Annual Study of the Status of

Aquaculture in Indonesia

with special reference to *Pangasius hypophthalmus*

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Preface

Global food systems increasingly recognize aquaculture as a key solution to pressing challenges of protein security, rural livelihood enhancement, and climate-resilient farming. The Food and Agriculture Organization (FAO) projects that by 2030, aquaculture will supply 60-65% of global fish production, making it not just an economic sector but a cornerstone of future nutrition.

In 2023, global aquaculture-including aquatic plants-produced 134 million tonnes, valued at over USD 295 billion. Asia remains the dominant hub, accounting for nearly 90% of total production, with China alone contributing more than 60 million tonnes. Other major producers include India, Indonesia, Vietnam, Bangladesh and Egypt. By contrast, developed nations show relatively modest growth due to regulatory, environmental, and economic constraints. While countries such as Norway and Chile continue to lead in high-value salmon production, the momentum clearly lies with developing countries, which are driving global expansion, creating employment, generating foreign exchange and ensuring affordable access to fish.

Yet, the sector faces persistent challenges. Disease outbreaks such as Early Mortality Syndrome (EMS) and White Spot Syndrome Virus (WSSV) threaten farm sustainability. Trade barriers, includingnew U.S. shrimp import tariffs, directly impact farmer incomes. Environmental pressures-water-useconflicts, salinity intrusion and climate risks-demand urgent adaptation. Furthermore, policy gaps in farmer insurance, access to credit and organized value chains remain unresolved.

One of the most important global shifts is the rise of traceability systems. International buyers now demand transparent, digital records of seed origin, feed quality, antibiotic usage and harvest practices. Alongside, growing health consciousness worldwide highlights fish as a functional food-rich in omega-3 fatty acids, vitamins (D, B12) and essential minerals like iodine and selenium. Unlike red meat, fish provides lean protein with lower cholesterol, making it an essential component of healthy diets. Public awareness campaigns, school meal programs and hospital diets can further enhance domestic consumption.

Looking ahead, species diversification is crucial for sustainable growth. Seabass and grouper offerexport opportunities; tilapia ensures affordable protein; pangasius (basa) stands out as a versatile white fish for fillets; mud crab and ornamental fish cater to niche markets; while seaweed and bivalves provide climate-smart, low-footprint options. Among these, pangasius has immense untapped potential, with fast growth, adaptability, and global consumer appeal for boneless fillets-making it a promising species for the next phase of aquaculture diversification.

Aquaculture is no longer a supplementary activity-it is now a central pillar of the global food system. With their natural resources and expertise, developing countries are well-positioned to shape its future.

In this context, I sincerely appreciate Prof. (Dr.) Dinesh Kaippilly, Registrar of the Kerala University of Fisheries and Ocean Studies (KUFOS)-India's first public-funded fisheries university-for compiling this compendium in association with Mr. Dilip Sathyanathan, President of the Shrimp Farmers' Association in Indonesia and a distinguished alumnus of KUFOS. Their effort provides valuable insights into the current aquaculture scenario in Indonesia, with special reference to pangasius culture and management.

I am confident this compendium will serve as a valuable reference for students, farmers, researchers, and stakeholders, keeping them informed of recent developments and guiding them towards sustainable practices in aquaculture.

Prof. (Dr.) A. Bijukumar
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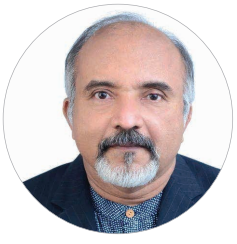

Foreword

At a time when the world is striving to secure affordable and accessible sources of animal protein, Pangasius stands out as a species of great promise and social relevance. Its remarkable growth performance, adaptability to diverse farming environments and high consumer acceptability position it as a key species for strengthening the nutritional landscape of many developing countries. Across many rural regions around continents, freshwater aquaculture has transformed livelihoods, enhanced dietary diversity and supported local economies. Pangasius, with its efficient feed conversion and suitability for smallholder farm ponds, has opened pathways for income generation, women-led aquaculture enterprises, youth engagement and village-based micro-business models. As we look ahead, empowering rural communities with knowledge, technology and market connect in freshwater fish farming will be crucial in ensuring inclusive growth and sustainable food systems.

Indonesia presents an inspiring example in this regard. Over the last two decades, the country has built a robust Pangasius value chain through scientific broodstock management, hatchery expansion, farmer extension, cooperative-based production and targeted marketing strategies. Their success in branding Pangasius as a safe, versatile and affordable fish for domestic consumption as well as export markets offers valuable learnings for many neighboring countries including India. Access to processed, chilled and value-added Pangasius products in Indonesian markets has demonstrated how a humble freshwater fish can evolve into a nationally significant commodity supporting food security and rural prosperity.

This work, therefore, comes at an important juncture. It highlights a species of tremendous potential; a farming model suited for villages and an opportunity to learn from global success. We took sincere efforts to compile this knowledge and disseminate it for the benefit of farmers, students, entrepreneurs and policy makers. We are confident that this publication will contribute meaningfully to the growing freshwater aquaculture movement of many Asian and African countries and inspire many to invest in sustainable, science-based Pangasius farming.

Prof. (Dr.) Dinesh Kaippilly

Mr. Dilip Sathyanathan

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Introduction

Feeding the Future: Blue Economy the Pillar of Protein Security

The importance of the Blue Economy in addressing current global food security challenges has become increasingly evident in recent years. As the world population continues to rise, projected to reach nearly 10 billion by 2050, the demand for food-particularly protein-rich and nutrient-dense sources-has escalated sharply. Conventional land-based agriculture, while still essential, is increasingly under pressure from climate change, land degradation, freshwater scarcity and biodiversity loss. In this context, the Blue Economy emerges as a critical and sustainable alternative, offering a broad spectrum of opportunities to enhance food security, improve nutrition and promote livelihoods across the globe keeping the doors open to employability.

The Blue Economy encompasses the sustainable use of ocean resources for economic growth, improved livelihoods and ocean ecosystem health. Within this framework, fisheries, aquaculture, marine biotechnology and ocean-based food systems form the most essential pillars. One of the most direct contributions of the Blue Economy to food security is its capacity to provide high-quality, affordable protein. Today, more than 3.3 billion people obtain at least 20% of their animal protein from fish and seafood. This makes the ocean an indispensable food source, especially for coastal and island communities where terrestrial farming options are limited.

Aquaculture, the farming of aquatic organisms such as fish, shellfish and seaweed, has emerged as the fastest-growing food production sector globally. It now accounts for more than 50% of the world's seafood consumption. With further innovation and investment, aquaculture or fish farming offers a scalable solution to meet growing global demand. Unlike terrestrial livestock, many aquatic species convert feed to protein more efficiently, require less land and freshwater and produce fewer greenhouse gas emissions. For instance, species such as tilapia, Pangasius, shrimp and bivalves like mussels and oysters have become cornerstone commodities in the global food system.

