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Socioeconomic impact analysis of Aquaculture Products in the Gaza Strip, Palestine

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Abstract

The study provide insight into the socio-economic aspects of fish farming in the Gaza Strip, Palestine. The collected data was analyzed using descriptive statistics, budgetary analysis, and profitability ratios. The study found that the majority of fish farmers in the Gaza Strip were between the ages of 21 and 40, with 98% being educated, and had 5-10 years of fish farming experience. The budgetary analysis in the study revealed that the average total cost of fish farming in the Gaza Strip was 2,014,691 US dollars, while the total revenue was 3,214,286 US dollars, resulting in a gross margin of 1,299,492 US dollars. The profitability ratios in the study showed that the benefit-cost ratio was 1.59, the rate of return was 0.59, the gross revenue ratio was 0.63, and the expense structure ratio was 0.055. These results indicate that fish farming in the Gaza Strip is a profitable enterprise, with a high benefit-cost ratio, a high rate of return, and a favorable revenue-to-expense structure. The study found that the main challenges faced by fish farmers in the Gaza Strip were high costs of fish feed and fluctuations in market prices. Despite these challenges, the study found that fish farming can be a significant source of income and has the potential to alleviate poverty in the region. The authors suggest that the government should provide credit with low interest rates to help fish farmers expand the sector and overcome these challenges.

Keywords: *Social; Economic; Aquaculture; Analysis; Gaza Strip*

Introduction

Aquaculture has a wide range of impacts on people and societies, both positive and negative. The positive impacts include employment opportunities for fish farmers, which supports economic development and income for individuals and their families (FAO, 2016). In addition, aquaculture jobs offer stability in terms of location, regular working hours, and the possibility of further education and other planned activities, which can improve household stability and access to education, health care, and housing (Smith et al., 2010). On the other hand, aquaculture can also cause negative impacts, such as boom and bust cycles, debt, loss of resilience and social capital, and resource conflicts with traditional users. These impacts are not unique to aquaculture, but are typical of fast-growing industries. Most of the insights into aquaculture's societal effects come from developing nations, while the research focus in developed nations remains on economic and societal conflicts around resource use, environmental concerns, and potential recreational and leisure conflicts (Slater et al., 2013). The impact of aquaculture on people and societies has led to the implementation of regulations, which can be onerous and costly. In developed countries,

the concept of "social license" has become increasingly important, where the public's demands and expectations for the industry are considered (Abate et al., 2016; van Senten & Engle, 2017). Conducting objective, stakeholder-led studies on the social and economic impacts of aquaculture can help improve understanding and trust in the industry, and effective communication by scientists can further improve the perception and influence science policy (Leith et al., 2014). The global aquaculture industry is a major contributor to the economy and has a positive impact on communities. It provides livelihoods, jobs, and access to food, infrastructure, education, and healthcare. A comprehensive and systematic research effort to understand the full economic and social impacts of aquaculture is needed to further support its growth and development (Olaoye, et al., 2013). Bhari and Visvanathan (2018) highlight that aquaculture is a more planned and technical approach to farming compared to capture fishing, making it a labor-intensive process. It provides income and sustains the livelihoods of many farmers and households. This highlights the importance of the aquaculture industry in supporting the economic growth and development of communities. Budzich-Tabor et al. (2018), noted that the location of aquaculture research institutes near production sites is becoming more common. This proximity allows for closer collaboration between researchers and farmers, leading to more practical and relevant research outcomes. Additionally, offering traineeships for students on aquaculture farms provides hands-on experience and helps to build a skilled workforce in the industry. According to Knowler et al. (2020), integrated multi-trophic aquaculture (IMTA) has the potential to improve social perceptions of aquaculture and provide financial benefits through product diversification. This is particularly important in light of declining prices for finfish due to the COVID-19 pandemic, as product diversification can help aquaculture producers to mitigate financial risks and maintain profitability. IMTA also has the potential to address some of the environmental concerns associated with traditional aquaculture, making it a more sustainable and socially acceptable practice.

