Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.9, No.16, 2018

Smallholder dairy farmer characteristics and their relationships with type of breeds kept in Uganda

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Abstract

Smallholder dairy farming is increasingly becoming an important source of livelihoods for farmers in Lake Victoria agro-ecological Zones (LVZ) in Uganda. This study was carried out in 3 major milk producing regions in Uganda. The main objective was to establish relationships between household characteristics with type of dairy breeds (technology) and also identify the factors that influence choice of a given dairy breed technology. Data came from 236 dairy producing households obtained from a secondary data set of the Uganda National Household Survey (UNHS) for year 2009. The data generated were analyzed using both descriptive statistics (ANOVA tests and chi-square tests) and a multinomial logistic model. The results revealed that out of the 236 studied households 166 had local dairy cows, 58 had improved dairy cows and 12 mixed breeds (both local and improved). The average milk yield was significantly different across households by type of dairy breed. The highest average milk yield was observed among households keeping improved dairy breeds (4.1l/day), 3.5l/day for households keeping mixed breeds and those keeping local had the lowest average milk yield (2.1l/day). The multinomial logistic model further revealed that the choice of improved dairy breeds for milk production over local dairy cows was significantly influenced by access to veterinary services, bicycle ownership and being located in the south western region at 1% level, education and age of the household head at 5% level, ownership of a motorcycle and market access at 10% level. Adoption of mixed breeds over local breeds is strongly influenced by household size, market access and farmer being located in the south western region at 5% level. The study evidently indicated the need to promote improved cows and local cows alongside improved cows (mixed) for sustainable dairy subsector development through extending veterinary services and training of dairy households especially among elderly household heads to adopt better dairy management practices.

Keywords: Smallholder farmers; dairy technology; multinomial logistic, choice of breeds

1. Introduction

Dairy technology development in developing countries plays a major role in increasing milk production, improving income level in rural areas, generating employment opportunities and improving the nutritional standards of the people, especially for small and marginal farmers. Low and unreliable income from cash crops suggests that alternative income generating farming activities should be developed. Adoption of improved dairy technology is associated with better milk yield and improved dairying has a direct impact on income generation, poverty alleviation and availability of animal protein (Fogwe, 2015). Therefore, to increase the milk production existing improved dairy technology should be adopted among smallholder dairy farms. According to Mohamed et al. (2004), dairy technologies encompass the use of improved animals, improved feed technology and improved management. The study focuses on improved dairy breeds and their relationships with household characteristic.

Cattle breeds consist of purebred exotic animals, indigenous (local) animals, their grades and crosses. In Uganda, the indigenous cattle breeds continue to be dominant over the exotic. Indigenous cattle breeds were reported to be 12,709 million (93.3% of the national herd) compared 914,000 exotic cattle breeds (6.7% of the national herd) in 2014 (UBOS, 2015). At least 26.1 percent of Uganda's rural households derive their livelihoods from indigenous cattle (MAAIF et al., 2010). Although exotic/cross breed cattle constitute less of the cattle population, in 2007 these breeds produced around 60% of all milk in Uganda (FAO, 2010). Majority (48.5%) of the exotic and cross breed cattle are found in the south western region, followed by Central with 30.0% and Eastern with 20.1%. Due to the high number of exotic/cross breed cattle the western region leads in milk production (UBOS, 2008). Although indigenous cattle have been faulted for low productivity and reproductive performances, they still remain popular in Uganda because of their adaptive traits to the local underprivileged

conditions (Balikowa, 2011).

2. Literature Review

Several approaches have been proposed in literature on the analysis of factors influencing adoption or choice of dairy breed technologies. Most studies using econometric models often relate the adoption decision to household characteristics or factors. Constraints imposed by these factors may discourage technology adoption. Therefore, understanding the factors affecting farmers' choice or adoption of a given dairy technology is critical to successful development and implementation of policies and programmes in dairy industry development.

Quddus (2012) studied the causes of adoption and non adoption of high yielding dairy breeds, the level of practices and constraints in adopting the improved technologies in Bangladesh. The study was carried out in three different agro-ecological zones and 180 dairy cattle farmers were interviewed. Self practiced dairy technologies were listed; adoption score for each technology and adoption index for each farmer were studied. 25% of the farmers used artificial insemination for breeding purpose and 80% belonged to medium or high level of technology adoption. Only 35% farmers adopted crossbred cows and some others upgraded indigenous with exotic breeds. About 17.5% rural farmers and 70% semi-urban farmers reared crossbred cows and rural farmers are reluctant to utilize all kinds of improved technologies. The level of technology adoption by smallholder dairy farmers was highly dependent on farmer's education, farming experiences, financial status and extension services. Secondary and higher educated farmers were 9.7 times more likely to be adopting improved technologies compared to illiterate farmers.