The resilience of ocean-based food systems in the face of climate change is another compelling advantage. Aquatic ecosystems are naturally dynamic and, when properly managed, can buffer against the impacts of extreme weather events. Water based horticulture, for example, not only produces nutrient-rich food but also sequesters carbon, absorbs excess nutrients and improves water quality. Integrated Multi-Trophic Aquaculture (IMTA) systems, which combine species such as fish, shellfish and plant species in a symbiotic arrangement, exemplify how ecological balance can be maintained while maximizing productivity.

Furthermore, the Blue Economy contributes to food security by alleviating the environmental burdens of terrestrial agriculture. Expanding aquaculture and similar modes of farming in aquatic environments reduces the strain on arable land, which is increasingly threatened by urbanization, soil erosion and climate-induced drought. By shifting part of the food production burden from land to water, the Blue Economy helps maintain biodiversity, preserves ecosystem services and ensures more efficient use of global resources.

From a socio-economic perspective, the Blue Economy is a cornerstone of livelihoods for millions of people worldwide. Fisheries and aquaculture provide direct employment to over 60 million people and support the livelihoods of around 800 million individuals when downstream and ancillary industries are included. In developing countries, small-scale fisheries are particularly crucial, not just as a source of food but also as a foundation for local economies and community resilience. Empowering women, youth, and indigenous communities within these systems fosters inclusive development and ensures that food security gains are equitably shared.

Technological innovation and scientific research have further expanded the scope and potential of the Blue Economy. Advances in Recirculating Aquaculture Systems (RAS), offshore aquaculture platforms and genetic improvement of aquatic species have enhanced productivity while reducing environmental impacts. Digital traceability tools, smart sensors and AI-based monitoring systems are enabling better management of fish stocks, disease control and food safety, thus bolstering consumer confidence and market access.

The Blue Economy also introduces new dimensions to the global food basket through marine biotechnology. Aquatic bioresources are being explored for their potential in developing functional foods, pharmaceuticals and nutraceuticals that contribute to human health and nutrition. Also, the seafood, rich in vitamins, minerals and antioxidants, are gaining popularity as superfoods, especially in the context of sustainable diets and climate-smart nutrition.

A vital but often underrecognized aspect of the Blue Economy's role in food security is its alignment with international policy frameworks, notably the United Nations Sustainable Development Goals (SDGs). The sector directly supports SDG 2 (Zero Hunger), SDG 14 (Life Below Water) and SDG 13 (Climate Action), among others. It provides a strategic avenue to promote food access, ecosystem health, economic equity and environmental sustainability simultaneously. Countries that invest in marine food systems are better positioned to meet their food security commitments while safeguarding marine biodiversity.

Consumer education and market transformation play critical roles in reinforcing the connection between the Blue Economy and food security. Raising awareness about the benefits of sustainable seafood, promoting certifications and encouraging responsible consumption patterns can drive demand for sustainably harvested or farmed marine products. Public and private sector collaboration, along with multilateral support, is necessary to build robust and transparent supply chains that deliver safe, nutritious, and traceable food from ocean to plate.

In recent years, global crises such as the COVID-19 pandemic, conflicts, and inflationary pressures have exposed the vulnerabilities of land-based food systems. In contrast, many marine food systems have demonstrated greater resilience due to their decentralized nature and proximity to local communities. This underscores the importance of diversifying food sources and investing in local blue food systems as a strategic hedge against future disruptions.

Education, research, and capacity-building are foundational to sustaining the Blue Economy's role in global food security. Academic institutions, like Kerala University of Fisheries and Ocean Studies (KUFOS), play a pivotal role in training the next generation of blue economy leaders, conducting research on sustainable aquaculture practices, and supporting evidence-based policymaking. Collaborations between universities, government agencies, NGOs and industry stakeholders can accelerate the adoption of innovative technologies and sustainable practices.

Securing Protein Through Inland Waters: The Role of Freshwater Aquaculture

Global freshwater aquaculture plays a critical and growing role in addressing food security in both developing and developed countries. As the world faces a convergence of challenges including population growth, land scarcity, climate change, and pressure on terrestrial food systems, freshwater aquaculture offers a resilient, scalable, and nutrient-rich solution to meet the rising demand for protein and micronutrients.

Freshwater aquaculture refers to the farming of aquatic species such as fish, crustaceans, and aquatic plants in inland water systems like ponds, tanks, lakes, reservoirs, and rivers. The sector has seen tremendous growth over the past few decades, with freshwater aquaculture now contributing more than 50% of total global aquaculture production. According to the FAO's State of World Fisheries and Aquaculture (SOFIA) 2024 report, aquaculture produced over 130 million metric tons in 2022, with approximately 50 million metric tons coming from freshwater sources. This represents not only a dramatic increase in volume but also a shift toward sustainable and localized food systems.

Freshwater fish species are typically easier to farm than marine species due to their lower salinity requirements, adaptability to artificial environments, and reduced input costs. Major freshwater species in global aquaculture include carps (e.g., Rohu, Catla, Grass carp, Common carp), tilapia, Pangasius (striped catfish), catfish (Clarias, Ictalurus), freshwater prawns (Macrobrachium spp.), and more recently, ornamental and high-value species such as trout and eel. These species are well-suited for both small-scale backyard aquaculture and industrialized commercial systems.

In terms of geographical distribution, Asia dominates freshwater aquaculture, accounting for over 90% of global production. China remains the top producer, followed by India, Bangladesh, Vietnam, Indonesia, and Myanmar. Africa is also emerging as a significant player, with countries like Egypt, Nigeria, and Uganda scaling up tilapia and catfish farming. Latin America, particularly Brazil and Colombia, has also shown strong potential for freshwater aquaculture expansion.

One of the greatest strengths of freshwater aquaculture is its ability to contribute to household food security in rural areas. Smallholder aquaculture provides access to fresh fish for home consumption, while also creating surplus for local markets. This improves both food availability and affordability. Moreover, fish is rich in high-quality protein and essential micronutrients such as omega-3 fatty acids, iron, zinc, and vitamin A, which are crucial for combating malnutrition, especially in vulnerable populations such as children, women, and the elderly.

Freshwater aquaculture also generates livelihoods along the value chain—from hatcheries and feed mills to transportation, processing, and retail—thus enhancing economic security. Women, in particular, play a vital role in post-harvest activities such as fish processing and trading. With proper training, infrastructure, and access to credit, aquaculture can be a transformative engine for rural development.

Environmental sustainability is another critical advantage of freshwater aquaculture, particularly when practiced using integrated systems. Models such as Integrated Fish Farming (IFF) combine fish culture with agriculture (e.g., rice-fish farming, duck-fish systems, or vegetable-fish farming), maximizing resource use efficiency and minimizing waste. Recirculating Aquaculture Systems (RAS), biofloc technology, and aquaponics offer high-yield alternatives with minimal ecological footprints, enabling aquaculture to thrive even in urban and water-scarce regions.

