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Assessing the Rainbow Trout Aquaculture Value Chain in Albania: From Production to Market Integration

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Abstract

Albania boasts abundant water resources that support both inland and marine fish farming. In 2024, the country's aquaculture sector yielded 7,149 tonnes from a total fish production of 16,901 tonnes. Nevertheless, domestic fish consumption remains modest at 8.51 kg per person annually. The sector's contribution to the national economy is minimal, accounting for less than 1% of GDP and employing around 620 people, with women primarily engaged in fish processing. Since the 1980s, rainbow trout farming has expanded to include 19 licensed businesses, mainly small-scale or family-run operations. Production peaked at 1,861 tonnes in 2018 but declined to 584 tonnes in 2024.

The rainbow trout value chain is relatively simple and locally sustainable, but lacks vertical integration. Producers often sell directly to markets, restaurants, or export outlets, with limited involvement from wholesalers. The cold chain infrastructure is in place, yet processing remains limited in scale. Distribution channels include fishmongers, supermarkets, and informal markets, with demand surging during tourist seasons and weekends.

Key challenges facing the sector include reliance on imported feed, outdated infrastructure in remote areas, restricted access to financing, and low market integration. Strategic investments in processing facilities, the development of local markets, and the establishment of a fish feed manufacturing plant could enhance competitiveness. Support from government financing and targeted policies—particularly in energy and transportation—could alleviate sector challenges. Data collected through surveys, expert interviews, and field visits informed a comprehensive mapping of the value chain and helped identify strategies to boost economic resilience and growth in Albanian aquaculture.

Keywords: value chain, rainbow trout, market, production.

1. Introduction

Albania is endowed with rich water resources, including a 476-kilometer-long coastline that facilitates fishing activities. The country also features numerous inland water bodies such as eight coastal lagoons covering 10,600 hectares, 66 natural lakes, and 103 smaller lakes used for aquaculture and fishing, collectively spanning 12,100 hectares. Additionally, there are 670 reservoirs that support national inland fisheries and aquaculture industries [1]. In 2024, the total output from marine and aquaculture sectors reached 16,901 tonnes, with aquaculture accounting for 7,149 tonnes, primarily derived from marine aquaculture efforts [2].

Fish consumption per capita in Albania is significantly lower than in European countries and globally. In 2024, the average annual intake was approximately 8.51 kg per person, which is about a quarter of the global average of 20.5 kg in 2018 [3].

Albania's fishery industry makes a small contribution to the nation's economy, representing less than 1% of the GDP. The sector provides over 9,550 full-time jobs, with approximately 620 positions in aquaculture. Women are significantly involved, mainly in processing and ancillary services[4]. The industry is predominantly focused on exporting to the European Union [2].

Aquaculture in Albania began in the 1960s, starting with carp hatcheries and later expanding to include the Ohrid Lake hatchery, primarily for fish restocking [5]. In 1980, the country established its first rainbow trout hatchery in Vlora, which was stocked with broodstock imported from Italy two years earlier. Initially, the hatchery produced around 300 tonnes of fish and one

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million fingerlings at a facility covering five hectares. Following the dismantling of the state-controlled system in 1990, this trout farm was privatized but quickly went bankrupt [5]. Subsequently, small-scale, family-run trout farms emerged mainly in the northeast, north, and south regions. These farms typically produce under 5 tonnes annually and operate on plots of 100 to 400 square meters. Larger aquaculture farms appeared towards the late 1990s, with facilities over 1,000 square meters producing approximately 650 to 700 tonnes each year. In 2003, a major hatchery dedicated to Ohrid Lake trout (*Salmo letnica*) was established in Lin, Pogradec. Fish production expanded significantly over the decades—from about 300,000 fingerlings in the 1960s to over 2 million in 2023-2025 [5].

Rainbow trout constitute a small share of Albania's total aquaculture output compared to other species. In 2024, the sector produced 7149 tonnes, mainly marine fishes (91.8%), with rainbow trout accounting for 8.2% [2].

The highest rainbow trout production occurred in 2018, reaching 1,861 tonnes, valued at approximately 7.191 million USD (see figure 2) [2].

The market prices for rainbow trout have generally risen over time, with a notable spike during the COVID-19 pandemic. A comparative analysis shows that wholesale prices in 2019 ranged from 350 to 400 ALL per kilogram, while the typical market size for the fish was approximately 250 to 350 grams [5].