Gunaseelan et al. (2018) assessed the adoption level of improved dairy farming technologies by farmers in peri-urban areas of Thanjavur district of Tamil Nadu. To this survey, a sample of 120 dairy farmers was selected randomly from 10 peri-urban villages located in and around 10 km radius of the urban areas of Thanjavur city. The analysis of the data revealed that overall, 41.67 % of the farmers had medium level of adoption improved dairy management practices, followed by low (35.00%) and high (23.33%) extent of adoption. The results of the logit model showed that the level of technology adoption by peri-urban dairy farmers is medium and is highly dependent on farmer's education (5% level), financial status, economic motivation and milk production (1 % level) in the selected peri-urban. He further noted the increase in educational status of the respondents and milk production in animal would favor respondents to adopt improved dairy farming technology in peri-urban areas.

Dehinenet, G. (2014) used a Heckman two-stage model to identify the factors that influence adoption of the technology (cross breeds) and level of adoption. Farm and household level data were obtained from 384 farmers consisting of 192 adopters and 192 non-adopters. The results demonstrated that family size, farming experience, availability of dairy production extension services, availability of cross breed cows, accessibility of saving institutions, total income from milk and milk products, availability of training on livestock, age of household head and off-farm activity participation played significant roles on both the probability of dairy technology adoption and its level of adoption.

Friedland, A., et al. (2016) used a logistical regression model to study determinants of adoption of Improved crossbred cattle in Suba and Laikipia Districts, Kenya District. The results showed that: family member's education, having an extra job in addition to farming, and exposure to external market forces was the farmer a local or immigrant all greatly contributed to the likelihood of adoption.

From the above selected literature on determinants of adoption/choice of dairy technology (breeds), it shows that much work had been focused of adoption of improved breeds, but little work has been done to examine the factors that influence a household to choose either; improved, local breeds or mixed breeds of dairy cows. Therefore, understanding the factors affecting the farmers' decision to choose a type of dairy breeds is critical to success of development and implementation of policies and programs to develop dairy industry in Uganda. But surprisingly little work has been done to examine the determinants of choice of different dairy technologies hence the main objective of this study.

3. Methodology

3.1 Sampling techniques and data type

The study uses a secondary data set of the Uganda National Household Survey (UNHS) collected by the Uganda National Bureau of Statistics (UBOS) for year 2009. The survey aimed to identify agricultural technologies and farming systems with potential to contribute to increased agricultural productivity and reduced poverty in

Uganda. The survey involved 91 communities (LC1s, which is the country's lowest administrative unit). The UNHS 2009 survey data consisted of 1,372 households from which 754 cattle keeping households were purposively selected from the 3-main dairy producing regions in Uganda (Eastern, central and south western); in that only those cattle keeping households which had at least one dairy cow in 2009 were purposively selected to remain with a sample of 378 household for study. From the 378 households, 5 districts with the highest number of households with dairy cows were selected from each of the three regions. Data with missing information was dropped to remain with a study sample of 236 households out of the 378 households which had at least one dairy cow (57 households from south western, 78 households from central and 101 households from eastern region).

3.2 Data Analysis

Data was analyzed using Statistical Package STATA (Version 14) software. Two types of data analysis, namely descriptive statistics and econometric analysis were used for analyzing the data. Descriptive methods of data analysis included the use of percentages, means, ANOVA tests and chi-square tests to examine and compare smallholder characteristics households by type of dairy breeds (local, improved and mixed). Econometric analysis involved the use of a multinomial logistic model to analyze the factors influencing choice of dairy breed technology. Type of dairy breeds technology is a mutually exclusive event because a farmer can only choose to produce using local breeds, improved or mixed breeds (both local and improved).

