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EFFECTS OF SOCIO-ECONOMIC CHARACTERISTICS OF PASTORALISTS IN ENHANCING TECHNOLOGICAL INNOVATION FOR LIVESTOCK PRODUCTION IN KACHIA AND BOBI GRAZING RESERVES, NIGERIA

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ABSTRACT
The study on the effects of socio-economic characteristics of pastoralists on enhancing technological innovation for livestock production was conducted in Kachia and Bobi grazing reserves, Nigeria. Two grazing reserves Bobi in Niger State and Kachia in Kaduna State were purposively selected and 260 pastoralists were randomly selected for both qualitative and quantitative data collection. Data collected were analyzed using descriptive and inferential (logistic regression) statistics. Results showed that pastoralists in the age bracket of 31-40 years (46.54%) were the majority in the grazing reserves. In terms of years of experience in grazing those with over 15 years of grazing experiences were the majority (75.77%). Attributes such as characteristics of the technologies promoted, their relative advantage, *triability* and *observability* had influence on the technological innovation among the pastoralists. Results on logit regression showed that age of pastoralist in Kachia grazing reserve had played a significant role in enhancing technological innovation in milk production, feed conservation and feed supplementation, at 5% levels and had given a good platform for the growth of dairy cooperative federation. While experience in livestock production had greatly influence adoption in deworming of livestock practice, fodder bank, feed conservation, crop process, vaccination of poultry and routine annual vaccination of ruminants against CRPP, Rinderpest and PPR. Household size had also greatly and positively influenced the technological innovation of fattening, poultry vaccination, cooperative, feed conservation and milk production, activities, in the grazing reserves. The study therefore, recommends that age, experience in livestock production among others should be considered in enhancing technological innovation of livestock production technologies in the grazing reserves.

Keywords: Adoption, Livestock, Pastoralist, Socio-economics, Technological innovation.

INTRODUCTION
Pastoralists are people who lived mostly in dry areas; their livelihoods depend on their intimate knowledge of the surrounding ecosystem and the productivity of their livestock. Pastoralist derived more than 50% of their income from livestock and livestock products, (International Fund for Agricultural Development [IFAD], 2014). Today, there are nearly 200 million pastoralists in the world, generating income where conventional farming is limited or not possible (IFAD, 2014). However, pastoral communities are marginalized and generally not given due consideration in the wider social-political analysis, although the livelihood of these communities is vulnerable to climate change, shifting global markets, population growth and increase competition for land and other natural resources, pastoralism remains a viable natural resource management system (IFAD, 2014). Pastoralist usually lives in areas that are rural and remote so as to be able to access pasture and water for their animals. This trend had resulted in

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the marginalization as no one seems to remember them in socioeconomic activities that affect them. It is worth mentioning that pastoralism, is concerned with the production of milk and yoghurt, cheese and beef and other products yet the major players in this sector are not accorded the required attention (IFAD, 2014). Grazing reserves are tracts of land set aside by government for use by pastoralists to hold and graze their cattle (Chin-Fook, 2014). In the last 20 years the Nigerian government policy has been centered on the establishment of grazing reserves in cattle producing areas with the objective of providing livestock owners with legal grazing rights and title to land as a response to the increase pressure on traditional grazing lands by arable crop farmers.

Establishment of grazing reserves encourages livestock owners to settle within the reserves, with the hope that they would enjoy access to veterinary and extension services that will lead to increase livestock productivity (Fayinka, 1982 in Moses, 1987). There are several reasons for the settling of Nigeria's livestock owners, it is estimated that traditional livestock owners control over 90% of the total national herd, but have no right to land, the movement of herds further limits their access to health facilities and the government's inability to institute an improved management of traditional livestock owners which had further disfranchise them as they do not participate in political decision making process, that affects them. The main objective of the study was to assess the effects of socio-economic characteristics of pastoralists in enhancing technological innovations for livestock production in Bobi and Kachia grazing reserves. The specific objectives of the study were to:

i. determine factors that may have influenced the adoption of these technologies,
ii. assess the attributes for the use of technological innovations in livestock production and
iii. assess the effects of socio-economic characteristics of pastoralists on technological innovation.

