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Research findings and application in aquaculture and fisheries: bridge-building measures among lecturers of agricultural education in Nigeria

Abstract

The reduction in the capture of wild fishes and other important aquatic organisms has created a wide gap between the quantity of aquatic products supplied by farmers and the quantity demanded by consumers in Nigeria. Meanwhile, agricultural educators are being encouraged to use their knowledge of aquaculture and fisheries to improve supply for sustainable food security. However, there are challenges in accessing and communicating such innovative research findings to the end users- farmers and prospective farmers- especially in the classroom. Hence, the study identified constraints and bridge-building measures among agricultural educators in accessing and applying research findings to teaching aquaculture and fisheries in Nigeria. The study adopted an exploratory sequential mixed method and a thematic approach. Sixty-three agricultural educators who are experienced specialists in aquaculture and fisheries were purposefully sampled. A validated online semi-structured interview guide and structured questionnaire were used to elicit qualitative and quantitative data, respectively, from respondents. A Cronbach's alpha reliability index of 0.93 was obtained. A t-test was used to test the null hypothesis at a 0.05 level of significance. The study, among others, identified 13 thematic constraints to accessing research findings, 14 thematic constraints to applying research findings, and 5 thematic and 7 thematic bridge-building measures for accessing and applying research findings, respectively, to educate farmers and prospective farmers in aquaculture and fisheries in Nigeria. There should be collaborative efforts by the government, scientists, research institutes, international research organisations, producers, and agricultural education lecturers in accessing and applying research findings for updated and globalised aquaculture and fisheries education in Nigerian universities.

Keywords: agricultural educators, bridge-building, exploratory sequential mixed method, purposive sampling, thematic approach

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Introduction

Aquaculture and fisheries have been major contributors to the global food supply and rural livelihoods for the past 30 years, providing just 7% of fish for human consumption in 1974. Fishery products are essential for both children and adults because they are high in protein, iron, zinc, magnesium, phosphorus, calcium, vitamin A, and C, and have low cholesterol content.[1] Especially in developing countries, Aquaculture and fisheries industries are facing challenges such as disease infection and high mortality, postharvest losses, poor value addition of products, high cost of feeds, issues in the development of brood-stock and domestication, development of qualitative and cost effective feeds and mechanisms of feeding, lack of technical know-how, hatchery and grow-out technology, inadequate supply of inputs, inadequate land, inadequate database on the biology and ecological requirements of endemic fish species with aquaculture potentials, lack of rational aquaculture development plan, lack of technical and extension experts, absence of research-extension linkage and budget issues.[2–4] The aquaculture and fishing industries in Nigeria are experiencing low productivity and a national demand gap, leading to a shortfall of 1.9 million metric tonnes (62%). This has left Nigeria with the option of importing an estimated 1.9 million metric tonnes of fish valued at over N125 billion per year.[5]

Onuche et al.,[6] explained that Nigerian consumption of fishery products continues to remain at levels below production, fueling a huge loss of foreign exchange. Data by the Food and Agriculture Organisation (FAO)[7] revealed that despite the encouraging growth and outperformance of artisanal fisheries in recent years, their growth rate has declined. Therefore, conscious and sustained efforts in Nigeria are required to enable it to provide the bulk of the fish supply in the future. Research efforts have been successful in developing improved and innovative technologies for aquaculture and fisheries in Nigeria.[8] These include local development of technology for breeding popular species, hatchery production of fingerlings, and research on seed collection from the natural environment.

The Nigerian Institute for Oceanography and Marine Research (NIOMR) has also developed pellets for clarias and tilapia, as well as culture systems based on indigenous species of fish.[9] These are just a few of the major aquaculture and research findings in Nigeria. The literature on aquaculture and fisheries is full of exotic and innovative research findings, some of which have already been localised in Nigeria to boost productivity.[3] These include artificial insemination, spawning, holding systems, block chain in aquaculture, aquaponics, aquaculture biotechnology, and the application of genetics.[10] Other technological and innovative developments in aquaculture and fisheries include the production of egg and fry from eel and bluefin tuna, the production of new marine and freshwater species, new raw materials, additives, and enzymes in fish feed, improved digestibility, biological and technological developments in re-circulating aquaculture systems, technological innovations in cage aquaculture, and breeding techniques.[11]

However, there is a disparity between research findings and application in developing countries, especially Nigeria. The application of these innovative aquaculture technologies in developing countries largely depends on the willingness of the producers, with the assistance of international donor communities, researchers, educators, and scientists, to work together in related research, infrastructural development, and capacity building.[3,10] For research findings from aquaculture and fishery research institutes to be applied in the farming industries, agricultural educators, like the lectures of Agricultural Education, must access and apply them during their classroom instruction. Currently, these are lacking in Nigeria due to certain constraints that are not even available in the literature.

Statement of the problem

The global research output in aquaculture and fisheries has increased significantly in the past 20–30 years.[12,13] The Directorate for Food Road and Rural Infrastructure's aquaculture development and research programme aims to develop simple technologies for the effective transfer of research results.[9] Agricultural Development Projects (ADP) in Nigeria were established to stimulate and motivate small-scale farmers to utilise local and foreign research findings or modern technologies. There is a gap between innovative research findings and application in the aquaculture and fisheries industries, especially in Nigeria.[14] The application of research findings in aquaculture and fisheries by farmers is determined by the accessibility and utilisation of such innovations by agricultural educators in classrooms. However, lecture notes of agricultural educators in 7 out of 34 universities in Nigeria are devoid of current research findings, and there is no empirical study targeting constraints and measures for accessing and applying research findings, hence the need for this study.