However, there are many challenges to be addressed in this context. Water quality management, disease control, limited access to quality seed and feed, and market fluctuations can hinder the performance of freshwater aquaculture systems. Moreover, improper siting, overuse of antibiotics, and poor waste management can lead to environmental degradation. Addressing these issues requires strong policy frameworks, investment in research and development, capacity building for farmers, and adoption of best management practices.

At the global level, freshwater aquaculture aligns with multiple Sustainable Development Goals (SDGs), including SDG 2 (Zero Hunger), SDG 1 (No Poverty), SDG 3 (Good Health and Well-being), SDG 12 (Responsible Consumption and Production), and SDG 14 (Life Below Water). Governments and international organizations such as the FAO, WorldFish, and the World Bank are increasingly supporting aquaculture development through funding, technical assistance, and policy guidance.

A indicated earlier, the COVID-19 pandemic underscored the need for resilient and decentralized food systems. While terrestrial meat and vegetable supply chains faced significant disruptions, many localized freshwater aquaculture systems continued to function, providing communities with accessible and affordable protein. This resilience further strengthens the case for integrating freshwater aquaculture into national and regional food security strategies.

Looking ahead, the future of global freshwater aquaculture will depend on innovation, equity, and sustainability. New technologies such as digital monitoring tools, AI-based water quality sensors, automated feeding systems, and blockchain-enabled traceability are beginning to revolutionize aquaculture practices. In addition, climate-resilient fish strains, low-cost renewable energy solutions, and community-based cooperative models will be key to scaling up production without compromising environmental or social outcomes.

In conclusion, global freshwater aquaculture has emerged as a vital pillar of food and nutrition security. By producing affordable, accessible, and nutritious food while supporting livelihoods and environmental sustainability, freshwater aquaculture offers a powerful tool to combat hunger and poverty in the 21st century. As we navigate the complex challenges of a changing world, investing in inclusive, sustainable, and innovative freshwater aquaculture systems is not only desirable but essential for achieving global food security.

Pillars of the Global Fish Basket: Major Freshwater Species in Aquaculture

1. . Carps (*Cyprinids*) – Most dominant group globally

- **Common carp** (*Cyprinus carpio*) – Hardy, omnivorous, widely farmed in Asia and Europe.
- **Grass carp** *(Ctenopharyngodon idella*) – Herbivorous, used in weed control.
- **Silver carp** (*Hypophthalmichthys molitrix*) – Planktivorous, fast-growing.
- **Bighead carp** (*Hypophthalmichthys nobilis*) – Filter-feeding species with high protein content.
- **Rohu** (*Labeo rohita)* – A major Indian carp.
- **Catla** (*Catla catla*) – Surface feeder, commonly polycultured with rohu and mrigal.
- **Mrigal** (*Cirrhinus mrigala*) – Bottom feeder, completing the Indian major carp triad.

2. Tilapia (*Oreochromis spp.*)

Nile tilapia (*Oreochromis niloticus*) – Second most farmed fish species worldwide.

- Fast-growing, disease-tolerant, and popular in Africa, Asia, and Latin America.
- Hybrid and genetically improved strains (e.g., GIFT tilapia) widely used.

3. Catfish

- **Pangasius** (*Pangasianodon hypophthalmus*) – Intensively farmed in Vietnam, India, and Indonesia.
- **African catfish** (*Clarias gariepinus*) – Prominent in African aquaculture due to air-breathing ability and hardiness.
- **Channel catfish** (I*ctalurus punctatus*) – Mainly farmed in the USA.

5. Trout

- **Rainbow trout** (*Oncorhynchus mykiss*) – Grown in cold freshwater regions (Europe, North America, parts of Asia).
- Valuable for high-end markets and sport fisheries.

6. Others

- **Snakehead** (C*hanna spp.)* – High-value predator species in Southeast Asia.
- **Eel** (*Anguilla spp.*) – Farmed in East Asia (especially Japan, China, and Korea).
- **Perch, bass, and gourami** – Cultured in niche or local markets.

Indonesia: A Model of Strategic "Natural Resource" Utilization for Protein Security

Indonesia, the world's largest archipelagic nation comprising over 17,000 islands, has long been endowed with immense marine and freshwater biodiversity, positioning its fisheries sector as one of the most vital contributors to the country's economy, food security and livelihoods. Stretching across the equator, Indonesia commands one of the richest marine ecosystems on Earth, spanning over 6 million square kilometers of exclusive economic zone (EEZ) and more than 81,000 kilometers of coastline. The fisheries sector is divided broadly into two sub-sectors: capture fisheries (both marine and inland) and aquaculture. Indonesia's aquaculture sector has grown rapidly, becoming the world's second-largest aquaculture producer after China. Its production includes finfish, crustaceans, mollusks and aquatic plants, with brackishwater, freshwater and marine culture practices distributed across Java, Sumatra, Sulawesi, Kalimantan and Papua. Shrimp farming, particularly vannamei (whiteleg shrimp)-has emerged as a high-value export commodity, contributing significantly to national foreign exchange earnings.

Indonesia's Freshwater Aquaculture

The fresh water aquaculture sector is vibrant, dynamic, and deeply intertwined with the country's geography, economy, food systems and rural livelihoods. As a vast archipelago with abundant inland water bodies; rivers, lakes, reservoirs, ponds, swamps and man-made irrigation canals; Indonesia has naturally evolved into one of the leading freshwater aquaculture nations in the world. Freshwater aquaculture in Indonesia is not just a source of fish production; it is a critical pillar of food security, employment generation, poverty alleviation and rural development. The country's inland aquaculture practices span across Java, Sumatra, Sulawesi, Kalimantan and Bali, with each region contributing unique species, technologies and cultural practices. Java, for instance, is known for its intensive catfish (lele) and Nile tilapia (nila) farming in concrete tanks, ponds, and biofloc systems. In Sumatra and Kalimantan, traditional floating cages (keramba) in rivers and lakes are widely used for farming indigenous species such as Patin (Pangasius spp.) and Gurame (Giant Gourami). Pangasius hypophthalmus, in particular, has emerged as the most dominant species in commercial aquaculture due to its fast growth, tolerance to high stocking densities, and suitability for fillet production. Other popular freshwater species include common carp (ikan mas), catfish (Clarias gariepinus), snakehead (ikan gabus) and freshwater prawns (Macrobrachium rosenbergii).

Indonesia's freshwater aquaculture encompasses a wide range of farming systems, from traditional extensive ponds to highly productive semi-intensive and intensive setups. Modern practices such as biofloc, recirculating aquaculture systems (RAS) and integrated farming (fish-crop-duck) are gaining ground, especially in peri-urban areas. Hatchery production, seed supply chains, and feed manufacturing are well-established in many provinces, supporting a robust ecosystem of smallholder farmers, cooperatives and private enterprises. According to the Ministry of Marine Affairs and Fisheries (MMAF), freshwater aquaculture accounts for more than half of Indonesia's total aquaculture output by volume, with Java and Sumatra being the highest contributors. Women play an increasingly visible role in this sector, particularly in seed production, feed mixing, harvesting, post-harvest handling and local marketing, making freshwater aquaculture a tool for gender empowerment and social inclusion.