Albania's trout farming industry is dispersed across seven districts situated in the nation's northern, southern, and western regions. These areas are characterized by their mountainous landscapes and abundant waterways. While most locations are accessible by road, some districts, notably Dibra and Gjirokastra, pose challenges for reaching the rainbow trout farms due to more difficult terrain.

In Albania, the trout farming sector has experienced notable fluctuations over recent years. In 2013, the FAO reported that there were 58 trout farms operating across the country, including one hatchery, 19 combined hatchery and grow-out facilities, and 38 dedicated grow-out farms [6]. By 2018, data from the Ministry of Agriculture and Rural Development indicated a reduction to 49 rainbow trout farms. However, only 24 of these held valid licenses, raising concerns about regulatory compliance. Further investigation revealed that many licensed farms lacked proper aquaculture or environmental permits, with merely six farms fully meeting the national standards for sustainable trout cultivation. This situation highlights ongoing challenges in aligning aquaculture practices with legal and environmental requirements in Albania.

[1] In this percentile is not included the fish processing industry.

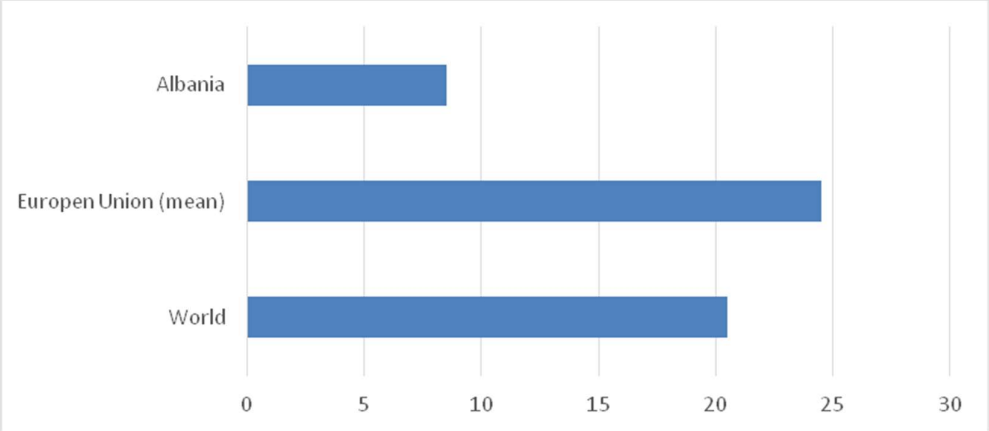

Figure 1. Fish consumption per capita [3]

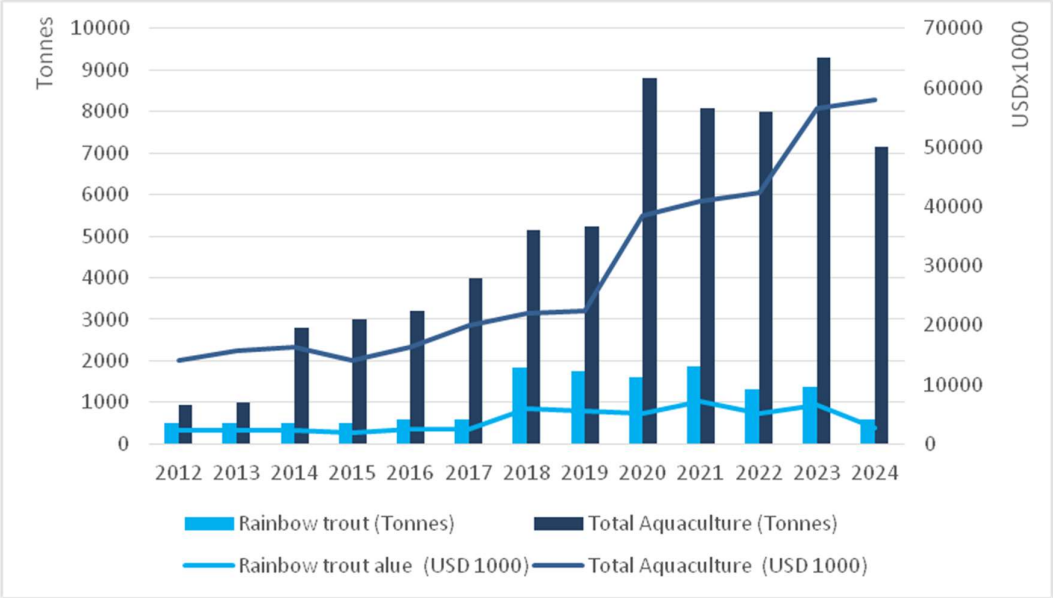

Figure 2. Annual Rainbow Trout and Aquaculture Production Data from 2012 to 2024 [2]

2. Material and Methods

The data collection plan was systematically implemented to achieve the objectives. This process included the collection of both primary and secondary data, along with field observations, expert group consultations, focus group interviews, farm surveys, and key informant interviews.

