# BUILDING A SUSTAINABLE FUTURE: GREEN ENTREPRENEURSHIP IN THE WORLD OF AQUACULTURE

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**Abstract**

Green entrepreneurship in aquaculture is an emerging sector that combines sustainable practices with innovative business models to tackle environmental challenges while fulfilling the growing demand for seafood. Green entrepreneurship in aquaculture provides a sustainable approach to fish production and creates a framework for future growth in the aquaculture sector. This paper explores the role of green entrepreneurship in reshaping the aquaculture industry by implementing eco-friendly practices. The study identifies the challenges the fish farmers face in adopting green practices and strategies for encouraging green entrepreneurship in fish farming. The study relies on both primary and secondary data. The statistical tools used for the study are the sample t-test and the independent sample t-test. Green entrepreneurship in aquaculture creates a balance between economic growth and environmental stewardship, ensuring a sustainable future for the global fish industry.

**Keywords:-** Aquaculture, Green Entrepreneurship, Sustainable Development, Economic Growth, Environmental Stewardship.

Green entrepreneurship aligns with current development trends and is closely linked to sustainable development, ecological sustainability, and corporate environmental responsibility.(Janicka et al., 2020). Green entrepreneurship is crucial in effectively achieving economic, social, and environmental goals. (Bergquist, 2017). Green entrepreneurship focuses on creating and managing businesses that prioritize environmental sustainability while being economically viable.

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It aims to guide long-term sustainableGreen entrepreneurship plays a crucial role in economic development by creating new jobs, introducing sustainable innovations in the market, and addressing society's demand for change. (Silajdžiæ et al., 2015). Green entrepreneurship acts as a driving force for sustainability and social change.(de Bruin, 2016). Environmental change and green entrepreneurship are shaped by three factors: compliance-based protection from government regulations, market-based incentives for eco-friendly practices, and value-based environmentalism driven by consumer demand for sustainable products. (Post & Altman, 2017). Green entrepreneurship promotes sustainable businesses focused on social change, often resulting in higher sales compared to non-green firms.(Oosterbeek et al., 2010).

The fast growth of fish farming has sparked environmental concerns. To address these, innovative solutions like green entrepreneurship are essential. Integrating green practices into fish farming offers numerous opportunities. Green entrepreneurship in fish farming promotes a sustainable aquaculture approach that balances economic growth with environmental responsibility. As global seafood demand rises, traditional methods have caused ecological issues like water pollution and habitat destruction. Green entrepreneurship seeks to address these problems through eco-friendly practices, innovative technologies, and circular economy principles. This study will explore the potential of green entrepreneurship in fish farming and its impact on environmental sustainability.

**Review of Literature**

Green entrepreneurship plays a crucial role in economic development by creating new jobs, introducing sustainable innovations in the market, and addressing society's demand for change. (Silajdžiæ et al., 2015). Green entrepreneurship acts as a driving force for sustainability and social change.(de Bruin, 2016). Environmental change and green entrepreneurship are shaped by three factors: compliance-based protection from government regulations, market-based incentives for eco-friendly practices, and value-based environmentalism driven by consumer demand for sustainable products. (Post & Altman, 2017). Green entrepreneurship promotes sustainable businesses focused on social change, often resulting in higher sales compared to non-green firms.(Oosterbeek et al., 2010).

Green enterprises face unique challenges in financing, market access for eco-friendly products, and technology selection. They require more support than traditional businesses. The government should foster green entrepreneurship through information sharing, financial incentives, technical support, and knowledge enhancement.(Kaur & Kaur, 2019).Muo & Azeez (2019).There is a need to clarify the process of green entrepreneurship and distinguish it from traditional entrepreneurship. Future studies should outline step-by-step practices to enhance accessibility for aspiring entrepreneurs. Green products aim to minimise resource consumption, prevent toxic waste, promote recycling, and reduce energy use. By addressing environmental issues, green entrepreneurs also challenge traditional marketing

practices with a sustainable approach. (Kumar &Yashwant, 2020). Farmers in both rural and urban areas should adopt green entrepreneurship to foster sustainable economic growth. Educational institutions need to enhance research and innovate for a cleaner environment, contributing to long-term sustainability and economic success. (Anabaraonye et al., 2021).

**Statement of the Problem**

The rising global demand for fish raises environmental and social concerns. Traditional fish farming causes water pollution, habitat destruction, and reliance on unsustainable feeds, contributing to ecosystem degradation and biodiversity loss. The industry faces challenges like inefficient resource use and increased scrutiny from consumers. While fish farming can be a sustainable alternative to overfishing, the adoption of eco-friendly practices remains low. Integrating sustainable methods is crucial for mitigating the issues tied to traditional practices, but challenges persist. Encouraging green entrepreneurship in the fish farming industry is vital for achieving a balance between economic viability and environmental sustainability.

