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Analyzing the Effectiveness of Linkages in fish marketing innovation System, Mubi Zone, Nigeria

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ABSTRACT

The study examined the effectiveness of innovation system of fish marketing in Mubi Zone, Adamawa State, Nigeria. Specifically, linkages among and between actors, their perception and socio economic characteristics were examined. Data was collected from 96 respondent using structured questionnaires. This was analyzed by descriptive and inferential statistics usingpurposive and simple random sampling technique. The study revealed that about 63.54% of the respondents were male while the remaining percentages (36.46%) were female. The result shows that majority of respondent 89.52% had formal education but do not belong to any membership association and about 97.92% of the respondents strongly perceive that they will adopt and Implement new Innovations introduced to them. The result of linear regression reveals that there were significant differencesin linkages between actors. R^2 was 99.46% and F- value (17771.14), this indicate that any increase in the value of any of the significant variables will increase effectiveness of linkages which implies efficient technology transfer in the innovation system. Furthermore the coefficient of age, household size, Experience, marital status, membership of association, quantity of fish produced, and spread of innovation, were found to be significant at 1% and 5% while, level of education and quantity of fish sold were not significant. The result revealed a significant relationship at 5% level of significance ($P<0.05$) between some socio-economic characteristics of respondents and the level of linkage/interaction in fish innovation system. However, there is need for policy personnel to design policies and programs to strengthen innovative capabilities among all actors in the innovation system; create more space for public/private sector service providers to participate/collaborate with smallholder innovation networks to sustain their livelihoods and in turn create more jobs.

I. INTRODUCTION

Nigeria, like some other developing countries is principally an agrarian nation which still face an ever increasing food crisis as the level of food production is yet to keep pace with demand (Madugu, *et al*2019). There is worsening food insecurity, even with massive food importation as evidenced by rising food import bill (Okoye, *et al.*, 2008). Nigeria is one of the worst hit countries globally given her unprecedented level of acute food shortage and its accompanying ravaging malnutrition. Though endowed with vast expanse of arable land for crop production and fresh waters for fish breeding, reports still show that Africa's largest country cannot produce food crops required by her population and thus had been depending on food importation to meet her domestic demands (Adepoju and Awodunmuyila, 2008; Akinsanmi, 2009).

Agricultural innovation systems are a set of agents that jointly and/or individually contribute to the development, diffusion and use of agriculture-related new technologies which directly or indirectly influences the process of technological change in agriculture by improving its productivity (Tugrul and Ajit, 2002).This is a process showing the interaction between individuals or groups (known as actors) involved in innovation, it goes beyond the creation of knowledge to encompass factors affecting demand for and use of knowledge in useful ways (Hall *et al*.2002).

Fish is an important source of protein in developing countries. However, it is highly perishable especially in the hot climate where unsanitary environment and poor handling practices worsen the situation (Ikeme, 2006). Marketing of fresh fish passes through several market linkages and exchange points before they reach the final consumers. The marketing system and structure is one of the main circumstances of socio economic condition of the local people and production system of any area (Alam *et al.*, 2010). It is a chain of different systems involved in marketing from production to consumption with intra and inter-linkages. At various stages in the marketing chain, fish has to be processed, packed and un-packed, loaded and un-loaded to meet consumer demand. Each handling cost will not amount so much but the sum total of all loading can be significant, depending on the length of chain (Ali *et al.*, 2008).

Mubi zone is a fish production and marketing location; diverse actors are involved in fish marketing. They all relate and interact through chains that are now called links and networks; however, the kind of links and networks as well as the roles played by various actors is not well definedand not properly ascertained. Innovation system study thus helps to identify the actors involved in fish marketing, determines their roles and gives an understanding of how they (actors) interact to generate, share, transfer knowledge and adopt new ideas so as to improve marketing performance. Innovation system brings about social interaction where different actors collectively introduce a new idea or improve on an existing idea. However, in Mubi zone, such collective interaction among actors particularly in the fisheries sub-sector has not been identified, rather, focus of previous studies has been on the economic aspect of fish productivity and marketing. The central concern of this paper is that innovation systems of fish marketing warrants special attention for several reasons, first, fish play an especially very important role in Nigeria as the cheapest source of animal protein in many homes and secondly,Linkages and networking among/between actors can suggest an easy, cheaper and efficient rout for technology transfer and finally, actors in the innovation systemand the role they play can affect the Local, State and nation's economy in significant ways, hence, the need for this study.