Specific objectives

The specific objectives of this research in aquaculture and fisheries were to:

a) Identify the constraints to accessing research findings;

b) Identify the constraints to applying research findings;

c) Determine bridge-building measures for accessing research findings; and

d) Determine bridge-building measures for applying research findings

Research questions

The following research questions in aquaculture and fisheries relation were posed for the study.

a) What are the constraints to accessing research findings?

b) What are the constraints to applying research findings?

c) What are the bridge-building measures for accessing research findings?

d) What are the bridge-building measures for applying research findings?

Hypotheses

The following null hypotheses were formulated and tested to accessing research findings in aquaculture and fisheries for the study.

H_{01}: There is no significant difference between the mean responses of male and female agricultural education lecturers on constraints

H_{02}: There is no significant difference between the mean responses of male and female agricultural education lecturers on constraints

H_{03}: There is no significant difference between the mean responses of male and female agricultural education lecturers on bridge-building measures

H_{04}: There is no significant difference between the mean responses of male and female agricultural education lecturers on bridge-building measures

Theoretical framework

The Diffusion of Innovation (DOI) theory is one of the oldest theories on technology adoption; propounded by E.M. Rogers.[15] It tries to explain how an idea spreads (diffuses) through a specific population or social system. The key to adoption (acceptance and use) of the idea is that individuals must perceive the idea as new or innovative. There are five adopter phases of a new idea, which describe the behaviour of individuals within a social system with regards to acceptance and use of the idea.

Innovators are individuals who make the first attempt at innovations and are inquisitive about new ideas.[16] Early Adopters are opinion leaders who enjoy leadership roles and embrace change opportunities. Strategies to appeal to this population include how-to manuals and information sheets on implementation. The most important details in this text are the different adopter phases of agricultural education. Early Majority: These people are rarely leaders, but they do adopt new ideas before the average person.[16]

Late Majority: These people are sceptical of change and will only adopt an innovation after it has been tried by the majority. Laggards: These people are bound by tradition and are very conservative.[16] The implication of the tenets of DOI theory is that for lecturers of agricultural education who are part of a social system (university) to accept and use research findings in aquaculture and fisheries, they must perceive the idea (research findings) as new. This ignites desired new behaviours (adoption) in individuals. Additionally, the different adopter phases reveal the need to understand the characteristics of agricultural education lecturers within a particular university system, and different strategies should be used to appeal to the different adopter categories.

Research methodology

The area of study is Nigeria, one of the most highly populated West African countries. It is an oil-rich country as well as agrarian, with 34 universities offering agricultural education programmes. The exploratory sequential mixed method was adopted for the study. Morteza & Sirous[17] explained that this type of mixed-methods approach has two phases. In the first phase, researchers collect qualitative data from a limited number of samples to explore a condition. In the next phase, researchers collect quantitative data randomly from a relatively large population to explain the relationships found in the qualitative data.[18] Sixty-three out of 234 lecturers of agricultural education in 34 universities offering agricultural education in Nigeria were purposively sampled as respondents for the study. The respondents were purposefully selected based on their area of specialisation and experiences in aquaculture and fisheries, as well as their online accessibility.

Data were collected from respondents for this study with ethical considerations. The permissions of the study participants were sought through email before data collection. Therefore, the respondents'

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participation was voluntary. To elicit qualitative data, researchers administered face-validated, semi-structured interview questions independently to respondents (mainly professors) through Zoom Cloud. Researchers ensured that the privacy and confidentiality of respondents were respected; respondents were assured that the Zoom interview would not be recorded. Secondly, a validated researcher-developed structured questionnaire titled "Accessing and Applying Research Findings Constraints and Bridge-Building Measures in Aquaculture and Fisheries Questionnaire (AARFCBMQFQ)", was administered to respondents through their e-mails in survey monkey software. The questionnaire was structured on a 4-point scale of strongly agree (SA), agree (A), disagree (D), and strongly disagree (SD), with respective values of 4, 3, 2, and 1. The instruments for data collection were face-validated by 5 experts in fisheries: 3 from the Department of Agricultural and Home Science Education, Michael Okpara University of Agriculture, Umudike, and 2 from the Department of Agricultural Education and Extension, University of Eswatini, Kingdom of Eswatini. A Cronbach's alpha reliability test on the structured questionnaire was conducted after a pilot study, and a reliability index of 0.93 was obtained.

Quantitative data collected on research questions using a structured questionnaire was analysed using descriptive statistics such as mean, standard deviation, frequency, and pie chart. Decision rules on questionnaire items were based on the following: mean scores ≥ 2.5 averages on a 4-point scale were described as "agreed," while mean scores < 2.5 average on a 4-point scale were described as "disagreed". An independent sample t-test was used to test the null hypothesis at the 0.05 level of significance. In taking decisions, the null hypothesis was upheld for any item whose t-cal. value was less than ± 1.96 but not upheld for any item whose t-cal. value was less than ± 1.96 at .05-level of significance. Researchers used SPSS software, version 22, for data analysis.

Data from interview questions was encoded into themes and described descriptively using frequency, percentage, bar, and pie charts. To determine the reliability of the qualitative data, the researchers had protracted conversations with participants in the Zoom meeting. Similarly, the researchers did peer-briefing and triangulation and ensured that data was collected logically and documented as suggested by Lincon and Guba[19]. The qualitative data collected from the Key Informant (KI) (professor) interviews was categorised into different groups, issues, or themes (thematic approach), encoded, and descriptively analysed using frequencies, percentages, bar charts, and pie charts.