Regarding secondary data, the review was conducted by examining existing literature relevant to the subject matter. This review covered potential project outcomes in the field, national statistics provided by the National Institute of Statistics (INSTAT), and other pertinent studies. Additionally, meetings were held with experts from the Directorate of Fisheries at the Ministry of Agriculture and Rural Development (MARD) to identify potential additional data sources.

Concurrently, several engagements were organized with rainbow trout farmers, focus groups, industry representatives, and other stakeholders. These activities aimed to deepen understanding, ensure stakeholder input, and enhance the comprehensiveness of the data collected.

2.1. Development of Questionnaire

In the initial phase of the research, a comprehensive questionnaire was developed to facilitate the collection of primary data. The data collection process was strategically organized to address two main dimensions: geographical regions and stages within the value chain. The geographical focus encompassed several districts, including Shkodra, Dibra, Gjirokastra, Elbasan, and Korça, ensuring a broad representation of the area. To cover all aspects of the rainbow trout industry in Albania, two distinct questionnaires were designed, each tailored to capture information related to different stages of the value chain. These stages included aquaculture farms and market outlets, thus providing a holistic view of the sector from production to market. This methodological approach aimed to ensure comprehensive and accurate data collection across the diverse components and regions involved in the rainbow trout industry.

3. Results and Discussion

3.1. Analyzing the elements of the value chain

The Albanian rainbow trout industry exhibits a streamlined supply chain that effectively connects fish farmers, processors, and distributors (Fig. 3). Fish farmers harvest their catch and distribute it directly to local or international wholesalers, fish shops, or restaurants, relying on farm-raised fingerlings and imported fish feed from global suppliers. Transportation is facilitated by domestic and international logistics providers, with some producers using their own vehicles. The supply chain highlights three primary pathways: 64% routed through a predominant processing company for export, 31% flowing through domestic wholesale channels to retail outlets, and 5% sold directly at farm gates (fig 3). These pathways illustrate a system focused on export while maintaining local access, with contract farming exemplifying successful collaboration between producers and processors, such as the agreement

between the largest trout producer and the "Koral" processing company.