The Gaza Strip is a part of the Palestinian Authority and located along the southeast coast of the Mediterranean Sea. Despite its location along the coast and its contribution to fishing pressure in the area, the Gaza Strip has been largely ignored in studies on Mediterranean regional fisheries management. In recent years, international organizations such as the European Union, German Agency for International Cooperation, Food and Agriculture Organization, Japan International Cooperation Agency, and others have been working to support the development of the aquaculture sector in Gaza. FAO, for example, has a long history of supporting the fisheries sector in Gaza and recently started a marine cage aquaculture pilot project with funding from the Italian Development Cooperation. The Gaza Strip and West Bank are also involved in scientific and institutional cooperation efforts to support accountable fisheries in the Eastern Mediterranean. Improving the value-chain of the fisheries and aquaculture sectors and promoting sustainable fisheries development have the potential to create more job opportunities and contribute to economic development in the region (Doaa et al., 2022). In the Middle East region, including the Gaza Strip, the growth of the aquaculture industry has been driven by a desire to meet the growing demand for fish and seafood in the market. The private sector, with support from the government, started fish farms in 2008 and since then, the production has rapidly increased. According to the World Bank, aquaculture production in Gaza reached 120 tons in 2011 and has continued to grow in the following years. This growth has played a significant role in helping to bridge the gap between supply and demand in the market (World Bank, 2020). The fish farming industry in Gaza has grown six times since 2011, producing 750 tons of fish in 2020. Breams are the main species farmed. Despite power shortages, fish farmers persist in increasing production due to increasing demand from consumers. When fresh local fish is not available, consumers purchase frozen fish imported from Israel. The political situation and fishing restrictions in Gaza have created a need for expansion of the fish farming industry to meet local demand and improve the livelihoods of fishermen and their families. Two successful fish farming companies in Gaza are Fish Fresh and Al-Bahar. Both companies have established hatcheries to reduce dependence on imported fish fry and eggs. The instability in the Strip affects all fish farms in Gaza, and backyard aquaculture projects have been implemented by humanitarian agencies to increase protein availability. The General Fisheries Commission for the Mediterranean (GFCM) is collaborating with the Palestinian Ministry of Agriculture and the FAO office in Palestine to promote the development of marine fisheries and aquaculture. The goal of this effort is to create new jobs, improve livelihoods, and support the recovery from recent social and economic challenges. This highlights the important role that international organizations and government agencies can play in supporting and promoting sustainable and socially responsible aquaculture practices, with the ultimate goal of promoting economic growth and improving the lives of people in communities where aquaculture is practiced (FAO,

2022). The broad objective of this study is 1) to describe the socio-economic characteristics of fish farmers in the study area study the socioeconomic analysis of fish farming in the Gaza Strip, 2) identify the types of fish farming Practices and characteristics in the study area, 3) identify the production constraints affecting aquaculture development in the study area, 4) determine the costs and returns of fish farming in the study area and 5) determine the profitability ratio of fish farming in the study area.

The paper on the sustainability of the fisheries sector in the Gaza Strip has four sections. Section two presents the methodology. Section three provides the results of a review and analysis of selected socio-economic aspects through an assessment process. Section four presents the significant findings obtained from the research.

Methodology and Data Collection

Study area

Aquaculture Fish farming operations are considered one of the most important economic activities in the Palestinian territories. A study previously noted that there are about five fish farming projects working in the governorates of the Gaza Strip. Five planted fish species have been cultured, including head Seabream), Mugil cephalus (Flathead Grey Mullet) and Clarias gariepinus (African Sharp Tooth Catfish) (Shaheen, 2016). Fish farming is an essential source of income in light of the limited employment opportunities provided by the Palestinian private sectors. Many investors have twisted to fish farming operations in the coastal area of the Gaza Strip. Aquaculture farms use saline water from the onshore wells as the primary water source and release the wastewater to the sea during the water exchange and harvest, basically without any treatments. At present, two main aquaculture farms are functioning in Gaza, called Al Bahar farm and Fish Fresh farm. The Al-Bahar farm area is about 16,000 m^2 and was established in 2014 in the Gaza Governorate. The fish farm (31° 29' 22.02' N, 34° 24' 6.8394' E) is located near the beach of Gaza and receives about 13,440 m3 of marine salty water from beach wells. The farm is semi intensive, consisting of 30 cylindrical ponds used for overfeeding and hatchery purposes. The ultimate water discharge takes place via manholes direct to the sea. The farm workers examine the ammonia level and salinity in the pipes to ensure that the water is suitable for fish farming and use copper sulphate to combat fish diseases in the ponds. The Fish Fresh farm area is about 32,000 m^2 and was established in 2009 in the Rafah Governorate, which lies in the southern Gaza Strip. The fish farm (31° 20' 37.6074' N, 34° 14' 44.1954' E) is located near the beach of Rafah and receives 28,800 m^3 of marine salty water from beach wells. The farm is semi-intensive, consisting of 25 cylindrical ponds used for overfeeding purposes. The water supply comes through beach wells. Qualified workers measure ammonia, dissolved oxygen, temperature, and salinity levels in the pipes. No sterilization methods are used inside the farm to control fish diseases.