II. Materials and methods

Study Area

The study was carried out in Mubi Zone which comprises of five (5) Local Government Areas LGAs namely: (Madagali, Michika, Mubi North, Mubi South and Maiha).The zone liesbetween latitudes 9^{o} 00' N to 11^{o} 00' N of the equator and longitudes 13° 00' E to 14°00'E of the green which meridian, it has a total land mass of 506.4Km^2 and a population size of 682,026 persons (Census 2006). Mubi Zone is bounded with Borno State in the north, in west by Hong and Song LGA and in the east by the republic of Cameroon. The zone has a tropical

climate which is determined by the movement of the Inter Tropical Convergence Zone (ITCZ), as well as the effect of relief (Ray, 2017). Rainfall begins in April, progressing and reaching its peak in July/August and stops most of the time in October. Average annual rainfall ranges between 998 mm and 1,262 mm. The areas just below the Mandara Mountains record the highest rains. Rainfall intensity is high with rainy days making up to 87 % of the days with more than 20 mm of rainfall. Various rivers and lakes are found in the zone and neighboring Cameroon which makes fishing a livelihood activity one of the prominent is river yadzeram (Ray, 2017).

Sources of Data

The study obtained data from primary sourceswhich were collected with the use of pre-tested and structured questionnaire administered to respondents in the study area.

Sampling Technique

Purposive and random sampling technique was adopted for this study. Only fish rearers/breeders (in ponds because artisanal fishing was restricted due to insurgency) and marketers were selected for the study from the five (5) LGAs. But the major areas of concentration were Mubi North, South, and Maiha because of their relative importance in fishproduction and marketing. Furthermore, major fish production and marketing activity in Madagali and Michika hinterlands has been brought to a standstill due to the boko haram insurgency. In stage one,3 LGAs were purposively selected, in stage two, only fish producers and marketers were selected from the sampling frame in proportion to LGA size while stage 3 involved the simple random distribution of 100 questionnaires for the study of which only 96 were returned for analysis.

Analytical technique

Descriptive and inferential statistics were the analytical tools adopted for the study. The descriptive statistics used include mean, frequencies and percentages these were used in the analysis of the socio economic status of respondents while inferential statistics used was the ordinary least square (OLS)regression analysiswhich was used in the examination of linkages/interactions among actors in the innovation system.

The Regressionfunction is given by:

$Y = f(X_l, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, \ldots\ldots Xn)$.

Where;
Y = Spread of innovation (frequency of interaction in Numbers)
X_1 = Age (in years)
X_2 = Level of education (in years)
X_3 = Experience (in years)
X_4 = Marital status
X_5= Household size
X_6 = Quantity of fish sold (Kg)
X_7= Quantity of fish produced (Kg)
X_8 = Membership in association
X_9 = Average income (₦)

The equations of the functional forms are specified as follows:

Linear:

$Y = bo + b_1X_1 + b_2X_2 + b_3X_3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + b_9X_9 + e\ldots\ldots(1)$

Semi-log:

$LogY = logbo + b_1logXi + b_2logX_2 + b_2 \log X_3\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + b_9 \log X_9 + loge \ldots(2)$

Exponential log:

$LogY=bo+b_1X_1+b_2X_2+b_3X_3+\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots+b_9X_9+loge\ldots\ldots\ldots\ldots(3)$

Double-log:

$LogY= \log bo + bi \log Xi + b_2 \log X_2 + b_3 \log X_3 + + b_9 \log X_9 + loge \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$

Criteria used for selecting the lead equation was based on the apriori expected economic criteria for the signs of coefficients, significance and size of coefficients of multiple determinations (R^2) as well as F and t- ratios. Age, educational status, experience, size of household, quantity of fish produced, volume of fish sold, membership in association and average income were expected to be positive and thus positively influence frequency of interaction or networking.

