# Developmental Local Policy for Aquaculture Farming in San Juan, Batangas: Basis for Sustainable Livelihood Program

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## ABSTRACT

The Municipality of San Juan, Batangas, has remarkable development in the tourism and aquaculture industries due to exquisite coastal resources. Aquaculture farming provides a significant source of income, livelihood, support for tourism, and food security. However, despite its development, the aquaculture industry threatens its sustainability due to environmental degradation, rapid population growth, and financial constraints of aquaculture farmers for sustainable livelihoods. Through descriptive research and purposive sampling of 125 respondents (aquaculture farmers), the statistical analysis used frequency and percentage in the demographics, the weighted mean for the variables of sustainable aquaculture livelihood, the chi-square test for determining the demographics and the variables of the sustainable aquaculture system, and the Spearman's rank order correlation for the challenges encountered by farmers and the sustainable aquaculture system. The survey shows that the majority of respondents are in the age range of 42 to 49, married, and have a monthly income of Php 10,000 or less. The production technology has a significant relationship with the monthly income of the respondents, while the status of aquaculture farming in terms of social and economic aspects has a significant relationship with the sex of the respondents. Primary challenges faced by respondents in aquaculture are the detrimental effects of climate change, followed by competition from other farms, while issues related to obtaining loans and regulatory compliance are less pressing concerns. Hence, a local ordinance is proposed for the Municipality of San Juan, Batangas, for the sustainable livelihood of aquaculture farmers on the basis of the outcome of research.

**Keywords:** aquaculture farming, environmental aspects, production technology, social and economic aspects, sustainable aquaculture system.

## INTRODUCTION

The Municipality of San Juan, Batangas, being part of the Verde Island Passage, has remarkable coastal resources manifested by the development in the tourism and aquaculture industries (Corachea, 2023). The aquaculture farming in the Municipality of San Juan, Batangas, provides a significant source of income, livelihood, support for tourism, and food security. As the population grows and tourism has prospered, the future demands environmental, social, economic, and technological challenges. However, despite this potential, the aquaculture industry in San Juan, Batangas, faces numerous challenges that hinder its growth and sustainability.

At present, the rapid growth of aquaculture in San Juan has brought about challenges that threaten its long-term viability. Unsustainable farming practices can cause environmental harm, while disease outbreaks in densely populated aquaculture farms may lead to substantial production losses (Leung and Bates, 2012). Recently, the closure of several aquaculture farms has raised concerns among both seafood consumers and local farmers, causing job losses and economic instability in a community heavily dependent on aquaculture (Bohnes et al., 2022). The social and economic environment presents further challenges as local farmers struggle with market

competition and shifts in consumer demand (FAO-UN, 2017). Many aquaculture practitioners lack effective marketing strategies to set their products apart in an overcrowded market, leading to reduced profitability (Dasgupta and Durborow, 2009).

This study is focused on providing data on the status of aquaculture farming in the municipality of San Juan, Batangas, as a basis to develop local policy. The said study encompasses and determines the demographic profile of the respondents in terms of their age, sex, marital status, and monthly income. Likewise, the current status of aquaculture farming will also be assessed in terms of environmental aspects, production technology, and social and economic aspects, which is a further objective of the researcher. Lastly, this research determines the challenges encountered by the respondents in aquaculture farming in San Juan, Batangas. Based on the findings of the study, the researchers will propose policy for a sustainable aquaculture farming system that will benefit the aquaculture farmers in the locality.

## METHODS

For purposes of this study, the participants or respondents consist of aquaculture farmers in San Juan, Batangas, with a total population of 184, all aged 18 and older. Descriptive research was utilized as a method to analyze and examine the current status of aquaculture farmers in San Juan, Batangas. The study surveyed the 125 participants selected using a sample size calculator by Raosoft. Purposive sampling was employed to intentionally select individuals who best represent specific characteristics relevant to the study.The procedure involved distributing survey questionnaires to aquaculture farmers in selected barangays, taking forms such as questionnaires, focus groups, or observational checklists suitable for groups of 10 or more participants. The survey questionnaire was divided into three sections. The first section focused on the demographic profile of respondents, including age, sex, marital status, and monthly income. The second section comprised statements developed by the researchers related to sustainable aquaculture, covering environmental aspects, production technology, and social and economic aspects. The final section addressed the challenges faced by aquaculture farmers. The researchers opted for survey questionnaires due to their applicability and convenience for gathering data from respondents.

