Research Article

Approaches for Enhancing Sustainable Fish Production among Farmers in Bayelsa State, Nigeria

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Abstract

This study determined approaches for enhancing sustainable fish production in Bayelsa state, Nigeria. Three objectives guided the study while three research questions were answered and three null hypotheses were tested at 0.05-level of significance. The study adopted survey research design using a target population of 401 made up of 377 fish farmers and 24 extension agents. A sample size of 220 respondents (196 fish farmers and all the 24 extension agents) was drawn using multistage sampling technique. A 32-item structured questionnaire titled 'Farmer's Sustainable Fish Production Enhancement Approaches Questionnaire (FSFPEAQ) with rating scales of 4 (strongly agreed), 3 (agreed), 2 (disagreed) and 1 (strongly disagreed) was developed by the researcher. The instrument was both content and face validated by experts. The reliability coefficient of the instrument was 0.794 using Cronbach alpha. Data were collected and analysed using mean and standard deviation to answer research questions and t-test statistics to test the null hypotheses at 0.05 level of significance. The result of the study revealed that there are three breeds of fish reared by farmers, three methods were used extensively by fish farmers for sustainable fish production and twelve approaches were adopted by fish farmers for enhancing sustainable fish production in Bayelsa state. The study further revealed that there was no statistical significant difference between the mean ratings of responses of fish farmers and extension agents on: the breeds of fish reared by fish farmers, methods used by fish farmers for sustainable fish production and approaches adopted by fish farmers for enhancing sustainable fish production in Bayelsa state. It was recommended amongst others that Stake holders should provide enabling environment for experts to package sustainable approaches into training programmes for farmers through Agricultural workshops and seminars.

Keywords: Fish farming; Fish breeds; Production; Approaches; Sustainability; Farmer

Introduction

In Nigeria today and Bayelsa state in particular, there is need to increase fish production because fish products are relatively cheaper compared to beef, pork and other animal protein sources [1]. Fish production in Nigeria is from artisanal fisheries, industrial or commercial trawlers and fish farming in ponds. Presently, the farming of fish has become important because fishing in the wild cannot replenish itself to meet up the demand; fish is cheap and a major source of protein consumed by Nigerians especially natives living in coastal communities as it is high in nutritional value with complete array of amino acids, vitamins and minerals [2].

Fish farming has contributed significantly to food security, income generation, trades, employment opportunities, improved living standards and aid to foreign exchange earnings in many developing countries [3]. As a result, the production of fish is becoming a more complex enterprise as farmers whether literate or illiterate find means of enhancing fish production because of the supply-demand gap for fish and fishery products in Nigeria. They further asserts that, the consumption of fish is highly relished among people of all classes and ages as it is less tough and more digestible when compared to beef, mutton, chicken and bush meat. Fish is also low in fat, calories and cholesterol. It is available to Nigerians in fresh, smoked, dried or frozen form with no religious or health taboos like pork and beef. Food and Agricultural Organization [4] also reports that fish oils enhance intelligence of foetus, infants and reduces incidence of heart related problems. Therefore, increased production of fish good fish breed will help combat hunger and malnutrition as fish is a rich source of food-protein that improves food security, economic and nutritional status of the human populace.

Fish breeds are specific group of animal's species that are homogenous in appearance, behaviour and characteristics. The choice of fish species to culture is very important for the success of fish farming business [5]. Some of the established breeds currently cultured in Bayelsa State fresh water fish farms include the catfish (*Clarias gariepinus, Clarias lazea*) Tilapia (*Oreochromis niloticus or Tilapia niloticus, Sarotherodom galilaeus, Gymnarchus niloticus, Lates niloticus*) and their hybrids (*Heterobranchus-Heteroclarias*). Although consumers accept other fish types, farmers' lack of major breakthrough breeding technology hampers their culture. In most cases, fish species must be able to breed naturally or artificially by spawning them in hatcheries then rearing under artificial conditions of environment and diet. Over the years, demand for fish has been on the increase but supply is not up to the projected demand for the country. Currently, the farming of fish is receiving increased attention in Bayelsa State and nation at large, as awareness of its importance increases among the people. As a result, the production of fish has become the major occupation of its inhabitants [6-8].

