International Journal of Management and Economics
www.managementjournals.net
Online ISSN: 2664-7079, Print ISSN: 2664-7060
Received: 22-06-2024, Accepted: 23-07-2024, Published: 08-08-2024
Volume 6, Issue 2, 2024, Page No. 40-45

Profile and characteristics of aquaculture producers in the state of Mexico, growth and development

Juan José Huerta Mata[1], Ruth María Zubillaga Alva[1], Víctor Hugo Sánchez Sotomayor[2]
[1] Professor, Department of Administration, Business Management Division, CUCEA, University of Guadalajara, Mexico
[2] Professor, Department of Administration, Business Management Division, CUCEA, University of Guadalajara and Deanery of the Academic Unit of Social, Economic, and Administrative Sciences, Autonomous University of Guadalajara Powered by Arizona State University, Mexico

Abstract
The primary sector worldwide is undergoing serious transformation. The economic perspective of countries is to promote industrial, commercial, and service companies. This is why analyzing the profile and characteristics of the owners, managers, or administrators of agricultural, forestry, livestock, and aquaculture companies will facilitate orientation toward growth and sustainability.
Fish farmers of the State of Mexico support the growth and economic development of different rural areas of the entity, despite not having coasts or coastal regions. The production of aquaculture species, such as trout, tilapia, and bullfrog, contributes an important percentage to the gross domestic product mix.
The methodology used for this research work is qualitative, exploratory, and non-experimental, based on data collection from fish farmers in the State of Mexico. Data collected consisted of gender, level of education, farm characteristics, location by municipality and area, and growth prospects of participants in the 1st. International Congress of Business Networks in Aquaculture.
Analyzing the characteristics of aquaculture producers will allow defining support, but above all, public policies that strengthen the growth and development of the sector in the State of Mexico.
Aquaculture at the local, national, and international levels will continue to grow as expected to produce 50% of food in controlled environments.

Keywords: Profile of aquaculture producers, preparation for academic growth, aquaculture producers

Introduction

The primary sector is fundamental for providing society with food and promoting growth in the industrial, commercial, and service sectors. However, the situation of rural producers, particularly in aquaculture, continue to be affected by the scarcity of subsidies and support, despite their efforts to maintain productive units. Linking aquaculturists in business networks can generate associativity, making their businesses more sustainable. This is especially important as their work is sometimes dedicated to self-consumption or local consumption without focusing on national and international production.
Given global population growth and environmental pressures, aquaculture farm development can contribute to food security. It can also support job creation in rural and semi-urban populations and involve women in entrepreneurial projects that benefit their families and allow participation in smaller-scale markets. Between 10% and 12% of the world's population generates income in the fishing and aquaculture sector, with 14% being women, allowing them to generate income for their livelihood (FAO, 2018b).
Mexico continues to make efforts in the aquaculture sector, reaching experimental-scale development in products such as white fish, native mojarra, abalone, snails, and caged red snapper. Other species, including catfish, carp, tilapia, trout, oyster, shrimp, prawn, and bullfrog, are produced in aquaculture farms throughout the national territory. Some farms receive support from government programs through the National Fisheries and Aquaculture Commission at the federal level and Rural Development Directorates at the state level. These programs seek to integrate fish farming in polycultures with agricultural work, thereby improving high-protein food production to promote growth and stability of the food system while reducing environmental impact.

Methodology

Previous research linked to the aquaculture sector at national and international levels (Huerta *et al*., 2020, 2021, 2023) [5] has employed a qualitative approach, based on in-depth interviews with key sector actors, including companies, academia, government, and social sectors. This approach was chosen due to the scarcity of quantitative data common among primary sector producers, particularly aquaculturists.
This study is exploratory, non-experimental, and non-probabilistic, aiming to understand the profile of aquaculturists in the State of Mexico and define specific support actions for this sector. The research utilized a database developed for registering participants in the 1st Business Networks Congress held in Toluca, State of Mexico, in October 2022. Data collected included full name, gender, address, municipality, telephone, email, age, and academic training.
The general objective of the research is to determine the geographical location, profile, and general characteristics of aquaculturists in the State of Mexico. The research question is: In what areas are they located, and what are the characteristics of the aquaculturists in the State of Mexico?