The statistical treatment of data makes use of the Statistical Package for Social Science (SPSS) in the statistical analysis of data. The frequency and percentage were used to describe the profile of the respondents in terms of age, sex, marital status, and monthly income. The weighted mean determined the assessment of the respondents on the status of aquaculture farming in terms of environmental aspects, production technology, and social and economic aspects in San Juan, Batangas. The Spearman's Rank Order Correlation in this study determined the significant relationship between the assessed status of aquaculture farming in San Juan, Batangas, and the challenges that need to be overcome in aquaculture farming.

The study adopts the Asian Institute of Technology (AIT) framework for sustainable aquaculture systems. Specifically, the framework emphasized the integration of production technology, social and economic factors, and environmental considerations.

## RESULTS AND DISCUSSION

The results and discussion of this study presented the profile of the respondents in terms of age, sex, marital status, and monthly income. It also assessed the extent of status of aquaculture farming in San Juan, Batangas

**1. Profile of the Respondents: Table 1. Distribution of Respondents by Age.**

| Age | Frequency | Percentage |
|---|---|---|
| 18 - 25 years old | 7 | 5.6 |
| 26 - 33 years old | 13 | 10.4 |
| 34 - 41 years old | 45 | 36.0 |

| | | |
|---|---|---|
| 42 - 49 years old | 48 | 38.4 |
| 50 years and above | 12 | 9.6 |
| **Total** | **125** | **100.0** |

Table 1 presents the age distribution of aquaculture farmers. The data shows that the majority of respondents are within 42-49 years, comprising 48 respondents, or 38.4%. It is followed closely by 34-41 years of age, with 45 respondents, garnering 36% of responses. This concentration of middle-aged farmers suggests a mature and experienced workforce in aquaculture farming. The younger age bracket, 18-25 years old, consisted of 5.6% of responses. The 26-33-year-old bracket comprises 10.4% of responses. Those aged 50 years and above are a relatively small percentage, consisting of 9.6% of farmers, where experienced farmers may soon be retiring.

**Table 2. Distribution of Respondents by Sex.**

| Sex | Frequency | Percentage |
|---|---|---|
| Male | 110 | 88.0 |
| Female | 15 | 12.0 |
| **Total** | **125** | **100.0** |

Table 2 illustrates the gender distribution among aquaculture farmers. It shows that there is a clear difference between male and female participation in the sector. The data demonstrates an overwhelming male dominance, with 110 respondents constituting 88.0% being male farmers, while female farmers comprise only 15 respondents, indicating 12% of the total population. This significant gender gap reflects the traditional nature of aquaculture farming in the region and highlights potential barriers to female participation in the industry. The gender disparity observed in global trends in aquaculture farming emphasizes that women participate more in post-harvest tasks, whereas men usually take the lead in aquaculture farming activities (Troell et.al, 2023).

**Table 3. Distribution of Respondents by Marital Status.**

| Marital Status | Frequency | Percentage |
|---|---|---|
| Single | 53 | 42.4 |
| Married | 65 | 52.0 |
| Widowed | 7 | 5.6 |
| **Total** | **125** | **100.0** |

Table 3 shows the marital status distribution of aquaculture farmers. It provides data on the family structure of individuals involved in the sector. The majority of respondents are married, accounting for 65 farmers, which is 52% of the total population, followed by single individuals comprising 53 respondents, signifying 42.4% response representation. A smaller proportion of respondents are widowed, representing 7 farmers or 5.6%. This distribution suggests that aquaculture farming in the region is predominantly supported by individuals with established family units, which may influence farming decisions, risk management approaches, and long-term commitment to the sector. According to the study of Ateweberhan et. al. (2018), the marital status composition of farmers can impact various aspects of aquaculture operations, including labor distribution, financial decision-making, and succession planning.

