Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol 2, No.11, 2012

Adoption of Innovations by Small Ruminant Farmers in Northern Ghana: The Case of Tolon-Kumbungu District

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Abstract
Northern region is one of the poorest regions of Ghana. About 80% of the population is poor, majority of who are small scale farmers. The rearing of small ruminants plays an important role in the livelihood sustainability of rural farmers in Northern Ghana. Up to 70% of the rural people in Northern region of Ghana are engaged in rearing of small ruminants. Small ruminant production in the region is often characterized by low productivity. The low productivity can partly be attributed to inadequate knowledge in small ruminant innovations. The present study was carried out in Tolon-Kumbungu district, which is one of the districts having the highest concentration of small ruminants in Ghana. The overall objective of this paper was to determine the extent to which personal factors such as level of education, family size and age influence the level of adoption of small ruminant innovations. In all, 120 small ruminant farmers were drawn from 12 communities using simple random sampling technique. Data were collected by questionnaire administration and observation; and analyzed using descriptive statistics with the help of SPSS software. Chi-square test was used to determine the relationship between adoption level and personal factors. The findings show that, aside level of education which exhibited level of significance with respect to technology such as forage preservation and utilization, the rest of the variables did not show any significance. Therefore, if adoption level is to be improved more attention should be paid to enhancing farmers' personal factors such as level of education.

Key words: Adoption, personal factors, small ruminant and innovations

1. Background

Livestock plays a very important role in the lives of African farmers (Tuah, 1990). Studies (Turner, 2007; Koney, 1992; MOFA, 2004) have argued that people keep livestock for various reasons, among which are source of wealth, for social and cultural obligation such as; payment of dowry, for festivals such as Christmas, a sign of wealth or prestige; sports; for work; Moslem festival and funeral performances. In most cases livestock is the source of cash income for subsistence farmers as well as endurance of family purchasing power in the event of unprofitable agriculture due to natural calamities (Rahman, 2007).

FAO (1980) asserted that small ruminants currently play a major role in the supply of meat in Africa. They hold promise for increasing meat production and small holder incomes as compared to cattle because they require fewer resources, shorter production cycles, faster rate of growth and greater environmental adaptability. Small ruminants are kept for both tangible (i.e., cash income from animal, milk and meat sales and for home consumption) and intangible benefits (e.g. savings, an insurance against emergencies, cultural and ceremonial purposes) (Kosgey et al., 2006). Gopalakrishnan and Lal (1985) observed that small ruminants are suited for poor rural folk especially landless laborers by virtue of their low cost of maintenance, short term returns to capital with low risk capital investment.

Small ruminants play a very significant role in farming systems of most subsistence farmers in Ghana. Subsistence farmers keep them alongside with crop production due to its immense contribution to the family income. Karbo et al. (2002) reported that small ruminants play important roles in the farming systems by contributing to household cash needs as well as the socio-cultural and risk management aspect of livelihood of rural farmers. Additionally, Reijntjes et al. (1992) noted that keeping ruminants extends the risk reduction strategy of farmers beyond multiple cropping, thereby increasing economic stability of the farm system. Furthermore, small ruminants are sold to equalize fluctuation of annual income, satisfy immediate cash needs and greet important relatives and authorities (Runge-Metzger, 1993).

Small ruminants are increasingly reared by households in the Tolon-Kumbungu district as a backyard venture for meat, income, ceremonies and sacrifice. The farmers fall on them for survival in the event of crop failure. Poverty is

endemic among the rural poor in the northern Ghana, including Tolon-Kumbungu (GSS, 2008). However, the keeping of small ruminant in commercial quantities has huge potentials to alleviate poverty (Agtax, 1996; Huq, 1989). This is because in Ghana, the demand for meat exceeds supply. The country still imports large quantities of meat in order to meet meat requirement of the country. Table 1 shows some quantities of meat products imported into the country from 2004-2007.

