

Factors Determining the Development of Sustainable Aquaculture: An Empirical Study

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Abstract

Aquaculture, today produces more than fifty percent of the total fisheries output. This itself depicts the rapid growth of aquaculture industry and indicate its extreme significance in the advancement of market economy as well as in the construction of an effective framework of food production and supply. The industry raises several challenges pertaining to social and economic problems which are crucial and can negatively impact the resource availability and conservation. Thus, development of sustainable strategies of aquaculture has emerged as a necessity of present in order to not compromise the requirements of future. Extensive research has been conducted in the discourse of aquaculture, discovering various innovative techniques of sustainability in its practice as well as identifying problems and prospects that hinder sustainable aquaculture goals. These researches lay down a framework that brings forward the essential to eradicate the imbalance between environment and aquaculture by promoting sustainability as an obligation of the society. The factors that affect or influence the development of sustainability ranges from economic, environmental, sociological to various health and accessibility issues. It is important to persistently examine and synthesize these factors to counter the existing challenges as well as to identify the further ones with ever expanding demands and technology in the period of globalization. Further, empirical study on the development of sustainable aquaculture ensures to recognize knowledge gaps and research needs in this critical area of inquiry that in turn provides scope to provide fruitful solutions for the same. The sample size of the study was 193 respondents. The data analysis was performed with the help of t-test and mean.

Keywords: *Aquaculture, Sustainable, Sustainability, Development.*

INTRODUCTION

Aquaculture is a rapidly growing sector of agriculture with increasing demand of proteinaceous food supply for a large section of people across the globe. The position of aquaculture being a form of agriculture that allows diversifying strategies and techniques of farming along with the huge business opportunities makes it one of the highly depended employment sector and food supplying industry. However, like any other sectors of agriculture, the industry of aquaculture also faces crucial challenges, which include severe problems such as environment deterioration, health risks and social as well as economic disparities. Sustainable aquaculture practices have emerged as a significant critical approach that not only counter these challenges but also ensures long-term viability in terms of economic and social factors, environment integrity, growth of market as well as sociological elements. Sustainability is a spirit, not only in production but also in marketing (Srivastav & Mittal, 2021).

Sustainable aquaculture refers to any practices of aquatic farming that promote the rearing of aquatic life to meet the food and economic requirements of the present without compromising the ability of future generations to meet their own requirements. In achieving the same, there are several existing challenges. To establish a sustainable ecosystem, one must be able to identify and execute practices that promote sustainability in terms of economic, environmental, and sociological aspects. The recent study conducted by Carol Engle and Van Senten (2022) intensifies the need to balance sustainability practices in all three above-mentioned aspects in order to construct an effective system that meets the futuristic goals

of environment and resource protection along with development.

Several empirical studies have been conducted to investigate and comprehend the major factors that determine the development of sustainable aquaculture. In achieving and implementing sustainable practices of aquaculture, immense consideration should be given to the social equity, environment impact, resources availability, financial feasibility, access, and quality of inputs in production and social, environmental as well as economic cost in the availability of these inputs. The major constraints that affect the sustainable development of aquaculture intertwines with all the above-mentioned aspects; be it social, environmental, or economic. The limitations of farmers in accessing environment-friendly technological equipment, lack of knowledge and exposure to wide variety of aquatic life, their breeding requirements etc., inadequate market information support and lack of infrastructure are some of the factors that pulls back farmers from taking their steps towards sustainable practices of aquatic farming. Figure 1 shows various aspects of sustainable agriculture:

Figure 1 Various Dimensions of Sustainable Agriculture



In order to achieve poverty alleviation and also to counter the rising food security problems, sustainable practices of aquaculture can have a profound impact. Proper measures and government policies that help encourage innovativeness in aquaculture, campaigns that increase the skill and knowledge of farmers particularly in terms of technology, access to adequate eco-friendly equipment, access to social capital and building a community-oriented market system can make evident changes towards sustainable aquatic farming objective. Most importantly, constructing a sustainable economy, society and ecosystem, be it for aquaculture or any agriculture sector have emerged as the need of times with declining availability of natural resources and rising population (Boyd, 2020).

Literature Review

Aquaculture, being a rapidly growing industry in food supply, rises the necessity to study, research and conduct on how to practice it in a sustainable manner to prevent environmental destruction as well as to promote social, economic and environmental benefits. Several studies have been conducted in this discourse that help understand to implement the practices of aquatic farming in a way that meet the needs of present without compromising the requirements of future generations. Most of these studies lay down several factors that influence the development of sustainable aquaculture. The empirical studies revolving around aquatic farming and its sustainable goals envisions a better futuristic industry that provide significant contribution not only to the world's seafood supply but also to overall health benefits and basic food requirements of large section of people.