The study analyzed data groups of registered aquaculturists. The results and their analysis will inform suggestions for action to interest groups in the Business sector, Government, Academia, Associations, and aquaculture producers, aiming to improve their operating conditions and product projection for national and international development.

Additionally, the content analysis research technique was employed to analyze official international and national government documents, including UN-FAO/2022 [4], Statistical Yearbook of Aquaculture and Fisheries 2021, and database articles related to the research topic.

Theoretical framework

International and national statistics on aquaculture and its employed population provide significant data on the number of people working in this activity, their gender, and the location of aquaculture production units on the national map. This information is contained in reports prepared by the National Commission of Fisheries and Aquaculture of Mexico (2021) and the Food and Agriculture Organization of the United Nations (FAO, 2022) [4].

The recent increase in aquaculture activity shows a trend towards increasing cultivation under controlled conditions and sustainable consumption for future generations, according to official projections from Mexico and the FAO (2023). By 2050, more than 50% of these products will be produced in farms or aquaculture systems in fresh and saltwater.

Despite the exponential growth of this activity, the conditions of production units (farms or aquaculture companies) remain precarious, with limitations in producer training, acquisition of specialized equipment, food, medicines, and other inputs (Huerta & Medina, 2023) [5]. This impacts the low-income levels and minimal investment in farm innovation and technology.

Given this complex situation in Mexican aquaculture farms and companies, it is crucial to consider appropriate administrative practices and aquaculturist training to increase productivity and improve production unit operating conditions (Dickson *et al*., 2016) [2]. Studies conducted in Nigeria (Olusegun *et al*., 2023) [8] indicate that 68% of aquaculturists in that country have formal education at a higher technical level, resulting in improved income and investment in innovation and technology. Tunde *et al*. (2015) also note that 52% of fish farmers in the Sari area of Oyo State, Nigeria, have tertiary education, contributing to increased fish farm productivity.

The adoption of best administrative practices in the aquaculture sector, aligned with certifications such as GlobalGAP, has been widely promoted to improve aquaculture farm performance (Dickson *et al*., 2016) [2]. This has allowed for additional benefits such as improving species feeding efficiency and environmental conditions.

Training in best management practices (BMP) systems

In Egypt, a field survey of major fish farms emphasized the importance of conducting planning workshops in various aquaculture areas, such as pond construction, cultivation, production, and post-production species management for preparation and marketing. Some farmers, experts, and consultants participated, focusing their training on short sessions of practical demonstrations for skill development. (Dickson *et al*., 2016) [2]

According to the National Commission for Aquaculture and Fisheries (CONAPESCA, 2023) [1]

Investment in the sector is necessary for the growth and internationalization of aquaculture products. This organization contributes to training producers and technicians to improve their operational and administrative practices, aiming for greater efficiency in cultivation, harvest, and product marketing. Online courses on comprehensive tilapia production and international congresses on aquaculture business networks, such as the one held in Toluca, State of Mexico, in October 2022, have been conducted to this end.

Mexican aquaculture offers producers ample opportunities for development and investment with different countries and associations. Training and best practices could lead Mexican producers to focus on exports and benefit from Free Trade Agreements with various nations, based on agreements for the Promotion and Reciprocal Protection of Investments with 33 countries and nine limited-scope agreements within the Latin American Integration Association (ALADI) framework.

Actions developed to encourage the production of high-quality, affordable food include improving genetic lines of aquaculture-susceptible species, supporting and developing applied research, and aquaculture planning aimed at promoting national aquaculture potential through the characterization of suitable areas.

The Government of Mexico states that currently, the main aquaculture species in Mexico are shrimp (261,958 tons) and mojarra tilapia (101,749 tons), with Sinaloa and Nayarit as the main producing states. Aquaculture production occurs in 23 of the 32 states, with Morelos, Nayarit, Jalisco, Veracruz, and Yucatán as the main producers. Morelos stands out, producing around 30 million fish annually across 62 different species, with 70% of total production destined for export.