Results and discussion

The descriptive and inferential results of the study are present in Tables 1–12 and Figures 1–12.

Table 1 Frequency distribution on gender of the respondents

Gender	Frequency	Percentage (%)
Male	35	55.56
Female	28	44.44
Total	**63**	**100**

Table 2 Frequency distribution on years of experiences of the respondents

YOE	Frequency	Percentage (%)
Below 5 years	10	15.87
5-10 years	18	28.57
Above 10 years	35	55.56
Total	**65**	**100**

YOE, Years of experience

Table 3 Frequency distribution on area of specialization of the respondents

AOS	Frequency	Percentage (%)
Fisheries and Aquatic Resource Management	8	12.70
Fisheries and Aquaculture	25	39.68
Fisheries and Wildlife	18	28.57
Fisheries	12	19.05
Total	**63**	**100**

AOS, Area of specialization

Table 4 Frequency distribution on rank of the respondents

Rank	Frequency	Percentage (%)
Prof.	8	12.70
Assoc. Prof	12	19.05
Senior Lecturer	20	31.75
Lecturer	23	36.51
Total	**63**	**100**

Table 5 Descriptive statistics and independent sample t-test of the mean responses of respondents on constraints to accessing research findings in aquaculture and fisheries (n=63)

S/N	Item Statements	$\bar{x}$	S	t-cal.	Remarks
1	Lack of funds for accessing research findings in aquaculture or fisheries	3.51	.043	1.099	A, NS
2	Inadequate infrastructure for accessing research findings	2.96	.135	1.158	A, NS
3	Poor promotion and information on innovative research findings	2.71	.062	.190	A, NS
4	Lack of ICT competence of some lecturers to access research findings	3.18	.967	.093	A, NS
5	Lack of ICT gadgets to access online published research findings	3.30	.470	.135	A, NS

Table 5 Continued...

S/N	Item Statements	$\bar{x}$	S	t-cal.	Remarks
6	Poor linkage of research institutes to lecturers	2.96	.605	-1.067	A, NS
8	Inadaptability of some research findings to local instructional environment	3.20	.616	.197	A, NS
9	Time constraints to accessing research findings	3.24	.534	.108	A, NS
10	Lack of motivation to accessing research findings in aquaculture and fishery	3.25	.489	1.069	A, NS
11	Poor attitude of some lecturers towards accessing research findings	2.99	.648	-1.161	A, NS
12	Inability to interpret some research findings in aquaculture or fishery	3.30	.470	1.056	A, NS
13	Lack of subscription of universities to published research findings	2.98	.711	.092	A, NS
14	Poor explanation of published technical jargons for easy understanding	2.95	.510	1.055	A, NS
15	Incompatibility of certain publication with some electronic Apps.	3.29	.620	.073	A, NS
16	Lack of open access to published research findings in aquaculture and fishery	3.10	.718	.063	A, NS

$\bar{x}$, mean; S, Standard deviation; **A**, Agreed; D, Disagreed; n, number of respondents; df, degree of freedom= 61, t-cal. is significant at ≥ ±1.96

Table 6 Frequency distribution of themes generated from the respondents' comments on research question 1 (n=8)

	Constraints to and Applying Research Findings in Aquaculture and Fisheries		
S/N	**Theme**	**Frequency**	**Percentage (%)**
1	Poor Promotion of Research Findings	1	2.04
2	Complexity of Research Findings	2	4.08
3	Inadequate technical know-how to accessing research findings	6	12.25
4	Funding Problems	8	16.32
5	Inadequate infrastructures for accessing research findings	4	8.16
6	Lack of Policy	5	10.20
7	Practicability of Research Findings	4	8.16
8	Little economic Benefits of some Research Findings	3	6.12
9	National Budgetary and Support Issues	6	12.25
10	Incompatibility with curriculum content and objectives	2	4.08
11	Cost of accessing Research Finding	1	2.04
12	Poor motivation of lecturers for accessing research findings	2	4.08
13	Adaptability of research findings in aquaculture and fishery	3	6.12
	Total	**49**	**100**

n = number of respondents

Table 7 Descriptive statistics and independent sample t-test of the mean responses of respondents on constraints to applying research findings in aquaculture and fisheries (n=63)

S/N	Item Statements	$\bar{x}$	S	t-cal.	Remarks
1	Lack of competence to demonstrate research findings in aquaculture or fishery	3.05	.510	.081	A, NS
2	Inadequate or inconsistency of technical information to apply the research findings	3.40	.518	.185	A, NS
3	Inadequate infrastructures in the universities to apply research findings	3.62	.510	1.084	A, NS
4	Cultural discrimination or incompatibility with the culture	3.36	.484	.143	A, NS
5	Non-availability of technical expert for guidance during demonstration	3.25	.550	.063	A, NS
6	High cost of some reagents for demonstration of published research findings	3.28	.606	.112	A, NS
7	High student-teacher ratio for effective class management while apply research findings	3.35	.510	.1087	A, NS
8	Complexity in the application of some research findings	3.51	.503	.123	A, NS
9	Inadaptability of some research findings to local instructional environment	3.00	.562	.068	A, NS
10	Time constraints to applying research findings	3.10	.587	.105	A, NS
11	Lack of motivation to applying research findings in aquaculture and fishery	3.70	.470	.068	A, NS
12	Inadequate specialized instructors in aquaculture and fishery	3.39	.703	.138	A, NS
13	Poor attitude of some lecturers towards applying research findings	3.15	.639	.060	A, NS
14	Impracticality of some research findings in aquaculture and fisheries	3.04	.665	1.178	A, NS
15	Curriculum overload	3.00	.324	.061	A, NS