III. RESULTS AND DISCUSSION

Socio Economic Characteristics of Respondents

Age of Respondents

The results presented in Table 1 shows the age distribution of respondents in the study area. The results showed that about 33.33%, of respondents were within the age range of 41-50 years, while those at the range of 31-40 years had 29.17%, and those ranging's from 21-30 years had 28.13%. Implication of these findings is that large proportions of the respondents were adults and can adequately be regarded as active, agile, and physically disposed to networking activities. Age is very important in agricultural production activities because age has a significant influence on the decision making process of farmers with respect to adoption of improved farming technologies and other production-related decisions. This findings supports by Olaye *et al*. (2009) and Ya aishe *et al*. (2009) who revealed that majority of the sampled farmers in their study were within the productive age of between 21 and 50 years. It is also is in line with the study of Nwabueze and Nwabueze, (2010) who reported that majority of the sampled farmers in their study were within the productive age of between 41 and 60 years.

Sex of respondents

There is disparity on gender in fish networking activity. The result in table 1 shows that about (63.54%) of the respondents were males while the remaining percentages (36.46%) were females, implying that males dominate the fish innovation system in the zone.This is contrary to the findings of Madugu and Edward, (2011) who observed that there was a 50-50 percentage participation of male to female in fish chain distribution of Adamawa State, This disparity might not be far from the insurgency which forced lots of residents to relocate and others to abandon their livelihoods.

Marital Status

The marital profile of the farmers in Table 1 shows that the majority of respondentswere married (62.5%), next is the singles (23.96%), and widowed (10.42%), the lest were the divorced (2.08%). Implying that married people are more responsible and might want to remain in the business to sustain their households. This is in line with (Afolabi, 2009), he opined that actors fish marketing are dominated by married people (56.67%). In another study by Kainga and Adeyemo, (2012), further showed that fish marketers were dominated by married people (69%), while single and divorced people were 14% each.

Household Size

The results reveals that about 25% of actors had household size of ≤ 5, 44.79% had household size between 6-10, 26.04% had household range of 11-16 members and about 1.04% had a size of ≥ 21 persons respectively. The implication of this is that, the larger the household size the better the innovation efficiency, ie networking and technology transfer will be greater among household members. Further, house hold members may help in providing some functions at a reduce cost which is an incentive to an efficient innovation system. This agrees

with the study of (Eze *et al.*, 2010)who found that household size affects efficiency since there may be synergies from larger household size in both production and consumption.

Years of Marketing Experience

Table 1 indicated that the majority of respondents (38.54%) had experience between 6-10 years, followed by 29.17% with experience of ≤ 5years, and the lowest percentage were those with experience of ≥ 16years. These results implied that actors had good experience in the innovation system. This finding was in line with the study of Madugu and Edward, (2011) who revealed that the level of experience of fish marketers in Adamawa State varies considerable from 35% for <10years, 30% for 11-20years, 28.75% for 21-30years and 6.25% for >30years respectively..

Educational level of Respondent

The result indicates that about 10.42% of the actors had access to informal education, 4.17% had primary education, 31.25% had secondary education, and about 54.17% had tertiary level education respectively. This implies that the educational level of the producers in the study area is high. The level of education is believed to influence the use of improved technology in agriculture businesses and, hence interaction, networking and linkage. The level of education determines the level of opportunities available to improve livelihood strategies, enhance food security, and reduce the level of poverty. It affects the level of exposure to new ideas and managerial capacity in production and the perception of the household members on how to adopt and integrate innovations into the household's survival strategies. This study is in agreement with that of Madugu, (2017) who observed that the level of education was highly significant and a major determinant of effectiveness of linkages in an innovation system. Omotosho and Falola, (2009) in their study also noted that level of education influenced farmers‟ adoption of 39 different agricultural innovations and decision on various aspects of farming.

Table 1: Distribution of Socio-Economic Status of the Respondents

Variable	Frequency	Percentage (%)
Age of Respondent		
21-30	27	28.13
31-40	28	29.17
41-50	32	33.33
≥ 51	9	9.38
Total:	**96**	**100**
Sex of Respondent		
Male	61	63.54
Female	35	36.46
Total:	**96**	**100**
Marital Status		
Single	23	23.96
Married	61	62.52
Divorced	2	2.08
Widowed	10	10.42
Total:	**96**	**100**
Household Size		
≤ 5	24	25
6-10	43	44.79
11-15	25	26.04
16-20	3	3.13

≥ 21	1	1.04
Total:	**96**	**100**
Years of Experience		
≤ 5	28	29.17
6-10	37	38.54
11-15	21	21.88
≥ 16	10	10.42
Total:	**96**	**100**
Educational level of Respondent		
Informal Education	10	10.42
Primary School	4	4.17
Secondary School	30	31.25
Tertiary Education	52	54.17
Total:	**96**	**100**

Source: Field Survey, 2019.