The State of Mexico is the largest aquaculture producer among 15 landlocked producing entities in the Mexican Republic. It showed a positive trend between 2015 and 2020, with a cumulative percentage increase of 68% and an average annual trout production volume of 95 tons (Statistical Yearbook of Fisheries and Aquaculture, 2021; see Table 1).

Sánchez & Huerta (2022) [9] argue that fishing and aquaculture are crucial for nations' food and territorial sovereignty and national security

The importance of fishing and aquaculture in the food and territorial sovereignty of nations, as well as in national security, and therefore are essential in national development planning, the fundamentals of food generation by the objectives that fishing and aquaculture must have to guarantee the intake of citizens and the supply of high-quality proteins, the conservation, restoration, and care in the preservation and protection of ecosystems where citizens reside and the recognition of the aquaculture industry as a productive activity that makes viable the plurality of fishing and the generation of sources of employment in the rural sector. (p.61)

Table 1: National fishing industry volume of fishing production, processed raw materials and production table 3.1.1 obtained by processes, according to coastline and federal entity, 2021. (tons)

LITORAL Y ENTIDAD	PRODUCCIÓN[1]	TOTAL		CONGELADO		ENLATADO		REDUCCIÓN		OTROS PROCESOS	
		M.P.	P.O.	M.P.	P.O.	M.P.	P.O.	M.P.	P.O.	M.P.	P.O.
TOTAL	1,874,550	1,157,881	617,986	517,530	326,840	234,845	179,841	393,033	104,279	12,473	7,026
LITORAL DEL PACÍFICO	1,666,923	1,063,795	545,550	424,900	255,163	234,239	179,401	392,654	104,201	12,002	6,785
BAJA CALIFORNIA	202,421	155,224	72,632	59,293	9,983	48,689	48,689	44,674	12,738	2,568	1,222
BAJA CALIFORNIA SUR	127,830	68,902	38,347	37,846	12,867	23,838	23,838	6,958	1,392	260	250
CHIAPAS	47,572	20,359	17,752	4,780	4,302	11,203	11,203	2,195	439	2,181	1,808
COLIMA	32,300	28,040	24,200	5,922	5,323	17,282	17,282	3,362	672	1,475	924
GUERRERO	8,002	1,931	1,088	1,241	941	2	2	1	0	686	145
JALISCO	13,685	1,030	900	1,017	888	12	12	0	0	1	0
MICHOACÁN	6,360	470	412	469	411	1	1	0	0	0	0
NAYARIT	63,570	26,922	19,968	26,459	19,534	322	322	1	0	139	112
OAXACA	6,119	2,303	1,983	1,564	1,387	546	546	159	32	34	18
SINALOA	316,194	219,846	174,513	113,211	99,544	65,401	65,401	36,892	7,493	4,342	2,075
SONORA	842,869	538,769	248,592	173,098	99,983	66,943	66,943	298,412	81,435	316	231
LITORAL GOLFO Y CARIBE	207,532	538,769	248,592	92,458	71,523	605	439	379	78	471	241
CAMPECHE	49,515	22,045	19,825	21,499	19,341	459	459	57	11	30	12
QUINTANA ROO	2,284	860	773	844	759	12	12	3	1	1	0
TABASCO	28,458	6,782	1,990	6,736	1,975	0	0	11	3	34	12
TAMAULIPAS	35,029	17,888	14,930	17,407	14,791	7	7	292	59	182	73
VERACRUZ	44,638	15,000	6,791	14,851	6,722	37	37	4	1	108	31
YUCATÁN	47,608	31,339	28,140	31,122	27,935	90	90	11	3	116	113
ENTIDADES SIN LITORAL	95	538,769	248,592	172	155	0	0	0	0	0	0
ESTADO DE MÉXICO	95	2	1	1	1	0	0	0	0	0	0
OTRAS ENTIDADES	0	0	0	0	0	0	0	0	0	0	0

/1 PESO DESEMBARCADO DE LAS ENTIDADES CON ACTIVIDAD INDUSTRIAL

Research findings

The State of Mexico, a federal entity in the Republic, has great importance due to its proximity to Mexico City and its contribution to the national GDP of 9.0% (2nd place out of 32). It has a population of 17,379,644 people, which represents 13.37% of the country's population. Its Social Progress Index ranks 14th nationally. The heaviest sector of the economy is manufacturing industries, representing 23.61% of the state total. Its economic growth is 0.6% annually between 2018 and 2022 (Mexico ¿Cómo Vamos? 2023).

