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ADVANCING THE SUSTAINABILITY OF AQUACULTURE THROUGH ECOSYSTEM SERVICES MONETIZATION

Angelica DOBRE[1, 2], Lorena DEDIU[1], Desimira Maria STROE[2], Mirela CREȚU[1, 2], Floricel Maricel DIMA[2]

[1]"Dunarea de Jos" University of Galati, 47 Domneasca Street, 800008, Galati, Romania
[2]Institute of Research and Development for Aquatic Ecology, Fishing and Aquaculture Galati, 54 Portului Street, 800211, Galati, Romania

Corresponding author email: angelica.dobre85@yahoo.com

Abstract

Most of the human interaction with nature affects ecosystems, influencing human life quality. The aquaculture industry plays a pivotal role in global food security, but its growth poses multifaceted challenges to environmental conservation, urging the implementation of sustainable measures to safeguard aquatic ecosystems. In this context, Payments for Ecosystem Services (PES) have emerged as a pioneering approach to incentivize and ensure sustainable practices within the aquaculture sector. This study emphasizes the fundamental role of PES, it highlights its substantial impact in ameliorating environmental repercussions, conserving biodiversity, and enhancing water quality within aquacultural zones. The study underscores the importance of collaborative efforts among stakeholders and advocates for effective monitoring systems to reinforce the efficacy of PES initiatives in fostering sustainable aquaculture practices. By centering on Romania's aquacultural context, this paper provides crucial insights into the implementation of PES within diverse socio-economic and environmental landscapes, contributing pertinent perspectives to the overarching discourse on sustainable aquaculture practices worldwide for a safe future.

Key words*: aquaculture, biodiversity conservation, economic incentives, environmental services, sustainable practices.*

INTRODUCTION

The relationship between humans and nature is a reciprocal cycle, where human actions impact ecosystems, and ecosystems, in turn, affect human life quality. Human decisions shape today's ecosystems, influencing aspects like land use, water management, and fisheries (Liu et al., 2007; Chapin et al., 2010).

The aquaculture industry is a vital component of the global economy, crucial for ensuring food security amid population growth (FAO, 2018; Turkowski, 2021). Recognizing the need for sustainable practices in aquaculture, the concept of Payments for Ecosystem Services (PES) has gained attention as an innovative approach. PES aims to harmonize socioeconomic development with ecological conservation, providing positive incentives for enhanced ecosystem services (Anderson et al., 2015; Chen et al., 2021; Blandon et al., 2016).

This paper delves into the significance of PES in the aquaculture industry, examining research and case studies showing its impact on sustainable practices and environmental conservation. Additionally, we address challenges and opportunities in implementing PES, stressing the importance of stakeholder collaboration for achieving sustainability goals.

MATERIALS AND METHODS

This study relies on the comprehensive collection and analysis of information gathered from reputable scientific platforms, including ResearchGate, Science Direct, and Google Scholar. The sources encompass research studies, reports from national and international organizations, and pertinent academic publications addressing topics related to aquaculture, conservation of aquatic ecosystems, and the application of Payments for Ecosystem Services (PES).

The research was conducted utilizing key search terms such as "aquaculture", "incentives", "environmental services", "ecosystems services", "PES", "Payments for Ecosystem Services", and specific services/functions (e.g., provisioning, regulating, supporting, cultural, filtration,

carbon, nutrient remediation, carbon trading, etc.).

To establish a global perspective on fish production trends, data from FishStatJ - Software for Fishery and Aquaculture Statistical Time Series, the Food and Agriculture Organization (FAO) on global aquaculture production, the European Commission Database, and the Statistics National Institute database were employed.

Microsoft Excel was used for the organization and analysis of gathered information and the ArcMap program from the ArcGIS 10.7.1 package was used for creating the map.

RESULTS AND DISCUSSIONS

The global aquaculture production has experienced an upward trend from 2010 to 2021 (Figure 1). These figures highlight the economic and nutritional importance of both fishing and aquaculture sectors, especially in China and, more broadly, in Asian countries, which have been leading in terms of production since 2011 (FAO, 2022).