3.2.1 Multinomial logistic model

For a finite number of choices (greater than two), multinomial logistic estimation is appropriate to analyze the effect of exogenous variables on choices. It is a simple extension of the binary choice model and is the most frequently used model for nominal outcomes that are often used when a dependent variable has more than two choices. The model is useful in analyzing data where the researcher is interested in finding the likelihood or probability of a certain event occurring (Gujarati, 1992). The multinomial logit model has been widely used by researchers such as Scup et al., (1999) and Fert and Szabo (2002). This study analyses the probability of choosing a dairy breed technology. To generate dependent variables, the farmers were classified into 3 groups: (i) those that produced with local dairy cows, (ii) those that produced with improved dairy cows, and (iii) those that produced milk with mixed breeds (both local and improved). Given the alternatives before a producer, the probability that an individual i chooses alternative j, therefore can be expressed by Equation (1):

$$\text{Prob}(Y_i = j) = \frac{\exp(x_i\beta_j)}{\sum \exp(x_i\beta_j)} \quad \text{.....(i)}$$

Where,

$\text{Prob}(Y_i = j)$- Probability of choosing to adopt local, improved or mixed dairy breeds

J = 1, 2, 3 (1=local, 2=improved and 3= mixed breeds)

i = 1, 2, 3, 4 …..., 236

Xi = Vector of the predictor variables, and

βj = Vector of the estimated parameters

The model estimates are used to determine the probability of choice of a breed technology given Xi factors that affect the choice j. With a number of alternative choices log odds ratio is computed as,

$$\text{In}\left(\frac{p_{ij}}{p_{ik}}\right) = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_k x_k + e_i \quad \text{.....(ii)}$$

Pij and Pik are probabilities that a farmer will choose a given breed technology and the alternative breed technology respectively.

$\text{In}\left(\frac{p_{ij}}{p_{ik}}\right)$ is a natural log of probability of choice j relative to probability choice k,

α is a constant,

β1……βk is a matrix of parameters that reflect the impact of changes in X on probability of choosing a given breed technology.

x_1.....x_2 are explanatory variables

e is the error term that is independent and normally distributed with a mean zero.

The parameter estimates of the multinomial logit model provide only the direction of the effect of the independent variable on the dependent (response) variable but do not represent either the actual magnitude of change nor probabilities. The marginal effects or marginal probabilities are required to measure the expected change in the probability of a particular choice being made with respect to a unit change in an independent variable from the mean (Green, 2000). Marginal effects of the attributes on choice are determined by getting the differential of probability of a choice and it is given by,

$$(\delta) = \frac{\delta p_i}{\delta p_i} = p_i\left(\beta_j - \sum_{k=0}^{j} p_k\beta_k\right) = p_i\left(\beta_j - \beta\right) \text{.....(iii)}$$

The multinomial logit model is given by $P_{ij} = \beta_0 + \beta_1 x_1 + \ldots \beta_k x_k + \varepsilon$.....(iv)

Choice dairy breed technology $(P_{ij}) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_k x_k + \varepsilon_i$.....(v)

3.2.2 Diagnostic Tests for Multinomial Logit

The assumption of independence Irrelevant Alternatives (IIA) is critical and leads to substantial computational difficulties involving the computation of multivariate integrals (Greene, 2002). If there is a change in the characteristics of any other alternative in the choices set, this property requires that the two probabilities must adjust precisely in order to preserve their initial ratio, that is, the percentage change in each probability should be equal. A Hausman test was carried out and showed no evidence that the study did not meet IIA assumption and therefore no need of using nested logit as an alternative. Potential multicollinearity among explanatory variables was also tested in a preliminary analysis using variance inflation factor(VIF). The results did not show any problem since none of the VIF of a variable exceeded 8 (Greene, 2002). In addition, a Bruesch-Pagan/ Cook-Weisberge test for heteroskedasticity which indicated a $\chi 2$ (Chi2) of 0.33 and Prob >$\chi 2$ of 0.5653 indicating that there was no problem of heteroskedasticity.

3.3 Hypothesis and Variable Definition

The data covered information necessary to make household level indices of social, economic, demographic and institutional indicators comparable across different categories of households. Thus continuous and discrete variables were identified based on economic theories and empirical studies as follows:

3.3.1 Dependent variable

Dairy breed technology- This is a categorical dependent variable that represents type of dairy breeds adopted by farmers in the study areas. The results revealed that households had two dairy breed technologies and a combination of the two. Accordingly, dependent variables were created from the data, which indicated choice of local breeds (1), improved breeds (2) and mixed breeds (3). For estimation purpose, the base category used was local breeds; thus the model assessed the effects of various independent variables on the odds of two dairy breed technologies versus adoption of local breeds.

