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Agricultural Educators in the Dissemination of Fish Farming Technologies for Sustainable Fish Production in Bayelsa State, Nigeria

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Abstract: *The study identified the existing fish farming technologies, challenges and strategies for improving dissemination techniques by Agricultural educators in Bayelsa state, Nigeria. A stratified random sampling technique was used to collect data with a four-point modified Likert scale questionnaire validated by test evaluators. The reliability of the instrument was determined by the Cronbach alpha method and gave an overall coefficient of 0.83. Responses were obtained from a sample size of ninety-seven agricultural educators from a sample population of two hundred and two final year student in the departments of Agricultural Economics, Fisheries and Agricultural Education, Niger Delta University Bayelsa state. Data collected were analyzed using descriptive statistics and the Null hypotheses were tested with Analysis of Variance at 0.05 level of significance. The results show that all the suggested existing technologies, challenges and strategies for improving the dissemination of fish farming technologies were accepted by the respondents. Major challenges identified include fish farmer resistant to adopting new techniques, inadequate training programmes and infrastructure and fear of risk/uncertainties in adopting new innovations. Strategies accepted most are early detection fish disease, ensuring proper land use and extensive education of fish farmers among others. Thus, it is suggested that; Provision of improved extension and fish farmers education, promotion of sustainable land use practices and development of fish farming/aquaculture infrastructure by the government and other agricultural related non-governmental organizations are suggested as a way of reducing the challenges and promoting the identified strategies.*

Keywords: Fish farming, fish farming technologies, dissemination techniques and Sustainability.

INTRODUCTION

Fish farming has played a sustainable role in enhancing food security, generating income, fostering trade, creating employment opportunities, improving standard of living and contributing to foreign exchange earning in numerous developing countries [Ayoola 2010]. Consequently, fish farming has evolved into a more intricate undertaking for both literates and illiterates that seek ways to augment fish production especially in Bayelsa state.

Therefore, the advancement of fish farming in Bayelsa state is contingent upon the integration of modern technologies which agricultural educator expected to perform. Modern fish farming technologies comprises a diverse range of techniques intended to enhance the cultivation of the required fish species for human consumption. The communication process involved in shaping modern technologies is aimed at reducing knowledge gap of the fish farmers. This shall instigate changes in their attitude and skills of the end-users. The spectrum of fish farming technologies required by farms spans various areas including pond construction techniques, pond water quality management, breed selection, stocking regimes feeds and feeding management, spawning techniques harvesting/storage, marketing and recordkeeping among others (Salau, et al. 2014). The effectiveness of the agricultural educators to imparting the required knowledge is crucial in the fish farming value chain.

Therefore, the main thrust in this study is to examine the roles of agriculture educators and assessing their level of preparedness in achieving sustainable fish production through fish farming in Bayelsa state.

PURPOSE OF THE STUDY/AIM/OBJECTIVE

The main aim of the study is to examine the role of agricultural educator in the dissemination of fish farming technologies for sustainable fish production in Bayelsa state. Specifically, the study is to:

i. Examine the existing fish farming technologies available to fish farmers in Bayelsa state.
ii. Examine strategies for the improvement of fish farming for sustainable fish production.
iii. Determine the challenges encountered by agricultural educators in dissemination of fish farming technologies for sustainable fish production in Bayelsa state.

RESEARCH QUESTION

To ensure effective coverage the following research questions were formulated to guide the study

1) What are the existing fish farming technologies in Bayelsa state?
2) What are the strategies for improving the technologies?
3) What are the challenges encountered by agricultural educators in the disseminating the modern fish farming technologies in Bayelsa state?

HYPOTHESIS

The following null hypotheses were proposed and tested at 0.05 level of significance

HO_1 There is no significant difference in the mean ratings of the students in fisheries, agricultural economics and agricultural departments on the existing fish farming technologies.

HO_2 There is no significant difference in the mean ratings among the students of Fisheries, Agricultural Economic and Agricultural Education Department on the strategies for improving fish farming for sustainable fish production in Bayelsa state.

HO_3 There is no significant difference in the mean rating among students from Fisheries, Agricultural Economics and Agricultural Education Department on the challenges encountered by Agricultural Educators in disseminating fish farm technologies in Bayelsa state.