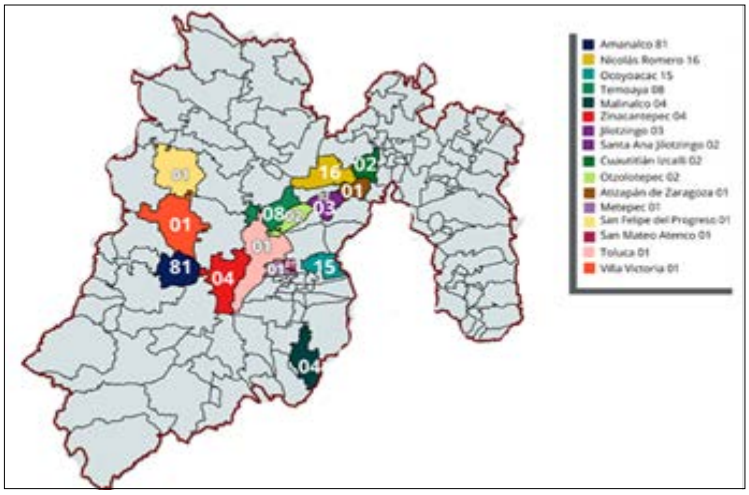
A relevant indicator linked to the activities of the primary sector is its informality rate, which places it at 12th nationally, with 55.1% of state workers having jobs without labor benefits or recognized business ties. The estimated goal for the following years is to reduce informal workers.

Derived from the data cited above, the current situation of aquaculturists in the State of Mexico is presented in terms of their profile, municipality of location, gender, use of email, and academic training.

The regionalization of the State of Mexico, contained in the State Development Plan 2017-2023, contemplates twenty development regions. The concentration of the largest number of aquaculture producers is found in:

- Region XX Valle de Bravo, Amanalco: 57% of the producers
- Region IV Cuautitlán Izcalli, Nicolás Romero: 11%
- Region VII Lerma, Ocoyoacac: 10.50%
- Region VI Ixtlahuaca, Temoaya: 5.5%
- Region XIII Tenancingo, municipality of Malinalco: 2.80%
- Region XVII Toluca, municipality of Zinacantepec: 2.80%
- Other regions with a smaller number of producers 15: 10%

Geographic conditions and access to water resources facilitate the installation of farms in these areas (see Figure 1).



Source: Secretary of the Countryside of the Government, State of Mexico, 2023. Census of aquaculture producers

Fig 1: Map of aquaculture producers by municipality, State of Mexico

According to the Rural Secretariat (2023) and the census of producers obtained in the registry of the International Congress of Business Networks in Aquaculture (Toluca, 2022).

The number of active producers in the State of Mexico is 143 (see Table 2). However, figures from the Fisheries and Aquaculture Commission show 512 productive units. It is worth mentioning that the considerable difference between both data is that the federal registry (Statistical Yearbook of Fisheries and Aquaculture, 2021) does not include farms that are not active or that are temporarily suspended due to the post-pandemic period.