3.3.1 Independent (Explanatory) Variables

Sex of the household head: This was a dummy variable that took a value of one if the household head was male and zero otherwise. Male household heads were expected to adopt improved breeds or mixed breeds over local breeds compared to female headed households. Male farmers get more access and exposure to get the information about the dairy technology (Dehinenet, G., 2014).

Age of the household head: This was measured in the number of years of the head of household. Age is assumed to be a proxy measure of experience. We hypothesized that age of household head to be positively related to improved breeds choice or mixed breeds over local breeds which means that as the age of the household head increase; the household is likely to keep improved breeds for production because younger farmers tend to be more enterprising, fast decision-makers and gain experience as they grow which increases their capacity to adopt new managerial systems and technologies.

Age –squared: Age squared variable was generated because adoption of dairy technologies is likely to vary differently among older household heads. Dehinenet, G. (2014) stated that the probability of adoption of improved breeds decreased with the increase of age of the household head. We hypothesize that age among older household heads will negatively influence a household to keep improved breeds or mixed breeds over local breeds which means that the older household-heads are more likely to keep local dairy breeds.

Education: This is a continuous variable measured by number of years of schooling of the household head. Literate households are expected to have better skills, better access to information and ability to process information hence education plays an important role in adoption of new technologies and believed to improve

readiness of a farmer to accept new ideas and innovations. According to Patil, A. P., et al. (2009), educated household heads have adequate knowledge of animal diseases, their prevention and control compared to the low resource poor dairy farming household which are technically constrained in adopting improved dairy management practices. Therefore, formal education of household head is hypothesized to positively influence a household to adopted improved dairy cows over local cows.

Household size: This is a continuous variable measured by number of members in a household. Households with more family members tend to have more labor which may influence the household to adopt mixed breeds (both local and improved breeds) over improved or local breeds.

Land size: It is a continuous variable and measured in acres of land owned by a household. A positive relationship between the size of land held by farm households and dairy technology adoption was hypothesized. Farmers with less land were expected to adopt improved breeds while households with more land are expected to adopt local or mixed breeds of dairy cows. A study by Quddus, (2017) on "Performance and perceptions of adoption of crossbred cattle by smallholder in Bangladesh" found out that dairy farmers having more lands were less likely to adopt improved (cross breeds) because they were motivated to crop cultivations or other jobs. But landless farmers are more motivated to adopt improved breeds.

Ownership of bicycle: It is measured as a dummy variable taking a value of one if the household owned a bicycle and zero otherwise. Bicycles are the cheapest and the easiest transport asset a household can own in Uganda. Ownership of a bicycle by household is likely to enhance access to improved dairy inputs, market information and dairy technologies hence the variable was hypothesized to influence adoption of improved breeds over local breeds positively.

Ownership of motorcycle: It is measured as a dummy variable taking a value of one if the household owned a motorcycle and zero otherwise. Motorcycles are likely to influence a household to commercialize dairy farming due to improved transport and access to milk market institutions (Andela et al., 2008). Therefore households with motorcycles are likely to adopt improved breeds of dairy cows as opposed to local breeds.

Access to Veterinary service: This variable is measured as a dummy variable taking a value of one if the dairy household has access to veterinary services and zero otherwise. It is expected that access to veterinary services widen the household's knowledge with regard to the use of improved dairy production technologies hence such households are likely to adopt improved breeds as opposed to local breeds

Access to credit: Access to credit is measured as a dummy variable taking a value of one if the household has access to credit and zero otherwise. Access to credit improves the financial capacity of dairy households to buy more improved dairy cows hence increases adoption of improved dairy cows over local breeds or mixed breeds over local breeds.

Milk market access: This variable is measured as a dummy variable taking a value of one if the dairy household accessed the milk market and zero otherwise. Households that aim at commercializing dairy farming are expected to adopted improved dairy cows or mixed breeds as opposed to local breeds because improved breeds are high yielding compared to local breeds.

South western: South western is measured as a dummy variable taking a value of one if the household was located in the south western part of Uganda and zero otherwise.

Eastern: Eastern is measured as a dummy variable taking a value of one if the household was located in Eastern part of Uganda and zero otherwise.

4. Results and discussion

4.1 Socio-economic and demographic characteristics of dairy farmer households by type of dairy breeds.

Table 2 (for continuous variables) summarizes important social, economic and demographic attributes of the sample households in the study areas. Household factors which differed significantly across households by type of dairy breeds were milk yield (1%), milk consumed per household per day (1%) and herd size at (1%).

