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BLUE ECONOMY: BUSINESS MODEL FEATURES OF AQUACULTURE FARMS

Abstract: *In conditions of limited resources, sustainable development of the economy is important. Among the modern theories and concepts of the economy, we should highlight the Blue Economy, which corresponds to the goals of sustainable development of the United Nations (goals 1; 8; 14: 15; 17). The Blue Economy includes sectors such as: coastal tourism, marine living resources - aquaculture, blue energy, blue biotechnologies and seabed mining. Aquaculture, the farming of aquatic organisms such as fish, shellfish, and aquatic plants, has emerged as a critical sector in meeting the growing global demand for seafood. As the industry evolves, various business models have emerged to address the unique challenges and opportunities associated with aquaculture. This comprehensive study explores the diverse aquaculture business models, their advantages, limitations, and implications for sustainable development, economic growth, and social equity. The study draws on existing literature, case studies, and expert insights to provide a thorough analysis of the different business models employed in the aquaculture sector.*

Keywords: *Blue Economy; Business Model; Aquaculture; economic analyses.*

JEL classification: *M21, O18, Q12.*

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ლურჯი ეკონომიკა: აკვაკულტურული მეურნეობების ბიზნეს მოდელის მახასიათებლები

აბსტრაქტი. *ეკონომიკის მდგრად განვითარებაში მნიშვნელოვან როლს ასრულებს „ლურჯი ეკონომიკა“, განსაკუთრებით კი ისეთი სექტორი, როგორიცაა აკვაკულტურა. უახლესი კვლევები ცხადყოფს აკვაკულტურის სექტორის მდგრადი განვითარების მნიშვნელობას*

რესურსების ეფექტურ მართვასა და გარემოსდაცვითი ზემოქმედების შემცირებაში. სტატიაში გამოყოფილია სექტორის წინაშე არსებულ საჭიროები, მათ შორის, ეფექტიანი ბიზნეს მოდელის შერჩევა და ინოვაციური ტექნოლოგიების გამოყენების აუცილებლობა.
სტატიის ძირითად ნაწილში განხილულია აკვაკულტურული მეურნეობების ბიზნეს მოდელების სხვადასხვა ტიპები. მდგრადი აკვაკულტურისთვის მნიშვნელოვანია ისეთი ტექნოლოგიების დანერგვა, რომელიც შეამცირებს რესურსების მოხმარებას და გარემოს დაბინძურებას. კვლევები აჩვენებს, რომ აკვაკულტურის როლი ვაჭრობასა და ეკონომიკურ განვითარებაში მაღალია, განსაკუთრებით საექსპორტო ბაზრებზე ორიენტირებული წარმოების შემთხვევაში. ქვეყნები, რომლებიც წარმატებით ახორციელებენ ლურჯი ეკონომიკის პოლიტიკას, არა მხოლოდ აძლიერებენ ეკონომიკურ ზრდას, არამედ ამცირებენ დამოკიდებულებას იმპორტირებულ ზღვის პროდუქტებზე და ამით აუმჯობესებენ სავაჭრო ბალანსს.
საერთო ჯამში, აკვაკულტურის მდგრადი ბიზნეს მოდელების გამოყენება ლურჯი ეკონომიკის სტრატეგიებში საშუალებას აძლევს ქვეყნებს განავითარონ ეკონომიკურად და ეკოლოგიურად ეფექტიანი სექტორი, რაც ხელს უწყობს არამხოლოდ ეროვნულ, არამედ გლობალურ მდგრად განვითარებას.

საკვანძო სიტყვები: *ლურჯი ეკონომიკა; ბიზნეს მოდელი; აკვაკულტურა; ეკონომიკური ანალიზები.*
JEL კლასიფიკაცია: *M21, O18, Q12.*

Introduction and review of literature

The origins of aquaculture can be traced back thousands of years to ancient civilizations such as the Chinese, Egyptians, and Romans, who practiced various forms of fish farming. However, it was in the 20th century that aquaculture witnessed significant advancements, leading to its rapid expansion on a global scale. Over the years, aquaculture has gained prominence as a means to supplement declining wild fish stocks and to reduce the pressure on overexploited marine ecosystems. By providing a controlled environment for aquaculture species, the industry can enhance productivity, minimize environmental impacts, and ensure a more stable supply of fish products. The sector has not only become a crucial component of the global food supply but also contributes significantly to employment, economic development, and trade in many countries.