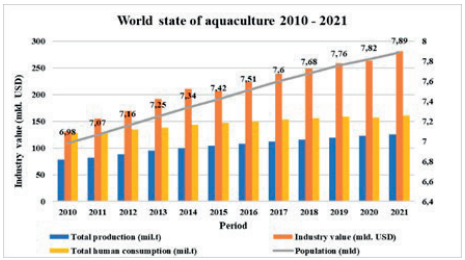

Figure 1 Global Production and Consumption trends of Aquatic Products from 2010 to 2020 (source: FishStatJ)[1]

Thus, the total aquaculture production has seen a steady increase from year to year, in the period 2010-2021, starting from 78 million tons in 2010 and reaching 126.03 million tons in 2021. This growth is strongly correlated with the expansion of the global population which increased from 6.98 mld. in 2010 to 7.89 mld. in 2021 (r^2=0.99). On average, production has experienced an annual increase of 1.84%. The smallest advancement during this period was recorded in 2020 compared to 2019 (2.42%±1.84%), a situation understandable given the global circumstances affected by the COVID-19 pandemic. The most significant increase was recorded in 2012 compared to the production in 2011 (8.04%±1.84%).

Similarly, the value of the aquaculture industry has consistently increased, being directly influenced by the increase in fish and other aquatic products consumption, registering an average growth rate of 5.47% in the period 2010-2021. The year 2011 marked the highest increase in value (18.06%±5.47%), while in 2015 the industry faced a decrease of 2% compared to the previous year.

The current state of aquaculture in Romania

Aquaculture in Romania primarily operates in two distinct directions: one involves extensive or semi-intensive cultivation of cyprinids in polyculture, utilizing natural basins such as ponds, reservoirs, and lakes, while the other focuses on the intensive cultivation of salmonids. Additionally, the freshwater aquaculture industry has diversified and expanded to include other species such as sturgeon, African catfish, tilapia, and perch (www.anpa.ro).

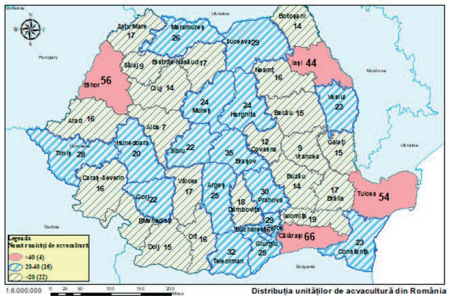

Figure 2 The distribution of aquaculture units with valid licenses across counties in Romania as of the year 2023 (Source: original map)

According to the Aquaculture Units Register (update by National Agency for Fishery and Aquaculture), in 2023, Romania had 944 aquaculture farms with valid licenses (Figure 2), occupying an area of 69,766.98 ha, out of which 168 nurseries, 690 farms, and 86 mixed.

Counting approximately 267 farms covering an area of 189.19 ha, trout farming represents approximately 28% of the total aquaculture farms in Romania, while pond cyprinids aquaculture and other freshwater species - 72%

[1] The parameter "Total human consumption" takes into consideration production values, supply values, exports, imports and non-food use products

- span over an area of 69,577.79 ha, with a total of 677 farms.

In the global context, Romania demonstrates a high potential for the development of the aquaculture sector, supported by a hydrographic network spanning over 843,710 ha (Pila et al., 2023), climatic and geographic diversity, providing opportunities for the cultivation of various fish and crustacean species in different regions. Furthermore, the country's long history in fishing and aquaculture contributes to a solid foundation of knowledge and expertise in the field.

Comparing with international trend, in Romania, from 2010 to 2021, aquaculture experienced relatively slow evolution both in terms of production (with an average annual evolution rate of 3.08%) and industry value (Figure 3). At the same time, it is important to note that there were significant fluctuations and certain periods experienced production declines, such as the year 2020, which was influenced by the COVID-19 pandemic.

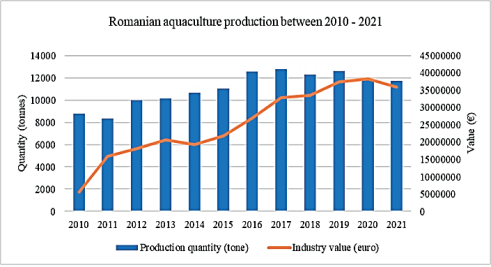

Figure 3 Evolution of Romanian aquaculture production and industry value between 2010-2021 (Source: FishStatJ)

The average annual growth rate of the sector value[2] during this period was approximately 20.10%, indicating a consistent increase, from €5,605,148.85 in 2010 to €35,860,002.26 in 2021. This growth could be attributed to rising prices in the global market and increased demand for fish products. An important microeconomic theory states that the intersection of supply and demand in the market determines both the price and the equilibrium quantity for the respective product (Marshall, 2009). This suggests that this increase in market prices of fish meat may stimulate production to meet the increased demand.