Production in the view of Olukosi and Ogungbile [9] is the process of combining various material inputs and immaterial inputs in order to make something for consumption. Production in this context involves the successful management of agronomic practices and approaches

for growing fish and enhances its sustainability in Bayelsa state. A number of approaches have been proposed by this study as means for enhancing sustainable fish production. They include individual approaches, government approaches and non-governmental approaches. An 'Approach', in the statement of Stephen [10] is a way of dealing with something as a problem or task. It refers to the method or strategy used in resolving a problem. In this study, approaches means the way in which fish farmers deal with challenges they experience in enhancing sustainable fish production in Bayelsa state. Some of the approaches adopted by individuals, government and non-governmental organizations are effective and produce desired results while some are not. This study is concerned with the identification of those approaches that are efficacious and could be adopted by fish farmers so that they can cope effectively with the challenges that limits their sustainable participation to enhance fish production. Some of the approaches that could be adopted by individual fish farmers for enhancing sustainable fish production as identified by lsibikalu [11], are the formation of groups. The formation of group is an important way to establish a collective voice for farmers, and to enable them to push both training programmes and local governance structure to meet their needs. They provide a forum for the exchange of knowledge, mutual support and the articulation of common needs. They take many forms including farmer fields, agric trade fares, farmers meeting, self-help groups, school, cooperatives, agricultural workshops, seminars and conferences, and have been a focus of many training programmes in rural areas. Self-help groups are small affinity groups that mobilize their own savings, which are then used as loans to group members. Earnings from interest income are converted into group equity for secured and sustainable fish production.

Sustainability in fish production is the ability to maintain an ecological balance in the process of exploiting aquatic resources without destroying the ecological balance of the area [12]. The promotion of sustainable fish production requires an enabling environment that will ensure continuity in production. The potentials in Bayelsa State calls for sustainable fish production which will involve management and conservation of the natural resources and the adoption of technological and institutional changes in a manner as to ensure the attainment of satisfaction and continuous supply of human needs for present and future generations [13]. The environment considered here for fish production is the pond.

Ponds are to be properly drained and bottom dried prior to fertilizer application, with water depth of about 20-40 cm and gradually increased to 1 m a week after fertilization. Then, stocking the pond with fingerlings at appropriate density and feeding them at early morning or late afternoon. Enhancement is the act of making progress in development, making advancement and having a change for the better [14]. It implies therefore, that enhancement is the act of improving or adding to the strength, worth, beauty or other desirable quality to production processes. The responsibility of enhancing fish production lies in the ability of the fish farmer who directly involved. Fish farmer is an individual that cultivates a piece of land for growing or rearing of fish and other aquatic animals. Amusa [15] defined a farmer as a person who owns or manages an area of land and buildings on it, for growing crops and or keeping animals. In the context of this study, a fish farmer is an individual who engages in production of fish at commercial scale. For fish farmers to obtain relevant fishery information and awareness on production methods and hence, be successful there is need to access agricultural information from extension programmes through extension agents.

An extension agent in the view of Onuoha is one that is professionally trained to extend improved farming practices to farmers. Extension agents in the opinion of Ogunsumi and Abegunde [16], are agricultural experts who assist farmers through educational procedure, in improving farming methods and techniques, increasing production efficiency and income, improving their levels of living and lifting social and educational standards. The author further explained that extension agents assist farmers to help them identify and analyze their production problems and become aware of the opportunity for improvement. Davies [7] opined that extension agents are individuals set to support and facilitate people engaged in agricultural production to solve problems and obtain information to improve their livelihoods. In the context of this study, an extension agent is a staff of Agricultural Development Programme (ADP) charged with responsibilities of disseminating information from agricultural research institutes to farmers for implementation and also taking the problems of farmers to the research institute for solution. Extension agents are professional agriculturists in the business of informing, educating and motivating farmers to adopt innovations. Fish farmers need information on planning, financing, fish farming technologies, construction and management, breeds and spawning, processing, storage and marketing [17]. Hence, the need for enhancement of the approaches used for fish production through empowerment programmes organised by government, stakeholders and non-governmental organizations. This prompted the researcher to study fish farming approaches as farmers' cooperative societies, loans or credit facilities, manpower development and training, effective extension service delivery among others. These approaches when improved upon and effectively utilized will make fishery business thrive well in Bayelsa state.