The average age for sample farmers with local dairy cows was 47.8 years, those with improved cows were 51 years and the average age for those with mixed dairy breeds was 48.6 years. However household head by breed types were not significantly different in mean age.

Table 2: Mean household characteristics by type of dairy breed

Characteristics	Type of breed			p-value
	Local(n=166)	Improved(n=58)	Mixed (n=12)	
Age(years)	47.77	50.95	48.58	0.2713
Education(years of schooling)	6.33	7.413	6.833	0.1846
Household size	10.53	10.60	13.5	0.0810*
Total land size(acres)	11.51	7.92	12.48	0.3659
Milk consumed per day	0.29	0.41	0.80	0.0001***
Milk yield(Litres/cow/day)	2.11	4.07	3.51	0.0000***
Volume milk sold per day(Litres)	1.25	2.85	5.25	0.0032***
Herd size	6.72	3.48	16.67	0.0001***

Values with *, ** and *** significant at 10%, 5% and 1% level

Households keeping improved dairy cows spent more years in school (7.4) on average compared to households keeping local (6.3) and mixed dairy breeds (6.8) however; household heads were not significantly different in years of schooling across type of dairy breeds. Household size by breed was 10.53, 10.60 and 13. 5 for farmer households keeping local improved and mixed breeds respectively and they were significantly different from each other at 10% level. This indicates that a large household size is likely to influence a household to keep mixed dairy breeds. Households keeping mixed breeds (12.48 acres) and local breeds (11.51 acres) owned more land compared to households with only improved breeds(7.92 acres), this shows that keeping local or mixed breeds required a larger piece of land compared to keeping improved breeds. However, there was no significant difference in average land size. The highest average milk yield was observed in households keeping improved dairy breeds (4.07*l*percowperday). Households keeping local (2.11*l*percowperday) reported a lower average milk yield compared to households keeping mixed breeds (3.51*l*percowperday). Households were significantly different in yield at 1% level. This shows that improved breeds have a significantly higher milk yield compared to local dairy cows. Households averagely consumed less than 1 liter of milk per day, consumption was highest among households keeping mixed breeds (0.8*l*) and lowest among households keeping local breeds (0.29*l*). The ANOVA test shows a significant difference in average milk consumed per day at 1%. Average volume of milk sold per day was 1.25 liters, 2.85 and 5.25 liters for local, improved and mixed breeds keeping households respectively. Volume of milk sold was significantly different at 1% level. This shows that households keeping improved breeds or mixed breeds sold more milk on average compared to households with local. This indicates the role of improved breed of dairy cows in influencing commercialization of the dairy farming.

Table 3 Percentage of household characteristics by type of milk breeds

Household variables	Type of breed (%)			p-value (Chi-square value)
	Local (n=166)	Improved (n=58)	Mixed (n=12)	
Sex				
Female	9.04	6.90	8.33	0.881 (0.2540)
Male	90.96	93.10	91.67	
Milk market access(yes)	42.17	53.45	75	0.043** (6.292)
Bicycle (yes)	75.90	51.72	83.33	0.001*** (13.068)
Motorcycle (yes)	12.65	17.24	25	0.390 (1.885)
vehicle(yes)	1.20	0	0	0.654 (0.851)
Access to credit (yes)	46.99	58.62	50	0.312 (2.327)
Access to vet services (yes)	16.67	46.55	21.69	0.001 *** (14.066)
Regions				
South western region	20.48	29.31	50.00	0.013** (12.626)
Central region	37.95	18.97	33.33	
Eastern region	41.57	51.72	16.67	

