Influence of improved technology adoption on livelihoods of small ruminant farmers in Ghana

ANAGLO, J. N.[1], ASARE, C. J.[1], MANTEAW S. A.[2] & BOATENG, S. D.[1]
([1]Department of Agricultural Extension, University of Ghana, P. O. Box LG68, Legon. Accra;
[2]Council for Scientific and Industrial Research
Post Office Box M 32, Accra
Corresponding Author: Manteaw S. A. (smanteaw@yahoo.com)

ABSTRACT

The study was conducted with the objective of finding how adoption of small ruminant technologies affected the livelihood outcomes of small ruminant farmers in Ghana. Data collected using questionnaires which were triangulated with focus group discussions. A sample size of 180 small ruminant farmers comprising 141 men and 39 women was used. Socio-economic factors such as sex, age and contact with extension agents were observed to have significant effects on adoption. Also, a significant relationship was found between adoption and incomes, ability to afford school fess, payment of utility bills and access to veterinary drugs. There was also significant relationship between adoption and food security and group membership. Adoption of improved technologies had influenced most of the livelihood outcomes of the farmers. It is recommended that extension officers continue to intensify education on the improved technologies so that more results can be obtained on livelihoods of the farmers.

Original scientific paper. Received 22 May 17; revised 23 Oct 17.

Introduction

Majority of the world's poor people live in rural areas where their main source of employment and income generation is in agriculture. However, depletion and degradation of land and water poses serious challenge to producing enough food for farmers who depend solely on crop and crop products to sustain their livelihoods and also meet the needs of urban populations. Thus, for many, their livelihoods are directly affected by environmental changes such as floods and drought. One way of managing this situation is to engage in small ruminant farming, which does not suffer as much as crop farming during drought and floods.

Small ruminants (goats and sheep) form an important economic and ecological niche in agricultural systems in the developing countries (Devendra, 2005). They are widely recognized for their role in food production (protein), economic importance in the tropics and sub tropics where they are concentrated and constitute an important component of traditional farming systems. Little capital investment in buildings required for their upkeep**,** while space and maintenance requirements are also low. This makes it easier for rural households to rear small ruminants as a means of livelihood in addition to crop farming.

The contributions of small ruminants are little understood leading to the neglect of this

valuable livelihood strategy that could help alleviate poverty among the rural poor (Devendra, 2005). According to the Ghana Statistical Services the livestock sector in Ghana contributes about 7 per cent of agricultural Gross Domestic Products (GDP).

The opportunities to improve on the small ruminant industry in the Suhum Kraboa Coaltar District (SKCD) are high as a result of the presence of favourable vegetation, climate and an existing culture of small ruminant rearing. According to Devendra (2005), in view of several demand-driven factors including population growth, urbanisation, increase in income, inability of current supplies to match requirements, and changing consumer preference, there is a real need to increase the contribution to meat production from the livestock sector and reduce the inefficiencies in individual animal production systems and natural resource management that can respond to increased supplies of foods of animal origin, and promote improved livelihoods. According to FAOSTAT (2013), there is a steady increase in production of sheep and goats over the period 2008-2011. This, indicates the potential to increase production and improve on livelihoods of small ruminant farmers if the appropriate policies, support structures and mechanisms are put in place.

The undesirably slow pace of the livestock sub-sector development in the country has created a situation whereby large volumes of ruminants, particularly, cattle are imported for slaughter from Sahelian countries of the West African sub- region. Foreign meat and dairy products are also imported annually to meet the growing demand in Ghana (LPIU, 2004). It is, therefore, becoming increasingly important to put in place efficient methods to improve animal production. These involve changes in management, husbandry practices, provision of adequate and appropriate health scheme, as well as effective and efficient livestock extension services.

Livestock extension aims at bringing changes in farmers' practices to increase productivity by introducing farmers to improved management practices and creating the awareness on the potential of small ruminant as an alternative means of livelihood. All these can be achieved through effective livestock extension. In the search for efficiency in the use of small ruminant as a livelihood asset, it is important to examine the contribution and importance of extension services on the small ruminant sector, and to identify ways to improve on livestock extension delivery.