**Significance and Scope of the Study**

The study on green entrepreneurship in fish farming examines environmental, economic, and social challenges in the industry. It promotes sustainable practices to reduce pollution and protect biodiversity, while demonstrating how sustainable fish farming can lower costs and attract eco-conscious consumers. The research also informs policy for sustainable aquaculture and advocates for ethical labour practices, enhancing community resilience in coastal and rural areas. Overall, it encourages a balanced approach to fish farming for long-term conservation, economic sustainability, and social well-being. The study focuses on fish farmers in the backwaters of Trivandrum and Kollam districts.

**Objectives of the Study**

- To identify the challenges faced by the fish farmers by adopting green practices.
- To identify the strategies for encouraging green entrepreneurship in fish farming.

**Research Methodology**

The present study is descriptive cum analytical in nature. Both primary and secondary data were used for the study. Primary data were collected from fifty (50) fish farmers in the Thiruvananthapuram and Kollam districts with a structured interview schedule. The purposive sampling method was used for the study. The selection criterion is that fish farmers are farming in backwaters. Secondary data for the study were gathered through an extensive and intensive literature survey.

**Analysis and Interpretation of Data**

Table 1 shows the frequency of fish farmers from Trivandrum and Kollam. It is clearly shown that there are equal numbers. Fifty per cent of respondents were from Trivandrum, and 50 per cent were from Kollam.

**Table 1**

**Frequency distribution**

| Districts | Frequency | Percentage |
|---|---|---|
| Trivandrum | 25 | 50 |
| Kollam | 25 | 50 |
| **Total** | 50 | 100 |

*Source: Primary Data*

**To identify the challenges faced by the fish farmers by adopting green practices**.

**H0 1a**: The challenges the fish farmers face in adopting green practices are insignificant.

**H1 1b**: The challenges the fish farmers face in adopting green practices are significant.

Table 2 presents the t-test results with a test value of 3. All p-values are below 0.05, leading to the rejection of H0, indicating significant challenges for fish farmers in adopting green practices.

**Challenges faced by the fish farmers in adopting green practices based on the districts.**

**H0 2a:** There is no significant difference in the mean scores of opinions on challenges faced by the fish farmers in adopting green practices based on districts.

**H1 2b:** There is a significant difference in the mean scores of opinions on challenges faced by the fish farmers in adopting green practices based on districts.

Table 4 displays the independent sample test results comparing the challenges fish farmers face in adopting green practices between Trivandrum and Kollam. The p-values for difficulties in waste management, resistance to change, lack of government support, community barriers, and pollution are below 0.05, indicating significant differences. However, the p-values for other variables exceed 0.05, meaning the null hypothesis (H0) cannot be rejected for those, suggesting no significant differences in opinions based on district.

**To identify the strategies for encouraging green entrepreneurship in fish farming**.

**H0 3a:** The strategies for encouraging green entrepreneurship in fish farming are not significant.

**H1 3b:** The strategies for encouraging green entrepreneurship in fish farming are significant.

Table 5 presents the sample t-test results, indicating a test value of 3. All p-values are below 0.05, leading to the rejection of H0, showing that the strategies for promoting green entrepreneurship in fish farming are significant.

**Strategies for encouraging green entrepreneurship in fish farming based on districts.**

**H0 4a:** There is no significant difference in the mean scores of opinions on strategies for encouraging green

**Table 2**

**One-sample t-test**

| Challenges | Test Value = 3 | | | | | |
|---|---|---|---|---|---|---|
| | t | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
| | | | | | Lower | Upper |
| **Economic challenges** | | | | | | |
| High initial cost | 7.945 | 49 | 0 | 1.26 | 0.94 | 1.58 |
| Limited access to finance | 6.861 | 49 | 0 | 1.12 | 0.79 | 1.45 |
| High cost of sustainable inputs | 6.472 | 49 | 0 | 1.14 | 0.79 | 1.49 |
| Unstable market demand | 3.642 | 49 | 0.001 | 0.7 | 0.31 | 1.09 |
| **Technical challenges** | | | | | | |
| Lack of knowledge and Training | 9.493 | 49 | 0 | 1.38 | 1.09 | 1.67 |
| Unavailability of green technology | 9.298 | 48 | 0 | 1.306 | 1.02 | 1.59 |
| difficulties in waste management | 5.84 | 49 | 0 | 0.98 | 0.64 | 1.32 |
| **Social challenges** | | | | | | |
| Resistance to change | 10.48 | 49 | 0 | 1.32 | 1.07 | 1.57 |
| Lack of government support | 6.139 | 49 | 0 | 0.96 | 0.65 | 1.27 |
| community and cultural barrier | 9.137 | 49 | 0 | 1.28 | 1 | 1.56 |
| **Environmental challenges** | | | | | | |
| climate change | 6.014 | 49 | 0 | 1.14 | 0.76 | 1.52 |
| pollution | 6.759 | 49 | 0 | 1.12 | 0.79 | 1.45 |