In terms of market structure, freshwater fish are widely consumed in domestic markets, with catfish and tilapia being staple proteins in many Indonesian diets. Wet markets, roadside stalls, warungs and supermarkets offer fresh, fried, smoked and filleted products across income levels. Processed and value-added products such as frozen fillets, fish balls, and nuggets are also expanding in urban retail. While marine fish dominate Indonesia's seafood exports, freshwater species like tilapia and pangasius have begun penetrating international markets, especially to the Middle East and the U.S. Collaborations with the private sector have led to innovations in automated feeding, mobile apps for pond monitoring and blockchain-based traceability systems for improving supply chain transparency.

Freshwater aquaculture in Indonesia is not just an economic activity, it is a cultural heritage, a survival strategy and a driver of local economies. With over 3 million smallholder aquafarmers engaged in inland fish production, it represents one of the most democratized sectors of food production in the country. Its integration with tourism (such as kuliner ikan and agro-edu tourism), education and rural entrepreneurship opens new doors for sustainable development. As Indonesia accelerates its vision of a sustainable blue economy, freshwater aquaculture stands out as a sector with immense potential to balance productivity, ecology and equity. From backyard tanks to vast fishpond clusters, from indigenous species conservation to export-grade fillet processing, the world of freshwater aquaculture in Indonesia is a living mosaic of tradition, innovation, and opportunity.

Freshwater aquaculture plays a pivotal role in empowering village women by providing them with accessible, sustainable and income-generating opportunities that align with their existing social and familial responsibilities. Unlike many other rural occupations, aquaculture can be practiced on a small scale in homestead ponds, tanks, or community water bodies, making it particularly suitable for women who may not have land ownership or mobility. Through involvement in fish rearing, feeding, pond maintenance, harvesting and post-harvest activities such as cleaning, drying and value addition, women gain critical technical skills and become active contributors to household income. This financial independence strengthens their decision-making power within the family and improves their ability to invest in children's education, nutrition and healthcare. Moreover, women-led aquaculture directly enhances household food security by increasing access to fish, a vital source of protein and micronutrients, thereby improving maternal and child nutrition. Government and NGO-led initiatives such as training programs and microfinance schemes further promote women's participation, primarily through self-help groups and cooperatives. These platforms not only facilitate resource sharing and collective marketing but also foster leadership, social cohesion and peer learning among women. In regions affected by climate variability or agricultural limitations, aquaculture offers a reliable and adaptive livelihood that enhances resilience, particularly for women-headed households. Additionally, integrated farming systems that combine fish with vegetables, poultry, or rice farming further diversify income sources and make efficient use of limited resources, with women playing a central coordinating role. By involving women in all nodes of the aquaculture value chain and recognizing their traditional ecological knowledge and managerial capacities, freshwater aquaculture becomes a transformative tool for gender equity, rural development and inclusive participation in the blue economy.

Pangasius:
The People's Fish Powering Protein Security

Pangasius hypophthalmus, commonly known as striped catfish is one of the most important species in Indonesia's freshwater aquaculture sector. Indigenous to Southeast Asia and popular for its fast growth, high market demand and adaptability to diverse farming systems, Pangasius cultivation has become a significant contributor to Indonesia's domestic fish supply and rural livelihoods. The primary production zones are concentrated in the islands of Sumatra (particularly in South Sumatra and Riau), Kalimantan (notably Central and South Kalimantan) and Java (especially West and East Java), where climatic conditions, freshwater availability and market access are favorable. Farmers cultivate Pangasius primarily in earthen ponds, concrete tanks or floating net cages (keramba) in rivers and reservoirs. The species is highly favored due to its resistance to low dissolved oxygen levels, tolerance to high stocking densities, omnivorous diet and relatively short culture period of 5-7 months to reach market size of 800-1,200 grams. Hatchery technology for Pangasius is well-established in Indonesia, with many private and public hatcheries producing fry and fingerlings using hormone-induced breeding techniques. Farmers typically feed Pangasius with commercial pelleted feed, often supplemented with agricultural byproducts to reduce costs. However, feed costs remain a major component of operational expenses, accounting for over 60% of the production cost. The rise of integrated value chains has improved efficiency in recent years, particularly in West Java where cooperatives and small-scale farmers are now connected with processors and retailers. Pangasius is consumed widely in Indonesia, both as fresh fillets and in traditional preparations such as pepes, pindang and goreng. Moreover, efforts are underway to promote Pangasius as an export-oriented species, taking inspiration from Vietnam's massive Pangasius industry. However, challenges remain, including limited cold chain infrastructure, lack of international branding and inconsistent fillet quality, which hinder large-scale exports. Training programs and farmer field schools have been launched to educate smallholders on sustainable aquaculture, record-keeping and disease control. In recent years, digital platforms have further empowered Pangasius farmers by offering automated feeding systems, fintech support and access to buyers. The sector also benefits from Indonesia's rising middle class and increasing preference for white fish protein, making Pangasius a vital component of the national food basket. As aquaculture expands in Indonesia's interior regions, Pangasius farming offers a sustainable solution for food security, poverty alleviation and regional development, provided environmental and health management are integrated with market development strategies.

Major Cultivated Species of Pangasius in Indonesia's

Indonesia's freshwater aquaculture sector has grown rapidly in recent decades, with Pangasius species—particularly *Pangasius hypophthalmus*—emerging as the foundation of commercial catfish farming. Known locally as "Patin," this species is vital to rural livelihoods, contributes to national food security, and supports income generation through both domestic and international markets. Widely recognized as the Iridescent Shark or Swai, *P. hypophthalmus* dominates large-scale production because of its fast growth, adaptability and suitability for high-density farming systems.

The cultivation of this species reflects the diversity of Indonesia's aquaculture practices, ranging from traditional earthen ponds to modern tank-based systems, while also highlighting a dual-market approach: high-volume production for mass consumption and export. Understanding the biology, farming techniques and market dynamics of *P. hypophthalmus* is crucial for developing sustainable strategies that enhance productivity and profitability, while also conserving biodiversity and ensuring the long-term resilience of Indonesia's aquaculture industry.

