OPEN ACCESS

Global Research Journal of Fishery Science and Aquaculture :ISSN: 2673-9497

Volume-11 | Issue-8, August, Pp. 19-24, 2024 | Research Paper

Sustainability Assessment of Artisanal Fisheries of the Fishing Communities along Shiroro and Kainji Dams, Nigeria

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Received: 7/7/2024| Accepted: 2/8/2024|

Abstract: This study assessed sustainability of artisanal fisheries of the fishing communities along Shiroro and Kainji dams, Nigeria. A Questionnaire was used to collect data from 460 fishers. Multi-stage and proportionate sampling techniques were used in selecting the respondents. Descriptive and inferential statistics were used for data analysis. The results of the study showed that most of the fishers (51.3%) were within the age bracket of 29-41years, indicating that respondents were middle aged fishers who were within the active fishing age. Majority (87.0%) of the fishers were married with an average household size of 12 persons. Findings of the study on sustainability of fisheries activities in the study area shows that the fishers agreed that the location of fishing communities is not too remote for any improvement in their livelihoods portfolios (=2.93, SD=0.76). This was an indication that fishers are optimistic that someday they will be part of rural transformation because of the contributions they are making in terms of provision of fish to local markets. The result further revealed that migration to better and more favourable fishing location (=2.64, SD=0.70) encouraged the sustainability of artisanal fisheries production. Respondents' capabilities in maintaining and sustaining fisheries resource base (=2.60, SD=0.52) and effective resolution of conflict (=2.60, SD=0.78) arising from the use of fisheries resources are evidence of sustainability of artisanal fisheries through co-management system in the area. In the face of fast depleting capture fisheries resources, respondents agreed to remain in fishing business (=2.50, SD=0.76) implying that artisanal fisheries livelihood account significantly for their household daily disposable income. Daily return from sales of fish caught contributes in meeting the day to day needs of fishers' households. Low indices for accessibility of fishing communities (=1.83, SD=0.81) and access to credit facilities to support other livelihoods (=1.33, SD=0.62) depict weak physical and financial assets that cannot sustain fisheries production. In conclusion, the study showed that, artisanal fisheries activities is an important livelihood activity in the lives of the fishers as it enhances food security and income of fishers. The study therefore recommended that government should give financial assistance to the fishers to enable them to seamlessly undertake their fishing activities. Fishery extension agents should advise fishers to join associations so as to access credit facilities and other benefits with a view to improving productivity. Government should provide subsidy on fishing inputs such as modern fishing gears to fisher

Keywords:: Sustainability, Artisanal Fisheries, Fishing Communities, Shiroro and Kainji Dams

Published 15/8/2024

INTRODUCTION

Fisheries production in Nigeria especially from marine is important for the socio-economic development of Nigerians and it contributes to the nation's economic growth through the Gross Domestic Products (GDP) (Kumaran *et al*., 2021). Ismail (2014) posits that Nigeria is blessed with enough marine fisheries resources that could enhance increased fish supply/production. Isaac (2013) posits that 43.5 million people were directly engaged in primary production of fish, either by artisanal fishing or in aquaculture. Most of these people who engaged in artisanal fishing are small-scale artisanal fishers, operating in coastal and inland waters. The

demand for fish has been rising rapidly in Nigeria as a result of increase in population, per capita income and prices of alternative sources of animal protein (Ibrahim *et al.* 2012). However, the domestic supply of fish does not satisfy the demand. Attempts to meet the demand have seen the country resorting to importation of fish. Nigeria's current annual national fish demand is in excess of 3.2 million m etric tonnes (Haque *et al*. 2022). The national production is about 1.1million metric tonnes from all sources, including aquaculture, artisanal and industrial fishing sectors, leading to a supply shortfall of about 2.1 million metric tonnes (Gosh*et al.* 2022). Fish makes up around 40 per cent of Nigeria's protein intake (Hussein. 2002). Nigeria have thus imported over 2 million metric tonnes of fish before 2015. Hence, fish catch and fish production had doubled by 600,000MT in the last three years, after government restricted food importation by directing fish importers to embrace backward integration through artisanal fishing and commercial aquaculture.