MATERIALS AND METHODS

The Study Area

The study area comprises of the Bobi grazing reserve (Niger State) and Kachia grazing reserve (Kaduna State)**.** Niger State is located in North Central Nigeria with an estimated population of 2,000,000 and a land area of about 6784km^2 (NPC, 2006). The Capital Minna is on latitude 9^0 and 37^0 North and longitude 6^0 and 33^0 East. It has an annual rainfall of about 1300 mm with highest in September and last in April to October (Weather Station records of the Federal University of Technology, Minna, 2014). Kaduna State is situated in slightly thick modern vegetation in the Northern Guinea Savannah agro-ecological zone of Nigeria located between latitude 10^0 N and 31^{0}N and longitude 6^{0}E. The State covers a land area of 46053 km^2 and estimated population of about 6,066,562 (NPC, 2006). The climate is tropical dry climate with uni-modal rain fall with peak rainfall in July to September with high humidity during the dry season (KARDA, 2015).

Sampling Procedure

There are 415 grazing reserve across 20 States and FCT in Nigeria. Among this number, only 141 grazing reserves had been gazette and at various stages of development (NLPD, 2000). Multistage sampling technique was employed to select the respondents for data collection. At stage 1, two grazing reserves were purposively selected based on the nature of the establishment and development activities. Kachia was established in 1965 and currently the most successful in terms of Dairy Cooperative Development in the country. Among the second generation grazing reserve, Bobi was selected and is the biggest in land area and located along

the major stock routes that linked the North with central and southwestern Nigeria where most seasonal migration occur. The reserve serves as a rest point for transhumant pastoralist during the peak and end rainy season when searching for feed and water. As presented in Table 1 and Table 2, the second stage involved random selection respondents from both settlement blocks and enclaves. In each settlement block, 10 respondents were randomly selected for questionnaire administration (Bobi grazing reserve) and 10 farmers were selected, however one did not return given a total 79. From the two grazing reserve, 79 and 98 respondents were randomly selected for questionnaire administration, making a total of 177 respondents from both settlement blocks (farmers and dairy cooperative association and enclaves). The respondents selected for key informant interview were 13; one each from the seven blocks in Bobi and six blocks in Kachia. The respondents (60) were selected for the focus group discussion with 30 each from the two grazing reserves making a total of 260 respondents.

Table 1: Population of Pastoralist in Grazing Reserve Enclaves and Settlement Blocks in the Study Area

Grazing Reserves	Settlement Blocks	Enclaves	Total
Bobi	250	300	550
Kachia	8,000	5,000	13,000
Total population			**13,550**

Table 2: Sample Size of the Pastoralists and Farmers in Bobi and Kachia Grazing Reserves

Grazing Reserve	Pastoralist in (settlement blocks)	Farmers in (enclave)	Total
Bobi	84	16	100
Kachia	73	16	87
Total respondents	157	32	**187**

Method of Data Collection

Primary data (quantitative and qualitative) were collected by means of a well-structured pre-tested questionnaire, and Focus Group Discussion (FGD), Oral Interview, respectively. The questionnaires were administered by the researcher and trained enumerators, while oral interview and FGD was conducted/facilitated by the researcher.

Analytical Techniques

Logistic regression and inference

The factors that may influence pastoralist adoption of technology were grouped into: Dependent variable (livestock Technologies, e.g., deworming, fooder Bank, feed conservation, crup process, fattening, vaccination, milk production, dry season. The independent variable, e.g., age, sex, household size, educational level, grazing area, access to extension, livestock rearing, experience.