Feature	Pangasius hypophthalmus	Pangasius djambal
Common Names	Iridescent shark, Swai, Patin Siam	Djambal catfish,
Origin	Mekong River Basin (Vietnam/Thailand)	Local Patin, Patin Asli Native to Indonesia (Sumatra, Kalimantan)
Body Colour	Silver-grey with iridescent shine	Darker, bluish-grey back, no iridescence
Natural Distribution	Exotic in Indonesia	Indigenous to Indonesia

Culture Aspect	Pangasius hypophthalmus	Pangasius djambal
Popularity in Farming	Widely farmed throughout Southeast Asia	Locally farmed in Indonesia, especially Sumatra
Stocking Density	High: 20–30 fish/m^2 in ponds	Medium: 15–20 fish/m^2 to reduce stress
Culture Period	Short: 5–6 months to 1 kg	Longer: 7–8 months to 1 kg
Survival Rate	Moderate (~80–85%)	High (~90%) under good management
Feed Requirement	Commercial floating pellets	Similar, but tolerates more natural feed
Water Quality Tolerance	High tolerance to poor conditions	Better suited to fluctuating natural water
Farming Systems	Ponds, cages, tanks, biofloc	Mostly ponds and river cages

Matric	*Pangasius hypophthalmus*	*Pangasius djambal*
Growth Rate	Fast	Moderate
Feed Conversion Ratio (FCR)	1.2 – 1.5	1.6 – 1.9 (slightly higher)
Average Harvest Size	1–1.2 kg in 5–6 months	1–1.2 kg in 7–8 months
Suitability for Export	High (fillet-oriented)	Low – mostly for local consumption
Breeding	Easy with hormone-induced spawning	Needs strict broodstock management

Market Criteria	*Pangasius hypophthalmus*	*Pangasius djambal*
Price per kg (Farmgate)	Lower (IDR 18,000–22,000)	Higher (IDR 25,000–30,000)
Domestic Demand	High in urban supermarkets and processors	High in traditional and specialty markets
Export Potential	Very high – used for fillets	Low – not used for fillet export
Processability	High fillet yield (~40–45%)	Lower fillet yield (~35–38%)
Market Position	Commodity fish	Niche/premium species

Taste Criteria	*Pangasius hypophthalmus*	*Pangasius djambal*
Flesh Texture	Soft, neutral	Firmer, meaty
Fat Content	Higher, especially in belly	Moderate, clean-tasting
Cooking Applications	Fried, filleted, steamed	Grilled, spicy soups (Pindang Patin, etc.)
Consumer Preference	Mass market, international	Preferred by traditional Indonesian consumers
Odor	Slightly muddy if raised in poor conditions	Clean, river-fresh flavor

Sustainable Factor	*Pangasius hypophthalmus*	*Pangasius djambal*
Environmental Impact	Moderate (high-density farming)	Lower (mostly small-scale, native range)
Biodiversity Role	Introduced species – potential risk	Indigenous – supports native conservation
Government Focus	Promoted for commercial scaling	Supported for biodiversity and local economy
Certification Potential	Easily certifiable (ASC, CBIB)	Less explored but ideal for organic aquaculture

P. hypophthalmus: The World's Favourite White Fish

Pangasius hypophthalmus is particularly suitable for fillet preparation compared to many other freshwater and marine fishes due to a combination of anatomical, textural, economic, and processing advantages.

1. High Fillet Yield

- *P. hypophthalmus* offers a fillet yield of around 40–45%, which is relatively high for a freshwater fish.
- Its boneless structure, large body size, and thick muscle mass along the sides make it ideal for producing sizeable fillets with minimal waste.
- The absence of intramuscular bones (pin bones) simplifies filleting and increases consumer preference.

2. Smooth Texture and Mild Taste

- Flesh is white, soft, and mildly flavored, making it highly adaptable to a wide range of culinary applications and processing methods.
- Unlike stronger-flavored fishlike mackerel or sardines its fillets do not have a "fishy" odour or aftertaste, making them ideal for export and international cuisines.

3. Neutral Appearance and Odor

- The fillets are white to cream-colored with no dark muscle lines
- If farmed properly, they have minimal earthy or muddy flavour, unlike some bottom-dwelling or pond-raised fish.

4. Soft Bones and Flexible Skeleton

- The cartilage-based soft skeleton of Pangasius enables easy filleting without heavy machinery.
- Unlike species with complex rib bones or spines (like carp) it allows for cleaner cuts and less meat loss.

5. Uniform Size and Shape

- Grows to a consistent harvest size (~1–1.2 kg), which helps in standardizing fillet dimensions for commercial packaging and processing.
- Its elongated, torpedo-shaped body yields long, symmetrical fillets important for visual appeal and industrial packaging.

6.Scaleless Body

- Pangasius lacks scales, which makes processing easier, faster, and more hygienic.
- No descaling step is required, reducing labour and equipment costs in fillet processing lines.

7. High Growth and Supply for Industry

- Fast-growing (5–6 months to harvest), adaptable to intensive aquaculture systems, and easy to mass-produce.
- This ensures a stable and continuous supply to large fillet-processing industries, especially in Vietnam, Indonesia, and India.

8.Cost-Effective and Export-Friendly

- Pangasius is cheaper to produce due to high stocking density, low feed cost, and short culture duration.
- It has become a key export commodity, especially from Vietnam to the EU, USA, and Middle East, where white fish fillets are in high demand.

9. Low Fat and High Protein

- Contains high moisture and moderate protein (~16–18%), and low fat (especially if raised under controlled diets), which matches the nutritional preference of many consumers and regulators.

10. Regulatory Acceptance and Certifications

- Pangasius farms and processors can easily be certified under ASC, BAP, HACCP, and other food safety standards.
- Traceability, sustainability, and standardized quality have enhanced its position in the global white fish fillet market.

Structured Farming Protocol for Pangasius (*P. hypophthalmus*) (1 acre)

Water Source: Groundwater from borewell and rainwater harvesting
Soil Type: Clay-loam, suitable for pond construction
Power Supply: Grid electricity with backup diesel generator

Pond Design and Layout

Component	Quantity	Dimensions
Grow-out ponds	4	20m × 25m × 1.5m
Sedimentation pond	1	each
Feed storage shed	1	10m × 10m × 1.5m
Staff/guard hut	1	4m × 6m

Stocking density & Production /Hector/Cycle

Method	Stocking density (Nos.)	Production (Ton)
Semi intensive	20- 30 Nos/M^3	15-20
Intensive	40- 60 Nos/M^3	30-50
Highly intensive	60- 80 Nos/M^3	200-300

Feed and FCR

- Feed type: Commercial floating feed (28–30% protein)
- Feed Conversion Ratio (FCR): ~1.6
- Feed required per cycle: 21.7 tonnes
- Annual feed requirement: ~43.4 tonnes

Operational Workflow

Phase	Duration	Activities
Preparation	1 month	Pond construction, water filling
Stocking	Week 1	Acclimatization and stocking of fingerlings
Grow-out	6 months	Feeding, water quality, monitoring
Harvesting	2 weeks	Harvest, grading, and sale
Maintenance	2 weeks	Pond drying, liming, re-preparation

Budget Estimate

Capital Expenditure (approx.)