Claude E Boyd and co researchers (2020), in their study analyzes various historical, current

and future perspectives towards the development of an intense sustainable attitude to practices of aquaculture. The study addresses the immediately increasing global requirement for proteinaceous food as well as expose the major food security issues that people across the globe face on a daily basis. In the intense research work they conducted; a huge emphasis is given to various factors that determine the development of sustainable aquaculture practices. The innovative practices of farming, effective and reduced use of freshwater as well as land resources, enhanced feed management, refined information about various species, their breeding and life cycle has helped evolve the execution of better steps in aquatic farming. This paper undoubtedly expands the vision towards implementation of sustainable aquaculture by proposing several integrable operations to increase efficiency in cultivation and distribution of aquatic as food.

In an empirical study conducted by Abiona et al (2011), the authors investigated factors that influence the development of aquaculture in Ogun state, Nigeria. This study explored several constraints to integrated and non-integrated aquatic farming in which around 349 farmers from the area were interviewed. The data collected from these farmers substantiate the significance of the farmer's knowledge and background in implementing effective strategies of aquaculture in gaining profit and meeting needs of people without compromising future generations' necessities. The production constraints in fish farming activities depict unavoidable relationship with the farming experience, age and cultural exposure of the farmer indicating the need for the farmer itself to persistently refine in order to be able to introduce effective measures in the farming.

Malcolm Beveridge and co researchers (2010) investigated the ever-expanding market of

aquatic farming industry and pointed its exponent growth particularly in effect with globalization. The study lays down a picture of evident shift in the global fish markets and portrays the position for persistent interaction between markets, even across continents, made easier in the contemporary times. In parallel to these substantial changes in the market communication, that helps develop the economy of the world, there comes a need for bringing into effect better policies for industries like aquaculture. The authors, in their study, emphasize strategies in aquaculture; such as establishing fisheries management structures, which aids in development of aquatic farming while ensuring the sustainability of resources.

Engle and D'Abramo conducted range of studies in the discourse of development of sustainability in aquaculture. In the study conducted by these two in 2018, they raised the urgent need for reviewing the existing literature and organizing it on the basis of farm-level data to counter various contradictions in the result regarding aquaculture techniques. In this attempt they help develop better practices and strategies of farming in a more sustainable manner meeting the needs of people in the present as well as in the future without deteriorating nature and its resources. Further in a study conducted by Engle and D'Abramo (2019) later, they talk about bringing sustainability and its goals in relation to aquaculture down to earth. In the interesting discussion on this subject, the authors put forward the cultural and heritage connections various communities have in relation to coastal and aquatic life. They envision a collective community direction in the development of sustainability by raising awareness of cultural traditions and practices in relation to aquatic farming.

Carol Engle and Van Senten (2022) gave an elaborated perspective on the above-mentioned concept of linking sustainability down to earth proposed by Engle and D'Abramo by focusing more on the development of sustainability in terms of community level. The study conducted by them exposes and explores how economic, social, cultural and environmental factors intertwine with sustainable economies, communities and ecosystems. The paper aims at establishing community resilience in the process of ensuring sustainable aquaculture strategies on a futuristic level.

Study conducted by Peter Edwards (2015) looks at the interactions between aquaculture and environment over a course of time. He states the diverse or complex nature of these interactions and depicts how traditional methods of aquaculture have been more in the benefits of nature compared to modern techniques of farming. By this he proposes the existing challenges in aquatic farming and its sustainability as it becomes more difficult to balance environment conservation and rising demand of food supply. The paper hence asks to combine modern and traditional techniques of aquaculture to ensure development of sustainability. Hambrey (2017) also develops the sustainable strategies in aquaculture and forms a framework of agenda looking forward to constructing and practicing goals of sustainability in the future. In this 2030 agenda and goals of sustainable aquaculture, the author stresses the importance of responsibility in advancing farming practices that do not deteriorate environment. Moreover, the study brings awareness regarding the main challenges in achieving sustainable aquaculture, ranging from social, economic to environment aspects.

The study conducted by David C Little et al. (2018) focusing on the sustainable

intensification of aquaculture analyzes the trade and development of aquaculture between Asia and Europe. In the study, the authors propose a more holistic level of approach towards techniques of aquatic farming that automatically leads to the progress of sustainability. The relevant result of the research exposes how imbalance in global food production and consumption act as one of the major challenges in attaining long term sustainable goals in aquaculture in the times of globalization and growing market economy. Another interesting point put forward by the study raises awareness about the need of sustainable development in increasing and improving the food security. On the other hand, research conducted by Michael and Habte (2017) specifically focus on the role of sustainability in developing food security. As part of an empirical study conducted by these researchers in Eritrea, a small country in Africa, they deliver how sustainable techniques of aquaculture improves the economic growth and food security of the country.