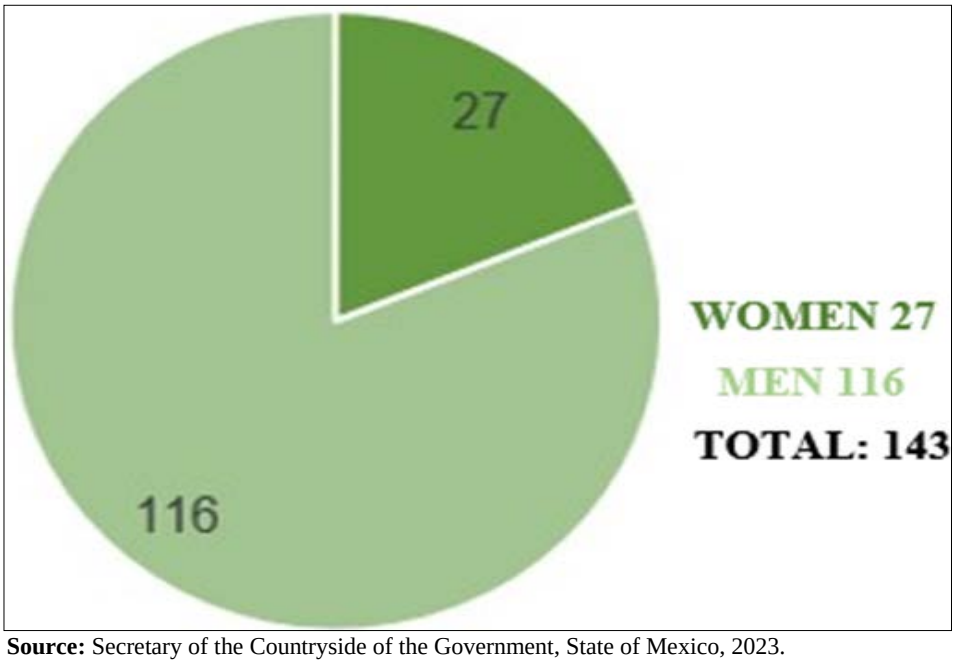
Table 2: Aquaculture producers of State of Mexico for municipality

Municipality	Producers
1. Amanalco	81-57%
2. Nicolâs Romero	16 - 11%
3. Ocoyoacac	15 -10.50%
4. Temoaya	08 - 5.50%
5. Malinalco	04 - 2.80%
6. Zinacantepec	04 - 2.80%
7. Jilotzingo	03 - 02%
8. Cuautitlân Izcalli	02- 1.40%
9. Otzolotepec	02 - 1.40%
10. Santana Jilotzingo	02- 1.40%
11. Atizapân de Zaragoza	01 - .70%
12. Metepec	01 - .70%
13. San Felipe del Progreso	01 - .70%
14. San Mateo Atenco	01 - .70%
15. Toluca	01 - .70%
16. Villa Victoria	01 -70%
TOTAL	143 - 100%

Source: Secretary of the Countryside of the Government, State of Mexico, 2023

Census of aquaculture producers.

Regarding the gender of aquaculturists, of the 143 that make up the census of the Secretariat of the Field of the State of Mexico (2023), there are 116 men (82%) and 27 women (18%). The participation of women in farm administration is notable, and in most cases where male owners or administrators are present, they are assisted by female family members or collaborators. The involvement of women in productive activities in rural areas is increasing.



Source: Secretary of the Countryside of the Government, State of Mexico, 2023.
Census of aquaculture producers.

Fig 2: Aquaculture producers by gender, State of Mexico

As mentioned in the theoretical framework of this research, the academic training of aquaculture producers is an important aspect of the productivity, profitability, and quality of farm crops (Dickson *et al*., 2016) [2]. For this reason, it is significant to determine the situation in the State of Mexico regarding this point.

The results obtained show that the academic preparation of aquaculturists, out of the 143 registered, is as follows:

- Master's studies: 1 (1%)
- Bachelor's degree: 19 (13%)
- Technical degree: 11 (8%)
- High school: 19 (13%)

- Secondary education: 42 (29%)
- Primary education: 27 (19%)
- No formal education: 24 (17%)

Grouping the levels, we have basic education (primary, secondary, and high school) accumulating 61% of the total. The higher technical, bachelor's, and postgraduate levels add up to 22%. It is necessary to increase academic training, especially at higher education levels, which will impact on the improvement of administrative practices in productive units and direct them towards national and international certifications.

Table 3: Aquaculture producers by level of education, State of Mexico

Education level	Number of Producers
No formal educational	24 - 17%,
Primary education	27 - 19%
Secondary education	42 - 29%
High school	19 - 13%
Technical degree	11 - 08%
Bachelor's degree	19 - 13%
Master's studies	01 - 01%
TOTAL	143 - 100%

Source: Secretary of the Countryside of the Government, State of Mexico, 2023. Census of aquaculture producers

Discussion of results

The State of Mexico, an entity of the Mexican Republic without coastlines, occupies the first place in trout production in controlled environments. This activity is linked to tourist, sports, and recreational activities in some areas of the state. However, environmental conditions, constant increases in inputs, food, and medicines for cultivated species, and particularly the operation of farms, significantly affect productive units.