A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (Inoni and Oyeide, 2017). Sustainable livelihoods are those that can avoid or resist stresses and shocks and /or that are resilient and able to bounce back. Household's portfolio of tangible (stores and resources) and intangible (claims and access) assets can be understood as partly chosen by design to reduce vulnerability and to enable the household to survive stress and shocks with minimum risk of threat to the future livelihood (Kumaran *et al*. 2021). Rural livelihood is a complex structure comprising of mostly agriculture, with part of the population diversifying into non-farm activities in order to attain a sustainable livelihood to get better income for their households (Harrison and Rask, 2019). Livelihood can be assessed in many dimensions. It can be looked at in terms of livelihood activities, livelihood assets, livelihood strategies, livelihood outcomes, food security, income etc. This study assessed livelihood in terms of livelihood activities engaged by the fishers, livelihood assets possessed by the fishers, livelihood strategies adopted by the fishers and livelihood outcomes obtained by the fishers.

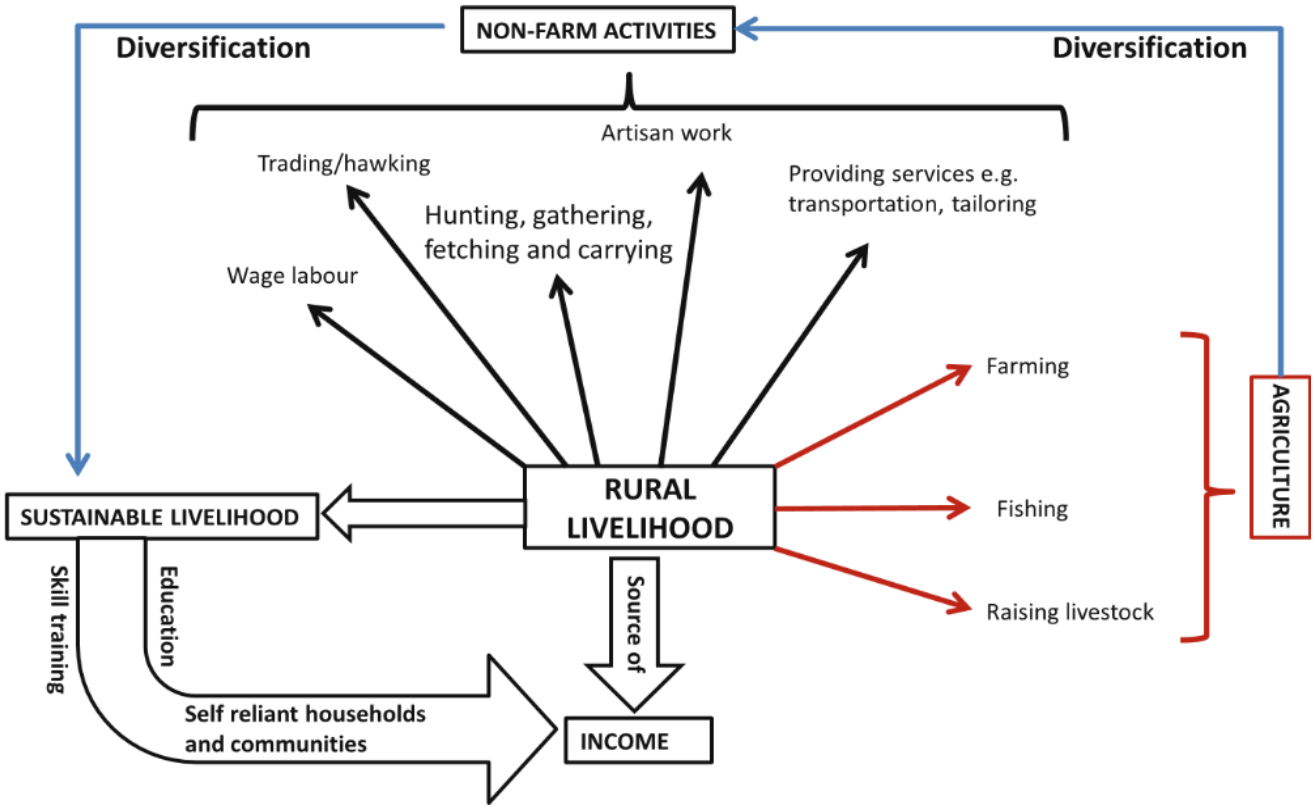

Fig i: Rural Livelihood as a Source of Income

Source: Adapted from Adedamola (2016).