The factors that may influence adoption from the aspect of the production technologies introduced to pastoralist were categorized as: dependent variable (livestock technologies) and independent variables (relative advantage of technology), e.g., compatibility, complexity, *triability* and *observability*.

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Logit model is more commonly used (Amemiya, 1981). Among these Logit models is the Univariate binary model which is defined as:

$P.(Y_i = 1) = (X_i = B_o)$, i = 1,2,…n. …(1)

where;
Y_i = sequence of dependent binary random variables taking the values of 1or 0;
X_i = k-vector of known constants;
B_o = k-vector of unknown parameters;
f = a certain known function.

The functional forms of Logit model most frequently used applications are as follows (Amemiya, 1981).

$f(x) = 2(x) = 1t^{e}r$ …(2)

The linear probability model has a defect because f is not a proper distribution function as it is not constructed to lie between 0 and 1. A major justification of a Logit method is that the logistic distribution function is similar to normal distribution function, but has much simpler form (Amemiya, 1981).

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

Socio-economic characteristics as presented in Table 3 indicated that approximately 46.54% of the pastoralist were aged between 31-40 years, and age of these group indicated that the active population are engaged in raising livestock and contribute to the decision making process of the household. While those respondents within the range of 21-30 years (12.3%) are the youth, capable of conducting more tedious livestock activities, by complementing the lowest age 18-20 years 4.62% youth who are active and capable of more tedious and long-distance walk to graze animals. The major pastoralist transhumant movement is conducted by this group moving from one area to another in search for feed and water, findings during FGD and KII had showed that this movement during the dry season is conducted by younger members and had significant impact on adoption of technologies.

The results further showed that years of experience in raising livestock ranged between 1-15 years (75.77%) were the majority of the pastoralist and adopt various technologies that are targeted towards improved livestock productivity, this is in consonance with Dehinenet *et al.* (2014) who in a study on factors that influence adoption of diary technologies on small holder dairy farmers view farming and livestock rearing experience as a continuous variable measured in years and hypothesized that there was a direct relationship between farmers' experience and adoption of technologies. Their studies revealed that farmers with high experience adopted the diary technology because they were getting more information about the diary technologies through different ways. The studies further showed that the total land holding of respondents in the two grazing reserves officially allocated was ten hectares (10ha) of land for fodder bank, grazing and arable crop farming which had proved insufficient. Majority of respondents' (41.54%) maintained the allocation of land to them while 34.23% and 24.23% had moved either outside reserve or within reserve to increase their land holdings (constituting an internal encroachment) or outside the grazing reserve to have more cropping land for cash crops to increase household farming activities. These groups with large land holdings had more crop bye-products and are found to keep large numbers of livestock.

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Table 3: Socio-economic Characteristics of Pastoralist and farmers in the Study Area

Characteristics	Frequency	Percentage
Age		
< 20 years	12	4.62
21-30 years	32	12.31
31-40 years	120	46.54
41-50 years	32	12.31
> 50 years	64	24.62
Household Size		
2-10	45	17.31
11-15	18	6.92
> 15	197	75.76
Years of experience to raising livestock		
1-10	45	17.31
11-15	18	6.92
> 15	197	75.77
Total land holding(ha) within reserve		
5-10 ha	108	41.54
Total land hold outside the reserve 10-20 ha	89	34.23
Fodder Bank		
4 ha	237	91.15
4-10 ha	13	8.85
Land for crop farming within and outside the G.R		
5-10 ha	191	73.46
11-20 ha	63	24.23
20-30 ha	6	2.31
Grazing Area within reserve		
2-4 ha	191	73.46
5-7 ha	63	24.23
8-10 ha	6	2.31
Number of livestock owned in household		
< 20	30	11.54
21-30	70	26.92
31-40	19	7.31
41-50	37	14.23
> 50	104	40

Source: Field survey, 2017

Table 4: Socio-economic Characteristics of Pastoralist and farmers in the Study Area **Cont'd**