The aquaculturists of the State of Mexico comprise a large workgroup whose operating conditions focus on utilizing the water resources of the Valley of Mexico, including its rivers, lagoons, and runoff in different areas. However, federal statistics from the National Fisheries and Aquaculture Commission show a significant difference compared to the number of aquaculturists registered by the Rural Secretariat of the Government of the State of Mexico. This discrepancy may be due to the lack of data updates for the post-pandemic period (2022-2023) and the increasingly extreme operating conditions for producers, forcing them to temporarily or permanently suspend their activities.

The largest number of aquaculture farms are concentrated in the central part of the state, particularly in the regions of:

XX-Valle de Bravo, IV-Cuautitlán Izcalli, VII-Lerma, and VI-Ixtlahuaca, totaling 120 units. The proximity to semi-urban areas or the outskirts of Mexico City facilitates the marketing of products harvested in controlled environments and delivered in a lower percentage to the largest sea market, the largest in the country, "Mercado Nuevo de la Viga". However, the majority of the farms are for self-consumption or local consumption, and there is no orientation towards commercialization; only some deliver the product to Querétaro, Hidalgo, and Michoacán. (Huerta & Medina, 2023) [5]

Regarding gender distribution, 82% (116) of producers are male, as field activities are traditionally carried out by men. However, in recent years, female participation has increased to 18% (27), either as family providers, partners in their spouse's activity, or as entrepreneurs starting profitable businesses that ensure food for their families.

Olusegun *et al*. (2023) [8] found that in the State of Mexico, only 22% (50) of owners or managers of productive units have technical or higher education, which is low. Therefore, it is necessary to promote technical or professional training through public organizations linked to this activity in the primary sector. These organizations include the National Fisheries and Aquaculture Commission, the Rural Secretariat, the Aquaculture Health Committee, and the National Agri-Food Health, Safety, and Quality Service. Collaborations with advanced aquaculture countries such as Chile, Norway, Scotland, and Canada, or through sponsorships and foundations, could promote technology and best practices in the sector.

Increased training could improve farm operations, focusing on increasing productivity, product diversification, and expanding marketing channels nationally and internationally.

Future research should include fieldwork to interview farm owners, detecting areas requiring greater technical support and instructing aquaculturists on the use of easily understood records and control systems applicable to their productive units.

Conclusion

We refer to the following academic articles where we highlight points of great importance to achieve the objectives set given the urgent need to take action given our reality at a global level and very specifically in the profile and characteristics of aquaculture producers in the State of Mexico.

Sheinbaum *et al*. (2009) [11] highlight the importance of the application of sustainability indicators in Mexican politics and argue the following

This article analyzes Mexico's national energy policy, especially its implications within the framework of sustainable development, using a methodology adapted on the proposal of the Economic Commission for Latin America and the Caribbean, together with other organizations, and designed around the issues of autarchy, robustness, productivity, electricity coverage, satisfaction of basic energy needs, relative purity in the use of energy, participation of renewable sources and the scope for fossil sources. The result is that although some indicators show an improvement, the average value for 2006 is less than in 1997, pointing to the distancing of Mexico's energy system from sustainability criteria. (p. 113)

Imaz & Sheinbaum (2017) [7] as part of their conclusion, they establish the next.

We believe that the finalized text for adoption, i.e., "Transforming our world: The 2030 agenda for sustainable development (UN, 2015)," presents a narrow vision and a limiting role to the science of sustainability. Moreover, if these issues are not recognized, the achievement of the SDGs will continue to gain only marginal success. Social sciences, humanities and different sources of knowledge must contribute as much as the natural and technical sciences toward an approach where the quality of life and sustainable patterns of consumption and production can be reconciled to reduce the environmental degradation, poverty

and inequalities. This approach will also lead to increasing peace and security. Further research on the different approaches, methodologies for specific countries and regions on the need to develop new science for sustainability in an integrate vision to achieve SDGs needs to be developed. (p. 12)

Sánchez & Huerta (2023) [5] concluded that aquaculture is a strategic activity for countries' socioeconomic development