Objectives of the study

The objectives of the study are:

1. describe the socioeconomic characteristics of artisanal fishers in the study area
2. assess the sustainability of artisanal fisheries activities in the study area

METHODOLOGY

Study Area

The study was carried out around Shiroro and Kainji dams, which are described below.

Description of Shiroro Dam

The study was carried out along Shiroro and Kainji Dams. The population of Shiroro is projected in 2020 to be 322,918 people using (3.2%) growth rate (NPC, 2006).The climate, edaphic features and hydrology of the state where the dam is located allows sufficient opportunities for harvesting fresh water fish such as *Tilapia spp*, *Bagrus spp*, *Clarias spp*, *Gymnarchus niloticus*, *Heterotis spp, Labeo spp, Mormysus spp, Latesniloticus* etc, It also permits the cultivation of most of Nigeria's staple crops such as maize, yam, rice, millet and sorghum. The Shiroro hydropower reservoir is a storage-based hydroelectric facility located in Shiroro Local Government, Niger State at the Shiroro Gorge which lies approximately between Latitude 9° 57' 25N and Longitude 6° 49' 55E.

Description of Kainji Dam

Kainji Lake is located between latitudes 9°5' and 10°55'N and longitudes 4°21' and 4°45'E. It cuts across Niger and Kebbi states, but is mostly located in Niger state. Kainji is the second largest lake in Africa and the largest man-made lake in Nigeria (Umar and Illo, 2014). The total annual rainfall for the Lake ranges between 1,100 mm and 1,250 mm, spreading from April to October (Ibrahim *et al.* 2012). The highest (about 30°C) and lowest (about 25°C) monthly temperatures are recorded in March and August, respectively. As shown by the studies conducted on the Lake basin, the socio-economic characteristics of the people are as follows: the majority of the fishers are *Sarkawa* sub-tribe of Kebbi Hausa, while others belong to such tribes as *Laru, Gungawa*, *Lopawa* and *Nupe* (Ismail, 2014).

Method of Data Collection

Both primary and secondary data were used for the study. Primary data was obtained using a structured questionnaire designed in line with the study objectives. The questionnaires were administered to the fishers selected for the study. Data collected included information on the socioeconomic characteristics of the fishers and livelihood sustainability of the fishers. Secondary data were collected from relevant text books, internet data bases, journal articles, seminar documents, conference papers, annual reports and other relevant materials.

Sampling Procedure and Sample Size

The study employed multi-stage and proportionate sampling techniques. Firstly, two dams in North central region where artisanal fisheries activities were widely practiced were purposively selected. The dams were Shiroro and Kainji. Secondly, 30 Villages were randomly drawn along Kainji dam and 20 along Shiroro dam, thereby giving a total number of 50 villages for the study. Thirdly, proportionate sampling technique was then employed to select (10%) of the fishing population from each of the selected villages, thus making 240 fishers along Kainji dam and 220 along Shiroro dam, thereby giving a sample size of 460 fishers for the study. The study identified 550 fishing villages along Kainji dam and 296 fishing villages along Shiroro dam. The fishing villages have a fishing population of about 3,823 along Kainji dam (Table 3.1) and 3,632 along Shiroro (Table 3.2). These figures (3,823 and 3,632) represent the sampling frame as obtained from NSMARD (2022) out of which the sample size of the study was drawn.

Analytical Techniques

Data collected were analyzed using descriptive statistics. Descriptive statistics such as frequency distribution count, percentages, mean and ranking were used to analyze objectives of the study

Descriptive Statistics

This method of analysis provides statistics that are used to describe the features of the data in a study. It provides simple summaries of the attributes of the sample such as measurement of dispersion and central tendency. The limitation with this analytical procedure is that descriptive statistics do not show the relationship among the variables and the influence that each variable may have on the response. Descriptive analysis does however, often provides guidance for more advanced quantitative analyses.