Characteristics	**Frequency**	**Percentage**
Male	248	95.4
Female	12	4.6
Marital status		
Married	227	86.3
Widow	30	11.5
Single	3	1.2
Head of house hold		
Male	227	86.3
Female	33	12.7
Educational attainment		
Primary	55	21.15
Secondary	27	10.38
Vocational	1	0.38
Qur'anic	23	8.85
Basic literacy	154	59.23
Contact with extension agent		
Yes	260	100
Extension messages		
Livestock	30	11.54
Crop	33	12.69
Combination	197	75.78
Extent of extension contact or visit		
Seasonally	70	26.92
Once a year	190	73.08

Source: Field survey, 2017

Table 4 showed that 248 (over 95%) of pastoralist and farmers were male, while about five percent were female; this is not surprising because males have more role to play in livestock production than female. The females are the major actors in processing and marketing of milk and milk products. The majority of male members who were married and more educated had an advantage of increased investment in the utilization of improved technologies, this is in line with Agwu *et al.* (2008) in a study reported that farmers who are more educated, more matured and have some level of education and have large household size are more innovative therefore have more potentials to adopt technologies. The study revealed that the majority of respondents (59%) had basic literacy in the study area as a result of intervention from government and non-governmental organizations as well as religious bodies which could be responsible for their innovativeness. The level of education had influence pastoralist and farmers to be more responsive to extension programmes and policies as Agwu (2008) reported that increase in education of farmers and extension activities has positive influence on adoption of innovation. All (100%) pastoralist and farmers had contact with various extension agencies (government, non-governmental, input dealers, faith based, through one form of activity or another household with more extension contact which widens their knowledge which had led to the use of technological innovations on livestock production. Sime *et al.* (2014) studied determinants of Artificial Insemination (AI) use by small holder dairy farmers and reported

that extension contact as a variable shows an effect in each model of analysis and were statistically significant in increasing the probability of adoption. Marginal effect analysis indicated that for each additional extension visit a farmer received, the probability of using technology was higher by six-point seven four percent (6.74%). Extension as a source of agricultural information has been reported to increase adoption and use of new agricultural technologies as (Feder, *et.al* 1985 in Sime *et al.* (2014) reported. Extension contact determines the information that farmers obtained on production activities and another cattle breeding programmes. The finding also agrees with the findings of Idris *et.al* 2012 and Sime *et al.* (2014) that effective extension enhance technology adoption.

Attributes for the Use of Technological Innovations in the Livestock Production

The results of Logit Regression that indicated the attributes (relative advantage of technology over existing practice, compatability with existing practice of pastoralists, complexity of the technologies, *triability* and *observability* of new technologies) for the use of technological innovations. The results of Table 5 had showed that relative advantage as an attribute had at 10% level of significance influenced the use of technological innovations such as Routine Deworming, fodder Bank, Bull fattening, poultry and ruminants' vaccinations which the pastoralists consider risk free and can be tried, and was compatible with need of the animals. However, feed conservation and crop process that had very low adoption rate and were considered as capital intensive and pastoralist production ways and transhuman nature. Rogers (2003) considered attributes of innovation as independent variables that explained the variance of dependent variables which is measured in the recent past (adoption) and the independent, which is measured in the present. Compatibility of technology as an attribute had positively influence the use of these technologies in the reserve.

The pastoralist by their nature consider the existing practice (Indigenous knowledge) and practices before agreeing to new innovations therefore technologies that are compatible with existing practice had potential for adoption, this is in agreement with Dahinenet *et al* (2014) in a study on dairy technology adoption found that the attributes of technology (compatibility) socio-economic characteristics of farmers influence adoption of dairy technologies also the result is in consonance with the findings of Washington *et al.* (2012) that reported on impact of technology adoption on small-holder farmers in Sub-Saharan Africa described factors that influence adoption of technologies to include compatibility with existing practices, assets, and vulnerability factors, level of exposure, risky nature of technology and institutional factors, this were inconsonance with the pastoralist adoption of those technologies they view as safe and compatible with existing practices that are sponsored by extension activities.