METHODOLOGY

The study was conducted in Bayelsa state of Nigeria lying between longitude 4.30° North and latitude 6.0° East (Dada et al 2007). The state is situated wholly in the Niger delta hence has a vast expand of swamps hence a promising area for fish farming if properly enhanced. A purposeful descriptive survey design was adopted in the study for eliciting responses from the sample population of two hundred and two (202) final year students from the departments of Fisheries, Agricultural Economics of the Faculty Agriculture and department of Vocational and Technical Education in the Faculty of Education in the Niger Delta University, Wilberforce Island, Bayelsa State.

These three departments were purposefully selected because of their role of training personnel for the dissemination of agricultural technologies.

The sample population of Ninety-seven (97) final year students was randomly selected, Fisheries Department (37), Agricultural Economics (33) and Agricultural Education (27).

The instrument for the study was a well-structured questionnaires designed based on the study objectives and review of existing literatures (Olaoye, 2010; Salau, et al 2014) Brown et al 2017 and Kumar et al 2018). The study instrument utilized a modified Likert scale with a four-point response formal: Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD), 4, 3, 2, 1 respectively. The questionnaire content was validated by three agricultural educators and two test evaluators from the Faculty of Education in Niger Delta University, Wilberforce Island, Bayelsa state. The reliability of the questionnaire was determined using Cronbach alpha test and gave an overall coefficient 0.83 indicating good reliability. The questionnaire was also protested with sixty (60) final year student from the three departments, thereafter a revised questionnaire was designed and administered in 2023 to the 97 final year selected students. The final questionnaires consist of three sections with each section devoted to the three study questions. Sections A eliciting responses on the existing technologies, B, information strategies and C on the challenges encountered in disseminating fish farming technologies.

Data collected were analyzed using descriptive statistics: mean, standard deviation to address the research questions. Whereas the Analysis of Variance (ANOVA) was applied to test the null hypotheses at 0.05 level of significance. A decisive criterion of an alpha level of 0.05 was used, with null hypotheses rejected if the P. value was less than 0.05. The decisive for research question was based on a criteria level of 2.50. That is, those with 2.50 and above are accepted as Agree while those less than 2.50 as Disagree. The Statistical Package for Social Science [SPSS] was employed for the analysis.

RESULTS PRESENTATION DISCUSSIONS

The results for the research question 1 what are the fish farming technologies available in Bayelsa state are shown in Table 1.

Table 1: Mean and standard deviation scores of respondents on the existing fish farming technologies for sustainable fish production

S/N	Item Statement	Fisheries Students ($n_1 = 37$)		Agric. Econs. Students ($n_2 = 33$)		Agric. Edu. Students ($n_2 = 27$)		Decision
		$\bar{\chi_1}$	SD_1	$\bar{\chi_2}$	SD_2	$\bar{\chi_3}$	SD_3	
1	Rearing fish in ponds, where water quality, stocking density, and nutrition are carefully managed.	2.76	1.06	2.79	1.14	2.97	1.09	Agree
2	Breeding fish with desirable traits such as fast growth, disease resistance, and improved feed conversion.	3.16	0.99	2.88	0.96	2.70	0.99	Agree

3	Application of biotechnological tools to modify fish genetics for enhanced characteristics.	2.68	1.03	2.91	0.95	2.70	1.10	Agree
4	Developing nutritionally balanced feeds to enhance growth and health of fish in aquaculture settings.	2.86	0.95	3.06	1.06	2.67	1.00	Agree
5	Using technology to automate the feeding process, ensuring consistency and efficiency.	3.11	0.97	3.03	0.81	3.04	1.02	Agree
6	Introducing air into the water to increase oxygen levels, vital for fish health.	3.11	0.99	3.18	0.88	3.26	0.90	Agree
7	Using equipment for efficient and rapid fish harvest from fish ponds	3.00	0.91	3.06	1.00	2.89	1.01	Agree
8	employing modern processing techniques to ensure the quality and safety of fish products.	3.32	0.83	3.22	0.85	3.19	0.84	Agree
9	Utilizing technology for early detection of diseases in aquaculture systems.	3.27	0.84	3.20	0.9	2.91	0.95	Agree
10	Integrating fish farming with hydroponic plant cultivation in a symbiotic system.	3.61	0.80	3.18	0.90	3.26	0.94	Agree
	Ground Mean and Standard Deviation	**3.09**	**0.94**	**3.05**	**0.95**	**2.96**	**0.98**	

Source: Field Survey, 2023

The mean values obtained ranged from 2.70 to 3.61 are all above the decision value of 2.50. This implies that respondents collectively agreed that there exist in Bayelsa state modern fish farming technologies for sustainable fish production in Bayelsa state.

