

Fish Consumption Patterns In Kenya: Case Of Makueni County

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Abstract:

Purpose: This study investigated the fish consumption patterns among consumers and farmers in Kenya, with a specific focus on Makueni County. The research aimed to explore the prevalence and reasons for fish consumption, the frequency of consumption, and the barriers to consuming fish.

Method: The researcher used a descriptive survey design that was both qualitative and quantitative. The target population was the fish farmers, fish consumers, and fish vendors. The study focused on the 26 community dams in Kilome, Kaiti and Mbooni in Kenya, Makueni County. The tools of data collection included a questionnaire and a focus group discussion guide for interviews with in Makueni County. The new knowledge will be useful for policy development especially in the provision of production and marketing of organic fish the only natural source of omega 3 fatty acids necessary for health hearts and brain development in human beings. Data analysis used included qualitative using thematic analysis, descriptive accounts of the phenomenon under investigation mainly counting occurrences, while quantitative analysis used descriptive statistics, inferential statistics and statistical significance.

Results: The findings revealed a high prevalence of fish consumption among both consumers and farmers in Makueni, emphasizing the economic and nutritional significance of fish in the region. However, challenges related to the accessibility and availability of fish were identified, hindering regular consumption. Health benefits were cited as the primary reason for fish consumption by both consumers and farmers. Despite the high prevalence of fish consumption, both groups faced difficulties in meeting the recommended frequency of consumption. Barriers such as taste preference, limited availability, and childhood habits were identified as reasons for not consuming fish. Based on the findings, recommendations were proposed to improve accessibility, promote awareness of health benefits, encourage diversification of fish products, support sustainable aquaculture practices, implement fish consumption guidelines, foster collaboration among stakeholders, conduct research on consumer preferences, invest in fish processing and value addition, promote fish consumption in school feeding programs, and support research and development. These recommendations aim to enhance fish consumption patterns, support the growth of the aquaculture sector, and improve overall nutritional outcomes in Kenya.

I. INTRODUCTION

The global population is rapidly growing and changing, posing significant challenges to sustainable food consumption and production (Gandhi & Zhou, 2014; Vos & Bellù, 2019). Achieving sustainable food security and quality is crucial to meet the needs of the expanding population (Zheng et al., 2018; Wang, X. (2022). The Food and Agriculture Organization (FAO) estimates that by 2050, the world will

have 9.2 billion consumers, necessitating a substantial increase in food production (FAO, 2013).

Fish has the potential to address the issue of food insecurity (Ogello, Munguti, 2016). Fish is a vital source of nutrition and protein, plays a significant role in global food security. The demand for seafood, including fish, is projected to increase due to higher incomes in developing countries (FAO, 2016). Aquaculture, the fastest-growing food sector, has the potential to meet the majority of the global seafood

demand (FAO, 2013; Bell, Kronen, Vunisea, Nash, Keeble, Demmke, & Andréfouët, 2009; Vågsholm, Arzoomand, & Boqvist, 2020). The value of fish in our lives is beyond dispute, as it holds a pivotal role in nourishing and sustaining humanity. There is a general agreement that fish consumption may prevent or improve metabolic health (Tørris, C., Molin, M., & Cvanarova Småstuen, 2014). Fish consumption reduces depressive symptoms (Tanskanen, Hibbeln, Tuomilehto, Uutela, Haukkala, Viinamäki, & Vartiainen, 2001).

In Kenya, according to Ngugi, Bowman, and Omolo (2007) Kenya's environment and climate is conducive for aquaculture farming due to the presence of the Indian Ocean, Lake Victoria, and several lakes, large rivers, and swamps with cold and warm waters, making it possible for the country to grow fish in ponds. In the 1920s Ngugi, et al.(2007) fish farming began with Tilapia, carp, and African catfish species. Following a government campaign in the 1960s Tilapia farming in small ponds increased. In the 1970s capacity inadequacy by the extension services saw a decline of fish farming, while mid-1990s fish production was limited to subsistence farming. Fish farming in the 2000s period was motivated by intentions to produce quality food for families and the market and to earn extra income. Makueni County fish farming was introduced in 2009 through the Economic Stimulus Program (ESP) by the government (Musyoka & Mutia, 2016).