This observation suggests that when market prices for fish products are rising, aquaculturists are often encouraged to increase their production to satisfy demand. With the increase in prices, an opportunity may arise for producers to earn higher profits, motivating them to invest in technology to amplify production. Thus, the relationship between market prices and quantity produced reflects the interaction between supply and demand in a dynamic economic environment.

In this general context, the traditional producers, operating in large pond farms, are in disadvantage in comparison with those operating intensive farms, given the lower unitary production imposed by low technologic intervention capacity. The adaptation to dynamic economic environment of these farms is slower and therefore they are more likely to lose market share in the competition with small farms that integrate intensive technology. In order to be competitive and sustainable large pond fish farms have to adopt ecological aquaculture principles (Costa-Pierce, 2002) which, beside the technical issues of ecosystem design, incorporates socio-cultural aspects, targeting the development of human community while decreasing aquaculture's inherent risks and environmental impacts, especially those on biodiversity (Bosma & Verdegem, 2011). Therefore, by switching the focus toward developing ecosystem services, large traditional farms could also improve their economical sustainability.

Fluctuations and unexpected events, such as the COVID-19 pandemic, have demonstrated that the aquaculture in Romania faces challenges in competitiveness compared to other regions, emphasizing the sector's fragility and the need for continuous adaptation to changing market conditions and the environment.

The combined insights highlight the potential for sustainable aquaculture development in Romania, with adequate legal framework and financial support. A strategic investment in aquaculture infrastructure, technology, and education could further drive the growth of the industry, creating economic opportunities while promoting environmental sustainability. This

[2] This parameter contains aquaculture production statistics by country or territory, species item, FAO Major Fishing Area and culture environment

approach aligns with global trends towards sustainable food production.

Ecosystems services

Considering that markets, global trade, and consumer preferences influence the growth of the sector (Subasinghe, 2009), in direct proportion to the expansion of the aquaculture industry, concerns have arisen about its impact on the environment and aquatic ecosystems (Froehlich et al., 2018; Poore & Nemecek, 2018; Weitzman, 2019) and the health of resident species (van Senten et al., 2018).

Uncontrolled expansion of aquaculture has led to issues such as water pollution, degradation of natural habitats, and a decline in biodiversity in affected regions (Troell et al., 2014; Henriksson et al., 2021). In recent years, significant progress has been made in developing approaches that consider ecological sustainability in aquaculture (Brugère et al., 2019; Alleway, 2019).

Some authors (Overton, 2023; Alleway et al., 2023) argued that aquaculture, when done correctly and in appropriate locations, using best practices, can provide ecosystem benefits, from habitat provision to improved water quality and biological control, thereby reducing the risk of negative environmental impacts. Innovative strategies are needed to meet the United Nations Sustainable Development Goals in a timely manner and in the context of a growing human population. These strategies must allow to produce sustainable biological resources with minimal environmental impact and ensure healthy food, sustainable energy, and harmless materials, contributing to biodiversity conservation (Duarte et al., 2022).

Already used at a global scale, a form of sustainable aquaculture practice is represented by integrated multitrophic systems (IMTA) From an environmental standpoint, this method aims to maintain water quality and carbon sequestration, stock enhancement and biodiversity conservation (Zhou et al., 2022; Arcade et.al., 2023).

Moreover, IMTA help reduce inorganic sulfur in sediments, distribution of dissolved inorganic selenium, and nutrient cycling; distribution and seasonal variation of picoplankton and contributes to the concept of a circular economy through nutrient recycling (Fang et al., 2015). Therefore, through this practice, aquaculture becomes a crucial provider of environmental services to society.

Romania has a great potential for IMTA development and also from the perspective of aquatic ecosystem services this direction is also promoted in National Multi-Annual Strategic Plan for Aquaculture 2021-2030 (www.anpa.ro).