It is evident that the resources suitable for fish production in Nigeria are grossly unexploited, yet all through the years the amount of fish produced has been lower than demand. The need for increased production to bridge this gap has been a major concern. Nigeria and Bayelsa state in particular, can be self-sufficient in fish production if her fishery resources are adequately developed, managed and conserved. Bayelsa state located in the heart of Niger Delta, is rich in petroleum resources and is believed to be among the rich States in Nigeria; yet, there is widespread poverty with close to 70% of the population living below the poverty line. Problems facing the fast growing population of Bayelsa state ranges from; high level of unemployment, idleness and youth restiveness resulting to militancy, kidnapping, stealing, sea piracy and other vices.

Personal interaction with some citizens of the state on why they do not embark on fish production enterprise reveals the inability of government and relevant stakeholders to provide the enabling environment and facilities made fish farming a risky venture. There is also the near absence of effective supporting services and fisheries infrastructure with skilled work force in fish farming technology. The researchers also observed that fish production methods adopted by farmers in study area are crude and environmentally unfriendly. These have led to poor quality and low quantity production that cannot meet the standards and demand of its citizens. The need to identify specific problems facing fish farmers with a view to unravelling solutions as 'approaches' that could make sustainable fish production a possibility prompted the researcher to undertake the present study.

Purpose of the Study

The main purpose of this study is to determine approaches for enhancing sustainable fish production in Bayelsa State. Specifically, the study sought to identify: Breeds of fish reared by fish farmers in Bayelsa State, Methods used by fish farmers for sustainable fish production

in Bayelsa State, Approaches adopted by fish farmers for enhancing sustainable fish production in Bayelsa State.

Research questions

The following research questions were raised and answered by the study

- What are the breeds of fish reared by fish farmers in Bayelsa state?

- What are the methods used by fish farmers for sustainable fish production in Bayelsa state?

- What are the approaches adopted by fish farmers for enhancing sustainable fish production in Bayelsa state?

Research hypotheses

The following null hypotheses were formulated and tested at a 0.05 level of significance.

- There is no statistical significant difference between the mean ratings of the responses of fish farmers and extension agents on the breeds of fish reared by farmers in Bayelsa state.

- There is no statistical significant difference between the mean ratings of fish farmers and extension agents on the methods used by fish farmers for sustainable fish production in Bayelsa State.

- There is no statistical significant difference between the mean ratings of fish farmers and extension agents on the approaches adopted by farmers for enhancing sustainable fish production in Bayelsa State.

Methodology

Survey research design was adopted by this study. The researchers adopted this design because it focuses on a sampled population for the purpose of examining the opinions of representative sample of the population in order to describe and interpret what exist at present [18]. The population of the study was 401 made up of 377 registered fish farmers and 24 (twenty four) extension agents in the eight Local Government Areas of Bayelsa State [19]. The sample for this study was 220 consisting of 196 registered fish farmers and 24 extension agents. The sample size was determined according to Krejele and Morgan sample size determination. Multistage sampling technique which involves simple random sampling and purposive sampling techniques was used for sample selection. The number of the fish farmers was selected from the entire population using simple random sampling technique. Since the researcher had a comprehensive list with their addresses and contact numbers. The entire population of the extension agents was involved in the study because it was small and was effectively handled by the researchers. The instrument for data collection was a questionnaire, titled: Farmer's Sustainable Fish Production Enhancement Approaches Questionnaire (FSFPEAQ), which is made up of two parts. Part one is on personal data, made up of only three items, while part two is the content, made up of three sections: A, B, and C. Section A has to do with the breeds of fish reared in each location. Section B elicits responses on methods of fish production used in each location while section C identifies approaches used by farmers for enhancing sustainable fish production. Each FSFPEAQ item was anchored on a 4-point rating scale of Strongly Agreed (SA), Agreed (A), Disagreed (D), Strongly Agreed (SD) with corresponding nominal values of 4, 3, 2 and 1, respectively. The instrument was both content and face validated by three experts in line with the specific objectives of