A study by Maina, et al.(2017), recommended the Kenya National Government under its Vision 2030 funded and prioritized fish farming as a better option livelihood strategy for farmers in Arid and Semi-Arid Lands (ASALs) and Makueni sustainability of fish farming reported promising for farmers that use earth ponds than liner ponds. However, data from Musyoka and Mutia (2016), stated that 92.5% of fish ponds funded by ESP recorded poor performance. From their findings, about 73% were completely abandoned, 11.3% ignored and only 15.3% survived. According to the study, the challenges faced by fish farmers that hinder them to prosper in the fish business were listed as: 76.6% of farmers lacked pond liners, lack of fingerlings (59.3%), lack of finance (57.2%), lack fish feeds (54.7%) and inadequate water (43.9%). It was observed that these challenges are increasingly affecting the performance of fish farming with more farmers continuously abandoning their ponds thus affecting the fish Small and Medium Enterprises (SMEs) in the county. A report by WRR (2015) recommended reducing the wild fish catch as an approach toward a sustainable fish supply in the short term to allow depleted stocks to recover. The report indicates a need to rebuild sustainable stocks by fish catch control measures, securing habitat, protecting fish breeding areas, and developing implemental regulations against illegal and unregulated fishing.

Despite the potential of aquaculture to address the increasing demand for fish, various factors can influence consumers' decisions regarding fish consumption. Understanding the prevalence and reasons for fish consumption, as well as the barriers to consumption, is essential for developing strategies to promote sustainable and healthy food choices. This study sought to: (a) explore the prevalence and reasons for fish consumption among

consumers, (b) investigate the frequency of fish consumption and its association with health benefits (c) identify the barriers and challenges that hinder fish consumption among individuals.

II. MATERIALS AND METHOD

The study utilized a mixed design approach incorporating both qualitative and quantitative data collected through questionnaires and discussion guides. Descriptive survey methodology was chosen to explore and gather relevant information, summarize findings, and present them clearly. The researcher also conducted observations of dams to assess fish presence, environmental conditions, and related business activities.

The study was conducted in Kilome, Kaiti, and Mbooni sub-counties within Makueni County. The target population consisted of community members around the dams, including key informants, community focus groups, vendors, fisherfolk, consumers, and fish-related businesses. The population distribution was determined based on data provided by the Fisheries department, categorizing fish farming into ponds, community dams, and rivers. The study aimed to include individuals conveniently available for interviews and group discussions.

Sampling was carried out using non-probability purposive sampling, which allowed for the selection of representative subsets of the population in a cost-effective manner. The researcher purposively chose successful dams from each sub-county, along with nearby dams for convenience and reduced travel costs. A total of seven dam communities were visited, and individual interviews were conducted with 51 farmers, 200 consumers, and fish vendors using questionnaires. Additionally, 64 participants took part in focus group discussions using a guide.

The sampling procedure involved selecting individuals or objects from the population to ensure the chosen group represented the characteristics of the entire population. The researcher selected Mbooni, Kilome, and Kaiti sub-counties due to their diverse climatic conditions and the presence of the majority of fish dams. The most successful dam within each sub-county was chosen, along with nearby dams and the populations associated with them. Exceptions were made for sub-counties with few dams. All individuals willing to participate in interviews and focus group discussions at the dam sites or nearby markets were included.

Data collection instruments included questionnaires and focus group discussions. The questionnaires, comprising closed and open-ended questions, were administered to fish farmers and potential fish consumers. This method was chosen for its efficiency in gathering information. The focus group discussion guide included two open-ended questions on environmental factors affecting fish farming. The researcher facilitated the discussions, probing further based on participants' responses. Participants were given the opportunity to share their opinions and suggest remedies.

III. FINDINGS

DEMOGRAPHIC DATA

Demographic characteristics were analyzed in the study, focusing on the gender, age, and education levels of both consumer respondents (n=200) and farmer respondents (n=51). Regarding gender, the majority of consumer respondents were male, with 56% male and 44% female out of the total 200 respondents. This finding aligns with previous reports suggesting that women are underrepresented in aquaculture and the seafood industry due to societal perceptions and gender roles (FAO, 2016). Among the fish farmers, 64.7% were male, 33.3% were female, and 2% did not disclose their gender. These findings again highlight the gender disparity in fish farming, despite the overall population in the area being relatively balanced in terms of male and female distribution.