Sustainability Index

Sustainability index was used to measure the sustainability of artisanal fisheries activities in the study area. Livelihood sustainability is the ability of the household to cope with, and recover from, stresses and shocks related to vulnerability. It also deals with the ability to maintain its capacity and assets base. It was computed by rating respondents on a four point Likert scale of

strongly agreed = 4, agreed = 3, disagreed = 2, and strongly disagreed = 1, based on their responses to the following statements;

i. Fishing community's location is not too remote for any improvement in livelihood portfolios
ii. Communities are accessible despite deplorable road network
iii. Planning to leave fishing business
iv. Have access to credit facilities to support other livelihood activities
v. Capable of maintaining and sustaining assets base
vi. Relocate to better and more favourable area
vii. Market situation is favourable to livelihood activities
viii. Number of people in the area is not a problem to livelihood activities
ix. Changes in flood / rain cycle is not a problem
x. Conflict is not a problem in the area

In calculating the sustainability index, the mid-point values of the scale (1+2+3+4) were summed up to get 10. The sum was further divided by 4 to obtain 2.5 which is the mean score. Any sustainability source with a mean score equal or above the cut off mean of 2.5 was regarded as an important (agreed) source of sustainability and any mean score of lower than 2.5 was regarded as not an important (not agreed) source of sustainability. To get the sustainability index, respondent's scores on the 10 items were summed up and divided by the expected total score on the 10 items (which in this case is 40 that was 10 multiplied by 4, with the highest scale representing strongly agreed).

In livelihood sustainability analysis, once scores are summed up from Likert scale items and divided by the expected total score, typically, mean scores or average index are been calculated. In computing the index, all the scores were summed up after collecting responses for the 10 items. Summation of the scores for each respondent or each group being analyzed was done. The average score was then arrived at after dividing the summed scores by the maximum possible score. In this case, the highest scale is 4 (representing "strongly agree") and there are 10 items, the maximum total score is 40 (10 items × 4). So, the sum was divided by 40 to obtain a score between 0 and 1. Sustainability index was used in decision-making by identify areas where the livelihood system is performing well and areas that need improvement. For instance, certain items score particularly low. These are potential areas of concern. Based on the index, there were specific items with lower scores, based on this fact, prioritization of interventions or improvements should be targeted at such areas. For example, the index was low due to poor performance in areas such as livelihood activities engagement or community engagement; those areas should be targeted for development. The index was used to communicate results to stakeholders, including community members, funders, or policymakers. The sustainability index provided a quantitative basis for decisions related to resource allocation, program design, and long-term planning.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Fishers

Age of the Fishers

Age is an important socioeconomic characteristic because it affects productivity, output and adoption of innovations. The result of socioeconomic characteristics of the fishers as shown in Table 4.1 indicate that (51.3%) were within the age bracket of 29-41 years, (24.2%) fell within the age of 42-54 years, (21.7%) were of 55years and above and the least (2.8%) fell within the age 16-28 years with a mean of 46.0. It is evident from the result that most (51.3%) of the respondents were middle aged fishers who fell within the active fishing age with high vigour and energy to contribute meaningfully to fishery development.

Marital Status of the Fishers

As regards marital status, majority (87.0%) of the respondents were married, (8.9%) were single, 1.3% were divorced, and (2.8%) were widowed. It is revealed from this result that greater percentage of the respondents were married indicating that they were saddled with the responsibility of meeting their families basic needs such as ensuring that their households are food secured. This agrees with Gosh *et al*. (2022) who also found out that majority (73.0%) of the artisanal fishers were married indicating that many of them were faced with family responsibilities and as such have the tendency of abandoning artisanal fisheries if enough financial proceeds to take care of their family were not forthcoming. The findings of Shettima (2014) which reported male dominance in artisanal fisheries because the result revealed that majority of the respondents (73.3%) were married, while (25.8%) were single, while (1%) of the respondents were separated. This implies that the highest proportion of the fishers were married suggesting strong attachment to the family institution. In most fishing households visited for the survey, artisanal fisheries is taken as a family business and most family members were involved in fishing at one stage or the other.