This immense potential of small ruminants in the district is limited by the traditional farming practices (traditional technologies) that unfortunately seldom assure adequate returns which can promote the development of commercially oriented level of production (Upton, 1985; Ntifo-siaw and Gbatey, 1988; Turkson, 1992).

Over the last two decades, the Government and its development partners have made a lot of efforts through research and technology to boost the small ruminant production in Ghana by intensifying extension and education on small ruminant innovations. Among innovations introduced included improved housing, supplementary feeding, improved breeding, record keeping, forage conservation and utilization, prophylactic treatment, tagging, castration and general care and management. However, since it was introduced no detailed empirical studies have been carried out to determine the extent to which innovations have been adopted by farmers. It has been argued that if agricultural technologies developed for farmers in developing countries are not transferred in correct (appropriate) manner and adopted accordingly, then all efforts by researchers who developed these new technologies would have been in vain (Rahman, 2007). This study was carried out to determine the extent to which small ruminant innovations have been adopted in Tolon-Kumbungu district in Northern Ghana. The main focus of this paper was to determine the effect of personal factors on adoption of small ruminant innovations. This type of research is important because it will provide important feedback to government and development partners in formulating rural poverty intervention policies.

2. Methodology

2.1 Description of the study area

The Tolon/Kumbungu District Assembly is one of the 45 new districts created by the erstwhile Provisional National Defense Council (PNDC) Law 207 in 1988 with Tolon as its Capital. The District covers an area of about 2,741 square kilometers and forms about 3.9% of the total landmass of the Northern Region. The District, which lies between latitude 10-20 north and Longitude 10 to 50 west, shares border with West Mamprusi District in the North, West Gonja District in the West and South and the East with Savelugu/Nanton District and the Tamale Municipal Assembly. The population, according to the 2000 Population and Housing Census stood at 132,338 (female 66,269, male 66,069).The current (2006) population is estimated as 145,876 with the growth rate of 3%. Population density is approximately around 50 inhabitants per Kilometer Square. [Tolon-Kumbungu district profile, 2008]. It is with a Guinea Savannah Zone with wet (May-October) and dry (November-April) seasons. The mean ambient temperature fluctuates between 15°C (minimum) and 40°C (maximum) with the annual mean temperature of 28 degrees Celsius (Dei et al, 2007). The rain fall pattern is monomodal with mean of 1060 mm per annum (NAES, 1984).

2.2 Choice of the study area

The Tolon-Kumbungu district is one of the highest in terms of migration of young women to the south for search for living conditions, due to the increasing levels of poverty in the area (Awumbila & Ardayfio-Schandorf, 2008). This could be partially attributed to the collapse of farming which is the main source of livelihood of the people. Besides, the district has huge potential for enhancing small ruminant production in commercial quantities. Adoption of innovations has the potential of improving upon their farming as well as reducing poverty in the area, which could go a long way to minimize the migration of young women from the area to the south.

2.3 Sampling technique and sample size

12 villages (Cheyohi, Mbanaayili, Bognaayili, Vagu, Kpalsogu, Zangbalun, Tolon, Tingoni, Waribogu, Waantugu, Yepalsi, Kpanyili) were randomly sampled from the four MOFA operational zones in the district for the study. From each selected community, 10 small ruminant farmers were then selected using systematic random technique. Overall 120 farmers were selected for this research.

2.4 Data and data collection

The data was collected using two (2) research instruments: semi-structured questionnaires and personal observations. In all 120 questionnaires were personally administered to small ruminant farmers in the 12 selected communities. The questionnaires had both closed and open-ended questions. In addition, personal observations were made to ascertain the realities of some of the submissions given by the farmers. Data were collected on 9 different aspects of farming practices such as housing, feeding, health care, record keeping, fodder storage and utilization, tagging, breeding and general care and management. Questionnaires were pre-tested at Manguli in the Saveligu-Nantong district, and all the necessary changes in the construction and sequence of the data collection instruments were made.