**Table 4. Distribution of Respondents by Monthly Income.**

| Monthly Income | Frequency | Percentage |
|---|---|---|
| Php10,000 and below | 100 | 80.0 |
| Php10,001 - Php20,000 | 22 | 17.6 |
| Php 40,001 - Php 50,000 | 3 | 2.4 |
| **Total** | **125** | **100.0** |

Table 4 entails the distribution of respondents according to their monthly income. The data reveals that a substantial majority of respondents, comprising one hundred farmers, 80% of whom earn Php10,000 and below monthly, represent the lowest income bracket in the sample. The second group consists of 22 farmers, or 7.6% of total responses from the sample, earning between Php10,001 and Php20,000 monthly. Only a very small proportion, consisting of three farmers (2.4% response representation), earns between Php 40,001 to Php 50,000 monthly, representing the highest income category. This income distribution pattern reveals significant economic disparities within the farming community, with the vast majority falling into the lower income bracket. This data indicates a need for interventions and support mechanisms to improve the economic conditions of these farmers, such as access to better resources, training, and market opportunities. In the study of Espaldon et.al. (2009) which states that aquaculture farming significantly supports household income, allowing families to meet their basic needs.

**Assessment of the status of aquaculture farming in San Juan, Batangas.**

**Table 5. Status of the Aquaculture Farming in terms of Environmental Aspect**

| As an aquaculture farmer, I ensure that our Aquaculture Farming… | Weighted Mean | Verbal Interpretation |
|---|---|---|
| **1.** implements sustainable water management practices to conserve water resources. | 3.81 | Always |
| **2.** uses environmentally-friendly and organic feed for aquatic animals. | 3.88 | Always |
| **3.** demonstrates responsible waste management by properly treating and disposing of effluents to minimize environmental impact. | 3.93 | Always |
| **4.** reuses and recycles materials when feasible | 3.98 | Always |
| **5.** support eco-friendly packaging for seafood products. | 3.92 | Always |
| **6.** regularly monitors and reports on the environmental impact of the venture to ensure ongoing compliance and improvement. | 3.96 | Always |
| **7.** implements bio security measures to prevent the introduction and spread of invasive species or pathogens, safeguarding the ecosystem. | 3.83 | Always |
| **8.** complies with all relevant environmental regulations set by the government. | 3.92 | Always |
| **9.** advocate for environmentally-friendly materials utilized in the aquaculture industry. | 3.94 | Always |
| **10.** attend seminars and conferences relative to impacts of climate in aquaculture. | 3.63 | Always |
| **Composite Mean** | **3.88** | **Always** |

The assessment of the status of aquaculture farming in San Juan, Batangas, in terms of environmental aspects yielded a composite mean of 3.88, which is interpreted as "Always". The data shows that aquaculture farmers are always compliant with the environment where they are situated. As presented in Table 5, the statement regarding the reuse and recycling of materials when feasible ranked first, achieving the highest weighted mean of 3.98, which was verbally interpreted as "Always." This finding indicates that aquaculture farmers prioritize resource efficiency, demonstrating a commitment to minimizing waste and conserving materials. According to Pounds (2021), the adoption of recycling practices in aquaculture significantly contributes to sustainability by transforming waste byproducts into valuable resources, thereby minimizing environmental impact. Although it indicates a strong commitment among stakeholders to stay informed about climate-related challenges, it is noteworthy that this is the lowest ranking among the assessed statements. In the study of Global Conference (2024) participating in a fisheries conference provides essential opportunities for networking, keeping up with industry developments, and learning from specialists.

**Table 6: Status of the Aquaculture Farming in terms of Production Technology.**

| As an aquaculture farmer, I ensure that our Aquaculture Farming… | Weighted Mean | Verbal Interpretation |
|---|---|---|
| **1.** employs automated feeding systems to ensure precise and controlled feeding schedules for the farmed species. | 1.94 | Seldom |
| **2.** uses special cages or nets to protect the fish from predators and provide them with a safe environment. | 3.61 | Always |
| **3.** implements monitoring and control technologies to regulate environmental parameters such as temperature, oxygen levels and the likes. | 3.40 | Often |
| **4.** uses special equipment to make sure the water in the aquaculture farm is clean and safe. | 3.78 | Always |
| **5.** uses innovative harvesting and processing technologies to ensure the quality and freshness of the final aquaculture products. | 3.30 | Often |
| **6.** explores the use of alternative energy sources, such as biomass or hydropower, to power the operations. | 3.26 | Often |
| **7.** has in place a comprehensive record-keeping system to track all activities, treatments, and other relevant information for traceability and regulatory compliance. | 3.61 | Always |
| **8.** has trained and skilled personnel to operate the production system. | 3.68 | Always |
| **9.** has adequate post-harvest handling and processing facilities | 3.63 | Always |
| **10.** has updated learning to adopt new methodology and technology. | 3.66 | Always |