Level of Education of the Fishers

The results in Table 4.1 shows that (14.1%) of the respondents acquired only primary school education, (16.3%) had only junior secondary school, (32.6%) attended up to senior secondary school, (7.4%) obtained tertiary education and the rest of the respondents

(29.6%) had no formal education but only had either Qur'anic or adult education. This may, to some extent, have a bearing on their livelihood. This low level of education implies that the demand for and access of the respondents, to bank credit and contact with extension agents will be affected. This finding is supported by Kumaran *et al.* (2021) and Haque *et al. (*2022) which in their separate studies showed that majority of artisanal fisheries operators studied up to only secondary school. Educated fishers as asserted by Isaac (2013) are supposed to be more receptive to innovations than the uneducated. The low educational level of respondents in this study is consistent with the results of Hussein (2002) which shows that (67.5%) of artisanal fishers had at least primary education.

Household Size of the Fishers

The result further revealed that most (40.0%) had 6-13 persons in their households, (35.0%) had a household size of 14-21 members, and another (10.0%) had a household size of 22 or more members and (15,0%) had less than 5 persons. Large household size is associated with the availability of timely, free and cheap labour force for the fishing households; in this case larger families are likely to be more effective and productive. Although this helped to increase the output of fish, substantial amount of fish was also consumed by the household causing a reduction in the overall households' income. This is in line with Gosh *et al. (*2022) and Ibrahim *et al*., (2012). Larger household size contributes greatly to efficient labour supply in artisanal fisheries activities as those households with greater number of members had more crew on board for inland fishing and hence capture more fish than those with lower household size.

Membership of Associations among the Fishers

The results further revealed that majority (75.0%) of the fishers did not belong to any form of fisher cooperative association while (25.0%) belonged to one form of fishing association or the other. It can be seen from the findings that majority of the fishers do not belong to any form of cooperative association and cooperative associations are very important to fishers as they can be a source of credit, source of training/information on improved fishing techniques, source of motivation and source of fishing gears. This also implies that fishers who belong to organizations through interaction could acquire information that could help them to improve their productivity (Inoni and Oyeide, 2019). This could be the reason for the low fishing output by the fishers across the two dams coupled with the fact that most of them had only secondary education**.**

Access to Extension Services by the Fishers

The result of the study indicated also that majority (84.6%) of the respondents had no contact with extension agents while (15.4%) had contact with extension services. Extension agents play a very vital role in enlightening fishers on new fishing techniques through periodic organization/arrangement of capacity building programmes targeted at improving fishing efficiency. However, majority of the fishers interviewed did not have access to extension agents and that had indirectly limited their level of productivity in terms of fish catch and other artisanal fisheries activities. Extension agents can educate fishers on the strategies to employ in order to effectively exploit water resources. They will also expose the fishers on ways to avoid dangerous aquatic animals and turbulent water volumes that might influence fishing activities. This work is in consonance with.

Sustainability of Artisanal Fisheries

Table 2 shows the mean values of sustainability assessment of respondents in artisanal fisheries activities. The fishers agreed that the location of fishing communities is not too remote for any improvement in their livelihoods portfolios ($\bar{x}$=2.93, SD=0.76). This was an indication that fishers are optimistic that someday they will be part of rural transformation because of the contributions they are making in terms of provision of fish to local markets. The result further revealed that migration to better and more favourable fishing location ($\bar{x}$=2.64, SD=0.70) encouraged the sustainability of artisanal fisheries production. Respondents' capabilities in maintaining and sustaining fisheries resource base ($\bar{x}$ =2.60, SD=0.52) and effective resolution of conflict ($\bar{x}$ =2.60, SD=0.78) arising from the use of fisheries resources are evidence of sustainability of artisanal fisheries through co-management system in the area. In the face of fast depleting capture fisheries resources, respondents agreed to remain in fishing business ($\bar{x}$ =2.50, SD=0.76) implying that artisanal fisheries livelihood account significantly for their household daily disposable income. Daily return from sales of fish caught contributes in meeting the day to day needs of fishers' households. Low indices for accessibility of fishing communities ($\bar{x}$ =1.83, SD=0.81) and access to credit facilities to support other livelihoods (=1.33, SD=0.62) depict weak physical and financial assets that cannot sustain fisheries production. The finding support FAO (2004) assertion that fishing communities lack adequate assets to support and improve livelihoods. Respondents felt that increase in fishers' number will likely lead to increased pressure on fisheries resources ($\bar{x}$=2.0, SD=0.78) which will affect fisheries sustainability negatively. Respondents disagreed that their market situation was favourable to enhanced fishing livelihood ($\bar{x}$=2.39, SD=0.76). Also, unfavorable market situation to fishing livelihood may be due to the exploitation of the fisheries by fish mongers in the chain of distribution. Most of the fishers received loans from mongers for procurement of fishing input. These loans were remitted