$\bar{x}$, mean; S, Standard deviation; A, Agreed; D, Disagreed; n, number of respondents;

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Table 8 Frequency distribution of themes generated from the respondents' comments on research question 2 (n=8)

	Constraints to and Applying Research Findings in Aquaculture and Fisheries		
S/N	**Theme**	**Frequency**	**Percentage (%)**
1	Funding problems	8	14.04
2	Complexity of some research findings	3	5.26
3	Inadequate technical know-how to applying research findings	6	10.53
4	Inadequate infrastructures for applying research findings in university classroom and laboratory settings	8	14.04
5	Policy Issues	6	10.53
6	Time	4	7.02
7	Little economic benefits of some research findings	2	3.51
8	National budgetary issues	4	7.02
9	Incompatibility with curriculum content and objectives	2	3.51
10	Cost of applying research findings	2	3.51
11	Poor motivation of lecturers	3	5.26
12	Adaptability of research findings	2	3.51
13	Attitude of lecturers	1	1.75
14	Poor linkage of lecturers and researchers/research institutes	6	10.53
	Total	**57**	**100**

n = number of respondents

Table 9 Descriptive statistics and independent sample t-test of the mean responses of respondents on bridge-building measures for accessing research findings in aquaculture and fisheries (n=63)

S/N	**Item Statements**	$\bar{x}$	**S**	**t-cal.**	**Remarks**
1	Adequate funding of lecturers' research	3.29	.787	1.161	A, NS
2	Adequate budgetary allocations to accessing innovative research findings	3.27	.592	.096	A, NS
3	Provision of ICT gadgets in universities	3.19	.785	.070	A, NS
4	Up-skilling of lecturers' ICT competence for easy access to reach findings	3.41	.700	1.083	A, NS
5	Collaboration with technical experts on research in aquaculture and fishery	3.26	.677	.068	A, NS
6	Publication of research findings in open access websites	3.13	.727	.136	A, NS
4	Attending worship and conferences on aquaculture and fishery for capacity building	3.33	.444	1.026	A, NS
5	Creating a special agency within universities for accessing practicable and economic benefit research findings	3.29	.787	1.211	A, NS
6	Strengthening Linkage between aquaculture and fishery research institutes to lecturers in universities	3.27	.592	.196	A, NS
7	Government support in accessing research findings from public, private and international research institutes	3.19	.785	.151	A, NS

$\bar{x}$, mean; S, Standard deviation; A, Agreed; D, Disagreed; n, number of respondents

Table 10 Frequency distribution of themes generated from the respondents' comments on research question 3 (n=8)

	Bridge-building measures for accessing research findings in aquaculture and fisheries		
S/N	**Theme**	**Frequency**	**Percentage (%)**
1	Promotion of Innovative and Economic Benefit Research Findings (PIEBRF)	3	9.68
2	Proper Funding for Accessing Research Findings (PFARF)	8	25.81
3	Re-training of Lecturers on Accessing Research Findings (RTLARF)	5	16.13
4	Adequate Government Budgetary Allocation and Support for Accessing Research Findings (AGBASASRF)	7	22.58
5	Bridging the Gap Between Research Institutes and Lecturers (BGBRIL)	8	25.81
	Total	**31**	**100**

n = number of respondents

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Table 11 Descriptive statistics and independent sample t-test of the mean responses of respondents on bridge-building measures for applying research findings in aquaculture and fisheries (n=63)

S/N	Item Statements	$\bar{x}$	S	t-cal.	Remarks
1	Adequate funding to provide current aquaculture and fishery facilities for practical	3.13	.727	1.093	A, NS
2	Lecturers attending workshop in aquaculture and fisheries for capacity building	3.35	.744	.160	A, NS
3	Regular curriculum review for integration of innovative research findings into curriculum	3.30	.735	-1.088	A, NS
4	Use of resource persons from department of aquaculture and fisheries for instructional delivery	3.13	.779	.167	A, NS
5	Collaborative efforts of scientists, research institutes, international research organizations and producers with lecturers in applying research findings	3.64	.679	1.067	A, NS
6	Strengthening Linkage between aquaculture and fishery research institutes to lecturers in universities	3.44	.687	-1.096	A, NS
7	Regular field trips to research institutes by lecturers and students in universities	3.06	.544	1.076	A, NS
8	Government support in applying research within universities	3.75	.705	.083	A, NS
9	Enactment of Policies to foster application of research findings	3.61	.482	.060	A, NS

$\bar{x}$, mean; S, Standard deviation; A, Agreed; D, Disagreed; n, number of respondents

Table 12 Frequency distribution of themes generated from the respondents' comments on research question 4 (n=8)

	Bridge-building measures for applying research findings in aquaculture and fisheries		
S/N	**Theme**	**Frequency**	**Percentage (%)**
1	Collaboration in Innovative Research Applications (CIRA)	5	11.36
2	Capital Investment by Government and Organizations in Innovative Research Application (CIGOIRA)	8	18.18
3	Capacity Building of Lecturers for Innovative Research Application (CBLIRA)	5	11.36
4	Government Budgetary Allocation for Innovative Research Application (GBAIRA)	7	15.91
5	Enactment of Policies for Innovative Research Application (EPIRA)	8	18.18
6	Bridging the Gap Between Research Institutes and Lecturers (BGBRIL)	7	15.91
7	Curriculum Integration of Innovative Research Application (CIIRA)	4	9.09
	Total	**44**	**100**

n = number of respondents

Figure 1 Pie chart showing the frequency distribution on gender of the respondents.