The term "Blue Economy" was first used in 1994 by Gunter Pauli in his book "Blue Economy 3.0", the concept and approaches of Blue Economy policies are new, still under discussion and development (Pauli, 2011). According to the World Bank, the Blue Economy is the sustainable use of marine resources for economic growth and development, improved living conditions and jobs, and the health of the ocean ecosystem. The Blue Economy includes sectors such as: coastal tourism, marine living resources - aquaculture, blue energy, blue biotechnologies and seabed mining (Bank, 2017).

Nowadays, approximately half of the world's population, which is around 3 billion people, lives within 200 kilometers of a coastline. According to anthropologists, that figure is likely to double by 2025 (Creel, 2013). In recent years, awareness of the concept of the Blue Economy has been growing, although it is still not a widespread policy with formulated goals.

Aquaculture holds immense promise as a catalyst for driving economic growth and enhancing trade balances in countries, especially when it strategically targets the export of fish to international markets. The expansion and development of aquaculture businesses can create a multitude of economic opportunities and generate a positive ripple effect across various sectors of the economy.

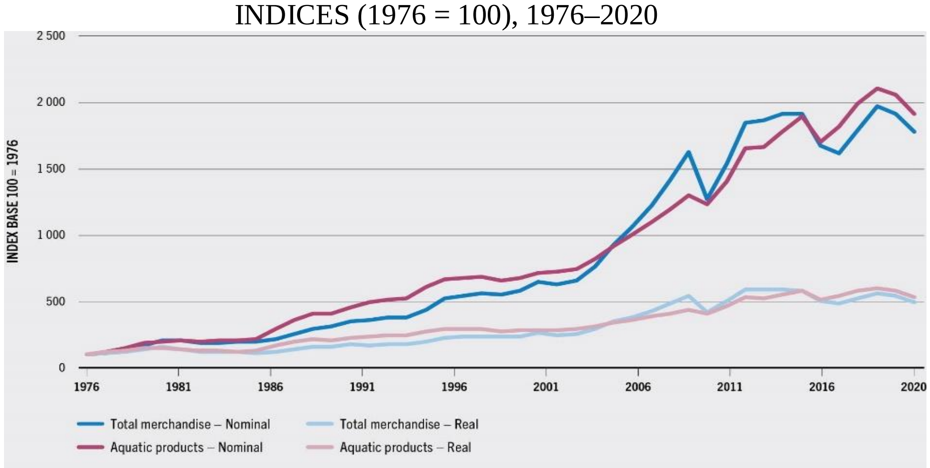
By focusing on exporting fish and seafood products to global markets, aquaculture farms can tap into the ever-increasing demand for high-quality and sustainable seafood. As international consumers seek diverse and nutritious protein sources, aquaculture provides a viable solution, contributing significantly to foreign exchange earnings and bolstering the national economy.

The growth of aquaculture businesses, with a deliberate emphasis on export-oriented strategies, not only generates direct revenue from fish sales but also stimulates related industries such as transportation, processing, and packaging. These economic linkages foster job creation and income generation, thereby supporting local communities and promoting inclusive growth (Kaminski A. M., 2020).

Moreover, the adoption of modern aquaculture practices, coupled with investment in research and development, enables farms to increase production efficiency, improve product quality, and optimize resource utilization. As aquaculture evolves to meet sustainability goals, businesses can minimize environmental impacts, enhance resource conservation, and mitigate concerns related to overfishing.

In addition to economic benefits, aquaculture's focus on export markets contributes to strengthening trade balances by reducing the dependence on imported seafood. By substituting imports with locally produced fish, countries can improve their trade position and potentially mitigate trade deficits (Department, 2018).