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Table 5: Attributes for the Use of Technological Innovations in the Livestock Production

Technology Attributes	**Relative advantage**		**Compatibility**		**Complexity**		***Triability***		***Observability***	
	β	**Sig.**	**β**	**Sig.**	**β**	**Sig.**	**β**	**Sig.**	**β**	**Sig.**
Routine Deworming	0.128	0.813*	0.992	0.079***	0.370	0.485*	1.216	0.076***	18.75	1.00*
Concept of fodder bank	0.128	0.813*	0.992	0.079***	0.370	0.485*	1.216	0.076***	18.746	1.00*
Feed conservation techniques	16.473	0.998*	2.001	0.038**	-36.719	0.997*	18.362	0.998*	-1.138	1.00*
Crop process for feed utilization in the dry season	16.504	0.998*	1.938	0.044**	-36.835	0.997*	18.362	0.998*	-1.138	1.00*
Bull, Ram, Buck fattening	0.128	0.813*	0.992	0.079***	0.370	0.485*	1.216	0.076***	18.746	1.00*
Vaccination of poultry	0.128	0.813*	0.992	0.079***	0.370	0.485*	1.216	0.076***	18.746	1.00*
Annual ruminant vaccination (CBPP, PPR)	0.128	0.813*	0.992	0.079***	0.370	0.485*	1.216	0.076***	18.746	1.00*
Hygienic Milk production	16.504	0.998*	1.938	0.044**	-36.635	0.997*	18.362	0.998*	-1.138	1.00*
Dry season feed conservation and supplementation	16.504	0.998*	1.938	0.044**	-36.635	0.997*	18.362	0.998*	-1.138	1.00*
Use of milk churner	16.504	0.998*	1.938	0.044**	-36.635	0.997*	18.362	0.998*	-1.138	1.00*

Note*:* *** = 10%; ** = 5% and * = 1% level significance.
Source: Field survey, 2016

Factors Influencing the Pastoralist Adoption of Livestock Production Technologies

Logit regression results of pastoralists and farmers in enclave that may have influence the use of technological innovations (age, sex, educational level, household size, experience in livestock keeping, land Size, contact with Extension Personnel) were also computed. Table 6 showed that age of pastoralist in Kachia grazing reserve had played a significant role in the adoption of technologies in milk production, feed conservation and feed supplementation and had given a good platform for the growth of dairy cooperative federation. While experience in livestock production had greatly influence adoption in Deworming of livestock practice, fodder

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bank, feed conservation, crop process, vaccination of poultry and routine annual vaccination of ruminants against CRPP, Rinderpest and PPR.

The household size had greatly and positively influenced adoption of fattening, poultry vaccination, cooperative, feed conservation and milk production, activities, in the grazing reserves. These findings were inconsonance with Dehinenet *et al.* (2014) who found out that the adoption of new innovation in dairy has positive association with farmers' level of education, experience; household income and size, while Ameluku *et al.* (2012) in Dehinenet *et al.* (2014) reported that adoption of dairy technologies increased were by 43 percent based on extension contact. The results of the study also showed that educational level in Kachia grazing reserve and extension had influence level of adoption of technologies which is inconsonance with the findings of Gebremedhin and Ahmed (2003) who reported on the determinants of adoption of improved forage technologies in crop-livestock mixed system and found out that household income and resources endowment, educational level of household head had encouraged adoption while poor household that are more risk averse or lack resource to adopt new innovation had led to lower adoption while age, gender and other non-farm activities had no significant relationship with adoption. Sonja (2007) considered age, education of household, contact with extension as significant attributes and predictors to innovativeness of farmers, as household receives education, the innovations index of household increases.