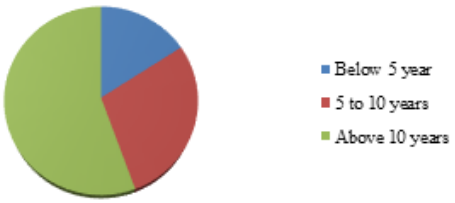

Figure 2 Pie chart showing the frequency distribution on years of experiences of the respondents.

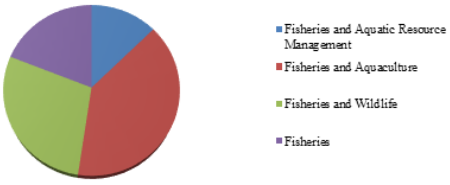

Figure 3 Pie chart showing the frequency distribution on area of specialization of the respondents.

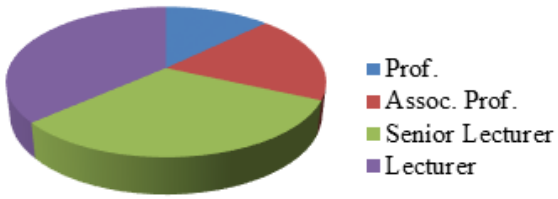

Figure 4 Pie chart showing the frequency distribution on rank of the respondents.

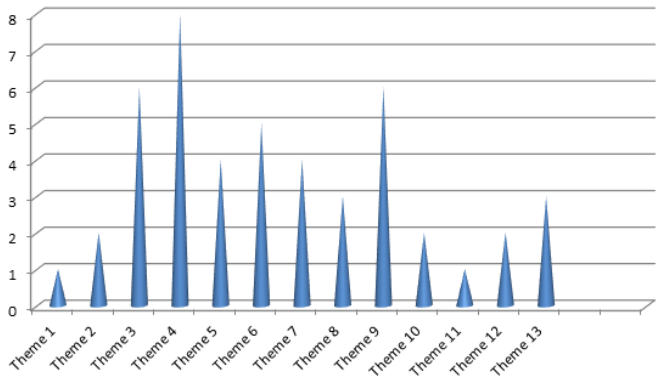

Figure 5 Bar chart showing the frequency distribution of themes generated from the respondents' comments on research question 1.

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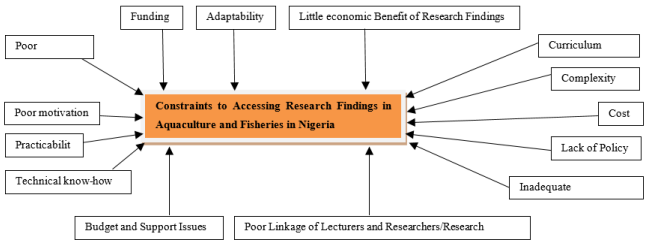

Figure 6 Conceptual framework on constraints to accessing research findings in aquaculture and fisheries (researchers).

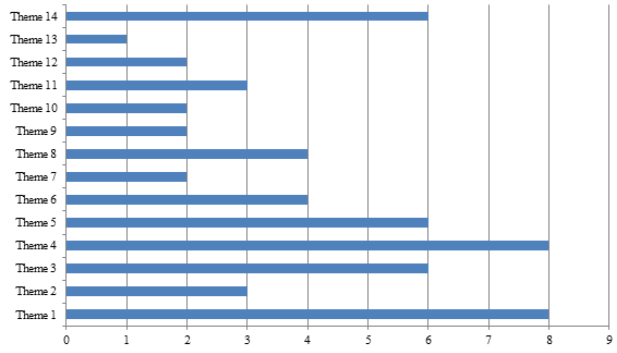

Figure 7 Bar chart showing the frequency distribution of themes generated from the respondents' comments on research question 2.

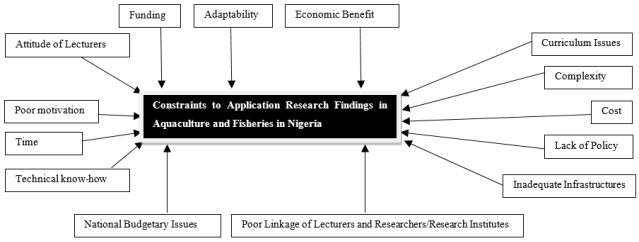

Figure 8 Conceptual framework on constraints to applying research findings in aquaculture and fisheries (researchers, 2020).

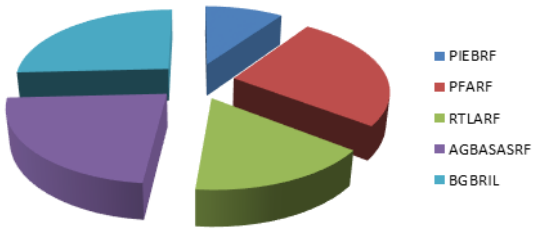

Figure 9 Pie chart showing the frequency distribution of themes generated from the respondents' comments on research question 3.

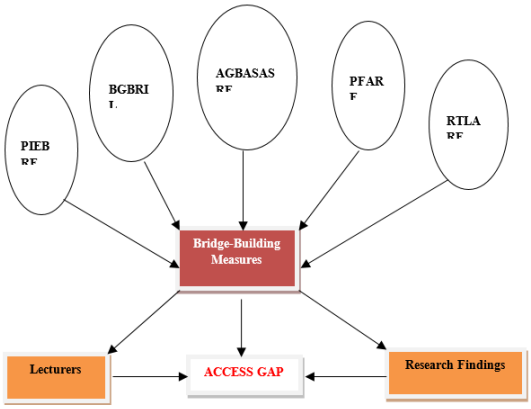

Figure 10 Conceptual framework on bridge-building measures for accessing research findings in aquaculture and fisheries (researchers, 2020).