Values with *, ** and *** significant at 10%, 5% and 1% level

Table 3 (for categorical variables) reveals 4 categorical characteristics which have a significant relationship with the dairy breeds types kept by a household which included, milk market access (5% level), ownership of a bicycle (1% level), access to veterinary services (1% level) and region where the household is located(5%) whereas sex of the household head, owning a motorcycle or vehicle and access to credit chi-square tests did not show a significant relationship with the type of dairy breeds owned. Male headed households were dominant in all the 3 categories however; chi-square test shows no significant relationship between sex of the household head and type of breed kept by household. Market access has a significant relationship with type of dairy breed kept by household at 5%. More households with mixed (75%) and those with improved breeds (53.45%) compared to households keeping only local breeds (42.17%) accessed the milk market. Hence keeping improved breeds alongside local dairy breeds is likely to enhance commercialization of dairy farming. More than 50% of the sampled households owned a bicycle; 83.33% among households keeping mixed breeds while, 75.9% among households with local breeds and 51.7% among households with improved breeds. Bicycle ownership shows a significant relationship with type of breed kept by household at 1% level. This shows that a bicycle was an important transport asset among small holder dairy households compared to ownership of motorcycles (<30%) and vehicles (<2%) in Uganda. Households keeping improved breeds shows majority (58.62 %) accessed credit those keeping mixed breeds (50%) and those keeping local 66.99% accessed credit. However credit access shows no significant relationship with type of breed kept. Access to vet services shows a significant relationship with type of breeds kept. Among households with improved dairy cows majority (46.55%) accessed veterinary services and those keeping local dairy cows (16.67%) show the lowest percentage of households with access to veterinary services. Access to veterinary services shows a significant relationship with type of dairy breeds kept at 1% level. Quddus (2017) using chisquare tests found similar results that few farmers (24%) received extension/veterinary services of which 67.2% were improved breed owners and 90% of the local (indigenous) cattle owners did not access veterinary (extension) services in Bangladesh.

4.2 Factors influencing choice or adoption of dairy breeds by household

The multinomial logit model was estimated by the maximum likelihood method. The overall model was significant at 1% significance level indicating 99% confidence level that the explanatory variables included in the model assessed the effects on the odds of two categories of dairy breeds(improved or mixed) versus production with local breeds as indicated by the log pseudo likelihood value of -139.9332. Moreover, based on the pseudo R^2 of 0.3029, the model appears to have a good fit to the data (Table 4).

The results indicated Out of 13 explanatory variables included in multinomial logistic model, eight variables were found to significantly influence the decision of a household to choose improved dairy breeds over local breeds. They include; Age of the household head, education, transport assets (motorcycle and bicycle), access to veterinary services, access to milk market and location in the south western region influenced the decision of a household to choose improved dairy breeds over local breeds. Whereas 3 variables significantly influenced Choice mixed breeds over local breeds. They include household size, participation in the milk market and south western region.

Age of the household head: As expected, age of the household head positively and significantly influenced the decision of a household to choose improved dairy breeds over local breeds at 5% level of significance. However, age squared is negative meaning age of the household head among older household heads negatively and significantly influenced the decision of a household to choose improved dairy breeds over local breeds at 10% level. According to Mafimisebi et al. (2006), the more the age of a farmer, the less the adoption rate probably because as farmers get old, they tend to become more conservative and unwilling to take risk. The unwillingness to adopt innovations may arise from the fear that misapplication of innovations may lead to losses which will spell doom for them at their old age and wipe off their income source. Contrary Quddus, (2017) found that the probability of adoption decreased with the increase of age of the household head up to 50 years but older farmers may be more interested to adopt new technologies or practices because as farmers get old, they understand its benefits and they learn more about practices of improved (crossbred) cattle farming.

Education: Number of years spent in school by the household head positively and significantly influenced the decision of a household to choose improved dairy breeds over local breeds at 5% level of significance. Literate households are expected to have better skills, better access to information and ability to process information hence education plays an important role in adoption of new technologies and believed to improve readiness of a farmer to accept new ideas and innovations. According to Gunaseelan et al., (2018), increase in educational status of the household head favored adoption improved dairy farming technology in peri-urban areas. Similarly, Friedland, et al., (2016) found education of family members to greatly to contribute to the likelihood of adoption of improved breeds of cattle.

Table 4 Multinomial Logistic regression result for determinants of dairy breeds choice

Variable	Choice of dairy breeds					
	Improved breeds			Mixed breeds		
	Coef.(Std.Err.)	dy/dx	P-values	Coef.(Std.Err.)	dy/dx	P-values
Sex	0.634	0.084	0.351	-0.345	-0.011	0.783
	(0.681)			(1.255)		
Age	0.195	0.030	0.046**	-0.091	-0.003	0.498
	(0.098)			(0.134)		
Age^2	-0.002	-0.001	0.075*	0.001	0.000	0.509
	(0.001)			(0.001)		
Education	0.098	0.015	0.035**	0.119	0.002	0.251
	(0.047)			(0.103)		
Household size	0.003	-0.010	0.994	2.486	0.052	0.035**
	(0.428)			(1.177)		
land size	-0.254	-0.039	0.236	-0.092	-0.001	0.811
	0.214			(0.385)		
Bicycle	-1.228	-0.221	0.002***	0.705	0.018	0.497
	(0.394)			(1.039)		
Motorcycle	0.869	0.159	0.082*	0.076	-0.003	0.929
	(0.501)			0.856		
Vet services	1.636	0.305	0.000***	-0.194	-0.011	0.847
	(0.425)			(1.006)		
Credit	0.287	0.048	0.458	-0.900	-0.021	0.256
	(0.386)			(0.793)		
Milk market access	0.616	0.088	0.090*	1.598	0.035	0.039**
	(0.363)			(0.773)		
South western	1.694	0.306	0.004***	1.695	0.035	0.062**
	(0.582)			(0.908)		
Eastern	0.495	0.081	0.289	-0.753	-0.017	0.430
	(0.466)			(0.956)		
Constant	-8.365			-8.102		
	(2.570)			(3.998)		

