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Determinants of adoption of exotic poultry breeds among smallholder poultry producers in North Western Amhara Region, Ethiopia

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Abstract

The study was conducted in Western part of the Amhara region, the study consider East Gojjam, West Gojjam, Awi and South Gondar zones. The main objective of the study was identifying factors affecting the adoption of exotic poultry breeds in the Region distributed by Andassa Poultry Multiplication Center and NGOs. A multi-stage random sampling technique was employed. Both descriptive and econometric analysis was used. For the econometric analysis Double Hurdle Model was used. Despite the huge effort by the Government as well as NGOs to improve traditional poultry production through introduction of exotic poultry breeds specially Day Old Chicks (DOCs) with full packages for the last 20 years, adoption of exotic poultry breed is very minimal in the smallholder poultry production system accounting only 7.8% from the total population including cross and pure breeds. The reasons for low adoptions are lack of sustainable supply of the breed, disease, predation, feed problem, poor awareness on breeds, lack of extension service, lack of training and market problem. Moreover, under farmers condition DOCs distribution is not effective and only less than 8% DOCs reach to younger ages (2 month pullets). Among the hypothesized factors only sex, family size, distance from road, distance from town, management system, number of poultry sold per year in the market and access to training significantly affected household's decision to adopt exotic poultry breeds. Among the hypothesized factors only sex, distance from road, distance from town, management system, number of poultry sold, access to training and year of adoption significantly affected the intensity of adoption exotic poultry breeds. Therefore this study recommends provision of training and extension service about breed, management, feeding and health aspects before technology distribution, improving sustainable supply of the exotic poultry breed, distribution of technologies (exotic poultry breeds) for women and resource poor farmers, distribution of technologies for market accessible areas. Generally this study strongly recommends pullets (2 months age exotic poultry breeds) distribution either through out-growers model or poultry multiplication centers rather than investing much on the less effective DOCs distribution.

Key words: Double Hurdle Model, DOCs and adoption

INTRODUCTION

In Ethiopia, chicken are widespread and almost every rural family owns chicken, which provide a valuable source of family protein and income (Tadelle et al. 2003).

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The total chicken population in the country is estimated at 52.3 million (CSA, 2013/14). The majority (98%) of this chicken are maintained under a traditional system with little or no inputs for housing, feeding or health care. The most dominant chicken types reared in this system are local ecotypes, which show a large variation in body position,

color, comb type and productivity (Teketel, 1986; Tadelle et al., 2003; Halima et al., 2007). The greater part of the feed for village chicken is obtained through scavenging, which includes the household cooking waste, cereal and cereal by-products, pulses, roots and tubers, oilseeds, shrubs, fruits and animal proteins (Tadelle, 1996).

Rural chicken in Ethiopia represents a significant part of the national economy in general and the rural economy in particular and contribute to 98.5% and 99.2% of the national egg and chicken meat production, respectively (Tadelle 1996; Aberra 2000). However, the economic contribution of the sector is still not proportional to the huge chicken numbers, attributed to the presence of many technical, organizational and institutional constraints. According to CSA (2013/14) the total chicken population of the Amhara Region is estimated to be 14.6 million accounting to 27.9% of the National chicken population.

According to Ministry of Agriculture, in Ethiopia, like many African countries, attempts have been made at various times to improve local chicken production through introduction of exotic chicken breeds. Distribution of pullets, cockerels, DOCs and fertile eggs, layers and duals breeds, has been one of the poultry extension packages accomplished by the Regional Office of Agriculture, since the last 20 years, aiming at improving chicken production and productivity. Despite this huge distribution of exotic chicken breeds, the contribution of improved chicken breeds in the current production system of the region is very low (<5%). A study by Tekelewold et al, (2006) on the adoption of poultry technology in the highlands of Ethiopia (East shewa and Welayta) indicated that adoption has been limited by a set of factors such as lack of knowledge on chicken husbandry (feeding, housing, health care, etc), lack of complimentary inputs (feed, alternative breeds, etc), lack of strong extension follow up, high disease prevalence and predation, unavailability of credit services and market problems. However, up to the knowledge of the authors no study has been made so far on determinates of adoption of poultry technology in Amhara Region Therefore, the study aims at determining factors affecting the adoption of exotic poultry breeds in the Region

Objectives of the Study

The main objectives of this study were:

- to assess the opportunities and challenges of smallholder improved poultry production systems
- to determine factors affecting decisions on adoptions of exotic poultry breeds
- to estimate the extent of exotic poultry technology adoption

RESEARCH METHODOLOGY

Description of the Study Area

The study was conducted at the Western part of Amhara Region, Ethiopia. Amhara National Regional State is grouped into Western and Eastern parts of the region. The Western part of the region comprises five administrative zones, namely North Gondar, South Gondar, East Gojjam, West Gojjam, and Awi Administrative zone. According to the Regional office of Agriculture, compared to the Eastern part of the region, the Western part of the region has better potential for agricultural activities and crop production is the first priority. The western part is also potential for chicken production more over much of the exotic breeds from Andassa Poultry Multiplication Center were distributed in this area. Therefore, the study selected this area purposively for its high potential, large exotic breed distribution and accessibility.