Problem statement

Majority of smallholder farmers in Ghana keep small ruminants in order to earn additional income to be able to enhance their standard of living. Most small ruminant farmers, however, are not able to improve on their standards of living using small ruminant population as a livelihood strategy (MOFA, 2010). There have been several efforts by development organisations in the SKCD to help small ruminant farmers improve on their management practices as well as their income levels through marketing of these animals in order to reduce their poverty levels. Some of these organisations and their efforts are enumerated below.

Cadbury Cocoa Partnership (CCP) is one of such organisations which offered training for small ruminant farmers on improved management practices such as supplementary feeding, proper housing, disease control, record keeping, improved breeds and sex ratio. As part of the training, some farmers were sponsored to visit the Livestock and Poultry Research Centre (LIPREC) of the University of Ghana to observe improved small ruminant production practices. Heifer Project International (HPI), a Non-Governmental Organisation (NGO) has also undertaken various forms of interventions including training and demonstrations on improved small ruminant management for various groups of small ruminant farmers in Ghana.

HPI also introduced improved breeds of small ruminants to some farmers. The World Bank assisted Livestock Improvement Project,

commissioned in 2003 and implemented by MOFA was another intervention for farmers to improve on their management practices and productivity. In terms of health of the animals, the Veterinary Services Department of MOFA continues to provide education to farmers as well as treating sick animals to ensure that disease conditions and mortality among animals are reduced.

In spite of the numerous improved small ruminant production practices available in Ghana through the efforts of development organisations, majority of farmers still practice the traditional extensive system of production where, the animals are not provided with housing and they roam and scavenge by themselves exposing them to diseases, theft, extreme weather conditions and high mortalities, especially among the young ones (MOFA, 2010). It is possible that farmers who practice the traditional production methods do not appreciate the contribution of improved small ruminant production practices on their livelihoods. On the other hand, it is known that improved production practices, whether for livestock or crops, have the potential to improve the livelihoods of farmers, the reasons why development organisations are still putting in efforts on providing such improved production practices to farmers. There is the possibility that farmers do not have adequate empirical evidence linking improved small ruminant production practices with improved livelihoods.

The objectives of this study therefore were to assess the relationship between the socio-economic factors of farmers on the adoption of improved small ruminant technologies, and also, how adoption of such technologies impacts on the livelihood outcomes of farmers in the three districts across the agro ecological zones in Ghana.

Materials and methods

The study was carried out in three districts selected from the three ecological zones in Ghana, namely Tolon District in the Northern Region, Techiman Municipal in the Brong Ahafo Region, and Suhum Kraboa Coaltar District (SKCD) in the Eastern Region. The study population consisted of small ruminant farmers.

With the help of the Agricultural Extension Agents (AEAs) working in these districts, a list of all communities were obtained from each district. Four villages were then randomly selected from each of the three districts to get 12 villages. These were Tanoso, Nsuta, Ahensua, and Kenten selected from Techiman Municipal, Tali, Kpendua, Gbullung, and Gbrimani from Tolon District, and Suhum, Nankese, Coaltar, Asuboi, from SKCD. Fifteen small ruminant farmers were subsequently selected randomly from each of the 12 villages. This was done based on the list of farmers obtained in the villages through the AEAs. Farmers' names were written on pieces of paper before randomly selecting 15 from the lot. A sample population of 180 small ruminant farmers was finally arrived at.

The main instrument used for data collection was questionnaire and interview schedule with respondents. This enabled the interviewer to clarify questions since most of the farmers did not have formal education. Structured questionnaires were, therefore, administered to individual farmers in their local language. Administration of the questionnaire was done mostly in the late afternoons to evenings after a prior arrangement with the farmers to enable them return from their farms. A focus group discussion was held in each district to ascertain the information collected from the participants. Data collected were entered into statistical package for social sciences (SPSS) and analysed.

