underlying weakness of commercial feed demand.

Key measures should include:

- establishing clear feed-quality and labelling standards;
- strengthening quality-control and laboratory testing capacity;
- increasing availability of species-specific feeds;
- supporting research into locally available and cost-effective feed ingredients;
- facilitating investment in commercial aquafeed manufacturing; and
- improving farmer knowledge of feed management, stocking density and feed efficiency.

Given the predominantly extensive nature of fish farming, expanding commercial feed demand will also require improvements in farm productivity and profitability. Reducing production and energy costs within the feed industry and developing reliable farmer payment and credit arrangements can further support market development.

For shrimp and other high-value species, stronger domestic feed capacity could also reduce dependence on imported feed and improve input security.

Priority: Medium | Time horizon: Medium term

8.12 Establish a National Aquatic Animal Health and Diagnostic System

As Pakistan moves towards more intensive production systems, stronger disease prevention and diagnostic capacity will become increasingly important. A national aquatic animal health system should establish the institutional and technical capacity required to identify, monitor and manage aquatic diseases.

The system should include:

- regional aquatic disease diagnostic laboratories;
- rapid-response diagnostic services;
- standardized disease reporting and surveillance;
- fish post-mortem facilities;
- farmer training in biosecurity and disease prevention;
- standard operating procedures for major production systems; and
- stronger biosecurity requirements for hatcheries, farms and movement of aquatic animals.

Particular attention should be given to shrimp, tilapia, trout and other systems where disease or environmental stress can result in substantial production losses.

Priority: Medium | Time horizon: Medium term

8.13 Policy Implementation Framework

The recommendations should be implemented through a phased approach, with early measures establishing the institutional and technical foundations for subsequent private-sector investment.

Priority Area	Short Term	Medium Term
National coordination	Harmonized standards	Periodic sector review
Seed quality	Improved-strain multiplication	Expanded species diversification
Export	Priority-market development	Market diversification
Extension & technology	Cluster-based extension	Digital extension network
Finance & insurance	Credit/risk-sharing products	Aquaculture insurance market
Cold chain & markets	Regional facilities	Integrated market network
Processing	Certified plants	Value-added export products
Data	Production database	Integrated digital information system
Consumer awareness	National and provincial awareness campaigns; quality-linked branding	Integration into nutrition and school programs; periodic impact review
Water & Climate Resilience	Improved drainage, farm protection and water-efficiency measures	Integrated water-resource management and climate-resilient aquaculture infrastructure
Aquafeed	Domestic manufacturing capacity	R&D in alternative ingredients
Disease management	Surveillance and biosecurity	Integrated aquatic health system

Implementation should be coordinated around major aquaculture clusters rather than through isolated programs. This would allow infrastructure, extension, finance, input supply and market development to be introduced together and evaluated against measurable outcomes.

8.14 Overall Policy Direction

The central policy objective should be to raise productivity and commercial viability before pursuing production at scale. Pakistan's regional competitors demonstrate that competitive aquaculture industries develop through the interaction of improved seed, reliable feed, appropriate technology, extension, disease management, processing, certification, finance and market access.

Pakistan can draw on complementary lessons from regional experience: Bangladesh's smallholder production and extension systems, India's experience in technology adoption and shrimp development, and Vietnam's integration of production, processing and export markets.

The policy agenda should therefore create an environment in which farm-level productivity, private investment and value-chain integration reinforce one another. Government's principal role should be to provide policy certainty, standards, public infrastructure, research, extension and appropriate risk-sharing mechanisms, while private-sector investment should drive production, input supply, processing, logistics, technology adoption and market development.

The success of the policy agenda should ultimately be measured not by the number of programs introduced, but by improvements in farm productivity, farmer profitability, investment, technology adoption, value addition and export performance.

List of Interviewees

S.No	Name	Designation
1	**Dr Ghulam Abbas**	Assistant Professor, Karachi University
2	**Dr Naveed**	Assistant Professor, Head of Aquatic Diagnostic & Research Center, Bahria University
3	**Dr. Khalid Abbas**	Chairman Department of Zoology, Wildlife and Fisheries, University of Agriculture Faisalabad
4	**Dr Muhammad Akmal Rana**	Lecturer, University of Veterinary & Animal Sciences (UVAS)
5	**Zubair Ali**	DG Fisheries, KP
6	**Dr Anser Chatta**	Director of Research & Training, Punjab
7	**Junaid Watto**	CEO - Fisheries Development Board
8	**Dr Abdul Malik**	Deputy Director Fisheries, Sindh
9	**Sajjad Khan**	Deputy Director, KP
10	**Wajahat Ameer**	Deputy Director Fisheries, Punjab
11	**Dr Jasim Shah**	Assistant Director, KP
12	**Naveed Ali Jokhio**	District Field Manager, Sindh
13	**Dr Kanwar Iqbal Jawed**	Senior Policy Specialist - FAO
14	**M Faisal Iftikhar Ali**	CEO, Aqua Hatch International
15	**Muhammad Kamran**	CEO- Aquatech Fisheries
16	**Nabeel Chaudhry**	CEO, AMG Thai Union Feed mill
17	**Asad Fawad**	CEO, Dhabeji Aqua Foods
18	**Dr Saqib Aziz**	GM, Supreme Feed
19	**Naeem**	Manager, Sind Feed
20	**Faqir Nazim Lark**	Fish Wholesaler
21	**Iqbal Ahmed Bhagio**	Farmer + Middlemen
22	**Ghulam Mustafa**	Farmer + Middlemen
23	**Syed Daim Shah**	Farmer
24	**Najam Soomro**	Farmer
25	**Malik Zaman Khan**	Farmer
26	**Yasin**	Farmer
27	**Muhammad Rashid**	Farmer
28	**Usman Ali**	Farmer
29	**Abdul Hasseb**	Farmer
30	**Ali Aman Tarar**	Farmer
31	**Inam Ullah**	Farmer
32	**Nasurallah Khalil**	Farmer
33	**Shahzaib Abdul Waheed**	Farmer
34	**Hajan Ali**	Farmer

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