The age distribution of consumer respondents showed that 37% of participants were in the age bracket of 31-40, followed by 32.5% in the age bracket of 21-30. This indicates that the majority of consumer respondents were in the childbearing age range, with 69.5% falling within the age range of 21-40. Additionally, 13% of respondents were above 51 years old. These findings are supported by the recommendation for increased consumption of organic fish among pregnant women and the preference for fish during periods of rapid growth (Bellows et al., 2015).

Among the fish farmers, the age distribution varied, with the highest proportion (27.5%) falling in the age bracket of 31-40. The distribution was relatively balanced across the age brackets, indicating a diverse range of age groups involved in fish farming.

In terms of education levels, among the consumer respondents, 38% had attained a secondary level of education, 34.5% had completed primary school, 14% had some college or university education, and 1% had no formal schooling. It is worth noting that 12.5% of respondents did not disclose their level of education. These findings indicate a higher level of education among the consumer respondents, with secondary education being the most common. However, there were fewer respondents with tertiary education.

Among the fish farmers, 47.1% had completed primary school, 37.3% had a secondary education, and 11.8% had some college or university education. These findings suggest that most farmers had completed at least primary school, indicating a good foundation for understanding concepts related to organic aquaculture. This aligns with previous studies emphasizing the importance of farmers' education in adopting sustainable practices and understanding stakeholder requirements (Bellows, Clifford, Niebaum, & Bunning, 2015; Wachira & Musyoki, 2015).

Variables	Consumer Respondents (%)	Fish Farmers (%)
Gender		
Male	56%	64.7%
Female	44%	33.3%
Not Disclosed	-	2%

Age Distribution

21-30	32.5%	-
31-40	37%	27.5%
41-50	-	15.7%
51 and above	13%	31.4%
Not Disclosed	-	25.5%

Education Levels

No Formal Schooling	1%	-
Primary School	34.5%	47.1%
Secondary Education	38%	37.3%
Some College/University	14%	11.8%
Not Disclosed	12.5%	-

Table 1: Demographic Details

In conclusion, the demographic characteristics of the study participants revealed gender disparities in both consumer respondents and fish farmers. The majority of consumer respondents were male, while fish farming was predominantly carried out by males. Additionally, the age distribution indicated a significant proportion of consumer respondents in the childbearing age range. Education levels varied, with secondary education being the most common among both consumer respondents and fish farmers. These findings provide insights into the demographic profile of the study participants and their potential influence on fish farming practices and consumption patterns.

FISH CONSUMPTION PATTERNS AMONG CONSUMERS AND FARMERS IN KENYA

The study examined the fish consumption patterns among both the consumer respondents and farmer respondents. Out of the 200 consumer respondents, a significant majority of 74% stated that they eat fish regularly, indicating a high prevalence of fish consumption among the people of Makueni. This finding is supported by previous studies, such as Aganyira (2005), which highlight the growing consumption of aquaculture products worldwide. The report by FAO (2015) also confirms the increasing supply of seafood from aquaculture. However, it is important to note that the limited accessibility and availability of fish in the market could be a contributing factor to this high percentage of fish consumption among consumers.

Turning to the farmer respondents, out of the 51 farmer respondents, an overwhelming majority of 92.2% stated that they consume fish. This finding aligns with a report by FAO (2014), which states that aquaculture fish is consumed more than wild-caught fish from marine sources. The report also highlights the economic and social benefits that result from capacity building among fish farmers (Kisaka and Obi, 2014). It is worth noting that while the majority of farmers consume fish, there may be some who are primarily engaged in the fish business for economic reasons rather than personal consumption.

The high percentage of fish consumption among both consumers and farmers in Makueni reflects the significance of fish as a food source and economic activity in the region. The

findings also underscore the importance of aquaculture in meeting the growing demand for fish. However, it is crucial to address the challenges related to accessibility and availability of fish in the market to ensure a steady supply for consumers and farmers alike.

In conclusion, the study revealed a high prevalence of fish consumption among both consumers and farmers in Makueni. The majority of consumer respondents reported regular fish consumption, while a significant percentage of farmer respondents stated that they consume fish. These findings emphasize the importance of the aquaculture industry in meeting the demand for fish and its contribution to the local economy. Efforts should be made to improve the accessibility and availability of fish in the market to further promote fish consumption and support the growth of the aquaculture sector.