Source: Primary data

**Table 3**

**Group Statistics**

| Challenges | Districts | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| **Economic challenges** | | | | | |
| High initial cost | Trivandrum | 25 | 4.12 | 1.166 | 0.233 |
| | Kollam | 25 | 4.4 | 1.08 | 0.216 |
| Limited access to finance | Trivandrum | 25 | 4 | 1.19 | 0.238 |
| | Kollam | 25 | 4.24 | 1.128 | 0.226 |
| High cost of sustainable inputs | Trivandrum | 25 | 4 | 1.354 | 0.271 |
| | Kollam | 25 | 4.28 | 1.137 | 0.227 |
| Unstable market demand | Trivandrum | 25 | 4.08 | 1.187 | 0.237 |
| | Kollam | 25 | 3.32 | 1.435 | 0.287 |
| **Technical challenges** | | | | | |
| Lack of knowledge and Training | Trivandrum | 25 | 4.32 | 1.108 | 0.222 |
| | Kollam | 25 | 4.44 | 0.961 | 0.192 |
| Unavailability of green technology | Trivandrum | 25 | 4.36 | 0.952 | 0.19 |
| | Kollam | 24 | 4.25 | 1.032 | 0.211 |
| Difficulties in waste management | Trivandrum | 25 | 4.4 | 0.577 | 0.115 |
| | Kollam | 25 | 3.56 | 1.474 | 0.295 |
| **Social challenges** | | | | | |
| Resistance to change | Trivandrum | 25 | 4.52 | 0.51 | 0.102 |
| | Kollam | 25 | 4.12 | 1.13 | 0.226 |
| Lack of government support | Trivandrum | 25 | 4.48 | 0.51 | 0.102 |
| | Kollam | 25 | 3.44 | 1.294 | 0.259 |
| Community and cultural barrier | Trivandrum | 25 | 4.48 | 0.51 | 0.102 |
| | Kollam | 25 | 4.08 | 1.288 | 0.258 |
| **Environment challenges** | | | | | |
| Climate change | Trivandrum | 25 | 3.92 | 1.47 | 0.294 |
| | Kollam | 25 | 4.36 | 1.186 | 0.237 |
| Pollution | Trivandrum | 25 | 3.76 | 1.508 | 0.302 |
| | Kollam | 25 | 4.48 | 0.51 | 0.102 |

*Source: Primary Data*

**Table 4**

**Independent sample test**

| Challenges | | Levene's Test for Equality of Variances | | t-test for Equality of Means | |
|---|---|---|---|---|---|
| | | F | Sig. | t | Df |
| **Economic challenges** | | | | | |
| High initial cost | Equal variances assumed | 0.256 | 0.615 | -0.881 | 48 |
| | Equal variances are not assumed. | | | -0.881 | 47.721 |
| Limited access to finance | Equal variances assumed | 0.018 | 0.893 | -0.732 | 48 |
| | Equal variances are not assumed. | | | -0.732 | 47.864 |
| High cost of sustainable inputs | Equal variances assumed | 0.634 | 0.43 | -0.792 | 48 |
| | Equal variances are not assumed. | | | -0.792 | 46.61 |
| Unstable market demand | Equal variances assumed | 0.686 | 0.412 | 2.04 | 48 |
| | Equal variances are not assumed. | | | 2.04 | 46.373 |
| Technical challenges | | | | | |
| Lack of knowledge and Training | Equal variances assumed | 0.391 | 0.535 | -0.409 | 48 |
| | Equal variances are not assumed. | | | -0.409 | 47.063 |
| Unavailability of green technology | Equal variances assumed | 0.01 | 0.919 | 0.388 | 47 |
| | Equal variances are not assumed. | | | 0.387 | 46.311 |
| Difficulties in waste management | Equal variances assumed | 28.46 | 0 | 2.653 | 48 |
| | Equal variances are not assumed. | | | 2.653 | 31.193 |
| Social challenges | | | | | |
| Resistance to change | Equal variances assumed | 5.595 | 0.022 | 1.613 | 48 |
| | Equal variances are not assumed. | | | 1.613 | 33.386 |
| Lack of government support | Equal variances assumed | 19.67 | 0 | 3.74 | 48 |
| | Equal variances are not assumed. | | | 3.74 | 31.282 |
| Community and cultural barrier | Equal variances assumed | 7.406 | 0.009 | 1.443 | 48 |
| | Equal variances are not assumed. | | | 1.443 | 31.338 |
| Environmental challenges | | | | | |
| Climate change | Equal variances assumed | 1.545 | 0.22 | -1.165 | 48 |
| | Equal variances are not assumed. | | | -1.165 | 45.95 |
| Pollution | Equal variances assumed | 39.33 | 0 | -2.262 | 48 |
| | Equal variances are not assumed. | | | -2.262 | 29.419 |