The transformation of conventional aquaculture into sustainable practices, such as IMTA, promotes economic viability and environmental protection. Private and financial benefits from multitrophic aquaculture platforms include sales of produce and services, energy savings, and improved productivity. Environmental benefits encompass mitigate global warming and enhanced water quality (Zugravu et al., 2016).

It has been observed that the initial emphasis on ecosystem services as an educational concept, designed to stimulate public interest in biodiversity conservation, has gradually shifted towards a growing focus on transforming ecosystem services into tradable commodities in potential markets (Kaiser et al., 2023).

Moreover, it was suggested (Galappaththi & Berkes, 2014; Bottema et al., 2019) that promoting aquaculture through economic incentives is not only necessary but also crucial for attaining farm management that considers environmental factors extending beyond the farm boundaries, a concept referred to as "beyond-farm management". Ecosystem services encompass the transfer of materials, energy, and information from natural resources to the services rendered by built and human capital, with the goal of enhancing human well-being (Costanza et al., 1997).

In the Millennium Ecosystem Assessment (MEA) Report, 2005, ecosystem services are presented as the benefits people obtain from ecosystems. TEEB, 2010 classified them into provisioning, regulating, supporting, and cultural services (Figure 4).

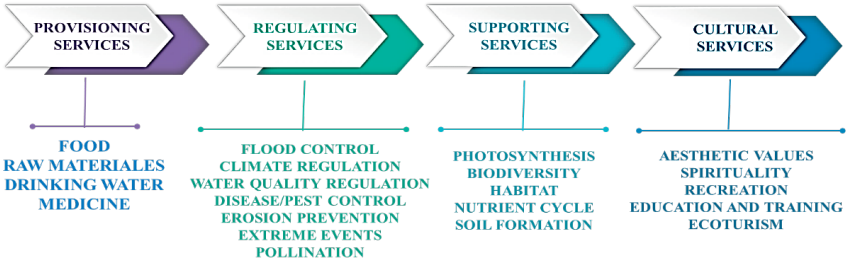

Figure 4. Classification of Ecosystem Services (according to TEEB, 2010)

Cole & Moksnes (2016) consider that one crucial aspect for policymakers who must make difficult decisions about allocating scarce financial resources for environmental protection is assessing the value of the benefits provided by nature in monetary terms.

As methods for the monetary evaluation of ecosystem services have advanced, there has been increased interest in developing market-based instruments that generate conservation incentives. Among these instruments, Payments for Ecosystem Services (PES) stand out (WWF Romania, 2016).

Payments for Ecosystems Services

Payments for Ecosystem Services (PES) are becoming increasingly widespread as a method of ecosystem management through the use of economic incentives. The economic approach within PES aims to incorporate ecosystem services into a market model, placing particular emphasis on efficiency (Farley & Costanza, 2010).

A simplified definition of the concept, as provided by Engel et al (2008), presents PES as a management tool where economic incentives are provided to participants in exchange for environmental services. Wunder (2005) further expands on Engel's (2008) explanation and defines the concept of Payments for Ecosystem Services (PES) as a voluntary transaction in which different users of environmental services "pay" a provider of ecosystem services under the condition that the flow of benefits remains constant. This description highlights an approach focused on market and customer requirements, preferences, and needs. Such an approach takes into account customer feedback and adapts products, services, or strategies to meet market demands and trends, aiming to maximize customer satisfaction and success in the competitive environment.

On the other hand, Muradian et al. (2010) focus on the actors involved in PES: institutions and intermediaries. They consider these actors to play a key role in correcting market failures and addressing issues.

Researchers believe that these types of incentives could yield results where traditional management approaches have failed (Kazakova, 2007; Engel et al., 2008; Blandon et al., 2016).

Unfortunately, there are a limited number of studies evaluating the effectiveness of these payments in aquaculture or other industrial sectors that provide environmental services. Even fewer studies focus on the impact on cultural services (tourism, recreation, spiritual and aesthetic values of the ecosystem), with the main focus being on provisioning, regulating, and supporting services.