REASONS FOR CONSUMING FISH AMONG CONSUMERS AND FARMERS IN KENYA

The study examined the reasons for fish consumption among the consumer respondents and farmer respondents. Figure 4.4 presents the reasons provided by the consumer respondents for eating fish. Out of the 200 consumer respondents, 70% stated that they eat fish because it is a healthy food choice. This finding aligns with the widely known health benefits of fish consumption. Fish is a natural source of omega-3 fatty acids, which can protect against various diseases, including blood clot formation, high blood pressure, and increased cholesterol levels, while improving the functions of artery cells (Bellows et al., 2015). The perception of fish as a healthy food option contributes to its popularity among the consumers surveyed.

A very small proportion, only 1%, stated that they eat fish because it is easy to cook, while 29% did not provide a specific reason for their fish consumption. This suggests that for some consumers, fish is viewed primarily as a healthy food choice rather than a convenient option to prepare. It is worth noting that some consumers may consider fish as a complement to their main dishes or a staple accompaniment to other foods.

Turning to the reasons for fish consumption among the farmer respondents, the most common reason cited by farmers was that fish is healthy, with 28 respondents highlighting this aspect. Other reasons included brain development (18 respondents), nutritional benefits (11 respondents), and considering fish as a source of food (10 respondents). Medicinal properties, being a source of protein, vitamins, energy for the body, being white meat, and the absence of excess cholesterol were also mentioned, but to a lesser extent.

These findings indicate that the farmers who consume fish are well-informed about the health benefits associated with fish consumption. They recognize fish as a healthy food option, which aligns with previous studies (Conte, 2014; Awuor & Thuo, 2014). However, it is important to note that some studies suggest that the omega-3 fatty acids, which are a key reason for consuming fish, may be more prevalent in organic fish (Dube & Chanu, 2012). These findings imply that farmers may have a perception that all fish provide the same health benefits, which may not be entirely accurate.

In conclusion, the study revealed that the majority of consumers, 70%, eat fish because they consider it a healthy food choice. The health benefits associated with fish consumption, particularly its omega-3 fatty acids content, contribute to its popularity among consumers. Among the farmer respondents, the reasons for fish consumption included its perceived healthiness, brain development, and nutritional benefits. However, it is important to consider that the health benefits may vary depending on the type of fish and farming practices employed. Further research could explore consumer awareness and understanding of the potential differences in health benefits among different types of fish.

FREQUENCY OF CONSUMPTION OF FISH AMONG CONSUMERS AND FARMERS IN KENYA

The study investigated the frequency of fish consumption among both the consumer respondents and farmer respondents. Figure 4.5 presents the frequency of fish consumption reported by the consumer respondents. Out of the 200 consumer respondents, a significant proportion of 36.5% stated that they could not remember when they last ate fish. This indicates a lack of regular fish consumption among these individuals. Additionally, 14% reported consuming fish annually, 19% reported monthly consumption, 25.5% reported weekly consumption, and only 5% reported eating fish on a daily basis. It is notable that only a small percentage, 30.5%, reported consuming fish at the recommended frequency of twice a week. This finding suggests that the majority of consumers surveyed do not meet the recommended frequency for fish consumption, which is concerning given the nutritional benefits associated with fish, particularly its omega-3 fatty acid content (Bellows et al., 2015).

These findings may be attributed to the inconsistency of fish supply in the market. Inadequate availability and accessibility of fish can hinder consumers from achieving the recommended frequency of fish consumption. It is important to address these supply challenges to ensure that consumers have access to fish on a regular basis.

Turning to the farmer respondents, a small proportion of farmers, 3.9%, reported consuming fish on a daily basis. Furthermore, 31.4% reported weekly fish consumption, 41.2% reported monthly consumption, and 15.7% reported annual consumption. It is worth noting that 5.9% of farmers did not provide a response to this question. These findings indicate that a considerable portion of farmers do not consume fish on a regular basis, with a majority consuming fish on a monthly basis or less frequently.

The similarity between the percentages of consumers (30.5%) and farmers (35.3%) who reported eating fish weekly suggests that farmers are also not meeting the recommended frequency of fish consumption. This may be attributed to limited fish production capacity among pond farmers and depletion of fish stocks in the dams due to uncontrolled fishing practices.