the study. Two were lecturers in the College of Agricultural and Science Education, University of Agriculture, Makurdi and one lecturer in the Department of Fisheries and Aquatic studies/animal science, Niger Delta University, Amassoma Bayelsa State. This was to ensure that the questionnaire exhaustively cover the specific objectives of the study. After validation by experts, the FSFPEAQ was administered to fifteen (10) fish farmers and 5 extension agents who were not to be part of the study population but have similar characteristics of interest with the population for this study. The data collected were subjected to reliability analysis to ascertain the reliability of the instrument. It was calculated using Cronbach Alpha formula and reliability coefficient obtained was 0.79. Three research assistants who were familiar with the study area were selected and given orientation on how to administer to and retrieve copies of the questionnaire from the respondents. The data collected were analysed using descriptive and inferential statistics. Mean and standard deviation was used to answer the research questions while t-test statistics was used to test the null hypotheses at a 0.05 level of significance.

Bench mark of 2.50 was established to accept any item with a mean rating of 2.50 or above as agreed while any item with a mean rating less than 2.50 was regarded as disagreed for research questions. The decision rule used for the mean ($\overline{X}$) is calculated as follows: Strongly agreed (SA)=4; Agreed (A)=3; Disagreed (D)=2 and Strongly Disagreed (SD)=1.

Hence; 4+3+2+1/4=10/4=2.50

The decision rule for rejection or otherwise of hypotheses was based on the p-value and alpha value. A hypothesis of no significant difference was not rejected for any cluster of item whose p-value was equal to or greater than alpha value of 0.05 (P ≥ 0.05) while it was rejected for any cluster of item whose p-value was less than alpha value of 0.05 (P<0.05).

Results

The results of the study were obtained from the research questions answered and hypotheses tested through data collected and analyzed.

The data for answering research questions and testing hypotheses are presented in Tables 1-6 as follows.

Research question 1

What are the breeds of fish reared by fish farmers in Bayelsa state?

Data in Table 1 revealed that three out of five items had their mean values ranging from 3.59 to 3.65, indicating that their mean values were above the cut off points of 2.50. This showed that the respondents agreed that the three items were the breeds of fish reared by farmers in Bayelsa state. The table also revealed that two items had their mean values as 2.39 and 2.33, respectively indicating that their mean values were below the cut off points of 2.50. This showed that the respondents disagreed that the two items were not breeds of fish reared by farmers

S/N	Item statement	Mean	SD	Remark
1	Cat fish	3.65	0.54	Agreed
2	Tilapia	3.61	0.56	Agreed
3	Shark	2.39	0.67	Disagreed
4	Hetrobranchus	3.59	0.63	Agreed
5	Mud fish	2.33	0.79	Disagreed

N=number of respondents; SD=Standard deviation of the respondents.

Table 1: Mean ratings and standard deviation of respondents on the breeds of fish reared among farmers in Bayelsa state (n=220: n_1=196 fish farmers; n_2=24 extension agents).

in Bayelsa state. The standard deviation ranged from 0.54 to 0.79, which indicates that the respondents were not too far from the mean and the opinion of one another in their responses on the breed of fish reared by farmers in Bayelsa state.

Research question 2

What are the methods used by fish farmers for sustainable fish production in Bayelsa state?

Data in Table 2 revealed that the mean values of three out of five items ranged from 3.52 to 3.58, indicating that their mean values were above the cut-off point of 2.50. This indicated that the respondents agreed that the three methods were used extensively by fish farmers for sustainable fish production in Bayelsa state. The data also showed that two out of five items had their mean values as 2.36 and 2.31, which were less than the cut-off point of 2.50, indicating that the methods were not used or common to fish farmers in Beyelsa state. The table further revealed that the standard deviation of the items ranged from 0.24 to 0.68, indicating that the respondents were not far from the mean and the opinion of one another in their responses on the methods used by fish farmers for sustainable fish production in Bayelsa state.