Number of obs = 236
LR chi2(26) = 71.23
Prob > chi2 = 0.0000
Log likelihood = -139.93322
Pseudo R2 = 0.3029

Figures within the parentheses show standard errors; ***p <0.01, **p <0.05, *p <0.10; The dependent variable is Dairy breeds: Local breeds = 1(base category), Improved breeds = 2 and Mixed breeds = 3,

Household size: Choice of mixed breeds for milk production over local breeds was positively and significantly influenced by number of members in a household at 5% level. Hence increase in the household size increases the likelihood of a household to choose mixed breeds over local breeds. This is probably due to the availability of labour provided by a large household size which enables a household to keep local alongside improved breeds. A study by Dehinenet, G., (2014) similarly reported a positive effect between households size and adoption of improved dairy technology.

Among the transport assets owned by a household, ownership of a bicycle decreased the likelihood of a household to adopt improved dairy breeds for production over local breeds significantly at 1% level contrary to prior expectation while ownership of a motorcycle as expected increased the likelihood of a household to adopt improved dairy breeds over local breeds significantly at 10% level. Motorcycles are likely to influence a household to commercialize dairy farming due to improved transport and access to milk market institutions (Andela et al., 2008), this motivates a household to adopt improved dairy technologies to increase production.

Access to veterinary services: Households which accessed animal health services had a higher likelihood to choose improved breeds over local breeds for milk production at 1% level of significance. This is because access to vet services is expected to widen the household's knowledge with regard to the use of improved dairy production technologies (breed). This is in line with findings by Quddus (2012) and Dehinenet, G. (2014) which reported more knowledge on improved technologies through training, availability of reliable and continuous

technical assistance, increased and timely provision of medicine, increasing A.I facilities and strengthening extension services increased use of improved technologies among dairy households.

Milk market access: Households which access milk market preferred improved breeds or mixed breeds over local breeds for milk production. Milk market access was significant at 10% for improved breeds keeping households and 5% mixed breeds keeping households. This is probably because improved breeds produced more milk increasing the volume of milk available for sell. Hence commercialization of dairy production was associated with adoption of improved dairy breeds or mixed breeds. Baltenweck I. and Staal S.J., 2000 stated that the main reason for keeping improved breeds (exotic breeds and their crosses) compared to local breeds cows is their higher milk potential, milk that is both consumed on farm and sold. Farmers with improved (grade) cows are usually market oriented since the higher production levels enable them to sell the milk surplus.

5. Conclusion and recommendations

This paper aimed to investigate the factors influencing choice of types of dairy breeds (local, improved or mixed) among smallholder dairy farming households in Uganda. The results of the multinomial logistic regression model show that access to veterinary services, bicycle ownership, being located in the south western region, education and age of the household head are positive and strongly significant in influencing the likelihood of a household to choose improved breeds for milk production over local breeds. Ownership of a motorcycle and market access are other significant factors. Adoption of mixed breeds over local breeds is strongly influenced by household size, market access and farmer being located in the south western region.

The results of this research offer policy intervention measures to increase adoption of improved breeds. In particular veterinary services, transportation facility, and household characteristics are critical to explaining smallholder farmers' choice of dairy breed types kept in Uganda. The study recommends that introduction of different dairy technologies should be supported with a dairy improvement program to provide continuous training, veterinary services, market access (transport facilities, information etc) and dairy productivity enhancing technical backup to the smallholder farming households in Uganda. This program should target the elderly house household heads and regions dominated by local cattle producing households especially the Eastern region of Uganda.

Acknowledgment

We are grateful to the Uganda National Household survey (UNHS) for entrusting us with the various data sets for investigation aimed to make a contribution towards reviewing of policy intervention measures in Uganda dairy sector.