Effectiveness of Linkages/Interaction among Actors in the innovation system

The perception of respondents with regard to effectiveness of linkages/interaction as measured by the indicators presented in Table 2. The pre-determined a prior mean range: 1.0-1.9 = low, 2.0-2.4 = moderate and 2.5 and above = high. The result reveals a very high respondents perception on Credit Loan Provision (13.82%), Technology Exchange (12.29%), Network Ties (11.89%), Provision of Market Outlet (10.29), Information Transfer (24.44%), which were ranked 1st to 5th respectively, all having a mean X=2.5 and above which signifies a high effectiveness level. This implies that these indicators were the most important determinant of linkage/interaction among the respondents. Other indicators such as Access to Market (16.73%), Access to Information (22.22%) and Information Generation (28.89%) Financial Assistance (13.34%), Collaboration (18.96%) were ranked 6th to 10th respectively all having a mean between X=2.0-2.4. This implies that such indicators had a moderate influence on interaction/linkages between respondents. The implication is that, these indicators donot significantly influence linkages/interaction among the actors. It further implies that they had an average effect on Linkage/Interaction among actors in the system. This study is in line with the study of Coulon, (2005) on social network analysis in innovation research, he observed that linkages among actors in exchanging relevant information were effective, their interaction were close (above 50%) leading to denser networks and eventual adoption of the technology transferred. Implying that respondents may be innovators or majority leaders based on the information benefits available to them, furthermore, Madugu, (2017) also had a similar result in cattle marketing innovation system of Adamawa State.

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Linkage Indicator	High = Very Often		Moderate = Often		Low = Less Often		Mean (X)	Rank
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage		
Credit Loan Provision	00	00	10	3.72	86	13.82	2.90e	1st
Technology Exchange	00	00	19	7.06	76	12.29	2.77e	2nd
Network Ties	01	2.22	21	7.80	74	11.89	2.76e	3rd
Provision of Market Outlet	04	8.89	18	6.69	64	10.29	2.63e	4th
Information Transfer	11	24.44	25	9.29	60	9.25	2.51e	5th
Access to Market	04	8.89	45	16.73	47	7.5	2.45e	6th
Access to Information	10	22.22	33	12.27	53	8.25	2.45e	7th
Information Generation	13	28.89	34	12.64	49	7.88	2.38e	8th
Financial Assistance	00	00	13	4.83	66	13.34	2.286e	9th
Collaboration	15	33.33	51	18.96	30	4.82	2.16e	10th
Mean Overall 2.39e								

Table 2: Distribution of Effectiveness of Linkages among Fish Marketers in Innovation System

Source: Field Survey, 2019.

Percentage are based on multiple responses

*: Mean ≥ 2.0 are significant

e: Effective

ne: Non-effective

Relationship between Socio-Economic Characteristics of Marketers and Effectiveness of Linkages/Interaction among Actors

The result of the regression analysis presented in Table 2 shows that 99.46% of variation on the linkage/interaction level of marketers with other major actors toward fish innovation system could be explained by the explanatory variables in the equation. Furthermore, seven out of nine explanatory variables were found to contribute significantly to the predictor variables, which were age, level of education, household size, marital status, and membership of association, quantity of fish produced and spread of innovation. This implies that age, level of education, household size, marital status, membership of association, and quantity of fish produced and spread of innovationof fish marketers made significant contribution to the level of linkage/interaction among fish marketers in the innovation system. The overall regression result showed that there is a significant relationship F=17771.14 (P<0.000) between some socio-economic characteristics of the farmersand the level of linkage/interaction in fish innovation system.