In conclusion, the study revealed that both consumers and farmers have challenges in meeting the recommended frequency of fish consumption. The majority of consumers do not consume fish at the recommended frequency of twice a week, which can be attributed to inconsistent fish supply in the

market. Similarly, a considerable proportion of farmers do not consume fish on a regular basis, potentially due to limited fish production capacity and depletion of fish stocks in the dams. It is crucial to address these challenges to ensure a steady and accessible supply of fish for both consumers and farmers, promoting regular fish consumption and maximizing the associated nutritional benefits.

FACTORS FOR NOT CONSUMING FISH AMONG CONSUMERS AND FARMERS IN KENYA

The study explored the reasons provided by both consumer respondents and farmer respondents for not consuming fish. Out of the 200 consumer respondents, 9.5% stated that they did not eat fish because they disliked the taste, while 13% mentioned that they detested the smell of fish. Additionally, 1.5% claimed that fish was not easily available in their area, 0.5% did not like the appearance of fish, and 0.5% did not grow up eating fish. It is worth noting that 1% of respondents provided other reasons for not eating fish. These findings indicate that personal preferences play a significant role in determining whether or not consumers choose to eat fish.

The dislike of the taste and smell of fish can be subjective and vary among individuals. Some consumers may have developed a dislike for fish due to past experiences or cultural factors. The limited availability of fish in certain areas can also impact consumers' ability to access and consume fish. These findings are supported by a study conducted in Nakuru, which found that some customers consider meat to be cheaper than fish and do not have the capacity to evaluate the quality of fish meat (Esilaba, Moturi, Mokuu, 2015). Additionally, the preferences and habits developed during childhood can influence food choices later in life.

Turning to the reasons provided by the farmer respondents for not consuming fish, Table 4.8 displays the responses. Only a small percentage, 1.96%, stated that they disliked the taste of fish, while the same percentage mentioned that fish was not available in their area. These findings suggest that taste preference and limited availability may also influence the fish consumption habits of farmers. It is worth considering that some farmers may be primarily engaged in fish farming for commercial reasons, focusing on meeting the demand for fish rather than personal consumption.

In conclusion, the study revealed that taste preference, dislike of the smell, limited availability, appearance, and childhood habits were among the reasons provided by consumer respondents for not consuming fish. These factors are subjective and can vary among individuals. The findings also indicated that taste preference and availability played a role in the fish consumption habits of farmers. These findings emphasize the importance of considering personal preferences and ensuring consistent availability of fish to promote higher levels of fish consumption among both consumers and farmers. Further research could explore strategies to address these barriers and encourage fish consumption among individuals who have negative perceptions or limited access to fish.

IV. DISCUSSION

The present study investigated the fish consumption patterns among both consumers and farmers in Kenya, shedding light on the prevalence and reasons for fish consumption, as well as the frequency of fish consumption and barriers to consuming fish. The findings provide valuable insights into the current status of fish consumption in Kenya and offer important implications for policy and practice aimed at promoting sustainable fish consumption practices in the country.

The results revealed a high prevalence of fish consumption among both consumers and farmers in the Makueni region of Kenya. Among the consumer respondents, a significant majority of 74% reported eating fish regularly, highlighting the importance of fish as a staple food in the region. This finding is consistent with previous studies that have indicated a growing consumption of aquaculture products worldwide (Aganyira, 2005). Similarly, among the farmer respondents, an overwhelming majority of 92.2% stated that they consume fish. This aligns with reports by the Food and Agriculture Organization (FAO, 2014) indicating that aquaculture fish is consumed more than wild-caught fish from marine sources. The high percentage of fish consumption among both consumers and farmers underscores the economic and nutritional significance of fish in the region.

The study also highlighted the role of aquaculture in meeting the growing demand for fish in Kenya. The increasing supply of seafood from aquaculture, as confirmed by the FAO (2015), supports the notion that aquaculture is becoming a critical component of the fish supply chain in the country. However, it is important to address the challenges related to accessibility and availability of fish in the market. The limited accessibility and availability of fish could be a contributing factor to the high percentage of fish consumption among consumers. Addressing these supply challenges is essential to ensure a steady supply of fish for both consumers and farmers and to promote sustainable fish consumption practices.