Research question 3

What are the approaches adopted by fish farmers for enhancing sustainable fish production in Bayelsa State?

Data in Table 3 revealed that all the twelve items had their means value ranged from 3.43 to 3.61, indicating that their mean values were above the cut-off point of 2.50. This showed that the respondents

S/N	Item statement	Mean	SD	Remark
1	Earthen pond	3.58	0.65	Agreed
2	Concrete pond	3.52	0.42	Agreed
3	Reinforced plastic pond	2.36	0.65	Disagreed
4	Ordinary plastic pond	2.31	0.68	Disagreed
5	Cages in natural waters	3.55	0.25	Agreed

N=Number of respondents; SD=Standard deviation of the respondents.

Table 2: Mean ratings and standard deviation of respondents on methods used by fish farmers for sustainable fish production in bayelsa state (n=220: n_1=196 fish farmers; n_2=24 extension agents).

S/N	Item statement	Mean	SD	Remark
1	Good planning, prior to establishment of fish pond	3.5	0.58	Agreed
2	Visits to successful fish farms.	3.53	0.65	Agreed
3	Attendance of training programmes	3.43	0.93	Agreed
4	Making reference to farm records for improvement	3.45	0.29	Agreed
5	Formation of fish farmers associations	3.49	0.36	Agreed
6	Access to loans or credits facilities	3.46	0.5	Agreed
7	Access to corporate organization	3.52	0.63	Agreed
8	Accessing government interventions with funds or infrastructure	3.53	0.76	Agreed

N=number of respondents; SD=Standard deviation of the respondents.

Table 3: Mean ratings and standard deviation of respondents on approaches adopted by fish farmers for enhancing sustainable fish production in bayelsa state (n=220: n_1=196 fish farmers; n_2=24 extension agents).

agreed to all the twelve items as approaches adopted by fish farmers for enhancing sustainable fish production in Bayelsa state. The standard deviation of the items ranged from 0.29 to 0.93, indicated that the respondents were not far from the mean and the opinion of one another in their responses on approaches adopted by fish farmers for enhancing sustainable fish production in Bayelsa state.

Hypothesis 1

There is no statistical significant difference between the mean ratings of the responses of fish farmers and extension agents on the breeds of fish reared by farmers in Bayelsa State.

Data in Table 4 shows a p-value of 0.09 which is greater than the alpha value of 0.05. This indicates that there was no statistical significant difference between the mean ratings of fish farmers and extension agents on the breeds of fish reared by farmers in Bayelsa State. Therefore, the hypothesis of no statistical significant difference between the two groups of respondents on the breeds of fish reared by farmers in Bayelsa State was not rejected.

Hypothesis 2

There is no statistical significant difference between the mean ratings of the responses of fish farmers and extension agents on the methods used by farmers in Bayelsa State.

Data in Table 5 shows a p-value of 0.53 which is greater than the alpha value of 0.05. This indicates that there was no statistical significant difference between the mean ratings of fish farmers and extension agents on the methods used by fish farmers for sustainable fish production in Bayelsa State. Therefore, the hypothesis of no statistical significant difference between the two groups of respondents on methods used by fish farmers for sustainable fish production in Bayelsa state was not rejected.

Hypothesis 3

There is no statistical significant difference between the mean ratings of the responses of fish farmers and extension agents on the approaches adopted by farmers for enhancing sustainable fish production in Bayelsa State.

Data presented in Table 6 shows a p-value of 0.79 which is greater than the alpha value of 0.05. This indicates that there was no statistical significance difference between the mean ratings of fish farmers and extension agents on the approaches adopted by farmers for enhancing fish production in Bayelsa state. Therefore, the hypothesis of no statistical significance difference between the two groups of respondents (fish farmers and extension agent) on the approaches adopted by farmers for enhancing fish production in Bayelsa state was not rejected.