The assessment of the status of aquaculture farming in San Juan, Batangas, in terms of production technology yielded a composite mean of 3.39, which is interpreted as "Often." The above data shows that aquaculture farmers frequently ensure the technological production of aquaculture. This means that aquaculture farmers in this region frequently engage in practices that incorporate modern production technologies, reflecting an increasing awareness of the benefits these technologies can bring to their operations

As shown in Table 6, the practice of using special equipment to ensure water quality received a high weighted mean of 3.78, categorized as "Always" and ranked as first in the list. This finding suggests that farmers prioritize maintaining clean and safe water conditions, recognizing their critical role in the health of aquatic species. In the study of Yusoff et. al (2024) effective water quality management is essential for promoting optimal growth and reducing disease risks in aquaculture systems.

**Table 7: Status of the Aquaculture Farming in terms of Social and Economic Aspect.**

| As an aquaculture farmer, I ensure that our Aquaculture Farming… | Weighted Mean | Verbal Interpretation |
|---|---|---|
| **1.** plays a crucial role in ensuring food security for local communities. | 4.00 | Always |
| **2.** contributes to poverty alleviation efforts by offering income-generating opportunities | 4.00 | Always |
| **3.** creates livelihood for unemployed individuals along the locality. | 4.00 | Always |

| | | |
|---|---|---|
| **4.** facilitates social mobility by enabling individuals to acquire entrepreneurial abilities. | 3.96 | Always |
| **5.** promotes gender equality by offering equal participation and economic empowerment opportunities for women in the sector. | 3.83 | Always |
| **6.** fosters a sense of pride and identity among farmers, contributing to the cultural fabric of the community. | 3.95 | Always |
| **7.** stimulates trade and export opportunities, contributing to the national economy. | 4.00 | Always |
| **8.** actively engages in development of industry-wide standards and certification programs. | 3.93 | Always |
| **9.** collaborates with non-government organizations to access support for development. | 2.10 | Seldom |
| **10.** participate in conferences relevant to poverty alleviation among aquaculture farmers. | 4.00 | Always |
| **Composite Mean** | **3.78** | **Always** |

The above data shows that aquaculture farmers are continuously ensuring the beneficial impact of aquaculture farming in their respective social and economic lives. This result indicates that aquaculture farmers in this area regularly engage in activities that benefit their communities and help the local economy. The role of aquaculture in ensuring food security for local communities received the highest weighted mean of 4.00, this was verbally interpreted as “Always” and ranked the first in the list of indicators. The indicator regarding collaboration with non-government organizations (NGOs) to access support for development received a weighted mean of 2.10, categorized as "Seldom", this was the tenth in the ranking. This low score indicates that aquaculture farmers in the region infrequently engage in partnerships with NGOs for developmental support. For Stoner (2020), the importance of collaboration among NGOs in advancing sustainability in aquaculture. Such cooperation facilitates the integration of various certification and assessment programs.

**Table 8. Challenges encountered by the respondents in aquaculture farming**

| **As an aquaculture farmer, I am experiencing challenges relative to…** | **Weighted Mean** | **Verbal Interpretation** |
|---|---|---|
| **1.** the availability and affordability of high-quality feeds for my aquaculture species. | 3.11 | Often |
| **2.** making sure that the farm is registered and legally complied with the authority. | 2.26 | Seldom |
| **3.** the negative impact of climate change, such as extreme weather events and temperature fluctuation on my aquaculture production. | 3.53 | Always |
| **4.** high energy costs associated with running and maintaining aquaculture systems. | 2.94 | Often |
| **5.** securing reliable and affordable acquisition to critical inputs, such as seeds and fingerlings. | 3.07 | Often |
| **6.** fluctuating consumer demand. | 3.18 | Often |
| **7.** competition from the competing aquaculture farm. | 3.24 | Often |
| **8.** developing and retaining a skilled workforce to ensure efficiency and productivity. | 2.68 | Often |
| **9.** staying up-to-date with the latest advancements in aquaculture technology. | 2.94 | Often |

| | | |
|---|---|---|
| **10.** securing the need for financial stability for the aquaculture farm's overall operations | 3.05 | Often |
| **11.** attending seminars and conferences relative to the impact of the aquaculture industry to climate change | 3.09 | Often |
| **12.** accessing loans, banks, and other financial institutions to accommodate low interest funding. | 2.26 | Seldom |
| **Composite Mean** | **2.95** | **Often** |