Figure 11 Pie chart showing the frequency distribution of themes generated from the respondents' comments on research question 4.

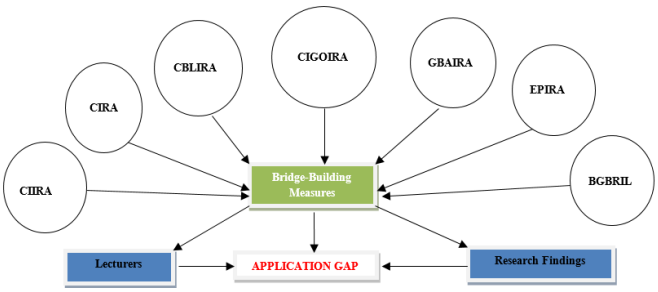

Figure 12 Conceptual framework on bridge-building measures for applying research findings in aquaculture and fisheries (researchers, 2020).

Demography of respondents for the study

Data presented in Table 1 reveal that 55.56% (35) of the total respondents for the study are males while 44.44% (28) are females (Figure 1).

Data presented in Table 2 indicate that 15.87% (10) of the total respondents for the study have professional experiences below 5 years, 28.57% (18) have professional experiences within 5 to 10 years while 55.56% have professional experiences of over 10 years. Thus, the majority of the respondents for this study have over 10 years' experience in aquaculture and fisheries (Figure 2).

Data in Table 3 show that 12.70% (8) of respondents specialize in fisheries and aquatic resource management, 39.685 (25) specialize in fisheries and aquaculture, 28.575 (18) specialize fisheries and wildlife and 19.05 (12) specialize in fisheries. This reveals the different forms in which aquaculture and fisheries are studied as disciplines in Nigerian Universities (Figure 3).

Data in Table 4 indicate that 12.70 % (8) of respondents are ranked professors, 19.05% (12) are associate professors, 31.75% (20) are senior lecturers and 36.51%(23) are lecturers (Figure 4).

Research question 1: What are the constraints to accessing research findings in aquaculture and fisheries by lecturers of agricultural education?

Hypothesis 1: There is no significant difference between the mean responses of male and female agricultural education lecturers on constraints to accessing research findings in aquaculture and fisheries.

Results obtained from quantitative data on Research Question 1are presented in Table 5.

Data in Table 5 reveal that the mean values of all 16 items range from 2.71 to 3.51, which are above 2.50 on a 4-point scale. This implies that respondents agreed that the information represented by the 16 items is a constraint to accessing research findings in aquaculture and fisheries by agricultural education lecturers. Also, standard deviations for all the items range from 0.043 to 0.967, which means that the

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responses of respondents were close to the mean and to one another in degrees of responses. Furthermore, the data in the table show that the t-cal. values of the independent sample t-test conducted on the mean responses of respondents range from -1.161 to 1.158, which are below ±1.96. This statistically means that there was no significant difference between the mean responses of male and female agricultural education lecturers on constraints to accessing research findings in aquaculture and fisheries. Hence, the null hypothesis is not rejected.

To gain a deeper understanding of the constraints to accessing research findings in aquaculture and fisheries, qualitative data were also collected, mainly from 8 respondents who are professors, and categorised into different groups, using a thematic approach. Respondents responded to the optional open-ended interview questions, and all comments were coded based on the identified themes. Results obtained from qualitative data on Research Question 1 are presented in Table 6 and Figure 5.

The data in Table 6 show the frequency and percentage distribution of themes generated from the respondents' comments during the interview on the constraints to accessing research findings in aquaculture and fisheries. Among other notable comments by respondents, the data presented in the Table above indicate that funding problems, with the highest percentage of 16.32% , are a major constraint to accessing research findings in aquaculture and fisheries, followed by inadequate technical know-how and national budgetary and support issues with a 12.25% response, lack of policy scoring 10.20%, and inadequate infrastructures for accessing research findings and practicability of research findings scoring 8.16% (Figure 6).

Research question 2: What are the constraints to applying research findings in aquaculture and fisheries by lecturers of agricultural education?

Hypothesis 2: There is no significant difference between the mean responses of male and female agricultural education lecturers on constraints to accessing research findings in aquaculture and fisheries.

Results obtained from quantitative data on Research Question 2 are presented in Table 7.

Data in Table 7 indicate that the mean scores of all 15 items range from 3.00 to 3.62, which are above 2.50 on a 4-point scale. This indicates that respondents concur that the 15 items' information restricts agricultural education lecturers' ability to apply research findings in aquaculture and fisheries. More so, standard deviations for all the items range from 324 to 0.703, which means that the responses of respondents were close to the mean and to one another in degrees of responses. In addition, the data in the table show that t-cal. values from an independent sample t-test on the mean responses of respondents range from 0.060 to 1.178, which are below ±1.96. This implies that there was no significant difference between the mean responses of male and female agricultural education lecturers on constraints to applying research findings in aquaculture and fisheries. Therefore, the null hypothesis is not rejected.

To gain a deeper understanding of the constraints to applying research findings in aquaculture and fisheries, qualitative data were also collected, mainly from 8 respondents who are professors, and categorised into different groups, using a thematic approach. Respondents responded to the optional open-ended interview questions, and all comments were coded based on the identified themes. Results obtained from qualitative data on Research Question 2 are presented in Table 8 and Figure 7.