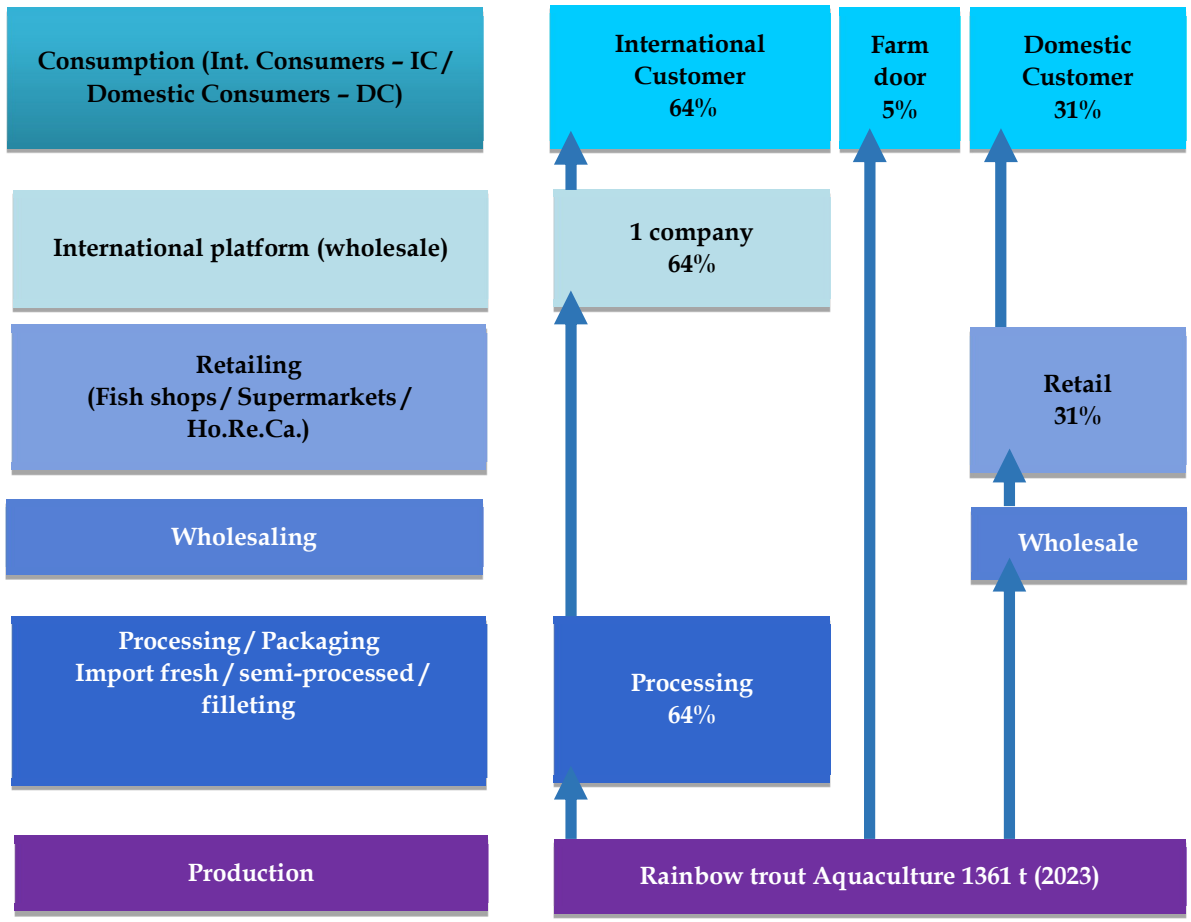

Figure 1. Value chain and market distribution for rainbow trout aquaculture (2023).

3.2. Primary producers

This study identified 19 active trout farms across Albania (Tab. 1). The decline in numbers may be linked to about 100 villages shifting focus to tourism. Interviewees cited environmental pollution concerns as the main reason for farm closures. The list below details the locations of these trout farms across the country. Only one company was found to export trout, and it is the largest, producing over 60% of the annual

trout. Unlike others, this company holds all necessary certifications for EU export [7].

Table 1. Distribution of Rainbow Trout Farms Across Albanian Districts

No	District	No. Rainbow trout farms
1	Shkoder	5
2	Dibër	6
3	Gjirokaster	5
4	Elbasan	2
5	Korce	1
6	Total	19

In Albania, rainbow trout aquaculture is conducted by 19 enterprises that collectively produced approximately 1,361 tonnes in 2023. These farms are concentrated in the northern, northeastern, and southern regions. Due to limited financial data, the European Commission classifies enterprises by employment size rather than economic performance, distinguishing between micro, small, and medium-sized farms [7].

Most trout farms in Albania are **micro-enterprises**, typically family-run operations with limited hired labor. These small-scale farms, particularly prevalent in the southern regions, operate closed production cycles—either maintaining their own broodstock or purchasing fingerlings for fattening to market size. They often integrate with other income-generating activities such as hospitality or small manufacturing.

Employment in these enterprises remains modest, with most farms engaging fewer than five workers and only one farm employing about thirty. Although labor contracts are formal and wages are paid monthly, technical expertise in aquaculture remains limited.

To better reflect the socioeconomic role of aquaculture, farms can be categorized according to their contribution to household livelihoods:

- Category A: Farms where aquaculture is one of several livelihood activities. This group represents the majority, with 10 of the 19 farms combining aquaculture with sectors such as tourism, hydropower, or manufacturing.
- Category B: Farms where aquaculture constitutes the primary source of income. Six farms fall into this category, typically family-run and employing few or no external workers.
- Category C: Farms that generate substantial income for reinvestment and expansion. Only three farms belong to this group, with production levels between 150 and 1,200 tonnes annually, reflecting higher technical capacity and productivity (Fig 4).

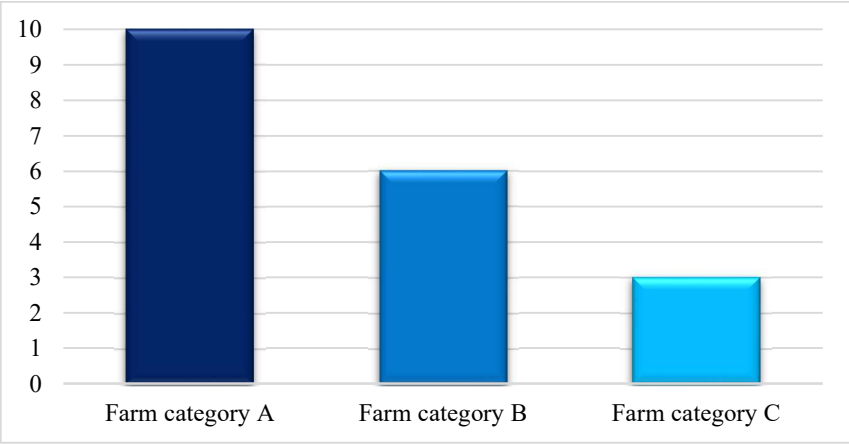

Figure 2. Categorization of farms in relation to the rainbow trout aquaculture activity in Albania