Figure 1. WORLD MERCHANDISE AND AQUATIC PRODUCT1 EXPORT VALUE, FIXED-BASE INDICES (1976 = 100), 1976–2020



Source: FAO

To fully realize the potential of aquaculture in driving economic growth and trade balances, governments and stakeholders must collaborate to create an enabling environment. This involves formulating supportive policies, facilitating access to financing, enhancing infrastructure, and promoting research and innovation. By embracing the opportunities offered by aquaculture and addressing the challenges, countries can leverage this dynamic industry to establish themselves as key players in the global seafood trade arena, securing a sustainable and prosperous future.

Modern aquaculture systems encompass a wide range of techniques and technologies, from traditional pond culture and extensive coastal farming to sophisticated recirculating aquaculture systems and integrated multi-trophic aquaculture (IMTA) (Nations, 2022).

This paper aims to provide a comprehensive analysis of aquaculture business models, exploring their strengths, weaknesses, and implications for sustainable development, economic growth, and social equity. The study aims to review and analyze the different types of aquaculture business models currently in practice, including traditional extensive aquaculture, intensive systems, semi-intensive methods, polyculture, integrated multi-trophic aquaculture (IMTA), recirculating aquaculture systems (RAS). Through an in-depth analysis of aquaculture business models, this study endeavors to guide decision-makers in making informed choices that can lead to a thriving and responsible aquaculture sector.

Overview of Aquaculture Business Models

As the aquaculture industry expands and diversifies, the need for well-defined and effective business models becomes increasingly critical. Different aquaculture species, geographic locations, market demands, and regulatory environments require tailored approaches to maximize efficiency and profitability. Business models in aquaculture encompass the organization, management, and operational aspects of the production process, including production methods, resource allocation, financing, marketing, and distribution.

The choice of an appropriate business model can significantly influence the economic viability and sustainability of aquaculture ventures. For example, traditional extensive aquaculture may suit certain regions with low-cost land and abundant water resources, while intensive recirculating aquaculture systems may be more suitable for land-constrained urban areas with limited water availability. The selection of the right business model is vital for optimizing production, minimizing environmental impacts, and ensuring the equitable distribution of benefits across different stakeholders.

Moreover, the aquaculture industry faces numerous challenges, such as environmental concerns, social equity issues, regulatory complexities, and market uncertainties. Business models can be tailored to address these challenges and capitalize on emerging opportunities, promoting the industry's long-term growth and sustainability.

Traditional Extensive Aquaculture - Aquaculture has been practiced for centuries in traditional extensive systems, which involve cultivating fish or other aquatic organisms in open waters, such as ponds, lakes, or coastal areas. Unlike intensive aquaculture, which relies on controlled environments, extensive aquaculture relies on natural water bodies and minimal human intervention. Traditional extensive aquaculture is characterized by its reliance on natural ecological processes and low input requirements. Ponds are the most common water bodies used in traditional extensive aquaculture. These ponds may be naturally occurring or artificially created. Fish or shellfish are stocked in the ponds and allowed to grow at their own pace, largely depending on the natural food sources available in the water. The stocking density in traditional extensive systems ensures that the fish have enough space to swim and access natural food resources present in the water. Traditional extensive aquaculture often focuses on cultivating local fish species that are naturally found in the region. These species are well-adapted to the local environment and are less prone to diseases and stress. In traditional extensive aquaculture water quality largely depends on natural processes and weather conditions (Nations, 2019).

The advantages of this model are that it has low investment and operating costs. Traditional extensive aquaculture requires minimal infrastructure and capital investment, making it accessible to small-scale farmers and communities with limited resources. As the system relies on natural food sources, the need for expensive feeds is reduced, thereby lowering operating costs. It should be noted that traditional extensive aquaculture contributes to the conservation of native biodiversity.

On the other hand, traditional extensive aquaculture is characterized by low productivity. Traditional extensive systems have lower stocking densities and slower growth rates, resulting in lower overall productivity compared to intensive aquaculture. Also, due to the reliance on natural conditions, farmers have limited control over the growth rates and environmental conditions. All this often has unpredictable consequences. In addition, in some regions, unregulated traditional extensive aquaculture can lead to overfishing and environmental degradation.