Table 6: Factors Influencing the Pastoralist Adoption of Livestock Production Technologies

Variable	Age		Sex		Education		Household size		Experience in Livestock		Land size		Extension Contacts	
	β	Sig.	β	Sig.	β	Sig.	β	Sig.	β	Sig.		Sig.	β	Sig.
Dew	-0.064	0.132*	21.979	0.999*	0.148	0.254*	-0.02	0.960*	0.65	0.0560**	0.14	0.999*	10.631	0.999*
FB	-0.064	0.132*	21.979	0.999*	0.148	0.254*	-0.02	0.960*	0.65	0.056**	0.14	0.637*	10.631	0.999*
FC	-0.213	0.59*	-16.368	0.999*	0.228	0.461*	0.217	0.42*	0.096	0.193*	0.011	0.796*	9.601	0.999*
CP	-0.213	0.59*	-16.368	0.999*	0.228	0.0461*	0.217	0.042*	0.096	0.193*	0.011	0.796*	9.108	0.999*
Fatt	-0.064	0.132*	21.979	0.999*	0.148	0.254*	-0.002	0.960*	0.065	0.056**	0.014	0.637*	10.631	0.999*
PV	-0.064	0.132*	21.979	0.999*	0.148	0.254*	-0.002	0.960*	0.065	0.056**	0.014	0.637*	10.631	0.999*
LRC	-0.064	0.132*	21.979	0.999*	0.148	0.254*	-0.002	0.960*	0.065	0.056**	0.014	0.637*	10.631	0.999*
HMP	0.213	0.059**	-16.368	0.999*	0.228	0.461*	0.217	0.042*	0.096	0.193*	0.011	0.796*	9.108	0.999*
DFC	0.213	0.059**	-16.368	0.999*	0.228	0.461*	0.217	0.042*	0.096	0.193*	0.011	0.796*	9.108	0.999*
UM	0.213	0.059**	-16.368	0.999*	0.228	0.461*	0.217	0.042*	0.096	0.193*	0.011	0.796*	9.108	0.999*

Note: ***10%; ** 5%; and * 1% level significance. Dew = Deworming, FB = Fodder Bank, FC = Feed conservation, CP = Crop process, Fatt = Fattening, PV = Poultry Vaccination, LRC = Ruminant Vaccination (CBPP; PPR), HMP = Hygienic Milk production, DFC = Dry season feed Conservation and supplementation, UM = Use of milk churner.

Source: Field survey, 2016

CONCLUSION AND RECOMMENDATIONS

From the study, it was established that a number of livestock production technologies had been disseminated in the grazing reserves. The technologies disseminated were targeted at

improving the productivity of the pastoralists. Adoption of livestock technologies in the reserves had integrated new innovations with the existing indigenous knowledge of pastoralist that resulted in increased productivity of livestock. Through diffusion of innovation process, enclave farmers had benefitted from technologies extended in the grazing reserve, however dwindling extension activities and other challenges are eroding the significant gain made by the pastoralist community in the grazing reserves. The study also highlighted pastoralist challenges that includes; insecurity, encroachment, and dwindling recourses. The pastoralists have indicated various measures to address the problems in collaboration with government, NGO's and other development partners. From the studies conducted, the following recommendations were made:

1. There is the need for a participatory introduction of livestock production technologies in the grazing reserves that are simple to adopt and are demand driven. Livestock production technologies such as feed conservation techniques that are targeted towards addressing feed problems of the pastoralist should be low cost because the technologies that were introduced such as Hay and Silage making were not adopted because of the cost involved.
2. Extension activities in the reserves had decline over the years, the study noted that lack of support from government is eroding the gains made by extension. It is therefore recommended that stakeholders need to sustain extension activities in the reserves to help improve the livestock sector.
3. A number of constraints to adoption of technologies in the reserve had been identified such as; the complexity and culturally incompatible characteristics of the technologies promoted. It is therefore recommended that future technologies to be introduced should take into consideration the cultural values and production systems of the pastoralists.

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