The coefficient of age was positive and significant at 1%level; the value of the coefficient was .0014359 indicating that 1% increase in age will lead to increase in effective linkage by .0014359. Also, the coefficient of level of education of the respondents (.0859306)was found to be positive and not significant. This implies that the absence of level of education in innovation system may not have significant effect on effectiveness of linkages/interaction of actors in the innovation system. The coefficient of experience of respondents (.3231595) was found to be positive and significant at 1% level. This implies that 1% increase in years of experience in fish marketing will increase effectiveness of linkages/interaction between respondents by the value of the coefficient. It signifies that respondents will have more and better ideas to share with the other actors in the system, by doing so might positively influence the decision of other actors to adopt new or upgraded technology that will improve the entire innovation system of fish marketing.

The result reveals that the coefficient of marital status of respondents (.0218189) was found to be positive and significant at 1% level. This implies that the effectives of linkages/interaction increase by the value equal to that of the coefficient as marital status of the respondent increase by 1%.this may be due to the fact that married men are assumed to be more responsible thus more effective in fish marketing in the zone.

The result also reveals that coefficient of household size of respondents (.5296172) was found positive and significant at 1% level; this means that with 1% increase in household size, there will be an increase in effectiveness of linkages by a value equivalent to the coefficient. The implication is that household members will have a favourable attitude to words collaboration and ease of exchange of information with other actors in the innovation system.

Furthermore, the result revealed that coefficient of Quantity of fish produced (.0024237) was found to be positive and significant at 1%level. It was also observed that the result the coefficient of membership in association was found to be positive (.0196453) and significant at 1% level. The result also reveals that coefficient of Spread of innovation was positive and significant at 1% level. The value of the coefficient was (.0517026) indicating that with 5% unit increase in the Spread of innovation, there will be increase in effective linkages equivalent to the value of coefficient among respondents in the innovation system.

Based on the finding study which revealed that all variables included in the model were positive and significant at 1% and 5% level except for X_2 (level of education) and X_6 (quantity of fish sold). It was concluded that there is a positive and significant relationship between fish marketer's socio economics characteristics and effectiveness of linkages among them. Therefore, null hypothesis which states that there is no significant relationship between socio economics characteristics of fish marketers and effectiveness Linkages/Interaction among Actors was rejected.

The coefficient of multiple determination R^2 was found to be 0.9946, implying that 99.46% of the variation of effectiveness of linkages was accounted for by age, level of education, experience, marital status, household size, quantity of fish sold, quantity of fish produced, membership in association and spread of innovation of the respondents while the remaining 0.54% is accounted for variables not included in the model. This finding is in line with that of Madugu and Edward, (2011) who observed that age, marital status, household size and experience were all positive and significant at various level with a high R^2 (63.8%) in relationship between smoked and dried fish distribution and marketing in Adamawa State.

Table 3: Socio-Economic Determinants of Marketers and Effectiveness of Linkages/Interaction among Actors

Variables	Coefficient	Standard Error	t-value	P>|t|
Age (in years) (X_1)	.0014359	.0002893	4.96***	0.000
Level of education (X_2)	.0859306	.1482037	0.58ns	0.564
Experience (X_3)	.3231595	.1133781	2.85***	0.006
Marital status (X_4)	.0218189	.0087973	2.48***	0.016
Household size (X_5)	.5296172	.0825907	6.41***	0.000
Quantity of fish sold (X_6)	.132323	.1607414	0.82ns	0.413
Quantity of fish produced (X_7)	.0024237	.0003402	7.12***	0.000
Membership in association (X_8)	.0196453	.0093678	2.10***	0.039
Spread of innovation (X_9)	.0517026	.028394	1.82**	0.072
Constant	3.731246	.3759521	9.92***	0.000
R^2	99.46%			
F- value	17771.140.000*			

Source: Field Survey, 2019.

***: Significant at 1% level
**: Significant at 5% level
Significant at P<0.05%

IV. CONCLUSION AND RECOMMENDATIONS

The study concluded that there is a low interaction between providers of credit loan provision, technology exchange, network ties and financial assistance in fish innovation system of the zone and there is a significant relationship at 5% level of significant (P<0.05) between some socio-economic characteristics of the farmers and the level of linkage/interaction in fish innovation system. Therefore, there is need for policy personnel to design

policies and programs to strengthen innovative capabilities among all actors in the innovation system; create more space for public/privatesector service providers to participate/collaboratewith smallholder innovation networks. Also, the Government should focus more on small holder innovators to sustain their livelihoods and create more jobs.

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