Discussion of Findings

The following findings emerged from the study based on the research questions answered and hypotheses tested. The result of the study was discussed as follows.

The findings in Table 1 revealed that there are three breeds of fish namely; catfish, tilapia and heterobranchus reared by fish farmers in

Status	N	Mean	Std. deviation	Std. error mean	Df	t-cal	Sig.	Remark
Fish farmers	196	3.63	0.56	0.04	218	-1.45	0.09	NS, NR
Extension Agents	24	3.83	0.38	0.08				

N=Number of respondents, Std=Standard deviation, df=degree of freedom, t-cal=t-calculated, Sig.=P-value; P>0.05, NS=Not significant, NR=Not rejected

Table 4: T-test analysis of the mean ratings of the responses of fish farmers and extension agents on breeds of fish reared by farmers in bayelsa state.

Status	N	Mean	Std. deviation	Std. error mean	Df	t-cal	Sig.	Remark
Fish farmers	196	3.58	0.6	0.04	218	0.5	0.53	NS, NR
Extension Agents	24	3.5	0.66	0.13				

N=Number of respondents, Std=Standard deviation, df=degree of freedom, t-cal=t-calculated, Sig.=P-value; P>0.05, NS=Not significant, NR=Not rejected

Table 5: T-test analysis of the mean rating on the responses of fish farmers and extension agents on the methods used by fish farmers for sustainable fish production in bayelsa state.

Status	N	Std. deviation	Std. error mean	Df	t-cal	Sig.	Remark
Fish farmers	196	0.04	0.04	218	-0.36	0.79	NS, NR
Extension Agents	24	0.46	0.09				

N=Number of respondents, Std=Standard deviation, df=degree of freedom, t-cal=t-calculated, Sig.=P-value; P>0.05, NS=Not significant, NR=Not rejected

Table 6: T-test analysis of the mean ratings of the responses of fish farmers and extension agents on the approaches adopted by farmers for enhancing sustainable fish production in bayelsa state.

Bayelsa State, with mean scores as 3.65, 3.61 and 3.59. The finding from Table 1 was further supported by findings from the corresponding hypothesis on Table 4 which revealed that that there was no statistical significant difference between the mean ratings of fish farmers and extension agents on the breeds of fish reared by farmers in Bayelsa State. This finding was supported by Omitoyin on the quality and breeds of fish reared for sustainability who listed common fish species grown in the tropics to include Tilapia, Catfish, Mud fish among others. The author further state that the purpose of rearing fish is to have enough to eat and generate additional income especially in commercial farms for a profitable venture, therefore, fish species must be fast growing, easy to breed in captivity, attract low production cost, resistant to diseases, accept and utilize supplementary feeds, tolerate poor water condition, be acceptable and marketable to consumers. The finding is realistic, since it tallies with the suggestions of the validates and the observation of researcher during visitations to some fishing farms in the State and the respondents for this study attached great importance to the breeds of fish itemized as a result of its huge demand and high price in the local market.

The above findings clearly show that farmers in Bayelsa state reared the three breeds of fish because they have greater capacity to tolerate odd conditions, are easy to breed in captivity, fast in their growth rate, have high feed conversion rate, with high acceptability and marketability to consumers.

The findings from research question two in Table 2 showed that three methods were used extensively by fish farmers for sustainable fish production in Bayelsa state. The three methods were: earthen pond, concrete pond and cages in natural waters with mean responses of 3.58, 3.52 and 3.55, respectively, while two items (reinforced plastic pond and ordinary pond) were not used by majority of fish farmers with mean responses of 2.36 and 2.31 were little below the average 2.5. The difference in their responses revealed that fish farmers and extension agents differ in their perception of culture methods that are available, suitable and affordable to them. The findings from Table 2 was further supported by findings from hypothesis two on Table 5 which revealed that there was no statistical significant difference between the mean ratings of fish farmers and extension agents on methods used by fish farmers for sustainable fish production in Bayelsa state.