Sampling Procedure and Sample Size

A simple random sampling technique was used to select 50 fish farmers from the 2 selected fish farms. The sampling procedure involved using simple random sampling techniques to randomly select 50 fish farmers from the population of farmers in the two fish farms. This method allows for a representative sample of fish farmers to be selected from the two fish farms, ensuring that the results of the study are representative of the wider population of fish farmers in the area.

Data Collection Instrument

A well-structured interview schedule was used for primary data collection in the study. The interview schedule was divided into four sections, each focused on a different aspect of the fish farming industry in the study area. Section a) focuses on the socio-economic characteristics of the fish farmers, section b) focuses on the types of fish farming practices and characteristics, section c) focuses on the costs and returns involved in fish farming, and section d) focuses on the constraints and problems of fish farming in the study area.

Using structured interview schedules is a common method for collecting data in social science research. The structured nature of the interview schedule ensures that the same questions are asked of each respondent, providing a standardized and systematic method of data collection. This helps to minimize the influence of interviewer bias and ensures that the results of the study are representative of the population being studied. Additionally, structured interview schedules are often used in combination with other data collection methods, such as surveys or focus groups, to provide a more comprehensive understanding of the topic being studied.

Data Analysis Technique

Different analytical tools were used to attain the objective of this section, and they include simple descriptive statistics such as percentages, averages (mean), net farm income (NFI), gross margin (GM), and profitability ratios.

Gross Margin (GM)

Gross margin is the difference between the gross farm income and the total variable cost (Olukosi and Erhabor 1989). Therefore, GM = GFI–TVC. Where GM = Gross margin; GFI = Gross farm income and TVC = Total variable cost.

Net Farm Income (NFI)

It was documented by Olukosi and Erhabor (1989) that net farm income gives an overall level of profitability of an industry by putting both fixed and variable costs into consideration and subtracting the cost from the total revenue.

Thus, NFI = TR – TC, where TR = Total Revenue and TC = Total cost.

Profitability Ratios

The profitability ratio is a type of financial metric that helps investors assess a business's capability to make earnings compared with its expenses and other pertinent costs earned during a specific period. When these ratios are higher than a contestant's ratio or than the company's ratio from a previous period, this is a sign that the company is doing well (Okwn and Acheneje 2011). Certain examples of profitability ratios are listed and explained below:

1. Benefit-Cost Ratio (BCR)

Benefit-cost ratio or analysis is the term that either refers to helping to evaluate the case for a project program or policy suggestion and a method to making the economic decision of any generosity. From the above definition, the method involves, whether explicitly or implicitly, weighing the total expected costs against the total expected benefits of one or more activities in order to choose the best or most profitable choice. Therefore, BCR = TR/TC, where TR = Total Revenue and TC = Total Cost.

2. Expense Structure Ratio (ESR) = FC/VC

Where, FC = Fixed cost and VC = Variable cost.

3. Rate of Return (ROR) = NR/TC

Where, NR = Net Return.

4. Gross Revenue Ratio (GRR) = TFE/GI

Where, TFE = Total farm expenses and GI = Gross income.

Results and Discussion

Socioeconomic characteristics of the fish farms in the Gaza Strip

During this study, the assessment of fish farmers with respect to their socioeconomic characteristics was made. Most (75%) of the fish farmers fall within the age bracket of 21-40 years, 10% were above 50 years of age, while 15% fell within the age range of 41-50 years. This age bracket is a productive age that indicates a better future for fish production; it is also considered an economically active age, as reported by Olowosegun et al. (2004). This indicates that very few young and older people are involved in fish farming. This is because fish farming requires tolerable attention and a lot of wisdom of responsibility.

Sex plays a crucial role in fish farming and agriculture, in terms of property acquisition, for example, fixed assets like land and machines. The majority (98%) of the fish farmers were males, while 2% were females working in the hatchery unit. This result can be justified by Brummett et al. (2010) statement that men mostly subjugate fisheries activities. It was observed that marriage in our society is highly valued. This observation was further inveterate by Fakoya's (2000) report and Oladoja et al. (2008), who highlighted that marriage deliberate some level of responsibility and commitment on married individuals. In this study, it was observed that the majority of the farmers were married (90%) while very few were single, widowed, and separated.