Table 8 demonstrated the challenges encountered by aquaculture farmers. The data shows that a composite mean of 2.95 indicates that respondents often experience various challenges in aquaculture farming, with the highest-ranked issue being "the negative impact of climate change such as extreme weather events and temperature fluctuation, on my aquaculture production." This statement is highest in the rank, which received a weighted mean of 3.53. It only implies that it was always experienced by the respondents. Thus, in the similar study by Tewabe (2015), there is an immediate need for adaptive management strategies that bolster resilience in aquaculture systems and assist vulnerable communities.

The statement "accessing loans, banks, and other financial institutions to accommodate low-interest funding" received a weighted mean of 2.26 and also ranked as the least, indicating that this challenge is seldom encountered by the respondents. This suggests that many farmers have established sufficient relationships with financial institutions, allowing them to secure funding when needed. It was supported by the article of Dubo (2024) which points out that obtaining financing for aquaculture projects poses difficulties, especially for new enterprises, as banks and financial institutions typically demand a solid business plan, collateral, and evidence of past profitability.

**Table 9. Significant Relationship between the Assessed Sustainable Aquaculture System and the Challenges in Aquaculture Farming.**

| **Variables** | **Challenges that Need to be Overcome in Aquaculture Farming** | | | |
|---|---|---|---|---|
| | **Spearman rho** | **p-value** | **Decision on Ho** | **Verbal Interpretation** |
| Environmental Aspect | 0.263 | 0.003 | Reject | Significant |
| Production Technology | 0.132 | 0.141 | Failed to Reject | Not Significant |
| Social and Economic Aspects | 0.092 | 0.092 | Failed to Reject | Not Significant |
| **Overall** | **0.202** | **0.202** | **Failed to Reject** | **Not Significant** |

Table 14 presents the significant relationship between the assessed status of aquaculture farming and the challenges in aquaculture farming. The assessment of the sustainable aquaculture system in terms of environmental aspects is significantly related to the challenges that need to be overcome in aquaculture farming based on the Spearman rho value of .263 and p-value of .003. Such a generated p-value is less than 5% of significance, which led to rejecting the null hypothesis. These issues reflect the complex relationship between aquaculture practices and environmental health, emphasizing the need for sustainable management strategies. Overall, there is no significant relationship between the sustainable aquaculture system and the challenges that need to be overcome in aquaculture farming, as indicated by the Spearman rho value of 0.115 and p-value of 0.202. Such a generated p-value is greater than 5 percent of significance that failed to reject the null hypothesis.

## CONCLUSION

Upon presentation of data and analysis, the study uncovered several key conclusions. The results are as follows:

1. In terms of the profile of respondents, the majority were in the age range of 42 to 49. A significant number of them were married, and most reported a monthly income of Php 10,000 or less. This predominance of male participants may be due to traditional gender roles in rural areas, where men typically serve as the primary earners and decision-makers in agricultural activities.
2. The assessment of aquaculture practices indicates a commendable commitment to environmental sustainability, with farmers actively engaging in recycling and resource reuse. However, there is room for growth, particularly in increasing attendance at seminar-related events relevant to climate impacts on aquaculture.
3. The status of aquaculture farming in terms of production technology has a significant relationship with the monthly income of the respondents. The status of aquaculture farming in terms of social and economic aspects has a significant relationship with the sex of the respondents.
4. The findings indicate that the primary challenges faced by respondents in aquaculture are the detrimental effects of climate change, followed by competition from other farms, while issues related to obtaining loans and regulatory compliance are less pressing concerns.
5. The analysis revealed that while the environmental aspect significantly relates to the challenges faced in aquaculture farming, the variables of production technology and social and economic factors do not, indicating that the latter should remain under consideration for further exploration.
6. The researchers proposed an aquaculture developmental policy for the local government of San Juan, Batangas that will help aquaculture farmers to integrate a sustainable aquaculture system to enhance their farming operation.

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### Research Ethics Committee

Not applicable.

### Conflicts of Interest

The author/autors declare no conflict of interest.

### Data Availability Statement

All data will be available and shared upon request.

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