2.5 Data processing and analysis

All responses were appropriately coded and entered in to SPSS 10.00 package and data interpretation was done using frequencies, percentages and chi-square tests. The data was analyzed based on previous research concerning factors influencing the adoption of agricultural innovations (Rahman, 2007). The study was conducted with 3 independent characteristics (X_1……X_3= personal characteristics) and one dependent variable (y= adoption of small ruminant innovations) by small ruminant farmers. The following independent variables were selected for the study:

- Age (X_1)
- Level of education (X_2)
- Family size (X_3)

Adoption was measured using level of practice. To determine the level, each of the practices was scored as below:

Level of adoption	Score
Complete new	1
Combination of both old and new	2
Complete old	3

A total score of each of the practices (Improved housing, supplementary feeding, record keeping, prophylactic treatment, forage preservation and utilization, castration, tagging, general care and maintenance and improved breeding) was obtained by summing up the scores of the respondents and finding averages. For instance, if a respondent A scores 1 for a particular innovation, respondent B scores 3 and respondent C scores 2, an average of 2 will be obtained. Then, depending upon the scores obtained for each practice, the respondents were classified as;

- fully adopted (1)
- Partially adopted (2)
- Not adopted (3).

The independent variables were cross-tabulated with the dependent variables and chi-square test performed to determine significance level of each of the independent variable with adoption of innovations. To ensure that the data was amenable to the statistical test, “fully adopted” and “partially adopted” were combined and labelled as “adopted”. It was now recoded as adopted (1) and not adopted (2).

1) 3. Results and Discussions

2) *3.1 Effect of personal characteristics on adoption of improved housing*

It is clear from Table 2 that, 31(13.8%) respondents adopted improved housing, while the majority (89) (74.2%) of the respondents however never adopted it. Out of 31(13.8%) respondents who adopted the improved housing, 12(10%) had their ages below 40 years, while 19(15.8%) respondents were either 40 years or above. Also, 53(44.2%) respondents who did not adopt improved housing had 40 or more years. A further look at the Table 2 shows that, out of 47(39.2%) respondents who had family size below 10 years, 14(11.7%) adopted the innovation but 33(27.5%) never did. Majority (103) (85.8%) of the respondents lacked formal education, while only a few (17) (14.2%) had formal education (Table 2). There was no significant relationship ($p>0.05$) between personal characteristics (age, family size and level of education) and adoption of improved housing (Table 2), which means that personal characteristics do not influence level of adoption of improved housing. The findings conform to that of Ekong’s (1998) that there is no association between age and adoption behavior of farmers. However, Polson and Spencer (1992) found age to have influence on adoption. According to the findings, younger farmers, being more adventurous and with longer planning horizon, are more inclined to accept innovations than older ones.

3) ***3.2 Effect of personal characteristics on adoption of supplementary feeding***

Table 3 reveals that 103(85.8%) respondents adopted supplementary feeding, while 17(14.2%) never adopted it. It is also clear (Table 3) that out of a total of 103 respondents who adopted supplementary feeding, 61(59.2%) had their age greater or equal to 40 years, while 42 (40.8%) had age below 40 years. Out of a total of 103 respondents who adopted supplementary feeding, 63(61.2%) and 40(38.8%) had family size above 10 and less than or equal 10 respectively. Majority (89) (74.2%) respondents lacked formal education, while the least (31) (25.8%) had formal education. There was no significant relationship ($p>0.05$) with respect to personal characteristics (age, family size and level of education) and adoption of supplementary feeding (Table 3), which means that personal characteristics (age, family size and level of education) do not influence level of adoption of supplementary feeding. This finding is consistent with observation made by Cramb and Nelson (1998) who argued that education is not important in explaining adoption. However, the findings contrast that of Kumar & Wasnik (1989) who found that age and target users of technology are significantly related to its adoption in progressive farming communities.