Farmers without formal education were 2%, while 98% had higher and middle education levels. This means that fish farming is dominated by the educated class and mostly by those armed with a high level of education. This is so because fish farming requires a lot of technical and scientific knowledge to be successfully undertaken. The mean household size was found to be seven persons per household. This was a sign that the more educated and urban-based an individual is, the less family-size that individual will keep, which was confirmed by Yarhere (2004). Based on farmers' responses during the field survey, it was found that very few farmers are engaged in other occupations apart from fish farming. It revealed that 60% had fish farming experience ranging between 5-10 years, 25% had between 3-5 years, 10% had less than five years, and 5% had above ten years' experience in fish farming. As a result, the farmers with the highest number of years of experience should have good skills and better approaches to the fish farming business. The owners with longer years of experience could also estimate the market situation in which they sell their products at higher prices. The farmers with fewer years of experience, especially those less than three years, faced many risks in the early days of their work in the fish farm. The majority (100%) of the owners purchased the land they are using for fish farming.

The workers in the fish farming industry in the Gaza Strip play a crucial role in its operation. Many workers are part of the owners' families, showing the significance of this industry as a source of livelihood and employment for the local community. The presence of trained engineers and technicians highlights the importance of technical expertise for the success and sustainability of the fish farming industry in the Gaza Strip.

The Fish Fresh farm has 25 ponds with a diameter ranging from 6 to 30 meters. The Al-Bahar farm has 30 ponds with a diameter ranging from 12 to 16 meters and a depth of 2.5 meters. The ponds are made of iron basins coated with fiberglass and covered with leather. Fish Fresh farm pumps water to its ponds from 15 drilling wells while Al-Bahar farm pumps water from 8 drilling wells located on the beach. Water is pumped for 24 hours a day with a capacity of 70-80 m^3 per hour, for a total of 28,800 m^3 (Fish Fresh) and 13,440 m3 (Al-Bahar) of saline water per day. The facility does not use a filter system, and the return water is pumped directly into the sea without any treatment process. The pond basins are cleaned every three days by a specialized team to remove 80-90% of the sediments adhered to the walls. The cleaning process involves partial emptying and refilling of the basin several times until it is completely cleaned, with the resulting water from the cleaning process being pumped directly into the sea.

The fish farms, Fish Fresh and Al-Bahar, employ modern techniques to breed their fish and provide them with high-quality feed. The feed is mainly composed of plant-based materials and animal by-products, and is fortified with vitamins and minerals. Fish Fresh's annual feed cost is estimated to be 100,000 USD, while Al-Bahar's is 60,000 USD. The feeding process is automated and overseen by trained workers, who calculate the amount of feed based on the growth and size of the fish. Both fish farms use chemicals like chlorine and hydrogen peroxide to maintain water quality and prevent disease. Fish Fresh's annual chemical cost is 5,400 USD and Al-Bahar's is 3,000 USD. The total annual operating cost for both farms ranges from 1.3 to 1.6 million USD and includes feed, chemicals, electricity, labor, and maintenance. The fish farming industry in the Gaza Strip provides fresh fish for the local market, but faces challenges like dependence on imported feed and chemicals and a need for sustainable water management. Despite these challenges, the industry is growing and providing economic opportunities for the local population. Both Fish Fresh and Al-Bahar farms use plastic boxes with ice to transport fresh fish to local markets, restaurants, supermarkets, and exports to the West Bank. Fish Fresh exports 66% of its fish production to the West Bank and sells 34% in the local market in the Gaza Strip, with a monthly sales rate of 30-35 tons. Al-Bahar exports 75% of its fish production to the West Bank and sells 25% in the local market in the Gaza Strip, with a monthly sales rate of 20-25 tons.

Cost and return of the selected fish farming in Gaza Strip

Estimate the cost and return analysis were made from fish farming using the average cost (Fixed and Variable) and yield data generated by each sampled fish farmer per cropping season. The cost and return analysis in Table 1 reveals that the variable cost accounted for the largest proportion (94.33% and 95.51%) of the total cost of fish farming in Al-Bahar and Fish Fresh, respectively. This shows that a large amount of money spent by fish farmers in the study area was majorly for the purchase of fish feeds, energy, and fish seeds. This finding agrees with (Olaoye et al. 2013) who documented that the cost of feeds was very high in catfish production. This is followed by the cost of energy and then fish feed. The fixed cost of production consists of the cost of land purchase/rent, water pump, concrete tanks, earthen pond, deep well, generator building/shed, dragnet, wheelbarrow, etc. which accounted for 5.67% and 4.49% of the total cost in Al-Bahar and Fish Fresh farms.