As an example, we can consider Nile Tilapia Pond Culture in Egypt. n Egypt, traditional extensive aquaculture plays a significant role in fish production, with Nile tilapia (Oreochromis niloticus) being the primary species farmed. Small-scale farmers construct earthen ponds along the Nile River's banks, allowing water to flow into the ponds during the annual Nile flood. Nile tilapia is stocked in these ponds and relies on the natural nutrients brought in by the floodwaters. Farmers harvest the fish once they reach marketable size. This traditional extensive aquaculture system contributes to local food security and provides livelihood opportunities for rural communities (El-Sayed, 2023).

Intensive Aquaculture - Intensive aquaculture represents a modern and highly controlled approach to fish and seafood production. In contrast to traditional extensive systems, intensive aquaculture involves high stocking densities and significant human intervention to optimize growth rates, feed efficiency, and overall productivity. Intensive aquaculture employs various advanced farming techniques to maximize production and minimize resource use. For instance, high stocking density. Intensive systems are characterized by high stocking densities, where a large number of fish or aquatic organisms are reared in a relatively small space. Intensive aquaculture often takes place in closed or semi-closed systems, such as recirculating aquaculture systems (RAS) or indoor tanks. These systems allow for precise control of environmental conditions, including water quality, temperature, and lighting. In intensive aquaculture, fish are typically provided with formulated feeds that contain all the necessary nutrients for rapid growth. This allows for consistent and predictable growth rates. This model often involves selective breeding programs to enhance desired traits, such as growth rate, disease resistance, and feed conversion efficiency. Intensive aquaculture often produces premium-quality fish and seafood products, commanding higher market prices. If we take into account that controlled environmental conditions and specialized feeds facilitate faster growth rates, reducing the time required to reach marketable sizes, we can conclude that year-round production is possible. This factor reducing seasonality effects on the market.

While intensive aquaculture offers high productivity, it is not without environmental concerns. Some of the major issues include disease and parasite management, waste generation, require significant energy inputs for water circulation, temperature control, and lighting and other.

Norway has implemented this model. Norway is a global leader in salmon farming, employing intensive aquaculture methods. Salmon are reared in sea cages, allowing for high stocking densities and water exchange with the surrounding marine environment. Advanced feed formulations, selective breeding programs, and precise water quality management have resulted in rapid growth rates and premium-quality fish. However, concerns about disease outbreaks, parasite infestations, and environmental impacts have led to increased focus on sustainable practices and disease management in the industry (Kozul-Wright, 2022).

Semi-Intensive Aquaculture - Semi-intensive aquaculture represents a hybrid approach that combines some of the elements of both traditional extensive and intensive aquaculture systems. This model strikes a balance between controlled interventions and utilizing natural ecological processes. Semi-intensive aquaculture incorporates specific practices from both traditional extensive and intensive systems. Some of the key characteristics of this approach include moderate stocking density, supplementary feeding and partial water management. The moderate stocking density allows for some control over the environment while still utilizing natural food sources to some extent. While natural food sources are available in the water bodies, semi-intensive aquaculture may include the supplementary feeding of fish to improve growth rates and overall production. Semi-intensive aquaculture typically requires less infrastructure and capital investment compared to intensive systems. However, some basic facilities, such as simple ponds or net enclosures, may be needed. Due to its hybrid nature, Semi-intensive aquaculture offers several sustainability benefits. As a result of such approaches productivity is improved, environmental impact is reduced, and business economic and financial viability is increased.

This practice is shared by many Asian countries, including India. for example, In India, semi-intensive aquaculture is commonly practiced in carp polyculture systems. Fish farmers rear multiple species of carp, such as rohu, catla, and mrigal, in the same pond. The fish are stocked at moderate densities and rely on natural food sources, such as plankton and detritus, as well as supplementary feeds. Carp polyculture benefits from the synergistic interactions between different carp species, improving overall productivity and providing economic stability for small-scale farmers (Nair, 2007).