The standard deviation values obtained (Table 1) ranged from 0.80 to 1.14 with an overall grand value of 0.94, 0.95 and 0.98 indicating that respondents are relatively close to the mean and exhibited a similar pattern in the response.

The collective mean response regarding strategies for enhancing fish farming for sustainable fish production is showed in Table 2.

Table 2: Mean and standard deviation scores of respondents on strategies for the improvement of fish farming technologies for sustainable fish production.

S/N	Item Statement	Fisheries Students ($n_1 = 37$)		Agric. Econs. Students ($n_2 = 33$)		Agric. Edu. Students ($n_2 = 27$)		Decision
		$\bar{\chi_1}$	SD_1	$\bar{\chi_2}$	SD_2	$\bar{\chi_3}$	SD_3	
1	Provide training programs for fish farmers on modern and sustainable fish practices.	3.00	1.11	2.85	1.03	2.93	1.07	Agree
2	Educate farmers on the latest techniques for fish breeding, feeding, and disease management	2.57	1.14	3.18	1.01	2.78	1.05	Agree
3	Invest in the development of aquaculture infrastructure, including pond construction, hatcheries, and facilities.	2.86	1.03	2.72	1.10	3.11	1.05	Agree
4	Encourage the adoption of modern technologies such as automated feeding	2.81	0.91	3.15	0.97	3.00	0.92	Agree

	systems, water quality monitoring tools, and biosecurity measures							
5	Support research initiatives focused on local fish species, breeding programs, and disease-resistant strains.	2.76	1.12	2.82	0.98	3.00	0.88	Agree
6	Promote sustainable land use practices to prevent habitat destruction and water pollution.	3.19	0.84	3.00	0.90	3.11	0.89	Agree
7	Encourage combination of enterprise with fish farming Water Recirculation System (WRS)	2.81	1.02	3.09	1.01	.85	1.06	Agree
8	Establish a monitoring and surveillance system to track fish feeding early.	3.08	0.92	2.79	1.11	3.33	0.78	Agree
	Ground Mean and Standard Deviation	**2.89**	**1.01**	**2.95**	**1.01**	**3.01**	**0.96**	

Source: Field Survey, 2023

The mean value obtained for the strategies ranged from 2.57 - 3.33 consistently above the established cutoff point of 2.50. This indicates that all given strategies are accepted i.e. there is full agreement among the respondents of strategies that can enhance fish farming to produce fish in Bayelsa state. Also, the standard deviations ranged from 0.78 to 1.14 with mean of 1.01 and 0.56 for the three groups of students. These similar value suggest that respondents ratings were closely aligned with the means and exhibited a comparable pattern in the response.

Table 3 show the cumulative mean response of respondents regarding the challenges faced by agricultural educators in disseminating of fish farming technologies in Bayelsa state.

Table 3: Mean and standard deviation scores of respondents on the challenges encountered by agricultural educators in the dissemination of fish production technologies for sustainable fish production

S/N	Item Statement	Fisheries Students ($n_1 = 37$)		Agric. Econs. Students ($n_2 = 33$)		Agric. Edu. Students ($n_2 = 27$)		Decision
		$\bar{\chi_1}$	SD_1	$\bar{\chi_2}$	SD_2	$\bar{\chi_3}$	SD_3	
1	Limited access to information due to a poor internet connectivity, poor infrastructure, or limited extension services.	3.11	0.91	3.09	0.88	3.26	0.94	Agree
2	Language differences and cultural nuances can hinder effective communication.	2.73	1.10	2.91	0.98	2.85	1.17	Agree
3	Farmers may have varying levels of education, and disseminating complex scientific information to those with limited formal education can be challenging.	3.08	1.14	2.70	1.02	2.81	0.83	Agree
4	Some farmers may not be aware of the latest advancements in fish production techniques or the benefits of adopting sustainable practices	2.95	0.97	3.24	1.00	3.07	0.83	Agree
5	Lack of resources for training programs.	3.19	0.97	3.12	0.93	3.26	0.98	Agree
6	Farmers may resist adopting new techniques due to a fear of risks,	2.70	0.91	3.18	0.68	2.89	1.01	Agree

	uncertainties, or a preference for traditional methods							
7	Inconsistent or unclear policies related to fish farming and aquaculture can create confusion and hinder the adoption of sustainable practices.	3.11	0.99	3.21	1.05	3.22	0.89	Agree
8	Inadequate infrastructure, such as poor road networks and transportation facilities, can hinder the efficient dissemination of information and access to resources.	3.14	0.86	2.85	1.06	2.90	1.02	Agree
	Ground Mean and Standard Deviation	**3.00**	**0.89**	**3.04**	**0.95**	**3.03**	**0.96**	

Source: Field Survey, 2023

The cumulative means responses of participants regarding challenge faced by agricultural educators in disseminating fish farming technologies for sustainable fish production in Bayelsa state is shown in table 3.