3.3. Wholesalers

The fish distribution network in Albania involves multiple stakeholders operating through distinct channels. In the case of marine fish, wholesalers predominantly rely on imported stock, distributing it to retail outlets, restaurants, and supermarkets. This distribution model is less applicable to rainbow trout, which is often produced on small farms where

producers frequently sell directly to markets, bypassing wholesalers altogether. Conversely, large trout farms typically engage wholesalers to manage distribution to various end-users such as markets, hospitality establishments, and retail outlets. Currently, efforts supported by the Albanian Ministry of Agriculture and Rural Development (MARD) aim to establish formal fish markets across the country, including in Shëngjin, Durrës, Vlorë, and Saranda. These markets are expected to streamline the distribution process, enhance the role of wholesalers, and positively impact the sector, particularly for rainbow trout.

3.4. Processing Industry

The processing segment is also concise, wherein processors obtain raw fish from local farms to prepare for export. They are primarily compensated for their processing services, often returning finished products to fish farmers for international distribution. Unlike more vertically integrated sectors, the rainbow trout industry lacks extensive integration, as all levels are primarily driven by local aquaculture operations with no significant imports.

Oversight of the fish value chain, including rainbow trout cultivation, falls under various departments of the MARD. To enhance coordination across production, distribution, processing, retail, and institutional sales, MARD has established the Fisheries and Aquaculture Advisory Committee [8], which includes representatives from the aquaculture and fishery industries.

Despite the interdependence of various stakeholders, the fish processing industry demonstrates a notable degree of independence from primary production sectors. The processing sector often relies on imports of raw or semi-processed fish, addressing its capacity to handle larger volumes than those provided by domestic aquaculture. This reliance raises critical questions regarding the sustainability and resilience of local fish supply chains amidst the broader operational framework of the industry.

3.5. Ho.Re.Ca.

In Albania, there is a well-established relationship between the hospitality sector—comprising hotels, restaurants, and cafes—and the fish industry. This connection becomes particularly evident during the summer months when coastal establishments prominently feature fish on their menus. The demand from the tourism sector often influences fish supply, leading to occasional shortages in the local fish market, as production prioritizes the hospitality industry to capitalize on higher prices driven by increased tourist numbers.

Specifically regarding rainbow trout, its consumption remains lower compared to marine fish; however, there is a notable increase during peak tourist seasons and festive occasions such as Christmas Eve. The hospitality sector effectively extends the market for rainbow trout, especially in northeastern and central regions of Albania, where it can be successfully sold even when marine fish demand declines. This dynamic highlights the adaptive nature of fish distribution routes in response to seasonal tourism and regional market demands.

3.6. Retail

The retail for the fish includes the following channels:

3.6.1. Fish shops

The fish retail industry in Albania comprises various sales channels, each characterized by distinct operational patterns and market dynamics. Specialized fish shops represent the primary segment, strategically distributed across major urban centers. These outlets experience heightened sales during weekends, with an observed surge in volume—particularly in coastal areas during the summer season, where sales on Saturdays and Sundays significantly surpass weekday figures by over 1000%. Rainbow trout emerges as a prominent product in central, northern, and eastern regions, with demand remaining relatively stable throughout the year, except during the Christmas period when sales notably increase. Strict adherence to cold chain protocols is a hallmark of these specialized establishments, driven by hygiene and safety regulations necessary for licensing.

3.6.2. Supermarket chains

Despite their extensive presence in Albania, demonstrate limited involvement in fish trade, especially concerning fresh rainbow trout. Unlike markets in Europe, these supermarkets typically lack dedicated refrigerated sections for fresh fish, concentrating instead on frozen products and mollusks. Small local markets within urban areas offer a different shopping experience, allowing consumers to purchase a variety of seafood—including canned and frozen items—though fresh fish is rarely available except in hypermarkets. The latter have expanded their dedicated

fresh fish sections in recent years, enhancing the accessibility of products such as rainbow trout within larger commercial centers.