Also, the result shows that a total cost (TC) of 1,662,239 US and 2,367,920 was incurred by both farms respectively per cropping season, while total revenue (TR) of 2,571,429 US and 3,857,143 US was realized with a returning gross margin (GM) of 1,003,475 US and 1,595,509 US and finally a net farm income (NFI) of 909,190 US and 1,489,223 US in both farms respectively. This indicates that fish farming in the Gaza Strip was profitable. This result is consistent with the finding of Ashaolu et al. (2006) and Olaoye et al. 2013 who identified that fish farming is profitable and inveterate in Table 2 (Profitability ratio).

Profitability and viability estimate of the selected fish farming

The analysis of ratios in Table 2 shows that the benefit-cost ratio of both fish farms was greater than one. This ratio is one of the concepts of the discount method of project evaluation. As a rule, look at any business with a benefit-cost ratio greater than one, equal to one or less than one, showing a profit, break-even, or loss, respectively (Olagunju et al. 2017). It is also in agreement with the work of Emokaro and Ekunwe (2009) and Olaoye et al. 2013 who studied the efficiency of resource use among Catfish farmers to be feasible. Since the ratio (BCR = 1.55 and 1.63) indicates that fish farming in Gaza Strip is profitable, it is much possible to have a higher value of BCR with increased capital and skilled labor.

Items	Amount Al-Bahar Farm	% Total cost Al-Bahar Farm	Amount Fish Fresh Farm	% Total cost Fish Fresh Farm
Variable cost				
Fish Feed	580,285	35	1,049,572	44
Fish seed	260,000	16	371,429	16
Lime/Fertilizer	2,057	0.12	2,400	0.11
Labour	221,143	13.30	272,571	11.51
Fuel	445,714	26.81	480,000	20.27
Transportation	28,571	1.72	42,519	1.8
Others	30,184	1.82	43,143	1.82
Total variable cost	1,567,954	94.33	2,261,634	95.51
Total fixed cost	94,285	5.67	106,286	4.49
Total cost	1,662,239	-	2,367,920	-
Total revenue	2,571,429	-	3,857,143	-
Gross margin	1,003,475	-	1,595,509	-
Net farm income	909,190	-	1,489,223	-

Table 1: *Economic analysis of the fish farms in Gaza Strip (inventory data).*

Rate of Return (ROR)

The rate of returns in fish production in Al-Bahar and Fish Fresh farms is 0.55 and 0.63, respectively. This shows that for every US 1.00 invested, 55 and 63 cents are gained by the respondent.

Gross Revenue Ratio (GRR)

The gross revenue ratio in Al-Bahar and Fish Fresh farms of 0.65 and 0.61 indicate that for every one US dollar return to fish farm enterprise, 65 and 61 cents are being spent, respectively.

Expense Structure Ratio (ESR)

The value of the ratio in both Al-Bahar and Fish Fresh farms is 0.06 and 0.05, which implies that about 6% and 5% of the total cost of production is made up of fixed cost components. This makes the business worthwhile since the increase in the production with variable cost will increase the total revenue leaving the fixed cost unchanged.

Ratios	Values/ Al-Bahar Farm	Values/Fish Fresh Farm
Benefit cost ratio (BCR)	1.55	1.63
Rate of return (ROR)	0.55	0.63
Expense structure ratio (ESR)	0.06	0.05
Gross revenue ration (GRR)	0.65	0.61
Net profit margin (NPM)	0.35	0.39

Table 2: *Profitability Ratios.*

Conclusion

The study concluded that fish farming in the Gaza Strip is a profitable enterprise, with a majority of fish farmers being young and educated and having 5-10 years of experience. The average cost of fish farming was 2,014,691 US dollars, and the total revenue was 3,214,286 US dollars, resulting in a gross margin of 1,299,492 US dollars. The results show that fish farming in the Gaza Strip is a profitable venture with a benefit-cost ratio of 1.59, meaning for every $1 spent, there is a return of $1.59. The rate of return of 0.59 indicates a positive return on investment, and the favorable revenue-to-expense structure (gross revenue ratio of 0.63 and expense structure ratio of 0.055) suggests efficient use of resources. Overall, the results suggest a successful and profitable fish farming enterprise in the Gaza Strip. Expanding inland and marine cage aquaculture requires a study of the entire value chain, including consistent and sustainable inputs, potential markets, and marketing strategies. The supply side should include fish seeds, feed, and equipment, while the marketing side should focus on target markets and species. Despite potential for capacity development in the sector, there is a lack of exchange of experiences with the outside world in the Gaza Strip which affects quality. Different stakeholders need to be identified and capacity development needs assessed. Improving the aquaculture industry with non-traditional equipment and collaborating with international donors to develop fishing farms in the Gaza Strip are recommended.

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