by fishers with fish caught and the bargaining power lies in the hand of the mongers.

Table 4. 1: Socioeconomic Characteristics of the Artisanal Fishers (n = 460)

Variables	Frequency	Percentage	Mean
Age			
16---28	13	2.8	
29 – 41	236	51.3	
42 – 54	111	24.2	46.0
55 and above	100	21.7	
Total	**460**	**100**	
Marital Status			
Married	400	87.0	
Single	41	8.9	
Divorced	6	1.3	
Widowed	13	2.8	
Total	**460**	**100**	
Level of Education			
Primary Education	65	14.1	
Junior Secondary Education	75	16.3	
Senior Secondary Education	150	32.6	
Tertiary Education	34	7.4	
No Formal Education	136	29.6	
Total	**460**	**100**	
Household Size			
Less than 5	69	15.0	
6 – 13	185	40.2	12.0
14 – 21	166	36.1	
22 and above	40	8.7	
Total	**460**	**100**	
Membership of Association			
Member	115	25.0	
Non-Member	345	75.0	
Total	**460**	**100**	
Access to Extension			
No	389	84.6	
Yes	71	15.4	
Total	**460**	**100**	

Source: Field Survey, 2023

Table 2: Sustainability Assessment of Artisanal Fisheries Activities (n = 460)

Sustainability assessment	Mean Score	Std. Deviation
Fishing communities location is not remote for any improvement in livelihood portfolios	2.93*	0.763
Migrate to better and more favourable fishing location	2.64*	0.696
Capable of maintaining and sustaining fisheries resource base	2.60*	0.524
Conflict is not a problem in the area	2.60*	0.778
Planning to remain in fishing business	2.50*	0.758
Market situation is favourable to fishing livelihood	2.39	0.763
Changes in flood / rain cycle is not a problem	2.10	0.876
Increased number of fishers in the area is not a problem to fishing livelihood	2.00	0.777
Community is accessible despite poor road network	1.83	0.811
Have access to credit facilities to support other livelihoods Activities	1.33	0.621

Source: Field Survey, 2023 *Agreed (mean ≥ 2.50)

CONCLUSION/ RECOMMENDATIONS

Conclusively, the study showed that, artisanal fisheries activities are important in promoting sustainability of artisanal fisheries activities that impacted positively on the lives of the fishers along the two dams. The study therefore recommended the following as ways to enhance sustainability of artisanal fisheries activities and livelihood conditions of the fishers.

1. Fishery extension agents should advise fishers to join fisheries associations so as to access credit facilities and other benefits with a view to improving productivity in terms of fish catch.
2. Training and seminars on livelihood diversification strategies should be provided by private organizations with the necessary support of the government. This will enlighten the fishers on how best to distribute their eggs among baskets and withstand shocks that could arise from the failure of their major livelihood source.
3. More extension officers should be recruited by government to provide more extension services to fishers that could boost artisanal fisheries practices around the two dams and in the country at large.
4. Relevant agencies should network with local fishers to import environmental compatible fishing gears and boats and other fishing equipment for sustainable fisheries development in Nigeria. Such gears and boats should also place premium on mending materials, efficiency, fisher's knowledge and experience as well as economic and environmental considerations.

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