Furthermore, the study delved into the reasons for consuming fish among both consumers and farmers. Among the consumer respondents, the primary reason cited for fish consumption was its perceived healthiness, with 70% of consumers stating that they eat fish because it is a healthy food choice. This finding is consistent with existing knowledge on the health benefits of fish consumption, particularly its omega-3 fatty acids content, which can protect against various diseases and improve cardiovascular health (Bellows et al., 2015). Additionally, among the farmer respondents, the most common reason for consuming fish was its health benefits, with 28 respondents highlighting this aspect. This suggests that farmers are well-informed about the positive health implications of fish consumption, which is crucial for promoting fish farming practices.

However, the study also revealed that both consumers and farmers face challenges in meeting the recommended frequency of fish consumption. The majority of consumers did not consume fish at the recommended frequency of twice a week, and a considerable proportion of farmers did not consume fish on a regular basis. The inconsistency of fish supply in the market and limited fish production capacity

among farmers were identified as potential factors contributing to this issue. Addressing these supply challenges is vital to ensure that consumers and farmers have access to fish on a regular basis and can incorporate it into their diets more frequently to maximize its nutritional benefits.

Moreover, the study explored the reasons for not consuming fish among both consumers and farmers. The results indicated that taste preference, dislike of the smell, limited availability, appearance, and childhood habits were among the reasons cited by consumers for not consuming fish. Taste and smell preferences are subjective and can significantly influence individuals' food choices. Additionally, limited availability in certain areas and childhood habits developed over time can also impact consumers' fish consumption patterns. Similarly, among farmers, taste preference and limited availability emerged as potential barriers to fish consumption. These findings underscore the importance of considering personal preferences and ensuring consistent availability of fish to promote higher levels of fish consumption among both consumers and farmers.

In conclusion, the study sheds light on the fish consumption patterns among consumers and farmers in Kenya, providing valuable insights into the prevalence and reasons for fish consumption, as well as the frequency of consumption and barriers to consumption. The high prevalence of fish consumption among both consumers and farmers highlights the economic and nutritional significance of fish in the region. However, challenges related to the accessibility and availability of fish need to be addressed to promote sustainable fish consumption practices. The study also emphasizes the importance of considering personal preferences and ensuring consistent availability of fish to encourage higher levels of fish consumption among both consumers and farmers. Overall, the findings provide valuable information for policymakers and practitioners aiming to enhance fish consumption practices in Kenya and support the growth of the aquaculture sector. Further research is recommended to explore strategies that can bridge the gap between fish consumption patterns among consumers and farmers, promoting sustainable fish consumption practices in Kenya.

V. RECOMMENDATIONS

To improve fish consumption patterns in Kenya, several key strategies can be implemented. Firstly, efforts should focus on improving accessibility and availability of fish in the market. This can be achieved through enhancing distribution channels and infrastructure, such as transportation and storage facilities, to ensure a steady supply of fish to all regions. Secondly, promoting awareness of the health benefits of fish consumption is crucial. Educational campaigns should highlight the nutritional advantages, particularly the omega-3 fatty acids content, and its positive impact on cardiovascular health and overall well-being. Another strategy is diversifying fish products that appeal to different consumer preferences and encourage consumption among those who may have reservations about certain fish species. This can be achieved

through exploring aquaculture practices to increase the production of various fish species.

Additionally, sustainable aquaculture practices are essential to meet fish demand while protecting aquatic ecosystems. Capacity-building programs should educate farmers on responsible methods, resource management, and environmental conservation. Developing fish consumption guidelines can help consumers and farmers meet recommended frequencies. These guidelines should emphasize the health benefits and nutritional requirements of regular fish consumption.

Collaboration among stakeholders, including government agencies, NGOs, research institutions, and fish farmers, is crucial to effectively address challenges related to fish consumption patterns. Joint efforts can lead to the development and implementation of policies and initiatives promoting sustainable practices.

Further research should be conducted to understand consumer preferences and perceptions, tailoring strategies accordingly. This will help address barriers to fish consumption and encourage its adoption. Investing in fish processing and value addition will enhance marketability and provide consumers with more convenient options. Processing facilities, packaging, and value-added products can stimulate interest and economic opportunities for farmers.

Promoting fish consumption in school feeding programs can shape healthy eating habits from an early age. Including fish in school meals can improve the nutrition of schoolchildren and influence future consumption habits positively. Supporting research and development in the aquaculture sector will drive innovation and productivity. Research on sustainable practices, nutrition, and market dynamics will contribute to the industry's growth and resilience.

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