3.6.3. Informal trade

Persists in rural and less developed regions, where sales often occur directly at fish farms or roadside stalls. Although roadside sales have diminished considerably, they still play a role in specific localities, particularly during weekends. Fish farm door sales are notably prevalent in small-scale aquaculture operations focused on rainbow trout, supported largely by unlicensed and illegal fishers. While these channels contribute to local supply, their overall volume remains limited and less influential in more developed urban markets.

3.7. Input suppliers & service providers in the extended VC

In the view of a more expansive VC, we are presenting the elements with which the VC is supplied to improve this sector

Three main types of support services are assessed:

- The provision of essential physical inputs (feed, packaging, ice, equipment)

These elements are critical for aquaculture. Albanian trout farms lack local feed production and rely on imports via wholesalers, factory agents, and large farms reselling to smaller ones, causing shortages, inflated prices, higher costs, and weaker competitiveness. A €1.5 million Rozafa Fish Processing Company plant planned in Elbasan aims to produce about 10 tons/hour to meet national demand. Processing centers focus on preserves and related methods: for folded preserves, raw fish is hand-processed under strict hygiene, then vacuum-packed, labeled on automated lines, and deep-frozen. Gutting and filleting are also manual, with products frozen for export—the dominant approach for rainbow trout.

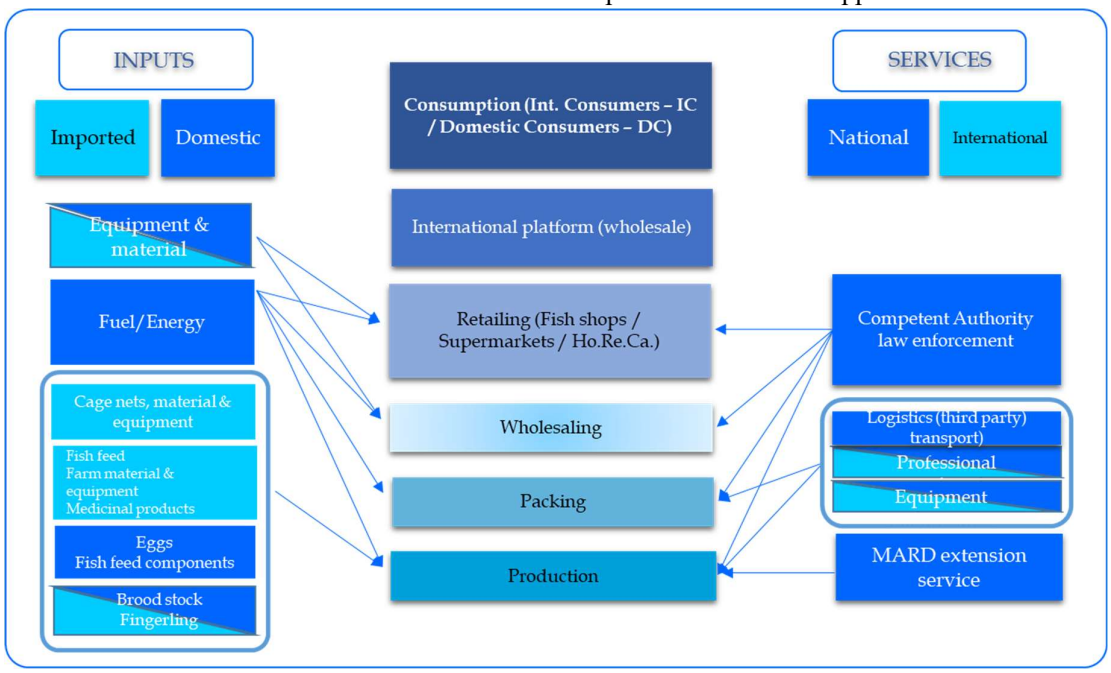

Figure 5. Supply of inputs and services to the rainbow trout value chain

- *The **provision of non-financial services** include storage, transport, extension, repairs, and market research.*

Cold storage for rainbow trout follows strict hygiene and safety protocols to maintain the cold chain across the value chain. Processing facilities meet these standards, with about €40 million invested in 2020 to expand capacity and integrate advanced technologies [9].

Transport in A–B farms faces cold-chain gaps: no regulated vehicle registry (outside MARD oversight), remote locations driving unsuitable live-fish transport, and poor refrigeration maintenance even in dedicated vehicles. By contrast, C-category farms shipping nationally and internationally meet strict standards. Some A–B farms use oxygenated live tanks; 9 of 19 prefer this to deliver fish alive despite higher oxygen costs. Maintaining transport integrity is critical for fish health and quality.