3.3 Effect of personal characteristics on adoption of record keeping

A perusal of data in Table 4 reveals that majority (98) (81.7%) of the respondents did not adopt record keeping, while least (22) (9.3%) adopted it. A further perusal of the Table 4 shows that out of 72 respondents who had age greater than or equal to 40 years, majority (56) (77.8%) never adopted the innovation, while only a few (16) (22.2%) adopted it. Further perusal of the Table 4 shows that 13 (17.9%) respondents who had family size greater than10 adopted the innovation, while 60(82.1%) of them did not. Out of a total of 17 respondents who had formal education, 16 (94.1%) never adopted the innovation, while only 1(5.9%) adopted it (Table 4). Personal characteristics such as age, family size and level of education did not exhibit a significant relationship ($p>0.05$) with respect to adoption of record keeping. The implication is that personal characteristics such as age, family size and level of education do not influence adoption of record keeping. The finding is not in agreement with Kumar and Wasnik's (1989) who reported that age of target users of technology is significantly related to its adoption in progressive farming communities. The findings also contrast that of Jabbar (1990) argued that although technology was originally characterized as scale neutral, larger families became early and major adopters.

3.4 Effect of personal characteristics on adoption of forage preservation and utilization

Table 5 shows that 23(47.9%) respondents who belonged to less than 40 years category adopted forage preservation and utilization, while 25(52.1%) of them did not adopt it. Also 22(30.6%) out of a total of 72 respondents who had age greater than or equal to 40 years adopted the innovation, while 50(69.4%) of them did not adopt. It is also clear from the Table 5 that 15(31.9%) respondents belonging to family size greater than or equal to 10 adopted the innovation, while 32(68.1%) of them did not adopt it all. Out of a total of 103 respondents who lacked formal education, 34(33.0%) adopted the innovation, while 69(67.0%) respondents did not (Table 5). It is further clear (Table 5) that personal characteristics such as age and family size did not show any significant relationship ($p>0.05$) with respect to adoption of forage preservation and utilization, indicating that age and family size do not influence of adoption of forage preservation and utilization. However, level of education exhibited a significant relationship ($0.012<p<0.013$) with respect to adoption of forage preservation and utilization. This means that level of education influences adoption of innovation. The findings conforms to the hypothesis of John et al (2005) that education is likely to have a positive influence on the decision of the household's head to adopt innovations. Evenson (1974), in Feder and Zilberman (1982) also found that education plays a strong role in determining rates of adoption of new technology in developing countries. Rahman (2007) also found in his study of adoption of innovations by pig farmers in India that education has a positive and significant association with adoption level. Similar finding was also found by Kunfaa (1999) in his studies of nine rural communities on the common causes of poverty. However, Cramb and Nelson (1998) believed that education is not important in explaining adoption.

4) ***3.5 Effect of personal characteristics on adoption of prophylactic treatment***

As shown in Table 6, out of 120 respondents who were interviewed, the majority (95) (79.2%) adopted prophylactic treatment, while 25(20.8%) did not adopt it. It is further shown (Table 6) that out of a total of 47 respondents who had family size to be less than or equal to10, 38(80.9%) and 9(19.1%) belonged to the adopted and not adopted categories respectively. 80(77.7%) and 23(22.3%) out of a total 103 who lacked formal education belonged to the not adopted and adopted categories respectively (Table 6). There was no significance relationship between personal characteristics (age, family size and level of education) and adoption of prophylactic treatment ($P>0.05$), which

implies that level of adoption of prophylactic treatment is not influenced by personal characteristics such as age, family size and level of education (Table 6). The findings confirm that of Rezvanfar (2005) who found no significant relationship between family size and adoption in a study of communication and socio-personal factors influencing adoption of dairy farming technologies among dairy farmers in Iran.