Ommani and Chizari (2010) developed a framework of three factors pertaining to sustainable aquaculture; environmental, economic and sociological. While the environment factors stress on the availability of natural resources, economic factors look upon the profit of marketing and sociological factors give importance to other aspects such as labor and employment. The research necessitates the need to have a balance between all the above-mentioned factors while developing the goal of sustainable aquaculture. On developing the economic factor side in the research of Ommani

and Chizari, Sullivan and Gouldson (2017) have conducted an empirical study about the response of corporate industries towards the sustainable policies proposed by government. In this study, they talk about the challenges faced by business industries in growing their economy while confirming to sustainability practices of farming.

The existing discourse of literature on sustainable aquaculture development states that the efficient techniques of sustainability and its goals in aquatic farming depend on several factors such as access to resources, capital, market growth, government policies as well as technical knowledge and skills. All these studies ensure that sustainable development is essential to guarantee economic viability and environmental conservation. The future research has immense scope on studying how to create balance in technological innovation and environment conservation in the process of creating a sustainable ecosystem and economy of aquaculture.

Objectives

1. To identify the factors that determine the development of Sustainable Aquaculture.
2. To ascertain elements that develop Aquaculture business.

Methodology

Nature of study is empirical. 193 participants were included in study. Questionnaire was structured in nature to collect data. To ascertain result of Mean and t-test applied. Method of sampling was convenience sampling.

Findings

Table 1 Factors Determining the Development of Sustainable Aquaculture

Sr. No.	Statement of Survey	Mean Values	T-Values	Significance.
1.	Inventive technology would help in removing imbalance between environment and aquaculture for its sustainability	4.21	17.105	0.000
2.	Promoting the rearing of aquatic life to meet the food and economic requirements is a sustainable element	4.03	14.653	0.000
3.	Economic, environmental and sociological aspects must be considered for development of sustainable aquaculture	4.09	15.754	0.000
4.	Major consideration must be given to the social equity, environment impact, resources availability for sustainable aqua business	4.17	16.569	0.000
5.	Financial feasibility, access and quality of inputs in production and social, environmental and economic cost are other major elements	4.00	14.394	0.000
6.	Proper measures and government policies help and encourage innovativeness in aquaculture business	4.10	15.566	0.000
7.	Innovative farming practices, effective and reduced use of freshwater as well as land resources are vital factors for sustainable aquaculture	4.11	15.856	0.000
8.	Establishment of fisheries management structures, aids in development of aquatic farming business	3.13	1.865	0.032
9.	Growth of market, support of government and technical knowledge and skills are essential for sustainability of aquaculture business	3.21	2.977	0.002
10.	Proper business framework and structure must be established for sustainable aqua business	3.23	3.317	0.001

Table 2 shows mean values of the “Factors Determining the Development of Sustainable Aquaculture” the first statements of T-test is Inventive technology would help in removing imbalance between environment and aquaculture for its sustainability (mean value 4.21), Promoting the rearing of aquatic life to meet the food and economic requirements is a sustainable element (mean value 4.03), Economic, environmental and sociological aspects must be considered for development of sustainable aquaculture (mean value 4.09), Major consideration must be given to the social equity, environment impact, resources availability for sustainable aqua business (mean value 4.17), Financial feasibility, access

and quality of inputs in production and social, environmental and economic cost are other major elements (mean value 4.00), Proper measures and government policies help and encourage innovativeness in aquaculture business (mean value 4.10), Innovative farming practices, effective and reduced use of freshwater as well as land resources are vital factors for sustainable aquaculture (mean value 4.11), Establishment of fisheries management structures, aids in development of aquatic farming business (mean value 3.13), Growth of market, support of government and technical knowledge and skills are essential for sustainability of aquaculture business (mean value 3.21), Proper business framework and

structure must be established for sustainable aqua business (mean value 3.23). T-value of survey statements with regards to Factors Determining the Development of Sustainable Aquaculture are significant as t-value of statement is positively significant as the value is less than 0.05.

Conclusion

Development of sustainable aquaculture plays key role in ensuring balance between economic feasibility and environment integrity in contemporary times of globalization, where there is an immediate rising need for food supply. There are several factors that affect and influence the advancement of sustainability in the arena of aquaculture. Exposure to technology, access to resources and social capital, innovativeness in agriculture skill is some of the critical factors that drive the efficiency of sustainable practices of aquaculture. Apart from these, limited awareness about various policies that help develop technical information about the strategies of modern, but sustainable farming also influences the same. The intense research that is done and ongoing in the discourse of development of sustainability in aquaculture expose the necessity and significance these strategies play in conserving the resources of nature while meeting the basic needs of people at present. It is only through community resilience, proper framework of government policies that contribute to sustainable practices and access to adequate social capital that one can constructively conduct their responsibility of implementing sustainable aquaculture practices. T-value of every statement in the context of Factors Determining the Development of Sustainable Aquaculture is significant because t-value statements are found to be positive and significance value also less than 0.05.

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