Nevertheless, these incentives represent an opportunity to align the aquaculture industry with the United Nations' goals for human prosperity and environmental sustainability. Even though the ecosystem can provide a multitude of ecosystem services, the compensatory payment scheme should target only those production services that can realistically be exploited by landowners.

Payments for Ecosystem Services meet the following conditions: they are voluntary, there is a well-defined environmental service, there is at least one buyer, there is at least one provider, and they relate to the provisioning services that the ecosystem offers (Fripp, 2014; Silva-Muller, 2022).

In contrast to other types of incentives, such as eco-certification, in the case of PES, contracts include conditions that impose restrictions on

land and/or resource use or establish environmental outcomes for a predefined number of land units (Wunder, 2005; Pagiola et al., 2008).

These specific requirements have significantly reshaped the approach to aquaculture practices and the conservation of aquatic ecosystems, as we will further explore in detail.

1. The impact of Payments for Ecosystem Services (PES) on aquaculture practices and the conservation of aquatic ecosystems and biodiversity.

The implementation of Payments for Ecosystem Services (PES) has had a significant impact on aquaculture practices and the conservation of aquatic ecosystems. PES programs have incentivized aquaculturists to adopt innovative techniques and strategies to reduce their negative environmental impact. These include more efficient use of water resources, reduced use of chemicals, and improved habitat conditions for wild species (Chen et al., 2021).

The idea of biodiversity conservation and the protection of wild species through PES implementation is sustained also by Martinez-Harms & Balvanera (2012). As a result, PES initiatives have supported conservation efforts for vulnerable species and contributed to maintaining ecological balance in aquatic ecosystems.

In a recent study, Duarte et al. (2022) present that the benefits of algae in the context of sustainability, extending beyond aquaculture and impacting a diverse range of industries, are highlighted. These benefits include ensuring food security, promoting population health, providing clean and affordable energy, contributing to the fight against climate change through long-term carbon sequestration (Sondak et al., 2017, Duarte et al., 2017), with potential for industrial innovation and future development, responsible production system implementation, and generating significant positive environmental effects, with additional societal benefits (Hasselström et al., 2018).

Furthermore, algae cultivation has helped alleviate poverty through the implementation and monitoring of innovative techniques, as seen in communities in northern Brazil (Freddi & Aguilar-Manjarrez, 2003; Rebours et al., 2014). Additionally, PES has led to improved knowledge among farmers about algae aquaculture and technologies, making algae a significant source of income.

2. The contribution of PES (Payments for Ecosystem Services) to improving water quality and reducing pollution.

The implementation of Payments for Ecosystem Services (PES) has led to improvements in water quality and a reduction in pollution in aquaculture areas (Barbier, 2007). This aspect is reinforced by other similar studies (Senff et al., 2018). Moreover, by adopting responsible practices such as efficient waste management and the use of more effective water filtration technologies and discontinuing the use of poisons and toxic substances to eliminate unwanted species, aquaculturists have reduced the impact of pollution on the aquatic environment.

In a study conducted in shrimp farms, (Hukom et al., 2020) where farms receiving financial incentives were compared with those which did not benefit from these incentives, was demonstrated that incentives beneficiaries have improved quality water parameters (dissolved oxygen, ammonia, salinity and temperature), reduced nutrient discharge, enhanced technical efficiency and higher production levels.

Shrimp farming has gained significant attention in recent years, intensifying in many countries (Primavera, 1997). This has been the main cause of the disappearance of mangrove habitats and, consequently, the reduction of ecosystem services provided by them. Therefore, sustainable shrimp farming practices are continuously sought after (Gunawardena & Rowan, 2005).

The bivalve industry has also experienced significant growth, considering the role it plays in supporting ecosystems, creating habitats (van den Burg et al., 2022), carbon sequestration (Han, 2017), nutrient removal, and water quality improvement, thereby preventing eutrophication (Troell et al. 1999; Marinho-Soriano et al. 2011; Gentry et al., 2020).

While some methods of aquaculture may harm the aquatic environment or interfere with vital services, others have the potential to provide notable environmental advantages. As a result,

it is crucial for the former to support the endeavors of the latter. Thus, the implementation of Payment for Ecosystem Services (PES) becomes imperative in this context.