The data presented in Table 8 above show the frequency and percentage distribution of themes generated from the respondents' comments during the interview on the constraints to applying research findings in aquaculture and fisheries. The table shows that funding and inadequate infrastructure [14.0%; 8] is the major constraints to applying research findings in aquaculture and fisheries. Other notable constraints include poor linkage between lecturers and research institutes, inadequate technical know-how and policy issues [10.53%; 6], time constraints and budgetary issues [7.02%; 4], poor motivation of lecturers and complexity of research findings [5.26%; 3], little economic benefit, adaptability, cost, and incompatibility with curriculum content and objectives [3.51%; 2], and the attitude of some lecturers [1.75%; 1] (Figure 8).

Research question 3: What are the bridge-building measures for accessing research findings in aquaculture and fisheries by lecturers of agricultural education?

Hypothesis 3: There is no significant difference between the mean responses of male and female agricultural education lecturers on bridge-building measures for accessing research findings in aquaculture and fisheries.

Results obtained from quantitative data on Research Question 3 are presented in Table 9.

Data presented in Table 9 above reveal that the mean responses of all 7 items range from 3.00 to 3.62, which are above 2.50 on a 4-point scale. This indicates that respondents concurred that the data represented by all seven items are bridge-building measures for accessing research findings in aquaculture and fisheries. More so, standard deviations for all the items range from 0.444 to 0.787, which means that the responses of respondents were close to the mean and to one another in degrees of responses. Data in the table also show that t-cal. values from an independent sample t-test on the mean responses of respondents range from 0.068 to 1.211, which are below ±1.96. This implies that there was no significant difference between the mean responses of male and female agricultural education lecturers on bridge-building measures for accessing research findings in aquaculture and fisheries. Hence, in this study, the null hypothesis is not rejected.

To gain a deeper understanding of the bridge-building measures for accessing research findings in aquaculture and fisheries, qualitative data were also collected, mainly from 8 respondents who are professors, and categorised into different groups using a thematic approach. Respondents responded to the optional open-ended interview questions, and all comments were coded based on the identified themes. Results obtained from qualitative data on Research Question 2 are presented in Table 10 and Figure 9.

Data presented in Table 10 above show the frequency and percentage distribution of themes generated from the respondents' comments during the interview on bridge-building measures for accessing research findings in aquaculture and fisheries by lecturers of agricultural education. Data indicate that five thematic bridge-building measures for accessing research findings in aquaculture and fisheries by lecturers of agricultural education based on respondent's comments include adequate funding and bridging the gap between research institutes and lecturers [22.58%; 8], adequate government budgetary allocation and support for accessing research findings [16.13%, 7], re-training of lecturers on accessing research findings [16.13%, 5], and promotion of innovative and economic benefit research findings [9.68%, 3] (Figure 10).

Research question 4: What are the bridge-building measures for applying research findings in aquaculture and fisheries by lecturers of agricultural education?

Hypothesis 4: There is no significant difference between the mean responses of male and female agricultural education lecturers on bridge-building measures for applying research findings in aquaculture and fisheries.

Results obtained from quantitative data on Research Question 4 are presented in Table 11.

Data presented in Table 11 indicate that the mean values of all the 9 items range from 3.06 to 3.75, which are above 2.50 on 4-point scale. This implies that respondents agreed that information represented by all the 7 items are bridge-building measures for accessing research findings in aquaculture and fisheries. In addition, standard deviations for all the items range from 0.482 to 0.779 which means that the responses of respondents were close to the mean and to one another in degrees of responses. Data in the Table also show that t-cal. values from independent sample t-test on the mean responses of respondents range from -1.096 to 1.093 which are below ±1.96. This implies that there was no significant difference between the mean responses of male and female Agricultural Education lecturers on bridge-building measures for applying research findings in aquaculture and fisheries. Hence, in this study, the null hypothesis is not rejected.

To gain a deeper understanding of the bridge-building measures to applying research findings in aquaculture and fisheries, qualitative data were also collected mainly from 8 respondents who are professors and categorised into different groups, using a thematic approach. Respondents responded to the optional open-ended interview questions and all comments were coded based on the identified themes. Results obtained from Qualitative Data on Research Question 3 are presented in Table 12 and Figure 11**.**

Data in Table 12 above show the frequency and percentage distribution of themes generated from the respondents' comments during the interview on bridge-building measures for applying research findings in aquaculture and fisheries by lecturers of agricultural education. The data presented in the table reveal seven thematic bridge-building measures for applying research findings in aquaculture and fisheries. These include capital investment by government and organisations and the enactment of policies for innovative research applications in aquaculture and fisheries [18.18%, 8], government budgetary allocation and bridging the gap between research institutes and lecturers [15.91%, 7], collaborative efforts and capacity building of lecturers in research applications [11.36%, 5], and curriculum integration of innovative research applications (Figure 12).