Classifying level of farmers' technology adoption

Out of the technologies introduced to the farmers as part of the interventions of the NGOs and MOFA, eight were selected for the study. These were proper housing, supplementary feeding, recommended sex ratio, proper sani-

tation, use of improved breeds, health care, controlled breeding and record keeping. Farmers who adopted four out of the eight technologies were described to have low adoption rate. Farmers who adopted more than four technologies were described as having high adoption rate (Table 1).

TABLE 1
Technology adoption classification

Technology adoption	*Frequency*	*Percentage*
High	137	76.1
Low	43	23.9
Total	**180**	**100**

Results

Socio economic characteristics and adoption

The socio-economic characteristics studied included sex, age, education, experience in farming, population of animals per farmer and contact with AEAs.

Relationship between sex and levels of adoption

Table 2 shows a statistically significant relationship between sex and levels of adoption (χ^2=62.8, df=1, p<0.001). Male farmers were significantly different from females with regard to levels of improved technology adoption. Peterman, Quisumbing, Behrman, & Nkonya (2011) made similar findings in their study of adoption rates among farmers. Fisher & Kandiwa (2014) also agreed, arguing that female farmers had low levels of adoption as compared with male farmers.

Relationship between age and levels of adoption

The results from Table 2 showed a statistically significant association between age and farmers' level of adoption (χ^2=30.1, df=2, p<0.001). Middle aged farmers were high adopters than elderly farmers. This agrees with the findings of Orebiyi, Benchendo & Onyeka (2007) that revealed that older and younger farmers were less ready to adopt than middle aged farmers who were ready to adopt new technologies in expectation of improvement. They further explain that middle aged farmers are still within their productive age and can easily accept and adopt innovations.

Relationship between education and levels of adoption

The results showed no significant relationship between education and farmers' level of adoption (χ^2=1.24, df=3, p=0.744) (Table 2). The reason for the above observation may be that the information on improved livestock production practices disseminated by extension service providers were not done using materials that require high level of education to use, thus, all farmers having both formal and informal education are equally able to apply the improved technologies. This is contrary to findings of Hamza & Boateng (2012) who observed that education significantly influenced adoption of technological innovations in small ruminant production. Other authors also observed similar findings in agriculture (Langyintuo & Mekaria, 2005; Asadullah & Rahman, 2009). It is likely that the packaging of such technologies may be in the form of print media which may require a certain minimum level of education to understand and use.

Relationship between experience and levels of adoption

There was no significant relationship between experience and level of adoption (χ^2=5.05, df=3, p=0.169) (Table 2). In contrast, Mulaudzi & Oyekale (2015) found a statistically significant relationship between experience of farmers and level of adoption, but negatively related. They explained that more experienced farmers were unlikely to adopt new technology, possibly due to their being close to retirement, leaving less time to increase or benefit from proceeds that investments may accrue.

TABLE 2
Relationship between factors of adoption and levels of adoption

Factors influencing adoption	*Levels of adoption*						χ^2 Test
	High		*Low*		*Total*		
	n	%	n	%	n	%	
Sex							
Male	126	92	15	35	141	78	$\chi^2 = 62.8$, df = 1, $P = 0.000$
Female	11	8	28	65	39	22	
Total	137	100	43	100	180	100	
Age							
Youth	13	9	4	9	17	9.44	$\chi^2 = 30.1$, df = 2, $P = 0.000$
Middle age	109	80	18	42	127	70.55	
Elderly	15	11	21	49	36	20.01	
Total	137	100	43	100	180	100	
Education							
Nil	56	41	18	42	74	41.11	$\chi^2 = 1.24$, df = 3, $P = 0.744$
Basic	50	36	13	30	63	35.00	
Secondary	20	15	9	21	29	16.11	
Post-secondary	11	8	3	7	14	7.78	
Total	137	100	43	100	180	100	
Experience (No of yrs.)							
1-10	11	8	8	19	19	11	$\chi^2 = 5.05$, df = 3, $P = 0.169$
11-20	28	26	10	23	38	21	
21-30	62	45	18	42	80	44	
31-40	36	21	7	16	43	24	
	137	100	43	100	180	100	
Population of animals							
1-25	120	88	37	86	157	87	$\chi^2 = 0.701$ df = 1, $P = 0.791$ NS
25-60	17	12	6	14	23	13	
Total	137	100	43	100	180	100	
Contact with Extension Agents							
1-2 weeks	47	34.3	6	14.0	53	29.4	$\chi^2 = 29.0$, df = 2, $P = 0.000$
3-4 weeks	69	50.4	13	30.2	82	45.6	
>4weeks	21	15.3	24	55.8	45	25	
Total	137	100	43	100	180	100	