Polyculture Systems - Polyculture systems in aquaculture involve the simultaneous cultivation of multiple species of fish or other aquatic organisms in the same aquatic environment. Unlike monoculture, where only one species is reared, polyculture harnesses the ecological interactions between different species to create a more balanced and sustainable farming approach. Polyculture systems offer several synergistic benefits that contribute to their popularity in aquaculture. For example, different species have different dietary preferences and feeding behaviors. In polyculture, the waste products of one species can serve as nutrients for another, creating a more efficient nutrient cycling system (nutrient cycling). Also, by utilizing different ecological niches and food sources, polyculture optimizes resource utilization and reduces competition for food and space We have as a result biological control (some species in polyculture systems may act as natural predators for pests or competitors, reducing the need for chemical interventions), improved water quality (Polyculture systems can enhance water quality by utilizing waste products and reducing the buildup of organic matter) and reduced disease risk (diverse species composition can reduce the risk of disease outbreaks by diluting the impact on a single species). At the same time this model contributes to biodiversity conservation and environmental resilience in several ways. Polyculture promotes the cultivation of a variety of species, some of which may be native and locally adapted. This diversification reduces the risk of genetic homogeneity and the spread of diseases. The presence of multiple species in a polyculture system can create diverse microhabitats, which can support a broader range of aquatic organisms. Based on these factors, it is possible that this model can be used to restore degraded ecosystems.

It is a good example as a case study is Rice-Fish Farming in Asia. Rice-fish farming is a traditional polyculture system practiced in parts of Asia, particularly in China and Southeast Asia. Farmers cultivate fish in rice paddies during the growing season, where the fish help control pests and feed on insects, weeds, and detritus. The fish waste provides nutrients for the rice plants, reducing the need for chemical fertilizers. This integrated approach improves rice yields and enhances fish productivity, providing economic benefits to farmers and supporting local food security (Sinxo, 2022).

Integrated Multi-Trophic Aquaculture (IMTA) – This is an innovative and sustainable approach to aquaculture that involves the cultivation of multiple species with different trophic levels in a single integrated system. IMTA harnesses ecological interactions between species, creating a balanced and mutually beneficial farming model. The fundamental principles of IMTA are based on ecological interactions and resource utilization. IMTA involves the cultivation of species from different trophic levels, such as finfish, shellfish, and seaweeds. Finfish are typically the high-trophic-level species, while shellfish and seaweeds are low-trophic-level species. In such a case the waste products generated by high-trophic-level species, such as finfish, provide nutrients for low-trophic-level species, such as shellfish and seaweeds. This nutrient cycling optimizes resource utilization and reduces waste. In this way, this model tries to mimic natural ecosystems by promoting symbiotic relationships between different species. This approach enhances ecosystem integration and creates a more balanced and resilient aquaculture system. IMTA can be applied in various settings, such as sea-based systems, coastal areas, and land-based recirculating aquaculture systems (RAS). In sea-based IMTA, different species are cultivated in proximity to each other, utilizing the natural environment to facilitate nutrient exchange. In coastal IMTA, species are cultivated in separate but interconnected aquatic zones, allowing for water and nutrient flow between the compartments. It should be noted that seaweeds in IMTA systems sequester carbon dioxide during photosynthesis, contributing to climate change mitigation.

In Canada, an innovative sea-based IMTA system involves cultivating salmon, blue mussels, and sea urchins. Salmon, a high-trophic-level species, is grown in cages, while blue mussels and sea urchins are grown on suspended ropes. Blue mussels filter excess nutrients from salmon waste, and sea urchins feed on seaweed that grows on the mussel ropes. The IMTA system has shown promise in reducing nutrient loading, improving water quality, and diversifying the aquaculture industry (Hossain, 2022).

Recirculating Aquaculture Systems (RAS) - Recirculating Aquaculture Systems (RAS) are a sophisticated and high-tech approach to aquaculture that aim to optimize water usage and create a controlled environment for fish and seafood production. RAS reuses and recirculates water through advanced filtration and treatment processes, reducing water consumption and waste discharge. RAS is designed to minimize water consumption and enhance resource efficiency through advanced filtration and treatment technologies. Key components of RAS include: water filtration, water treatment and water reuse. RAS employs various filtration systems, such as mechanical, biological, and chemical filters, to remove solid particles, ammonia, and other waste products from the water. The water in RAS is subjected to treatment processes, such as biofiltration, denitrification, and UV sterilization, to maintain optimal water quality and remove harmful pathogens. The treated water is continuously recirculated through the system, reducing the need for frequent water exchanges and minimizing water consumption. Simply put, RAS operates as a closed-loop system, which means that water loss due to evaporation is minimized, and there is minimal discharge of waste into the environment.