The provision of financial services (including insurance products).

Financial services, including insurance, are vital for sector sustainability, yet Albania's banking system inadequately supports aquaculture and fishing industries. High loan interest rates, especially in marine aquaculture, increase production costs, disproportionately affecting small-scale rainbow trout farmers who struggle to access affordable financing due to high interest and limited income. None of the interviewed operators reported receiving assistance from EU or national schemes, potentially contributing to stagnation in micro-scale freshwater aquaculture and hindering the adoption of international quality standards. The same findings were reported from AGT & DSA. [6] when the policymakers could alleviate financial burdens related to energy and fuel costs through targeted support, fostering sector growth.

3.8. Energy

Energy is essential for aquaculture operations. In trout farms utilizing water from natural sources and raceway systems, electricity impacts are less significant; however, electricity generators are vital for energy-dependent processes such as ice production. Many facilities are situated in remote areas prone to power outages. To date, there has been no adoption of renewable energy sources, such as photovoltaic panels, nor initiatives to improve energy efficiency in Albanian aquaculture or fish processing sectors.

3.9. Land property right

Land tenure and property rights are vital for stimulating investments in aquaculture by providing a secure environment and enhancing credibility with financial institutions. In trout cultivation, property rights are often ambiguous, leading to conflicts among government agencies and private entities, especially in micro and small to medium-sized enterprises. In the fish processing sector, property rights are typically established through contractual agreements with government or private stakeholders. A favorable investment climate in this industry is supported by strong relationships with banks and government initiatives, which promote growth and sustainability.

3.10. End-market analysis

3.10.1. Domestic Market

The Albanian fish market is dominated by fresh, locally sourced species—hake, European seabass, gilthead seabream, sardines, anchovies, and rainbow trout—supplemented by imports of seabass/seabream, frozen squid and shrimp, and canned anchovies, sardines, and tuna. A substantial share of salted anchovies arrives semi-processed for domestic processing, canning, and re-export. The absence of market monitoring hampers price estimation; respondent data indicate trout prices have risen about 20% since early 2017, reflecting a shift to formal channels (fewer roadside sales), relative stability until just before COVID-19, and renewed increases after the pandemic and the 2022 energy shock. Freshwater species remain cheaper than marine fish; rainbow trout prices are roughly one-third below aquaculture-origin marine species.

Rainbow trout is sold mainly fresh and whole in polystyrene boxes with ice (≈6 kg), with fillets and frozen forms rarely offered in local shops. Consumers view specialty-shop fish as fresher than supermarket products. Regional preferences diverge: central Albania ranks trout below marine options (e.g., hake, imported shrimp), whereas northern areas—especially Shkodra—prefer larger trout (800–1000 g), reflecting inland consumption traditions. Interviews corroborate preferences for whole fish and limited retailer interest in filleted trout; hospitality demand is steady but favors wild sea and imported frozen marine fish. Trout consumption rises in summer with Eastern European tourism and during Christmas in southeastern Albania. Concerns about mislabeling rainbow trout as Ohrid lake trout persist, underscoring the need for targeted, region-specific marketing and product strategies.

3.10.2. Export market

Since 2010, Albania’s fishery exports have grown steadily, quadrupling between 2015 and 2018. In 2018, about 2,000 tonnes of fresh aquaculture fish (mainly sea bass, seabream, and rainbow trout) were exported. The EU is the main market (EU seafood imports totaled 12.48 million tonnes in 2018). Despite rising exports, roughly 60% of Albania’s domestic seafood consumption is met by imports. Italy absorbs 63% of Albanian exports, followed by Sweden and Spain.

Export patterns reflect proximity and cuisine. Aquaculture output is largely marine, while inland producers face weaker access to Mediterranean markets. Rainbow trout exports concentrate where dietary preferences align; Germany is Europe’s leading consumer, and Albania primarily ships trout to Poland and Romania, with smaller volumes elsewhere.

Key barriers to trout expansion in Mediterranean markets include heterogeneous consumer demand and

stringent certification and sustainability requirements. Only Kilic holds relevant certifications and export access; most producers lack certification and sell domestically, constraining inland aquaculture growth. Small farms often self-process and transport with non-refrigerated or inadequately cooled trucks, risking cold-chain breaches, whereas larger farms (e.g., Kilic) use refrigerated logistics to export processed fish. COVID-19 sharply reduced sales (by 70% to 90%) among supermarket- and restaurant-oriented firms.