Debates and Challenges in Implementing PES in Aquaculture

While the concept of Payments for Ecosystem Services (PES) holds significant potential for promoting sustainable aquaculture and conserving aquatic ecosystems, there are examples of flawed implementations of these programs (Vatn, 2010). Often, these incentives are used to address an immediate problem rather than focusing on prevention (Sone et al., 2019). Such inadequate implementations can result in limited impact on aquaculture practices or the surrounding environment, raising questions about the effectiveness of these programs.

They assume that farmers and, in general, providers of ecosystem services are paid for a certain behavior. This implies, on the one hand, that the proposed goal is difficult to achieve, and on the other hand, that human greed knows no bounds. In situations where payments are made for behavior that should be considered normal, such as environmental protection (Gneezy et al., 2011; Kruijssen et al., 2022), the implementation of PES could lead to a diminishing of certain moral values (Bowles, 2016).

Additionally, Vatn (2010) argues that the distinction between incentives and compensation is important in terms of the relationships built between the involved agents, based on the idea of "reciprocal exchange" rather than goodwill, influencing the level of control and reciprocity within contracts.

Certainly, one might contemplate the longevity of the "beneficial" effects associated with the implementation of ecosystem service payments, especially considering the prospect of ceasing such payments. A crucial aspect to ponder is whether the positive impacts observed during the period of payments would endure and remain perceptible if ecosystem monitoring were continued post the cessation of payments. (WWF Romania, 2014*)*

1) Accurate Assessment of Ecosystem Services

It is not difficult to identify the services provided by an aquaculture farm. What presents a challenge is quantifying these services (van den Burg et al., 2022). We are not discussing provisioning services, which can be evaluated at market prices. The issue lies with the evaluation of regulating, cultural, and supporting services, where exact accounting values cannot be established.

Furthermore, researchers are concerned that intrinsic and socio-cultural aspects of ecosystems may transform into interchangeable values, thereby reducing ecosystem complexity and integrity (Dextre et al., 2022; Cole and Moksnes, 2016). The process of economizing nature through labeling is considered unethical (McCauley, 2006; Peterson et al., 2010; Munda, 2004).

Additionally, it has been observed that some small and medium-sized farms may face financial difficulties in implementing the necessary changes to qualify for PES, without necessarily leading to a collective effort to improve ecosystem functionality, as seen in Lombok, Indonesia (Senff et al., 2018). Chen et al. (2021) emphasize the need for an accurate determination of the environmental services that will be the subject of the transaction and the effects of aquaculture species on the environmental service involved in the scheme to establish precise ways of mitigation/ prevention.

2) The Role of Collaboration Among Stakeholders

Government institutions play a significant role in the outcomes of PES implementation in aquaculture. Many PES schemes have failed due to the lack of adequate or incomplete governmental support (Wunder, 2007; Senff, 2018; Silva-Muller, 2022). Policies regarding the implementation of payments and methods for evaluating ecosystem services can be vague and inconsistent, as seen in certain regions of Russia where these incentives are active (Yakovlev & Mikhaylov, 2020).

Studies by Chen et al. (2020) highlight that the success of PES implementation in aquaculture largely depends on close collaboration between government authorities, the aquaculture industry, environmental organizations, and local communities. Therefore, effective

collaboration ensures better-coordinated planning and implementation of PES programs, addressing specific challenges and ensuring long-term sustainability (Chen, 2021).
One of the conditions of PES is the existence of a provider. This implies that there is a right of ownership over the environmental service to be the subject of the transaction (Vatn, 2010).

3) Undermining Compensation Policies
Gordon et al. (2015) highlight the potential risk of "greenwashing," where aquaculturists may adopt sustainable practices only to receive financial rewards without a genuine commitment to environmental conservation. This underscores the importance of continuous monitoring and evaluation of the impact of PES programs.
Alternatively, there is the possibility that the value of payments is too low, given that they depend on the market value of the service provided, such as the price of carbon sequestration. Consequently, owners of aquaculture farms may not be willing to provide environmental services, potentially violating one of the defining rules of PES (van de Burg, 2022).
This raises the need for funding from not only public sources but also private organizations, companies, the public, and non-profit organizations, among others. Such an example is represented by the emergence and development of AIPs (aquaculture improvement projects). AIPs are partnerships between private actors in the aquaculture industry aimed at enhancing sustainability in the aquaculture sector that involve engaging and empowering value chain actors to collectively address sustainability issues (https://sustainablefish.org/). AIPs reflect a broader trend of using market-based approaches to promote sustainable and responsible food production (Bottema, 2019).
Furthermore, Vatn (2010) and Kosoy & Corbera (2010) raise concerns regarding how payments are delivered to the providers of environmental services within compensation transactions. Payment for ecosystem services can manifest as incentives tied to the level of provision or as rewards for positive actions, with the distinction resembling the cost-sharing dynamics found in sales-compensation relationships.