Source: Authors (2013)

Relationship between population of animals and levels of adoption

From Table 2, there was no statistically significant relationship between number of animals and levels of adoption ($\chi^2 = 0.701$, df = 1, $p = 0.791$).This is in sharp contrast with the findings of Rahman (2007), who discovered a positive and significant relationship between herd size and adoption levels among farmers.

Relationship between extension contact and levels of adoption

There was a statistically significant relationship between farmers' contact with extension agents and levels of adoption as can be seen from the results ($\chi^2 = 29.0$, df = 2, $P < 0.001$) (Table 2). Orebiyi *et al*. (2007) also found a positively significant association between extension contact and farmers' level of adoption. They explained that frequent interaction with extension agents built a rapport that created conducive atmosphere for adoption of technologies.

Levels of adoption and livelihood outcomes

Relationship between levels of adoption and incomes of farmers

From Table 3, there was a statistically significant relationship between income and levels of adoption ($\chi^2 = 19.5$, df = 1, $P < 0.001$). This means that income levels of farmers belonging to the different adoption levels vary, that is, those farmers with high adoption levels generally obtained higher incomes than farmers who have low adoption levels. The results suggest that majority of farmers with high adoption levels (88.32%) recorded improved incomes as compared to low adoption (58.14%). This is similar to findings of Aku-dugu, Guo & Dadzie (2012), who observed increased incomes as a result of adoption of modern agricultural production technologies by farm households in Ghana.

Relationship between levels of adoption and food security

There existed a significant association between farmers' level of adoption and food security ($\chi^2 = 31.9$, df = 1, $P < 0.001$) (Table 3). High level adoption resulted in farmers improving their ability to afford food for their households (91.24%) while those with low adoption levels (46.51%) slightly improved their ability to afford food for their household. Thus, farmers with high adoption levels were more likely to afford food for their households than those with low levels of adoption. This finding agreed with the results of studies conducted by Shiferaw, Kassie, Jaleta, & Yirga (2014) that revealed a consistent relationship between increased food security and high adoption levels among farmers.

TABLE 3
Relationship between farmers' level of adoption and livelihood outcome

Factors influencing adoption	*Levels of adoption*						*χ^2 Test*
	High		*Low*		*Total*		
	n	*%*	*N*	*%*	*n*	*%*	
Incomes							
Improved	121	88.32	25	58.14	146	81.11	$\chi^2 = 19.5$, df = 1, $P =$ 0.000
Slightly improved	16	11.68	18	41.86	34	18.59	
Total	137	100	43	100	180	100	
Afford food for household							
Improved	125	91.24	23	53.49	148	82.22	$\chi^2 = 31.9$, df = 1, $P =$ 0.000
Slightly improved	12	8.76	20	46.51	32	17.78	
	137	100	43	100	180	100	
Pay hospital bills							
Improved	128	93.43	13	30.23	141	78.33	$\chi^2 = 77.0$, df =1,$P = 0.000$
Slightly improved	9	6.56	30	69.77	39	21.67	
Total	137	100	43	100	180	100	
Pay utility bills							
Improved	125	91.24	15	34.88	140	77.78	$\chi^2 = 60.1$, df = 1, $P =$ 0.000
Slightly improved	12	8.76	28	65.12	40	22.22	
Total	137	100	43	100	180	100	
Disease incidence on farm							
Improved	74	54.0	19	44.2	93	51.65	$\chi^2 = 1.27$, df = 1, $p = 0.261$
Slightly improved	63	46.0	24	55.8	86	61.4	
Total	137	100	43	100	140	100	
Social capital (group membership)							
Improved	76	55.5	18	41.9	94	52.2	$\chi^2 = 2.43$, df =1, $P = 0.119$
Slightly improved	61	44.5	25	58.1	86	47.8	
Total	137	100	43	100	180	100	
Human capital (Pay school fees)							
Improved	131	95.62	15	34.88	146	81.11	$\chi^2 = 78.8$, df = 1, $P =$ 0.000
Slightly improved	6	4.38	28	65.12	34	18.89	
Total	137	100	43	100	180	100	