Despite the higher initial investment costs, RAS allows for higher stocking densities and faster growth rates, resulting in increased productivity and higher yields per unit of water and land area. The water recycling capabilities of RAS significantly reduce the water consumption, leading to lower water costs over the long term. In addition, RAS can be implemented in various locations, including urban areas and landlocked regions, reducing the dependency on specific geographical locations. Also, RAS can maintain a stable environment, allowing for year-round production regardless of external weather conditions. This allows us to have an increasingly sustainable production of fish and seafood.

Norway, a leading salmon-producing country, has embraced RAS technology for salmon farming. Land-based RAS facilities allow for the controlled production of salmon in a closed-loop system. The use of RAS enhances the biosecurity of salmon farms, reduces the risk of sea lice infestations, and minimizes the environmental impact on coastal ecosystems. The RAS salmon farming model in Norway has shown economic viability, high-quality product output, and reduced reliance on wild fish for feed (Drengstig, 2011).

Economic aspects of aquaculture business models

Aquaculture business models play a significant role in the global fish and seafood production industry. To ensure the sustainability and profitability of aquaculture ventures, it is essential to conduct thorough economic analyses. Cost-benefit analysis is a fundamental tool used to evaluate the financial feasibility and profitability of aquaculture projects. It involves assessing the costs associated with setting up and operating the aquaculture venture and comparing them to the expected benefits and revenue generated from the sale of fish and seafood products. Consider the components of each side. Costs in aquaculture business models include infrastructure and equipment, wages of the workforce, feed and feeding costs, water and energy costs, seed or fingerlings, costs of disease control, government taxes and regulations, and more. And in the benefit and income section, we have income from the sale of fish and seafood products, as well as income from the purchase of additional value, benefits from by-products, benefits from tourism and recreational activities, and others. Revenue generation in aquaculture business models is influenced by various market dynamics. For example, the demand for specific fish and seafood species, as well as market prices, directly affect revenue generation. Aquaculture products may experience seasonal fluctuations in demand and price, impacting revenue throughout the year. Also, access to local and international markets, as well as efficient distribution channels, influences revenue opportunities. In addition, one of the most important factors is consumer preferences and trends. Shifting consumer preferences, such as a preference for sustainable or organic products, can impact market demand. The economic analysis of aquaculture business models is essential for assessing their financial feasibility and long-term sustainability. Cost-benefit analysis helps determine the viability of projects by evaluating potential costs and revenue streams. Market dynamics influence revenue generation, making it crucial to consider market demand, pricing, and consumer preferences. Investment and financing strategies play a pivotal role in obtaining the necessary capital to establish or expand aquaculture ventures. By conducting comprehensive economic analyses and implementing sound financial strategies, aquaculture businesses can position themselves for success and contribute to the growth and development of the global fish and seafood production industry (Kruijssen, 2020).

The implementation of aquaculture business models faces various challenges and constraints that can impact the success and sustainability of ventures. Regulatory and policy hurdles pose significant challenges to the development and growth of aquaculture businesses. Obtaining licenses and permits for aquaculture operations can be a lengthy and complex process, leading to delays and increased costs. Compliance with environmental regulations and standards can be challenging, especially when addressing issues related to water quality, waste management, and habitat protection. in addition, inconsistent or conflicting policies at different levels of government can create uncertainty and hinder long-term planning. Also, weak governance and enforcement mechanisms can lead to illegal or unregulated aquaculture practices, causing negative environmental and social impacts (Kaminski A. , 2020).

In the rapid development of aquaculture farms, a lot of attention is paid to technologies. The adoption of advanced technologies and knowledge transfer in aquaculture can be challenging. Access to reliable and up-to-date information on best practices and technological advancements may be limited, especially in remote or developing regions. A lack of technical skills and training among aquaculture farmers and workers can hinder the adoption of new technologies and practices. We must say that limited investment in aquaculture research and development can slow the dissemination of innovative technologies and solutions. Policy planning and implementation are influenced by knowledge and established opinion in society. Therefore, Awareness and perception issues can influence public support, consumer acceptance, and market demand for aquaculture products.