References

Ahmed, M. A., Ehui, S., & Assefa, Y. (2004). *Dairy development in Ethiopia*. Intl Food Policy Res Inst.

Balikowa, D., (2011). Dairy development in Uganda: a review of Uganda's dairy industry, Dairy Development Authority (DDA). Uganda, (also available at http://www.fao.org/3/a-aq292e.pdf). Accessed 28th May 2018.

Baltenweck, I., & Staal, S. J. (2000). Determinants of adoption of dairy cattle technology in the Kenyan highlands: a spatial and dynamic approach.

DDA, (2010). Annual Report 2009/2010, Dairy Development Authority, Kampala, Uganda

Dehinenet, G., Mekonnen, H., Kidoido, M., Ashenafi1, M. and Guerne Bleich, E., (2014). Factors influencing adoption of dairy technology on small holder dairy farmers in selected zones of Amhara and Oromia National Regional States, Ethiopia. Discourse *Journal of Agriculture and Food Sciences* www.resjournals.org/JAFS ISSN: 2346-7002 Vol. 2(5): 126-135, May, 2018

FAO, (2010): Status of and Prospects for Smallholder Milk Production – A Global Perspective, by T. Hemme and J. Otte. Rome.

Fert, I, Szabo G., (2002). The choice of supply channels in Hungarian fruit and vegetable sector. In: Economics of Contracts in Agriculture, Second Annual Workshop, Annapolis, MD, 21-23 July.

Fogwe Z. N., (2015). The development of a potential local dairy for an emerging peri-urban population of

Cameroon. *World J. Business and Management*. 1 (2): 43-57

Friedland, A., Demeke, A., B. and Sekora., A., (2016). Determinants of Adoption of Improved Crossbred Cattles: A Case Study of Suba and Laikipia Districts, Kenya. *Journal of Economics and Sustainable Development* www.iiste.org ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online) Vol.7, No.3, 2016

Greene, W. H. (1993). Econometric Analysis. Second Edition. Macmillan Publishing Co., London. 792pp.

Greene, W.H., (2002). Econometric Analysis. Fourth edition. Prentice Hall International Upper Saddle River, USA.

Gujarati, D. (1992). Essentials of Econometrics. MacGraw–Hill, New York. 264pp

Gujarati, N., (2004). Basic Econometrics. Third Edition. McGraw-Hill Book Company, New York.

Gunaseelan, M., Thilakar, P., Mathialagan, P., & Serma Saravana Pandian, A.(2018). Adoption Level of Improved Dairy Farming Technologies by Peri-urban Dairy Farmers in Thanjavur District of Tamil Nadu. *International Journal of Livestock Research*, 8(1), 103-111. http://dx.doi.org/10.5455/ijlr.20170805093320

MAAIF/UBOS, (2010). National Livestock Census Report 2008. Kampala, Uganda: Ministry of Agriculture, Animal Industry and Fisheries, Entebbe /Uganda Bureau of Statistics, Kampala, Uganda.

Mafimisebi, T. E., Onyeka, U. P., Ayinde, I. A., & Ashaolu, O. F. (2006). Analysis of farmer-specific socio-economic determinants of adoption of modern livestock management technologies by farmers in Southwest Nigeria. *Journal of Food Agriculture and Environment, 4*(1), 183.

McFadden D (1973). Conditional logit analysis of qualitative choice behavior. In: Zarembka P. (ed.): Frontiers in Econometrics. Acad. Press, New York. pp. 105-142

Patil, A. P., Gawande, S. H., Nande, M. P., & Gobade, M. R. (2009). Constraints Faced by the Dairy Farmers in Nagpur District while Adopting Animal Management Practices. Veterinary World, 2(3), 111.

Quddus, M. A. (2012). Adoption of dairy farming technologies by small farm holders: practices and constraints. *Bangladesh Journal of Animal Science, 41*(2), 124-135.

Quddus, M. A. (2017). Performance and perceptions of adoption of crossbred cattle by smallholder in Bangladesh. *International Journal of Agricultural Policy and Research*, *5*(3), 63-69.Scup A, Gillepsie J, Reed D., (1999). Consumer choice among alternative red meats. J. Food Distrib. Res. 29(3):35-43

Uganda Bureau of statistics, (2008). Statistical Abstract, Kampala Uganda.

Uganda Bureau of statistics, (2015). Uganda Bureau of Statistics; Statistical Abstract, Kampala Uganda.