Post-pandemic demand has risen for fish, including trout, with seasonal peaks in July–August tourism and year-end traditions in southeastern districts. Respondents anticipate further growth across supermarkets and restaurants.

Since 2018, the trade balance by value has turned positive even as import volumes exceed export volumes. The surplus likely reflects importing lower-value raw or semi-processed inputs and exporting higher-value products. Imports have remained near 2,000 tonnes annually.

3.11. The Societal Environment

3.11.1. Formal institutional elements (such as national policies, regulations, laws, and standards);

Addressing formal institutional elements—national policies, regulations, laws, and standards—requires a coherent agenda centered on Allocated Zones for Aquaculture (AZA). Under Law 103/2016, AZAs must be approved; non-adoption has stalled growth across marine and inland aquaculture. MARD has completed the maritime AZA study pending interministerial clearance, while the inland AZA study (Agricultural University of Tirana) is due mid-next year. Although tourism concerns have delayed approval, international experience indicates that trout farms can complement tourism and education. IPARD III analyses suggest that AZA adoption alone could expand the sector four- to fivefold [1].

Cost-reduction measures are equally pivotal. Unlike capture fisheries, aquaculture receives neither fuel subsidies nor VAT exemptions on imported cage nets. Given that 65.2% of Albanian trout production occurs in cages, removing VAT on nets would materially lower unit costs. Feed tariffs also warrant attention: trout feed is imported and accounts for roughly 30% of final product cost, so tax relief would transmit directly to prices.

Structural constraints in labor and capabilities further limit competitiveness. Emigration and urbanization have created shortages of skilled and unskilled workers, depressing quality and raising costs. Only one firm (Kilic) holds export-relevant certifications; subsidized certification and compliance support for small farms would open international markets. The current MARD extension service excludes fisheries and aquaculture; establishing a dedicated service would improve product selection, uptake of financial schemes, and profitability.

Finally, infrastructure and market organization remain binding constraints. Remote farm locations and weak transport infrastructure undermine cold-chain integrity and increase costs. Targeted upgrades, together with operationalizing the one fish auction and completing three additional planned auction sites, would strengthen price discovery and sales channels for inland aquaculture.

3.11.2. Informal socio-cultural elements

The trout aquaculture sector's short supply chain enhances producers' price-setting influence, yet competition among small farms remains intense despite recent closures. Only 65.% of output is linked to processors, typically through bilateral contracts between a single primary producer and one processor; many small farms lack access to processing facilities as processors prioritize imported inputs to ensure continuous throughput. Cooperation among operators persists, with larger producers supplying fingerlings and other support to smaller farms without treating them as rivals. Wholesalers maintain close ties with primary producers, providing price signals and guidance on optimal harvest and market timing. The labor structure offers opportunities for both men and women, with women concentrated in hatcheries and in packaging, grading, and storage, though many micro-enterprises operate as family businesses employing mainly household members.

3.11.3. Infrastructural elements

Trout aquaculture operates across five water-rich districts with improving road access to markets; however, some small, remote farms depend on poor roads, increasing fuel and vehicle service costs and risking freshness. Fish auction markets near major ports, though distant from trout farms, provide compliant infrastructure for hygienic trade; MARD plans four such facilities, with Shëngjin ready for operation, Vlora under construction, and Saranda

scheduled for completion in 2023. No dedicated wholesale markets exist for trout due to low production volumes, while large firms (e.g., Kilic) export directly under EU standards. All farms are grid-connected but keep generators to manage outages, especially in mountainous areas; electricity is generally unnecessary for water pumping but is required for ice production during transport. Processing plants, typically urban and port-adjacent, rely heavily on electricity, maintain backup supply, and report uncertainty about rising household energy prices potentially affecting business costs.

4. Key features and challenges

The main segments of the supply chain, such as primary production and processing (where vertical integration is lacking), can ensure significant flexibility and resilience against external market disruptions affecting their business models.

Vertical integration is absent in rainbow trout production. The primary BOs typically rely on contracts with processing companies to handle their products, which are then distributed through an international wholesale platform.

In the domestic market, aquaculture products like rainbow trout face difficulties convincing local consumers to purchase them. Many believe foreign aquaculture products are of higher quality than domestic ones.

The leakage from fish feed factories negatively affects production costs. Building such factories could lower the price of 1 kg of trout and boost competitiveness in the global market. A key challenge is increasing flexibility and adapting trout products to changing consumer preferences. In Albania, consumers are drawn to new products, creating an opportunity to promote and position trout as a high-quality choice.

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