Conclusions

Aquaculture, the farming of aquatic organisms, has gained immense significance as a crucial source of food, income, and employment worldwide. As the global population continues to grow, the demand for fish and seafood products rises, placing immense pressure on wild fish stocks. Consequently, aquaculture emerges as a sustainable solution to meet the increasing demand. However, despite its potential, the successful implementation of aquaculture business models faces various challenges and constraints. Aquaculture has transformed from a traditional practice to a significant global industry. That is why it is important to study the business models of existing aquaculture farms. At the very first stage, we should do their economic, social and environmental analysis. This will allow us to see the real picture and to assess and plan the right policy for the development of the aquaculture business model within the existing possibilities.

The various models described in the paper clearly represent potential opportunities. These models can be successfully implemented in countries with different circumstances and resources. Economic analysis and ecological assessment have shown that aquaculture farms are facing significant challenges, overcoming which will give developing and developed countries the opportunity to overcome the imbalance in the seafood market, increase employment in this sector and be able to preserve biodiversity.

REFERENCES

Arellano, N. (2023). Norway aquaculture survey shows low confidence in land-based operations. Retrieved from https://www.rastechmagazine.com/norway-aquaculture-survey-shows-low-confidence-in-land-based-operations/

Bank, T. W. (2017). THE POTENTIAL OF THE BLUE ECONOMY. Washington DC. Retrieved from https://bit.ly/3ttb6SN

Creel, L. (2013). Ripple Effects: Population and Coastal Regions. Retrieved from https://www.prb.org/resources/ripple-effects-population-and-coastal-regions/

Department, A. O. (2018). The state of world fisheries and aquaculture. Retrieved from https://rb.gy/954e5

discoveragriculture. (2020). Modern Fish Farming Technology | FISH FARMING IN INDIA. Retrieved from https://discoveragriculture.com/modern-fish-farming-technology-fish-farming-in-india/

Drengstig, A. (2011). Norwegian salmon smolt farms embracing RAS to raise production. Retrieved from https://www.globalseafood.org/advocate/norwegian-salmon-smolt-farms-embracing-ras-to-raise-production/

El-Sayed, A.-F. M. (2017). Egypt's success with tilapia a blueprint for all Africa. Retrieved from https://www.globalseafood.org/advocate/egypt-tilapia-blueprint-africa/

El-Sayed, A.-F. M. (2023). From Africa to the world—The journey of Nile tilapia. Retrieved from https://onlinelibrary.wiley.com/doi/full/10.1111/raq.12738

Hossain, A. (2022). Lessons for Coastal Applications of IMTA as a Way towards Sustainable Development: A Review. Retrieved from https://www.mdpi.com/2076-3417/12/23/11920

Kaminski, A. (2020). A review of inclusive business models and their application in aquaculture development. Retrieved from https://dx.doi.org/10.1111/raq.12415

Kaminski, A. M. (2020). A review of inclusive business models and their application in aquaculture development. doi: https://doi.org/10.1111/raq.12415

Kozul-Wright, A. (2022). A salmon tax: could Norway's plan share the benefits of the seas? Retrieved from https://rb.gy/ip2wf

Kruijssen, F. (2020). A review of inclusive business models and their application in aquaculture development. Retrieved from https://onlinelibrary.wiley.com/doi/full/10.1111/raq.12415

Nair, M. (2007). Carp polyculture in India. Retrieved from https://www.globalseafood.org/advocate/carp-polyculture-in-india/

Nations, F. a. (2019). AQUACULTURE METHODS AND PRACTICES: A SELECTED REVIEW. Retrieved from https://www.fao.org/3/t8598e/t8598e05.htm

Nations, F. a. (2022). TRADE OF FISHERIES AND AQUACULTURE PRODUCTS. Retrieved from https://www.fao.org/3/cc0461en/online/sofia/2022/trade-of-aquatic-products.html

Pauli, G. (2011, January). The Blue Economy. Retrieved from https://www.jef.or.jp/journal/pdf/175th_cover04.pdf

Sinxo, Z. (2022). Rice-fish farming: The perfect pair in one place. Retrieved from https://www.foodformzansi.co.za/rice-fish-farming-the-perfect-pair-in-one-place/