Therefore, various axes of economic policy by different administrations over the last few years have been directed by four economic models: industrialization by substitution of imports, shared development, accelerated economic growth, and neoliberalism. Consequently, these policies have had a significant impact on the development of public policies. However, the lack of follow-up and the policies' effect on the productive sector and its development have been reflected in the comprehensive failure to meet their proposed sustainability objectives. (p. 6224)

In our particular point of view, what is striking is the importance that the authors above generally place regarding the application of sustainability indicators in Mexican politics, as well as the impact on the 2030 agenda, the reduction of environmental damage, the reduction of poverty and inequality to achieve peace and security at a global level.

Integrating the fivefold helix—academia, government, business, organized civil society, and the environment—is crucial for ensuring comprehensive and sustainable development in aquaculture activities. This approach facilitates collaboration across sectors, enhances policy effectiveness, promotes economic viability, engages stakeholders, and ensures environmental stewardship. It's a holistic strategy essential for achieving long-term success and meeting diverse objectives in aquaculture. We consider that it is a challenge to raise awareness among the general population and intensify the implementation of the solution measures studied and analyzed in this article.

References

1. CONAPESCA. Anuario Estadístico de Pesca y Acuicultura 2021 [National Commission for Aquaculture and Fisheries. Statistical Yearbook of Fisheries and Aquaculture 2021]. Comisión Nacional de Acuacultura y Pesca, Secretaría de Agricultura y Desarrollo Rural, Gobierno Federal de México, 2021, 2023.
2. Dickson M, Nasr Allah A, Kenawy D, Kruijssen F. Increase the profitability of fish farms through training in the best aquaculture management practices in Egypt. Aquaculture, 2016:465:172-178. https://doi.org/10.1016/j.aquaculture.2016.09.015
3. FAO. Improving employment governance in aquaculture: A global assessment (FAO Fisheries and Aquaculture Technical Paper No. 576). Food and Agriculture Organization of the United Nations, 2014. ISBN 978-92-5-107416-9 (print), ISBN 978-92-5-108060-3 (pdf).
4. FAO. The State of World Fisheries and Aquaculture 2022. Food and Agriculture Organization of the United Nations, 2022. https://doi.org/10.4060/cc0461en
5. Huerta JJ, Medina F. Business networks in aquaculture. South Florida Journal of Development, 2023:4(8):3221-3242. https://doi.org/10.46932/SFJDV4N8-021
6. ILO. The future of work in aquaculture in the context of the rural economy (Reference document for discussion at the Technical Meeting on the future of work in aquaculture in the context of the rural economy). International Labor Organization, Department of Sectoral Policies, 2021.
7. Imaz M, Sheinbaum C. Science and technology in the framework of the sustainable development goals. World Journal of Science, Technology and Sustainable Development, 2017:14(1):2-17. https://doi.org/10.1108/WJSTSD-04-2016-0030
8. Olusegun O, Olushola A, Derera E. Impact of training and development on the quality of fish produced; evidence from fish farmers in Odogbolu, Ogun State, Nigeria. Research in Business & Social Science, 2023, 12(3). https://doi.org/10.20525/ijrbs.v12i3.1885
9. Sánchez VH, Huerta JJ. Análisis Jurídico Normativo de la Pesca y Acuicultura en México, Colombia y Chile [Legal and Regulatory Analysis of Fishing and Aquaculture in Mexico, Colombia, and Chile]. Revista Gestión Pública y Empresarial Gespye, 2022:5(10):61-78. https://drive.google.com/file/d/1yCKbk73XNUHy0thqg-CF5tGsusp_STY8/view
10. Sánchez VH, Huerta JJ. Sustainability in aquaculture in Mexico, Chile, and Colombia, towards internationalization. International Journal of Science Academic Research, 2023:4(9):6220-6225. https://scienceijsar.com/article/sustainability-aquaculture-mexico-chile-and-colombia-towards-internationalization
11. Sheinbaum C, Rodríguez V, Robles G. Política mexicana e indicadores de sustentabilidad [Mexican policy and sustainability indicators]. Problemas del Desarrollo, 2009:40(158):113-135. http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0301-70362009000300006&lng=es&tlng=es