5) *3.6 Effect of personal characteristics on adoption of general care and management*

As shown in Table 7, out 90 respondents who adopted General care and management practices, 52(57.8%) belonged to the age category of 40 years and above, while 38(42.2%) respondents belonged to age category of less than 40 years. Perusal of Table 7 further indicates that 33 respondents belonged to family of 10 and below and adopted the innovation. Out of the majority (103) of those who lacked formal education, 75(72.8%) adopted the innovation, while 28(27.2%) did not adopt it. Personal characteristics such as age, family size and level of education did not show a statistical significant relationship ($p>0.05$) with adoption of general care and management. The findings conform to that of Ekong's (1988) in Nigeria that there is no association between age and adoption behavior of farmers. Also, John et al (2005) hypothesized that household with larger farm size are more likely to adopt new technologies.

6) *3.7 Effect of personal characteristics on adoption of tagging*

The outcome of the findings shows that out of the 120 respondents who were interviewed, the majority (112) (93.3%) never adopted tagging, only a few (8) (6.7%) adopted it (Table 8). A perusal of the table 8 reveals that 2(4.2%) and 46(95.8%) out of 48 respondents who had age below 40 years belonged to the adopted and the not adopted categories respectively. Further perusal of the Table 8 indicates that 6(8.2%) and 67(91.8%) out of a total of 73 who had family size below 10 belonged to the adopted and not adopted categories. 96(85.7%) out of 112 who lacked formal education belonged to the not adopted category, while 16(14.3%) of them belonged to adopted category. Personal characteristics such as age, family size and level of education did not exhibit significance ($p>0.05$) with respect adoption of tagging (Table 8). This implies that variables such as age, family size and level of education do not influence adoption of innovation. The findings are not in agreement with other studies which found aged persons reluctant to adopt innovations (Motamed and Singh, 2003) and (Haque and Ray, 1983).

7) *3.8 Effect of personal characteristics on adoption of castration*

From Table 9, it is evident that the majority (95) (79.2%) did adopt castration, while a few (25) (20.8%) adopted it. Also, out of a total of 72 respondents who had age greater than or equal to 40 years, 17(23.6%) adopted the innovation while 55(76.4%) did not adopt it (Table 9). Furthermore, 8(17.0%) and 39(83%) out of a total of 47 respondents who had family size either equal to or less than 10 belonged to the adopted and the non-adopted categories respectively (Table 9). From Table 9 again, 22(21.4%) and 81(78.6%) respondents who had no formal education belonged to the adopted and non-adopted categories respectively. Personal characteristics such as age, family size and level of education did not show any significant relationship ($p>0.05$) with respect to adoption of castration. The implication is that personal characteristics such as age, family size and level of education do influence adoption of innovation. The findings confirm that of Rezvanfar (2005) who found no significant relationship between family size and adoption in a study of communication and socio-personal factors influencing adoption of dairy farming technologies among dairy farmers in Iran.

3.9 Effect of personal characteristics on adoption of improved breeding

Out of 120 respondents who were interviewed, the majority (112) (93.3%) adopted improved breeding, while only a few (8) (6.7%) did not. Out of a total of 8 respondents who did not adopt improved breeding, 2(25%) belonged to the age category of less than 40 years, while 6(75%) belonged to the age category greater than or equal to 40 years (Table 10). Also 6(8.2%) and 67(91.8%) out of 73 respondents who belonged to the family size of less than 10 also belonged to the adopted and not adopted categories respectively (Table 10). Again, 7(6.8%) and 96(93.2%) out of a total of 103 respondents who lacked formal education belonged to the adopted and non-adopted category respectively. There was no significant relationship ($p>0.05$) between Personal characteristics (age, family size and level of education) and adoption of improved breeding (Table 10). The implication is that age, family size and level of education do not influence adoption of innovations. The findings are in agreement with that of Cramb and Nelson (1998) that education is not important in explaining adoption. However it does not agree with Polson and Spencer's

(1992) that younger farmers, being more adventurous and with longer planning horizon, are more inclined to accept innovations than older ones.