Source: Authors (2013)

Relationship between levels of adoption and ability to pay hospital bills

The results from Table 3 showed a statistically significant association between a farmer's level of adoption and the ability to pay hospital bills (χ^2 = 77.0, df = 1,P = 0.000). Farmers with high levels of adoption (93.43%) generally demonstrated an improved ability to pay hospital bills as opposed to majority of farmers with low levels of adoption (69.77%),

who had slightly improved their ability to pay hospital bills. Similarly, Okello (2010) discovered in his study among smallholder farmers in Kenya that farmers with high adoption levels were able to afford increased family medical expenses as compared to their counterparts who had lower adoption levels.

Relationship between levels of adoption and ability to pay utility bills

From Table 3, there was a statistically significant difference in ability to pay utility bills ($\chi^2 = 60.1$, df = 1, $P < 0.001$). In general, farmers with a high level of adoption (91.24%) were more likely to improve their ability to pay their utility bill**s,** while those with low levels of adoption (65.12%) were likely to slightly improve their ability to pay utility bills. Cole's (2010) study agreed with this finding as her study also revealed that farmers who were high adopters improved their household well-being, which included ability to pay for utilities and other household expenses.

Relationship between levels of adoption and disease incidence on the farm

There was no significant difference in disease incidence on farms across various levels of adoption ($\chi^2 = 1.27$, df = 1, $P = 0.261$) (Table 3). Majority of farmers with high levels of adoption (54.0%) demonstrated an improvement in managing disease incidence as compared with the majority of those with low levels of adoption who had a slightly improvement in handling disease incidence on farms (55.8%). This is comparable to the findings of Bonabana-Wabbi, Taylor & Kasenge (2006) who observed low crop disease incidence among farmers who demonstrated high levels of adoption.

Relationship between levels of adoption and social capital

From the figures, there was no statistically significant relationship between social capital improvement and levels of adoption ($\chi^2 = 2.43$, df = 1, $P = 0.119$) (Table 3). The results imply that a high level of adoption is not likely to result in improved social capital. The finding contrasts with that of Mathijs (2003), who discovered that farmers who were more willing to adopt sustainable practices had more social capital. Hennessy & Heanue (2012) also established a strong relationship between membership of groups and levels of adoption among farmers in Ireland.

Relationship between levels of adoption and ability to pay children's school fees

There was a statistically significant difference in ability of farmers to pay children's school fees across the various levels of adoption ($\chi^2 = 78.8$, df = 1, $P < 0.001$) (Table 3). Majority of farmers with high levels of adoption (95.62%) demonstrated an improvement in the ability to pay fees compared with the majority of those with low levels of adoption. Consequently, farmers with high levels of adoption were more likely to be able to pay their children's school fees than farmers with low adoption levels. This is similar to findings by Marenya & Barrett (2007) that revealed increase in household welfare of farmers with high levels of adoption, resulting in improving the ability to educate their children.

Conclusion

The study revealed that age, gender, and contact with extension agents were primary factors that improved farmers' level of adoption. However, population of animals, and level of farmer's experience had no relationship with levels of adoption. Adoption of improved technologies had positive effects on the livelihood outcomes of farmers. This was expressed in terms of improved income levels, enhanced ability to afford food, hospital bills, school fees and utility bills. It is recommended that adoption levels of farmers be improved by improving the influencing factors indicated above. Consequently, it is important that stakeholders in extension recognize the relevance of these factors.