*Source: Primary Data*

**Table 5**

**One-Sample Test**

| Strategies for encouraging green entrepreneurship | Test Value = 3 | | | | | |
|---|---|---|---|---|---|---|
| | t | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
| | | | | | Lower | Upper |
| Financial support | 6.34 | 49 | 0 | 1.04 | 0.71 | 1.37 |
| Technical support & training | 7.493 | 49 | 0 | 1.16 | 0.85 | 1.47 |
| Creating green aquaculture cooperatives | 4.461 | 49 | 0 | 0.76 | 0.42 | 1.1 |
| Strict environmental policy and regulation | 4.484 | 49 | 0 | 0.8 | 0.44 | 1.16 |

*Source: Primary Data*

entrepreneurship in fish farming based on districts.

**H14b:** There is a significant difference in the mean scores of opinions on strategies for encouraging green entrepreneurship in fish farming based on districts.

Table 7 presents the results of an independent sample test comparing strategies for promoting green entrepreneurship in fish farming between Trivandrum and Kollam. The p-values for creating green aquaculture cooperatives are below 0.05, indicating a significant difference. However, all other variables have p-values above 0.05, meaning the null hypothesis cannot be rejected, and there is no significant difference in mean scores for other strategies based on the districts.

**Findings**

- Significant differences were found between districts in waste management challenges, resistance to change, government support, community barriers, and pollution. No significant differences were found for other challenges, indicating similar perceptions among fish farmers in Trivandrum and Kollam.
- The green entrepreneurship strategies in fish farming between Trivandrum and Kollam showed significant differences only in the establishment of green aquaculture cooperatives. For all other variables, there were no significant differences in the opinions between the districts.

**Table 6**

**Group Statistics**

| Strategies for encouraging green entrepreneurship | District | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Financial Support | Trivandrum | 25 | 4.24 | 1.012 | 0.202 |
| | Kollam | 25 | 3.84 | 1.281 | 0.256 |
| Technical Support &Training | Trivandrum | 25 | 4 | 1.225 | 0.245 |
| | Kollam | 25 | 4.32 | 0.945 | 0.189 |
| Creating Green Aquaculture Cooperatives | Trivandrum | 25 | 4.08 | 1.525 | 0.305 |
| | Kollam | 25 | 3.44 | 0.651 | 0.13 |
| Strict Environmental Policy & Regulation | Trivandrum | 25 | 3.76 | 1.268 | 0.254 |
| | Kollam | 25 | 3.84 | 1.281 | 0.256 |

*Source: Primary Data*

**Table 7**

**Independent Samples Test**

| Strategies for encouraging green entrepreneurship | | Levene's Test for Equality of Variances | | t-test for Equality of Means | |
|---|---|---|---|---|---|
| | | F | Sig. | t | df |
| Financial Support | Equal variances assumed | 0.597 | 0.443 | 1.226 | 48 |
| | Equal variances are not assumed. | | | 1.226 | 45.56 |
| Technical Support & Training | Equal variances assumed | 1.751 | 0.192 | -1.034 | 48 |
| | Equal variances are not assumed. | | | -1.034 | 45.1 |
| Creating Green Aquaculture Cooperatives | Equal variances assumed | 14.6 | 0 | 1.93 | 48 |
| | Equal variances are not assumed. | | | 1.93 | 32.45 |
| Strict Environmental Policy & Regulation | Equal variances assumed | 0.087 | 0.77 | -0.222 | 48 |
| | Equal variances are not assumed. | | | -0.222 | 48 |

*Source: Primary Data*

**Suggestions**

- Enhance waste management for fish farmers by providing tailored infrastructure, technical guidance, and training
- Boost government support through targeted subsidies, simplified procedures, and effective extension services to promote eco-friendly practices.
- Encourage green aquaculture cooperatives with institutional support, financial incentives, and capacity-building programs, especially in areas with low adoption.

**Conclusion**

Fish farmers face various challenges in adopting green entrepreneurship, including economic, technical, social, and environmental factors. Key obstacles are waste management issues, resistance to change, lack of government support, and pollution. To address these challenges, strategies such as providing financial aid, offering technical training, establishing green aquaculture cooperatives, and enforcing environmental regulations are essential. Among these, forming green cooperatives is particularly crucial, as it supports sustainable practices in fish farming while balancing economic growth and environmental responsibility.

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