Conclusion and Recommendation

This paper focused on the effects of personal factors influencing adoption of small ruminant innovations. The study considered nine main innovations introduced in study area over the last two decades. These innovations include: Improved housing, supplementary feeding, record keeping, prophylactic treatment, forage preservation and utilization, castration, tagging, general care and maintenance and improved breeding. Three main personal factors were considered in this study. These include age, level of education and family size. In an attempt to determine the extent to which personal factors influence the adoption of small ruminant innovations, the independent variables (age, level of education and family size) were cross tabulated with dependent variables (adoption of innovations: Improved housing, supplementary feeding, record keeping, prophylactic treatment, forage preservation and utilization, castration, tagging, general care and maintenance and improved breeding). The results obtained show that aside level of education which exhibited significance with respect to forage utilization and conservation; all other personal factors did not show any significance. It is therefore concluded that level of education is important in adoption of small ruminant innovations. This paper therefore recommends that the government and development partners should pay greater attention to educating livestock farmers since it contributes to their adoption of innovations.

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Table 1: Distribution of meat imports (2004-2007)

TYPE OF IMPORTS	**IMPORT 2007 (MT)**	**IMPORT 2006 (MT)**	**IMPORT 2005 (MT)**	**IMPORT 2004 (MT)**
BEEF	16,250.37	9,578.49	6,331.7	2.419.4
BUFFALO	8,108.95	4,498.96	2,257.1	1,169.2
MUTTON	6,887.07	4,445.04	3,640.8	1,797.1
CHICKEN	63,276.29	40,429	40,591	34,265.8
PORK	10,551.50	11,777.56	10,286.8	7,145.1

Source: MOFA 2007 annual report

Table 2: Distribution of Personal Characteristics and Levels of Adoption of Improved Housing

Characteristics		Level of adoption of improved housing			
		Adopted	Not adopted	Total	Test and interpretation
Age	< 40	12	36	48	χ^2=0.029 df=1
	≥ 40	19	53	72	0.9>p >0.8
	Total	31	89	120	Not significant
Family size	≤10	14	33	47	X^2=0.630 df=1
	>10	17	56	73	0.5>p>0.4
	Total	31	89	120	Not significant
Level of education	No formal	25	78	103	χ^2=0.197 df=1
	Formal	6	11	17	0.7>p>0.6
	Total	31	89	120	Not significant

Source: Field survey, 2008.

Table 1: Distribution of personal characteristics and level of adoption of supplementary feeding

Characteristics		**Level of adoption of supplementary feeding**			
		Adopted	Not adopted	Total	Test and interpretation
Age	< 40	42	6	48	χ^2=0.183 df=1
	≥ 40	61	11	72	0.7>p>0.6
	Total	103	17	120	Not significant
Family size	≤10	40	7	47	χ^2=0.034 df=1
	>10	63	10	73	0.9>p>0.8
	Total	103	17	120	Not significant
Level of education	No formal	89	14	103	χ^2=0.197 df=1
	Formal	14	3	17	0.7>p>0.6
	Total	103	17	120	Not significant

Source: Field survey, 2008.

Table 4: Distribution of personal of characteristics and levels of adoption of record keeping

Characteristics		Level of adoption of record keeping			
		Adopted	Not adopted	Total	Test and interpretation
Age	< 40	6	42	48	χ^2=1.818 df=1
	≥ 40	16	56	72	0.2>p>0.1
	Total	22	98	120	Not significant
Family size	≤10	9	38	47	χ^2=0.034 df=1
	>10	13	60	73	0.9>p>0.8
	Total	22	98	120	Not significant
Level of education	No formal	21	82	103	χ^2=2.051 df=1
	Formal	1	16	17	0.2>p>0.1
	Total	22	98	120	Not significant

Source: Field survey, 2008.