This finding was in agreement with Akinbosoye [20] and Bamidele [21] who identified fish production in earthen ponds, concrete ponds, reinforced plastic ponds, ordinary plastic ponds and cages in natural waters as methods of production used among fish farmers. The authors suggested that once a suitable land has been acquired, it should be surveyed and a topographic map produced to permit the design of the fish ponds and other structures.

The finding was also supported by Agbamu and Orhorhoro [2], in a study on adoption of aquaculture management technique, which showed how 55.5% of fish farmers adopted concrete pond methods of production among others. The implication is that, the finding of this study is the real nature of fish production methods used in Bayelsa State by fish farmers. This methods used may be as a result of the prevailing conducive environment (humid weather and marshy soil condition) that favours the production of fish in earthen, concrete and cage culture methods of fish production. The culture methods employed depends largely on the fish survival and safety, as it requires soil that is swampy, floodable and able to retain water for earthen and cage culture methods, while concrete, reinforced and plastic culture methods requires good source of water that is free from pollutants either from river, stream, spring, well or borehole.

The finding in Table 3 showed that twelve approaches were adopted by fish farmers for enhancing sustainable fish production in Bayelsa state. The approaches were: good planning, prior to establishment of fish pond, visits to successful fish farms, making reference to farm records for improvement, formation of fish farmers associations, access to loans or credits facilities, access to corporate organization, accessing government interventions with funds or infrastructure, invitation of extension and other government agencies for advice, utilization of moderns technologies in production, utilization of e-marketing channel and attending ICT Training to blend with technological advancement. The result of the corresponding hypothesis tested in Table 6 further revealed that there was no statistical significant difference between the mean ratings of the responses of fish farmers and extension agents on the approaches adopted by fish farmers for enhancing sustainable fish production in Bayelsa state. This added validity and credence to the findings that emerged from research question answered above. This finding was in agreement with Ayinla [13] and Anyanwu et al. [22] who in their separate studies identified formation of fish farmers association, access to loan, role of corporate organizations, government interventions, manpower development and training among others as major approaches that will enhance sustainable fish production [23-27].

This finding was also in congruous with findings are supported as effectiveness of farmers' cooperative societies and stakeholder's interventions. Similarly, the effectiveness of financial assistance to business expansion and reduction of poverty was identified by World Bank, that the lucrative and fast growing nature of fish farming calls for training and development of its manpower to face the challenges ahead. Fish farming knowledge can be gained through agricultural education in form of training, enlightenment campaigns, seminars and workshops, were an agricultural extension agent is responsible in disseminating this knowledge to fish farmers. Training as the most singular factor that affects the individuals' attitude, productivity,

improvement, risk minimization and management gives quality of job performance in any endeavour [13].

Conclusion

The need to enhance fish farming is very vital for the development of Bayelsa State in the areas of food security, improved livelihood and infrastructural development. All stakeholders in the State must ensure the transformation of fish farming venture from its present state to sustainable level of production. It was in a bid to make fish farming sustainable and profitable that this study on the approaches for enhancing sustainable fish production was carried for effective implementation, monitoring and utilization of the approaches among farmers. The study conclude that Catfish, Tilapia and their hybrids are commonly reared in Bayelsa State, Nigeria with the use of earthen pond, concrete pond, reinforced plastic pond, ordinary pond and cages in natural waters respectively. The success of fish farming business depends largely on how well it is planned, designed, constructed and meticulously maintained to ensure that the resident fish and the whole pond ecosystem remain healthy and prolific. Fish farmers in a bid to succeed are adopting sustainable measures known as approaches in this study as good planning, visits to successful farms, attendance of training, belonging to fish farmers associations, accessing of loans from financial institutions and formation of corporate organizations, use of effective extension agents and utilization of available modern technologies among others.

Recommendations

The following recommendations were made:

1.   Stake holders should provide enabling environment for experts to package sustainable approaches into training programmes for farmers through Agricultural workshops and seminars.

2.   Bayelsa state government and Non Governmental Organizations should anchor and sponsor mass-media for programmes that will enlighten the fish farmers on sustainable approaches that will enhance fish farming.

3.   Funds should be released by government and relevant agencies to carryout effective extension services to fish farmers.

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