The mean values for all items varied from 2.70 to 3.36, they are being greater than the cutoff value of 2.50 which suggest that those values are the items being represented are acceptable constraints. The overall grand means scorer of 3.00, 3.04 and 3.03 for the three groups of respondents also exceeded the decision mark 2.50. This therefore indicates an agreement among the group of respondents that the eight (8) statements accurately reflect the challenges encountered by agricultural educator while disseminating fish farming technologies for sustainable fish production in Bayelsa state. Also, the standard deviations for each item ranged from 0.68 to 1.17 as well as the standard deviation values of 0.98, 0.95 was 0.95 for the three groups of respondents. This finding suggests that respondents were closely aligned with the mean values and exhibited a similar pattern in their response.

HYPOTHESES TESTING

HO_1 There is no significant difference in the mean ratings of the students from the Departments, Fisheries, Agricultural Economics and Agricultural Education on the fish farming technologies for sustainable fish production in Bayelsa state.

The results of Hypothesis 1 testing in given in table 4.

Table 4: Analysis of Variance (ANOVA) of the three groups of respondents on the Fish production technologies for sustainable fish production in Bayelsa State.

ANOVA

	95% Confidence Interval for Mean				
	Sum of Squares	df	Mean Square	F	Sig. of p-value
Between Groups	.146	2	.073	.081	.923
Within Groups	84.888	94	.903		
Total	85.033	96			

ANOVA analysis of the groups of respondents on the fish farming technologies for sustainable fish production in Bayelsa state.

Table 4 shows that the P-value obtained in analysis was 0.923 which is greater than 0.05 hence suggests that, the Null hypothesis is accepted i.e., there is no significant difference in the mean ratings among the three groups regarding fish farming technologies for sustainable fish production in Bayelsa state.

HO_2: There is no significant difference in the mean ratings of the students from the departments Fisheries, Agricultural Economics and Agricultural Education on strategies for the improvement of fish farming technologies for sustainable fish production in Bayelsa state.

The results of the HO_2 testing are shown in Table 5.

Table 5: Analysis of Variance (ANOVA) of the three groups of respondents on Strategies for the improvement of fish farming technologies for sustainable fish production in Bayelsa State.

ANOVA

	95% Confidence Interval for Mean

	Sum of Squares	df	Mean Square	F	Sig. of p-value
Between Groups	0.262	2	0.131	0.142	0.86
Within Groups	86.583	94	0.921		
Total	86.844	96			

Table 5 shows the P-value obtained from the analysis as 0.868 which is greater than 0.05 therefore we accept the Null hypothesis that there is no significant differences in the mean rating among the students in the three departments regarding the strategies proposed for improving fish farming technologies for sustainable fish production in Bayelsa State.

HO_3 There is no significant difference in the mean ratings of the students from the Departments Fisheries, Agricultural Economics and Agricultural Education on the challenges encountered by Agricultural Educators while disseminating fish farming technologies for sustainable fish production in Bayelsa state.
The results of the HO_3 testing are in Table 6

Table 6: Analysis of Variance (ANOVA) of the three groups of respondents on the challenges encountered by Agricultural Educators while disseminating fish farming technologies for sustainable fish production in Bayelsa state.

ANOVA

	95% Confidence Interval for Mean				
	Sum of Squares	df	Mean Square	F	Sig. of p-value
Between Groups	0.036	2	0.018	0.021	0.979
Within Groups	79.265	94	0.843		
Total	79.301	96			

In Table 6, the P-value obtained from the analysis is 0.979 which is greater than threshold 0.05 therefore, the Null hypothesis which states that, there is no significant differences in the man ratings among the three groups of respondent regarding the challenges faced by Agricultural Educators while disseminating the fish farming technologies for sustainable production of fish in Bayelsa state was accepted.