REFERENCES

Akudugu, M. A., Guo, E. & Dadzie, K. (2012) Adoption of modern agricultural production technologies by farm households in Ghana: What factors influence their decisions? *Journal of Biology, Agriculture and Healthcare;* **2** (3), 1-14.

Asadullah, M. N., & Rahman, S. (2009) Farm productivity and efficiency in rural Bangladesh: the role of education revisited. *Applied Economics* **41**(1), 17-33.

Bonabana-Wabbi, J., Taylor, D. B. & **Kasenge, V.** (2006) *A limited dependent variable analysis of integrated pest management adoption in Uganda.* Annual meeting, July 23-26, Long Beach, CA 21040, American Agricultural Economics Association.

Cole, J. (2010).Social and environmental impacts of payments for environmental services for agroforestry on small-scale farms in southern Costa Rica. *International Journal of Sustainable Development & World Ecology* **17**(3), 208–216.

Devendra, C. (2013) Investments on pro-poor development projects on goats: Ensuring success for improved livelihoods. *Asian-Australasian Journal of Animal Acience* **26**(1) 1-18.

Devendra, C. (2005) Small ruminants in Asia; Contribution to food security, poverty alleviation and opportunities for productivity enhancement http://www.mekarn.org/procsr/ Devendra.pdf Feb 2006

Fisher, M., & **Kandiwa, V.** (2014) Can agricultural input subsidies reduce the gender gap in modernmaize adoption? Evidence from Malawi. *Journal of Food Policy* **45** (2014), 101–111.

Adam, H. & **Boateng, S.** (2012) Adoption of innovations by small ruminant farmers in northern Ghana: The case of Tolon-Kumbungu District. *Journal of Biology, Agriculture and Healthcare* **2** (11), 10-20

Hennessy, T. & **Heanue, K** (2012) Quantifying the effect of discussion group membership on technology adoption and farm profit. *The Journal of Agricultural Education and Extension* **18** (1), 41-54.

Langyintuo, A. S. & **Mekuria, M.,** (2005) *Modelling agricultural technology adoption using the software STATA,* Presented at a Training Course, Econometric Application to Modelling the Adoption of Agricultural Technologies, 21-25, Harare, International Maize and Wheat Improvement Centre (CYMMT), Harare, Zimbabwe.

Marenya, P. P. & **Barrett, B. C.** (2007) Household-level determinants of adoption of improved natural resources management practices among smallholder farmers in western Kenya. *Journal of Food Policy* **32**(4), 515 – 536.

Mathijs, E. (2003) Social capital and farmers' willingness to adopt countryside stewardship schemes. *Outlook in Agriculture* **32**(1), 13-16.

MOFA (2010) *APD Annual Report.* District Agricultural Directorate Unit.–SKCD

Mulaudzi, S. V. & **Oyekale, S. A.** (2015) Smallholder farmer's adoption intensity of genetically modified maize varieties in Thulamela municipality, Limpopo province, South Africa. *Environmental Economics* **6** (1), 104 – 112.

Okello, J. J. (2010) *Does use of ICT-based market information services (MIS) improve welfare of smallholder farmers? Evidence from Kenya.* Proceedings of the 4th ACORN-REDECOM Conference Brasilia, D.F., May 14 – 15, 2010.

Orebiyi, J. S., Nenchendo, N. G., & **Onyeko, O. P.** (2007) Determinants of contact farmer's adoption of improved cassava production technologies in Imo State, Nigeria. *Agrosearch* **7**(1), 12-21.

Peterman, A., Quisumbing, A., Behrman, J. & **Nkonya, E.,** (2011) Understanding the complexities surrounding gender differen-

ces in agricultural productivity in Nigeria and Uganda. *Journal of Development Studies* **47** (10), 1482–1509.

Rahman, S. (2007) Adoption of improved technologies by the pig farmers of Aizawl district of Mizoram, India. *Livestock Research for Rural Development* **19** (1), 1-11.

Shiferaw, B., Kassie, M., Jaleta, M. & **Yirga, C.** (2014) Adoption of improved wheat varieties and impacts on household food security in Ethiopia. *Food Policy* **44** (2014), 272-284.