Discussion of findings

The findings of the qualitative study on research question 1 reveal 13 thematic constraints to accessing research findings in aquaculture and fisheries by agricultural education lecturers. Among other notable comments by respondents, funding issues are the major constraint to accessing research findings in aquaculture and fisheries; inadequate technical know-how; national budgetary and support issues; a lack of policy; inadequate infrastructures for accessing research findings; and the practicability of research findings, among others. Other constraints found through a quantitative study are poor promotion and information, lack of ICT competence of some lecturers, lack of ICT gadgets to access online published research findings, poor linkage of research institutes to lecturers, time constraint, lack of motivation, poor attitude of some lecturers towards accessing research findings, inability to interpret some research findings, lack of subscription of universities to published research findings, poor explanation of published technical jargon for easy understanding, and lack of open access to published research findings in aquaculture and fishery, etc. Similarly, Kleih et al.,[21] found that inconsistent information and poor access to credit are major constraints for SMEs in the aquaculture and fisheries sector. Production constraints for fed species may be categorised as either market-related (dropping market prices) or environmental (eutrophication of receiving water bodies, increasing disease incidence, and concerns about food and feed safety).[22]

In addition, 14 thematic constraints to applying research findings in aquaculture and fisheries were found in a qualitative study on research question 1. These, among others, include major funding problems, adaptability and complexity of some research findings, policy issues, time, cost, budgetary issues, incompatibility with curriculum content and objectives, and inadequate infrastructure and technical know-how for applying research findings. In corroboration, other constraints revealed by the quantitative study on research question 2 include lack of competence to demonstrate research findings, inadequate technical information to apply the research findings, inadequate infrastructures in the universities, cultural discrimination, non-availability of technical experts for guidance, high cost and complexity of application, time, inadaptability of some research findings, lack of motivation, and curriculum overload, among others. Mungkung et al.[23] found that there is minimal Open Educational Recourse content available for higher education in the aquaculture and fishing industry due to a lack of knowledge, institutional support, and technical hurdles. Other studies support this finding are Baildon and Ong, Zhao & Hou.[24,25]

Furthermore, the findings of the qualitative study on research question 3 revealed five thematic bridge-building measures for lecturers of agricultural education to access research findings in aquaculture and fisheries. These include promotion of innovative and economic-benefit research findings, proper funding, retraining of lecturers on accessing research findings, adequate government budgetary allocation and support, and bridging the gap between research institutes and lecturers. Other bridge-building measures uncovered through a quantitative study on the same research question include the provision of ICT gadgets in universities, upskilling of lecturers' ICT competence for easy access to reach findings, collaboration with technical experts on research in aquaculture and fishery, creating a special agency within universities for accessing practicable and economic benefit research findings, strengthening linkage between aquaculture and fishery research institutes and lecturers in universities, and government support in accessing research findings from public, private, and international research institutes. Vanchukhina et al.[26] and Kleih et al.[21] suggest new financial models for SMEs in the aquaculture and fisheries sector to fill the gap between traditional banking and grant-based donor finance.

Finally, there are seven thematic bridge-building measures for applying research findings in aquaculture and fisheries identified through a qualitative study on research question 4. These include collaboration in innovative research applications, capital investment by the government and organisations, capacity building of lecturers, government budgetary allocation, and enactment of policies, bridging the gap between research institutes and lecturers, and curriculum integration for innovative research applications. Bridge-building measures identified in the quantitative study on research question 4 include adequate funding to provide current aquaculture and fishery facilities for practical, lecturers attending workshop in aquaculture

and fisheries for capacity building, regular curriculum review for integration of innovative research findings into curriculum, use of resource persons from department of aquaculture and fisheries for instructional deliver, collaborative efforts of scientists, research institutes, international research organisations and producers with lecturers in applying research findings, strengthening linkage between aquaculture and fishery research institutes to lecturers in universities and regular field trips to research institutes by lecturers and students in universities among others. Fenemor et al.[27] and Larson et al.[28] found that creating complementary public and private support systems, such as loans drawn from private banking systems but backed by insurance and guarantees, can strengthen the financial portfolio of investors in mariculture.

Conclusion

The bridge-building measures for lecturers in agricultural education to access and apply research findings in aquaculture and fisheries include inadequate technical know-how, national budgetary and support issues, lack of policy, inadequate infrastructures, poor promotion and information, lack of ICT competence, poor linkage of research institutes to lecturers, time constraints, lack of motivation, poor attitude, inability to interpret some research findings, and lack of subscription of universities to published research findings. Bridge-building measures to access research findings include promotion of innovative and economic benefit research findings, proper funding, retraining of lecturers, provision of ICT gadgets, up-skilling of lecturers' ICT competence, collaboration with technical experts, creating a special agency, strengthening linkage between aquaculture and fishery research institutes to lecturers, capital investment, capacity building, government budgetary allocation, and enactment of policies, bridging the gap between research institutes and lecturers, curriculum integration, funding to provide current aquaculture and fishery facilities, capacity building, regular curriculum review, use of resource persons from department of aquaculture and fisheries for instructional deliver, collaboration efforts of scientists, research institutes, international research organisations and producers, strengthening linkage between aquaculture and fishery research institutes to lecturers, and regular field trips to research institutes.

Recommendations

Based on the findings of the study, the following recommendations were made:

a) There should be collaborative efforts by the government, scientists, research institutes, international research organisations, producers, and agricultural education lecturers in accessing and applying research findings for updated and globalised aquaculture and fisheries education in Nigerian universities.

b) The Nigerian Federal Ministry of Education, in conjunction with NUC and university authorities, should ensure that the gap between research institutes, farmers, and agricultural education lecturers is closed for timely and efficient access and integration of research findings in aquaculture and fisheries.

c) University authorities should organise workshops and seminars to retrain agricultural education lecturers on accessing and applying research findings in aquaculture and fisheries for effective instruction of farmers and prospective farmers.

d) The Federal Government of Nigeria should enact realistic policies as well as make necessary budgetary provisions that will facilitate agricultural education lecturers' accessing and applying research findings in aquaculture and fisheries for food security and globalisation.

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Conflicts of interest

The authors had no potential conflicts of interest.

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