Item	Total (USD)
Pond excavation & lining	3,226
Water inlet & drainage	645
Feed and storage shed	516
Aerators (paddlewheel)	1,032
Generator (backup)	645
Misc. tools and equipment	387
Fencing and security	323
	6,774

Revenue Projection

- Harvest per cycle: 13.6 tonnes
- Market price: 20,000 IDR/kg = USD 1.29/kg
- Gross revenue/cycle: USD 17,544
- Net profit per cycle: USD 7,153
- Annual profit (2 cycles): USD 14,306

Payback Period

- Initial investment (CAPEX): USD 6,774
- Annual net return: USD 14,306
- Payback period: < 1 year (approx. 5–6 months

Pangasius Seed Production in Indonesia: Status, Trends, and Prospects

Pangasius seed production in Indonesia is a well-established and rapidly growing segment of the freshwater aquaculture industry, supporting the country's increasing demand for Pangasius hypophthalmus (locally known as ikan patin) farming. As Indonesia intensifies its freshwater aquaculture, especially in provinces like West Java, South Sumatra, Riau, South Kalimantan, and parts of Central Java, the availability of quality fry and fingerlings becomes crucial for ensuring high survival, fast growth, and

Seed Production Centers

The production of Pangasius seed is carried out by:

- Government hatcheries under the Ministry of Marine Affairs and Fisheries (MMAF)
- Private hatcheries and small-scale operators
- Farmer cooperatives that manage broodstock and distribute fry within local clusters

Major seed-producing areas include:

- **West Java** (Cianjur, Sukabumi, Bogor)
- **South Sumatra** (Ogan Komering Ilir, Palembang)
- **Riau** (Kampar, Indragiri Hulu)
- **South Kalimantan** (Banjarmasin, Barito Kuala)

Seed Production Process

The seed production of Pangasius hypophthalmus follows a standardized induced breeding process:

Broodstock Management

- Broodstock are maintained in separate earthen or concrete ponds (ratio ~1 male: 2 females)
- Brooders are conditioned using quality feed (30–35% protein) for 2–3 months

Mature fish (~2.5–3 kg) are selected based on external and gonadal maturity indicators

Induced Spawning

- Hormonal induction is done using Ovaprim or LHRH analogues (doses: 0.5–1.0 ml/kg)
- After injection, brooders are kept in a spawning hapa or circular tanks under monitored conditions
- Spawning occurs ~8–10 hours post-injection at 27–30°C water temperature

Egg Collection and Incubation

- Fertilized eggs are stripped manually and placed in flow-through incubation jars
- Hatching occurs in 18–24 hours
- Hatch rates range from 75%–90% under good management

Larval Rearing

- Newly hatched larvae are transferred to nursery tanks or ponds
- First feeding starts 2–3 days after hatching using boiled egg yolk, rotifers, or micro-pellets
- After 2–3 weeks, larvae reach fry stage (2–3 cm), then grow to fingerling stage (5–7 cm) in 30–45 days

3. Production Capacity

- One average-sized hatchery can produce 2–5 million fry per season
- Larger hatcheries produce up to 10 million fry annually

Pangasius Processing in Indonesia: An Industry on the Rise

The Pangasius processing industry in Indonesia is a growing sector within the country's broader aquaculture value chain. While Indonesia is a major producer of *Pangasius hypophthalmus* (locally known as ikan patin), especially in Sumatra, Java, and Kalimantan, its processing industry is still developing and gradually positioning itself as a competitive player in both domestic and export markets. The industry involves cleaning, filleting, freezing, packaging, value addition, and distribution of Pangasius products for various segments—wet markets, retail chains, HoReCa (Hotel-Restaurant-Catering) and international buyers.

Processing Infrastructure and Locations

- Processing facilities are concentrated in South Sumatra (Palembang, Ogan Komering Ilir), West Java (Subang, Indramayu), Riau (Kampar), and parts of South Kalimantan, where Pangasius farming is intensive.
- These units range from small-scale cottage-level processors supplying local markets, to mid-sized semi-automated plants processing 1–10 tonnes per day, and a few export-oriented modern facilities.

Key Products

Fresh whole Pangasius:
Scaled, gutted, and packed for wet markets.

Frozen fillets:
Trimmed, skinless, boneless white fish fillets (main export item).

Frozen whole fish: IWP (Individually Wrapped Packs) for retail or bulk.

Steaks & portions: For restaurant and foodservice use.

Surimi & nuggets: Value-added processed products for supermarkets and institutional buyers.

Smoked Pangasius: Locally consumed and gaining popularity in culinary tourism.

Processing Steps

1 Receiving live or chilled fish from farms (within 50–100 km radius).
2. Stunning and bleeding.
3. De-heading, gutting, and scaling.
4. Skinning and filleting using knives or filleting machines.
5. Grading (based on size and fillet thickness).
6. Washing and dewatering.
7. Freezing using IQF (Individual Quick Freezing) or plate freezers.
8. Packing (vacuum or modified atmosphere).
9. Storage in cold rooms at –18°C or lower.

Domestic Market

- Most Pangasius is consumed fresh or chilled in local wet markets or as cooked fish in traditional cuisine (pepes patin, pindang patin, etc.).
- Processed and packaged Pangasius products are now seen in Indomaret, Alfamart, Hypermart and other retail chains.
- Middle-income consumers are slowly shifting toward ready-to-cook or ready-to-eat fillet products for convenience.

Export Market

- Compared to Vietnam (a global leader), Indonesia's Pangasius export volume is still small, but growing steadily.
- Main export destinations: Malaysia, Singapore, Middle East, and some EU buyers.
- Export-quality processors are HACCP-, ISO-, and HALAL-certified; a few have ASC/BAP certifications.
- Barriers to scaling up exports:
- Inconsistent fillet quality
- Limited cold chain and traceability systems
- Competition with lower-cost Vietnamese fillets

Quality and Certification

- Major processors are adopting:
- Good Manufacturing Practices (GMP)
- Hazard Analysis Critical Control Point (HACCP)
- SNI (Standar Nasional Indonesia)
- HALAL certification for Muslim markets
- Some are working toward Aquaculture Stewardship Council (ASC) and Global GAP certifications to meet export requirements.

Value Chain and Employment

The Pangasius processing industry supports:

- Upstream farmers and seed suppliers
- Transporters and ice suppliers
- Processing line workers (many are women)
- Packaging and cold chain operators
- Retailers and exporters

One mid-sized processing plant can employ 50–150 workers, many of whom are from local fishing or farming communities.

Cold Chain and Logistics

- Cold storage availability is improving but remains a challenge in remote production zones.
- Most large processors maintain in-house or outsourced cold storage (–20°C) and refrigerated trucks.
- Processed fish is transported to urban centers like Jakarta, Bandung, Surabaya, and exported via ports such as Tanjung Priok (Jakarta) or Belawan (Medan).