Table 5: Distribution of personal characteristics and level of adoption of forage preservation and utilization

Characteristics		Level of adoption of forage preservation and utilization			
		Adopted	Not adopted	Total	Test and interpretation
Age	< 40	23	25	48	χ^2=3.704 df=1
	≥ 40	22	50	72	0.06>p>0.05
	Total	45	75	120	Not significant
Family size	≤10	15	32	47	χ^2=0.028 df=1
	>10	30	43	73	0.4>p>0.3
	Total	45	75	120	Not significant
Level of education	No formal	34	69	103	χ^2=6.255 df=1
	Formal	11	6	17	0.01<p<0.02
	Total	45	75	120	Significant

Source: Field survey, 2008.

Table 6: Distribution of personal characteristics and level of adoption of prophylactic treatment

Characteristics		Level of adoption of prophylactic treatment			
		Adopted	Not adopted	Total	Test and interpretation
Age	< 40	41	7	48	χ^2=1.895 df=1
	≥ 40	54	18	72	0.2>p>0.1
	Total	95	25	120	Not significant
Family size	≤10	38	9	47	χ^2=0.133 df=1
	>10	57	16	73	0.8>p>0.7
	Total	95	25	120	Not significant
Level of education	No formal	80	23	103	χ^2=0.988 df=1
	Formal	15	2	17	0.4>p>0.3
	Total	95	25	120	Not significant

Source: Field survey, 2008.

Table 7: Distribution of personal characteristics and level of adoption of general care and management

Characteristics		Level of adoption of general care and management			
		Adopted	Not adopted	Total	Test and interpretation
Age	< 40	38	10	48	χ^2=0.741 df=1
	≥ 40	52	20	72	0.4>p>0.3
	Total	90	30	120	Not significant
Family size	≤10	33	14	47	χ^2=0.944 df=1
	>10	57	16	73	0.4>p>0.3
	Total	90	30	120	Not significant
Level of education	No formal	75	28	103	χ^2=1.850 df=1
	Formal	15	2	17	0.2>p>0.1
	Total	90	30	120	Not significant

Source: Field survey, 2008

Table 8: Distribution of personal characteristics and level of adoption of tagging

Characteristics		Level of adoption of tagging			
		Adopted	Not adopted	Total	Test and interpretation
Age	< 40	2	46	48	χ^2=0.804 df=1
	≥ 40	6	66	72	0.4>p>0.3
	Total	8	112	120	Not significant
Family size	≤10	2	45	47	χ^2=0.722 df=1
	>10	6	67	73	0.4>p>0.3
	Total	8	112	120	Not significant
Level of education	No formal	7	96	103	χ^2=0.020 df=1
	Formal	1	16	17	0.9>p>0.8
	Total	8	112	120	Not significant

Source: Field survey, 2008.

Table 9: Distribution of personal characteristics and level of adoption of castration

Characteristics		Level of adoption of castration			
		Adopted	Not adopted	Total	Test and interpretation
Age	< 40	8	40	48	χ^2=0.842 df=1
	≥ 40	17	55	72	0.4>p>0.3
	Total	25	95	120	Not significant
Family size	≤10	8	39	47	χ^2=0.681 df=1
	>10	17	56	73	0.5>p>0.4
	Total	25	95	120	Not significant
Level of education	No formal	22	81	103	χ^2=0.122 df=1
	Formal	3	14	17	0.8>p>0.7
	Total	25	95	120	Not significant

Source: Field survey, 2008.

Table 10: Distribution of personal characteristics and level of adoption of improved breeding

Characteristics		Level of adoption of improved breeding			
		Adopted	Not adopted	Total	Test and interpretation
Age	< 40	2	46	48	χ^2=0.804 df=1
	≥ 40	6	66	72	0.4>p>0.3
	Total	8	112	120	Not significant
Family size	≤10	2	45	47	χ^2=0.722 df=1
	>10	6	67	73	0.4>p>0.3
	Total	8	112	120	Not significant
Level of education	No formal	7	96	103	χ^2=020 df=1
	Formal	1	16	17	0.9>p>0.8
	Total	8	112	120	Not significant

Source: Field survey, 2008.