DISCUSSION OF FINDINGS

Ten specific fish farming technologies were identified (Table 1) for improving fish production in Bayelsa state. These identified fish farming technologies include;

i. Rearing of fish in well constructed pond and the practice of modern technologies in terms of management of water quality, stock manipulations and careful management of fish nutrition in feeds.
ii. Use of proper breeding techniques to ensure desirable traits such as fat growth, resistance to disease.
iii. Use of biotechnological tools to modify fish genetics for improved performance.
iv. Enhancing growth with the use of nutritionally balanced diets and early diagnosing disease breakout.
v. Using automated feeding device to ensure consistency and efficiency.
vi. Application of modern aeration techniques to increase dissolved oxygen for healthy fish production.
vii. Applying efficient and effective fish harvesting techniques to ensure maximum fish recovery in pond.
viii. Employing modern fish process techniques to ensure quality and safety of fish products.
ix. Utilization modern early disease detection and treatment system.
x. Application of integration fish farming system using hydroponic placto cultivation in a symbolic system.

These identified modern technologies were further substantiated by the results of the hypothesis (Table 4) which indicated no statistically significant difference in the mean rating among the three groups of respondents for fish farming technologies for sustainable fish production in Bayelsa state. This assertion corroborates with the findings of Kumar et al 2018. Kumar and associates in the finding emphasized that the adoption of modern technologies contributes to growth in aquaculture hence enhancing farm productivity resulting to 0.332 ± 0.24 per square meter a pond area.

The results for research question two outlined eight key strategies for enhancing fish farming to ensure sustainability in Bayelsa state (Table 2). These strategies are;

i. Providing tailored training for fish farmers on modern sustainable fish farming practices.
ii. Education of fish farm on the latest techniques on fish breeding, feed as disease management.
iii. Investment in the development of infrastructure for Aquaculture i.e. construction of pond/hatchery facilities.
iv. Encourage fish farmer to adopt modern fish farming modern technologies.
v. Support research initiatives i.e. to research on our local fish species
vi. Support sustainable multiple land use practices
vii. Encourage integrated fish farming
viii. Establishment for monitoring & surveillance system into the production arena.

These identified eight strategies for improving fish farming are in line with the results obtained by Brown et al (2017). Brown and associates studied the approaches for enhancing sustainable fish production in Bayelsa. They identified approach in infrastructure development and training of fish farmers among others. Also Bankole et al (2005) specifically identified such approaches as training of fish farmers in improved fish farming methods and infrastructure development among others which corroborates the finding of this study (Table 2).

The outcome of the research question three delineated eight (8) challenges faced by agricultural educators in disseminating fish farming technologies (Table 3). The challenges among other are limited access to information due to a lack of internet connectivity, poor infrastructure, limited extension service activities and language/cultural difference which impede communication. Other challenges are inadequate resources for training programs inconsistent/unclear policies relating to fish farming and farmers resistant to adopting new technologies and inadequate publicity of new technologies.

These challenges were validated by the results of the hypothesis 3 results indicating that there was no statistically significant different in the mean ratings among the three groups studied regarding the challenges faced by agricultural educator in disseminating fish farming technologies. This observation is in line with the result of Olaoye, (2010) who identified challenges in adoption of new technologies such as insufficient research and extension services, high cost of inputs including inadequate infrastructure. Also Ekeremor (2012) in a similar study identified challenges or inadequate financial resources, infrastructure and other farming inputs as observed in this study.

CONCLUSION

The results of this study suggest that agricultural educators are crucial in the dissemination of innovations/productive technologies to fish farmers. They serve as linchpins in advancing and promoting sustainable fish production technologies. Therefore, the success of sustaining fish production through fish farming in Bayelsa state hinger on massive motivation of the educators by boldly addressing the identified challenges in this study. These challenge include sustainable, extension services, improved extension and fish farmers massive training, development of fish farm/aquaculture infrastructure and promoting the strategies identified for promoting fish production.

RECOMMENDATIONS

Based on the challenges and strategies identified, the following recommendations are suggested:

1. Improvement of the information dissemination apparatus to effectively research on the rural fish farmers especially improvement and encourage the use of the modern social media, internet service etc.

2. Strengthening of the Agricultural Extension Service network by employing dedicated, well equipped and committed personnel to reach out to the rural areas.

3. Development of the essential infrastructure as road networks, transport infrastructure to assist rural producers to being their products to markets.

4. Provide massive training of Extension offices and the fish farmers on recent technologies

5. Strengthen and encourage Research organizations to be proactive in the development and dissemination of research findings.

6. Design facilities to alleviate the fear of risk in the fish farming business by embarking on massive Public Enlightenment Programmes.

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