Indonesia's Pangasius Market in 2024: Price Trends and Production Dynamics

Market price of *Pangasius hypophthalmus* seed in 2024

Price (in *Rp) per seed of *P. hypophthalmus* (*Patin Siam*)

Sl No.	Length (inches)	Length (cm)	Weight in G	Price (Rp/piece)	Avarage-Price(Rp/Kg)	Approx. Price (USD)
1	0.5-0.9	1.27-2.28	0.5-1	100-120	150000	$0.006 – $0.0075
2	1.5-2.0	3.8-5.08	1.8-2.3	250-350	145000	$0.016 – $0.022
3	2.5-3.0	6.35-7.62	3.0-5.3	350-450	100000	$0.022 – $0.025
4	3.0-4.0	7.62-10.16	5.3-13.1	450-500	40000	$0.025 – $0.031
5	4.0-5.0	10.16-12.7	13.1-22.8	500-600	30000	$0.031 – $0.047
6	5.0-6.0	12.7-15.24	22.8-33.2	600-750	25000	$0.031 – $0.056
7	6.0-7.0	15.24-17.78	33.2-51.2	750-900	20000	$0.034 – $0.063
8	7.0-8.0	17,78-20.32	51.2-68.3	900-1000	17000	$0.063 – $0.075
9	>8.0	>20.32	>70.8	1000-1500	15000	> $0.075

Note:

- *Prices are average market rates per seed in 2024 across various provinces in Indonesia.*
- *1 USD = Rp. 16,000 (approximate conversion used for USD).*
- *Larger seed sizes fetch significantly higher prices due to better survival rates and grow-out readiness.*

The 2024 data on Patin fish seed production reveals that prices have remained relatively stable compared to previous years, with no significant increase observed. However, a notable disparity in prices continues to persist, even for seeds of similar size. This price variation can be attributed to several critical factors. Foremost among them is breed differentiation; for example, enhanced genetic strains such as Patin Jambal consistently fetch higher prices than standard varieties due to their superior quality and performance. Other contributing factors include market accessibility, the scale and technological advancement of hatchery operations, and logistical constraints, particularly in remote or island regions where transportation and distribution costs are higher. From a regional perspective, South Sumatra maintains its position as the country's leading producer, benefiting from a well-established hatchery network and proximity to key aquaculture zones. North Sumatra and Riau also report high production volumes, further solidifying Sumatra's strategic importance as a national seed supply hub. Conversely, although Java hosts a large number of hatcheries, its production is more fragmented, dominated by small-scale operators in highly competitive and saturated markets.

Market Price and Demand of Siam (*P. hypophthalmus-whole fish*) by Weight Range – 2024			
Weight Range (g)	Price/piece (Rp)	Approx. Price (USD)	Market Demand
100 – 200	10,000	$0.625	Low
200 – 250	15,000 – 16,000	$0.93 – $1	Low
250 – 350	16,000 – 17,000	$1 – $1.06	Low
400 – 500	17,000 – 17,500	$1.06 – $1.09	High
500 – 1,000	17,500 – 18,000	$1.09– $1.13	High
1,000 – 1,100	18,000 – 19,500	$1.13 – $1.22	High
1,200 – 1,500	25,000 – 27,000	$1.56 – $1.69	Low
1,500 – 2,000	27,000 – 30,000	$1.69 – $1.81	Low
2,000 – 3,000	30,000 – 35,000	>1.69- 2.2	Low
> 3,000	<30,000	<1.69	Not for market

Note:

1 USD = Rp. 16,000 (approximate conversion used for USD).

Insights

Peak Market Demand

Fish in the 400g to 1,100g range are in high demand, especially for:

- Retail markets
- Restaurants
- Fillet processors

These sizes represent an ideal balance between meat yield and handling size, allowing for efficient processing and attractive presentation in fresh and frozen markets.

Less Demand for Small & Large Fish

- Fish below 250g have less demand due to:
- Low meat yield
- Difficulties in filleting
- Limited retail appeal

Fish above 1,200g, though fetching higher prices per unit, show reduced market demand. Likely reasons include:

- Oversized for table use
- Slower growth rate beyond this size
- Not cost-effective for processing plants

Special Segment: Breeding Stock

▪ Fish above 3 kg are priced below 30,000 Rp and are primarily sold for broodstock purposes in hatcheries.

o These command specialized demand, with prices influenced more by genetics and strain quality than by weight alone.

2024- National Output of Pangasius in Indonesia Reaches 339,812 Tons

In 2024, South Sumatra stands out as the dominant force in Indonesia's Pangasius production landscape, contributing a disproportionately large share to national output. Its leadership position is closely tied to its top ranking in seed production, reflecting a well-integrated aquaculture value chain that spans hatcheries, grow-out operations, and possibly local processing infrastructure. This success is underpinned by natural advantages such as abundant rivers and wetlands, alongside established aquaculture facilities and strategic market access to Sumatra and Java.

In the second tier, South Kalimantan, Riau, and West Java emerge as mid-level producers. South Kalimantan showcases strength in both hatchery and grow-out operations, while Riau's performance may be attributed to its access to cross-border trade routes, ports, and ready availability of feed and inputs. Despite spatial and demographic limitations, West Java maintains a robust Pangasius output—outpacing other species—through intensive farming techniques and strong domestic demand, particularly in urban markets.

Meanwhile, Central Kalimantan, East Java, and Lampung report moderately high production levels in the 12,000–15,000 ton range. These regions are likely supported by mid-scale operations, and may cater to specialized processing markets such as fillets or exports. Of these, Central Kalimantan shows great potential for expansion due to its ample land availability and clean water resources, ideal for intensifying production.

A noteworthy feature of the current market is the wide variance in average weighted prices across provinces. Prices range from Rp 12,017/kg in West Java to Rp 39,505/kg in Central Kalimantan, signalling unequal access to premium markets, differing input or transport costs, and likely variations in product quality and post-harvest handling. This unevenness presents both a challenge and an opportunity for improving value chain efficiency and regional competitiveness in Indonesia's growing Pangasius industry.

2024 Price Trends of Commercial Pangasius Feed by Protein Content

Protein (%)	Price Range (Rp/kg)	Remarks
20%	8,000 – 9,000	Low-grade, suitable for older fish
22%	9,300 – 9,400	Transition feed
24%	9,500 – 10,000	Economic starter feed
26%	10,010 – 10,100	Balanced growth feed
28%	10,400 – 10,500	Enhanced formulation
30%	12,000 – 12,500	Premium grow-out feed
32%	12,100 – 12,200	Slight increase; marginal gain
35%	15,000 – 15,300	High-performance feed
38%	18,000 – 18,500	Specialized feed, possibly for broodstock or early fry
40–42%	19,500 – 19,800	Ultra-high protein, fry feed or breeding-specific

Insights

Strong Positive Correlation:

- There is a clear, progressive increase in feed price with rising protein levels.
- Prices almost double from 20% to 30% protein, and more than double from 20% to 40% protein, indicating the cost of protein sources (fishmeal, soybean meal, etc.) as the key cost driver.

Economical Protein Ranges (20–26%):

- Feeds in the 20–26% protein range are commonly used in grow-out phases for semi-intensive or traditional farming systems.
- They offer better cost-efficiency but require longer grow-out durations and may result in lower feed conversion efficiency.

Standard Commercial Range (28–32%):

- The 28–32% protein range is the sweet spot for commercial grow-out systems, balancing growth performance with input cost.
- Widely used in intensive culture where growth rates and survival are prioritized.

High-End Feeds (35%+):

- Feeds with 35–42% protein are formulated for:
- Larval and fry stages (starter feeds)
- Breeding stock conditioning
- Nutrient-sensitive environments (e.g., RAS systems)

These are significantly more expensive and are not cost-effective for grow-out stages, unless returns are equally premium.