CONCLUSIONS

The synthesis concludes by affirming that PES holds promise in promoting sustainable aquaculture and conserving aquatic ecosystems, provided that challenges are addressed and recommendations implemented.
The importance of continuous research, collaboration, and awareness is highlighted to ensure the long-term success of PES in the aquaculture industry.
In summary, the analysis underscores the intricate relationship between aquaculture, ecosystem services, and the potential of PES to foster sustainability in the industry, both globally and in the specific context of Romania.
From the analyzed data regarding aquaculture in Romania, it can be observed that our country has significant opportunities for the expansion and consolidation of this sector in a sustainable manner. Considering the generous natural resources, as well as the extensive experience in fishing and aquaculture, the country has all the prerequisites to develop a strong and competitive ecological aquaculture industry. However, to achieve this, an integrated approach is necessary to promote sustainable practices, biodiversity conservation, and water quality maintenance. Additionally, the involvement and collaboration of all stakeholders are essential, as well as the implementation of efficient policies, regulations, and economic support to ensure that sustainable aquaculture development is carried out responsibly and in line with the country's environmental and social objectives.

RECOMMENDATIONS

To improve the implementation of Payments for Ecosystem Services (PES) in aquaculture, considering the specific context of Romania, the following concrete suggestions can be proposed:

- Develop a Clear and Incentive Legal Framework: Draft and implement a specific legal framework for PES in aquaculture,

providing clarity and substantial incentives for producers adopting sustainable practices.

- Establish a National Fund for Aquaculture PES: Create a national fund exclusively dedicated to PES in aquaculture, funded by budgetary resources and contributions from the private sector, to financially support projects and initiatives for conserving aquatic ecosystems.
- Implement an Efficient Monitoring System: Develop and implement an efficient monitoring system to assess the impact of PES in aquaculture. This system should provide clear performance data and contribute to the continuous optimization of programs.
- Introduce an Educational and Awareness Program: Launch a national education and awareness program for communities, farmers, and consumers to promote the importance of PES in aquaculture and the benefits it brings to ecosystems.
- Enhance Collaboration Among Various Stakeholders: Facilitate collaboration between governmental bodies, non-governmental organizations, the private sector, local communities, and researchers. This collaboration can consolidate resources and expertise to ensure the effective implementation of PES.
- Tailor PES to the Diversity of Romanian Aquaculture: Customize PES programs to account for the diversity of aquatic systems and species cultivated in Romania. Specific approaches can be developed for freshwater and marine farms, as well as different fish and crustacean species.
- Involve Local Communities in Decision-Making: Ensure the active participation of local communities in the decision-making process regarding PES projects. Consultations and involvement of locals can contribute to identifying the most suitable solutions for conserving aquatic ecosystems.
- Promote Examples Through Successful Case Studies: Create and promote successful case studies of aquaculture farms in Romania that have successfully implemented PES programs. These examples can serve as inspirational models for other producers and communities.
- Financial Accessibility for Small and Medium-Sized Farmers: Establish specific financial facilities for small and medium-sized farmers wishing to participate in PES programs. This may include grants, preferential loans, or financial insurance schemes.
- Integrate PES into Regional Development Strategies: Integrate PES into regional development strategies to ensure these programs align with overall economic development and environmental conservation goals in respective regions.
- Engage Key Stakeholders in Aquaculture: Actively involve farmer associations, research organizations, and other key stakeholders in the aquaculture sector in developing and promoting PES initiatives, ensuring they are tailored to the realities and needs of local industries.

Implementing these proposals could contribute to the efficiency and adaptation of PES programs in Romanian aquaculture, ensuring they align with the country's specific context and sustainability objectives.

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