Price Comparison of Patin Fish Fillets by Glazing Level – 2024 (BL vs. NBL)		
Glazing (%)	BL Price Range (Rp)	NBL Price Range (Rp)
20%	39,500 – 42,000	41,000 – 46,000
25%	37,500 – 40,000	—
30%	35,500 – 39,000	37,500 – 42,000
40%	32,000 – 36,000	34,000 – 39,000
45%	30,000 – 32,000	33,000 – 36,000
50%	28,000 – 30,000	30,000 – 34,000
55% – 60%	25,000 – 26,000	27,000

Note:

1 USD = Rp. 16,000 (approximate conversion used for USD).

The 2024 average market price data for Patin fish fillet (both BL – Bleached and NBL – Non-Bleached) shows a clear pricing structure influenced by the level of glazing — the percentage of protective ice coating added to the fillet during freezing.

Market Analysis: Pangasius By-product Prices (2024)

The pricing data for Pangasius (P. hypophthalmus) by-products in 2024 demonstrates a diversified secondary market with value being extracted from almost every part of the fish. This is crucial for maximizing profitability, reducing waste, and supporting circular economy models in aquaculture processing.

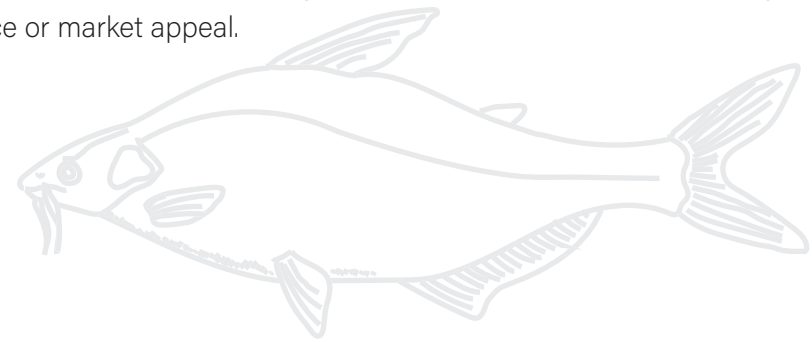
By-Product	Price Range (Rp/kg)	Remarks
Fresh fish (whole)	18,000 – 20,500	Main raw material, unprocessed
Frozen fish (whole)	20,000 – 20,500	Slightly higher due to freezing cost
Frozen fish with head (no viscera/gills)	13,000 – 18,000	Lower value, partially cleaned
Fresh fish pieces	10,000 – 12,000	Trimmed ends, usable for local market
Frozen fish pieces	12,000 – 14,000	Longer shelf life, higher cost
Fresh/frozen fish skin	7,000 – 11,000	Cosmetic, leather, or gelatin applications
Fresh fish waste (head, viscera, fin)	500 – 1,000	Mostly for compost or low-end rendering
Fish belly	1,000	Fatty part, valued in some cuisines
Trimming (meat offcuts)	2,000	Used in fish balls, patties, or pet food
Kerok trimming (scrapings)	1,000	Residual meat for low-cost processing
Kerok duri (bones with some flesh)	1,500	Soup base or processed into bone meal
Fresh fish fat	3,000 – 10,000	Valuable for fish oil extraction
Fish bone (fresh/frozen)	2,000	Processed into gelatin, meal, or extract
Fish head (fresh/frozen)	2,000	Local wet markets and soups
Fish meal	12,500 – 13,000	For feed manufacturing
Fish oil	9,000 – 11,000	Rich in omega-3; used in pharma, feed
Surimi	10,000 – 12,500	High-value, export-oriented paste product

Insights

Whole Fish vs Processed Parts

Whole fish (fresh/frozen) remains the most valuable, commanding up to Rp 20,500/kg.

- Freezing adds value, reflecting preservation and extended shelf life.
- Partially processed fish (head-on, gutted) sells at a discount, indicating reduced convenience or market appeal.



Mid-value Products

- Trimmings, pieces, and skin are moderately priced, reflecting secondary usability in ready-to-cook, snack, or industrial products like collagen.
- Fresh skin has a wide price range, likely depending on thickness, cleanliness, and size — higher-end skins go for leather, chips, or cosmetic collagen extraction.

Low-value Waste

- Viscera, fins, and bones, when unprocessed, fetch very little (Rp 500–2,000), though they hold potential when rendered into fertilizer, fish meal, or biofuel.

High-value Extracts

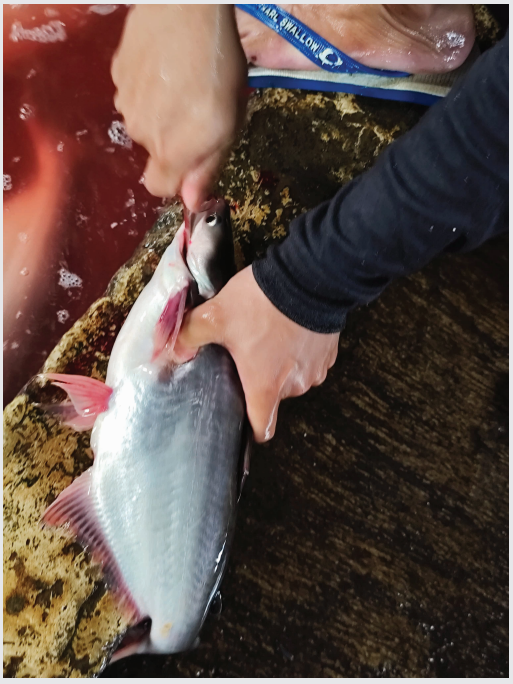
- Fish oil (Rp 9,000–11,000) and fish meal (Rp 12,500–13,000) are essential in aquaculture, poultry, and pet feed industries.
- Surimi, a refined and washed fish protein, is a high-margin export product used in imitation crab meat, sausages, and frozen snacks.

By-product Optimization

- With skin, bones, fat, and trimming all holding commercial value, a well-integrated processing unit can increase revenue by 20–30% through by-product channels. Further innovation in gelatin, nutraceuticals, or pet food could enhance value recovery.

photo gallery

Pangasius farming in Indonesia - Relevant pictures




IMAGINATION


A = 58% = 12^8 - 13 kg.
B = Sisa 58% = 12^8 - 13 kg.
B = +3 = 50% = 10^3 - 10^8 kg.
C = 55% = 11^3 - 11^5 kg.
D = 50% = 13^5 - 14 kg.
MCO
BL 58% 3P: PCS
4P: PCS
BL 40% 4P: 3 PCS
BL 55% 3P: PCS
4P: PCS
BL 30% 4P: PCS
NBL TG: 2^8 kg + 1 PCS
PG: 1 PCS
BL 45%/3P: 6 PCS
BL 20%/4P: 5
TANDON
BL 30%
BL 58%
BL 55%
BL 50%
NBL 30%:
BL 20%
BL 45%:
ABF 1
ABF 3
RM Rabu
A:
B:
TG:
PG:
BRK:


TRANS Comm
THE DOCTOR
AG 8663 RT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Hexform