Sampling Procedures and Data Sources

Sampling design and procedure

From Western part of the Amhara region, the study considers all zones (East Gojjam, West Gojjam, Awi and South Gondar). A multi-stage random sampling technique was employed. First two Woredas from each Zone were selected randomly. Second two kebeles were selected randomly from randomly selected Woredas. Third, smallholder poultry producers were selected randomly based on representativeness of the population and finally sampled farmers were interviewed using semi structured questionnaire. The main reason for using this procedure was to avoid sample biasedness so that our sample can represent the entire population.

Data Sources and Collection Methods

In this study both primary and secondary data were used. The primary data were collected by taking the sample poultry producers through semi-structured questionnaire prepared for this purpose. In addition to the semi-structured questionnaire, personal observations and group discussion were made using checklists. The enumerators who speak the local language (Amharic) were recruited who are research assistants of the research center and experienced in methods of data collection and interviewing techniques. Moreover, the researcher explained the contents of the questionnaire to the enumerators. The questionnaire was pre-tested and the contents were revised based on the feedbacks obtained during the pre-test. Collection of primary data was made in different ways using semi-structured questioners and checklists. Trained enumerators made interview with sample respondents using the questionnaire and the researcher made personal observations and informal discussions with the experts and key informants. Continuous supervision was made to reduce error during data collection and to correct possible errors right on the spot.

Techniques of Data Analysis

Based on the objectives of the study appropriate tools and techniques of analysis such as descriptive statistics and Double hurdle model was employed.

Descriptive analysis

Demographic and socio-economic conditions of sample households and institutional factors in the study areas were analyzed by using descriptive statistics like mean, standard deviations and percentages

Econometric analysis

A feature of many models of technology adoption, for example straightforward binary or censored data models, is that the process, which results non-adoption, is assumed to be the same as that which determines the intensity of adoption. Thus, for example, if a given farmer's characteristic is known to have a positive effect on the extent of adoption, then a very high value of this characteristic would inevitably lead to the prediction of adoption for such farmer. While such assumptions may turn out to hold, there is no reason to expect this apriori. One reason why such an assumption might fail is that there may exist a proportion of the population of farmers who would out of principle, never adopt under any circumstances.

In principle, the decisions on whether to adopt and how much to adopt can be made jointly or separately (Berhanu and Swinton 2003). The Tobit model used to analyse under the assumption that the two decisions are affected by the same set of factors (Greene 1993). In the double-hurdle model, on the other hand, both hurdles have equations associated with them, incorporating the effects of farmer's characteristics and circumstances. Such explanatory variables may appear in both equations or in either of one. Most importantly, a variable appearing in both equations may have opposite effects in the two equations. The double-hurdle model, originally due to Cragg (1971), has been extensively applied in several studies such as Burton et al (1996) and Newman et al (2001). However, this model has been rarely used in the area of adoption of agricultural technologies; an exception would be Berhanu and Swinton (2003).

The double-hurdle model is a parametric generalization of the Tobit model, in which two separate stochastic processes determine the decision to adopt and the level of adoption of technology.

The double-hurdle model has an adoption (D) equation:

$$\left.\begin{array}{l} Di = 1 if Di^* > 0 and 0 if Di^* < 0 \\ Di = \alpha' Zi + ui \end{array}\right\}$$

being D* a latent variable that takes the value 1 if the farmer adopts exotic poultry breed and 0 otherwise, Z is a vector of household characteristics and α is a vector of parameters. The level of adoption (Y) has an equation of the following

$$\left.\begin{array}{l} Yi = Yi^* if Yi^* > 0 and Di^* > 0 \\ Yi = 0 otherwise \\ Yi^* = \beta' Xi + Vi \end{array}\right\}$$

where Yi is the observed answer to the proportion of exotic poultry breeds, X is a vector of the individuals characteristics and β is a vector of parameters. The error terms Ui and Vi are distributed as follows

$$\left.\begin{array}{l} Ui \approx N(0,1) \\ Vi \approx N(0,\delta^2) \end{array}\right\}$$

The log-likelihood function for the double-hurdle model is:

$$LogL \sum_0 \ln\left[1-\Phi(\alpha Zi')\left(\frac{\beta Xi'}{\sigma}\right)\right] + \sum_+ \ln\left[\Phi(\alpha Zi')\frac{1}{\sigma}\phi\left(\frac{Yi-\beta Xi'}{\sigma}\right)\right]$$

under the assumption of independancy between the error terms U_i and Vi the model (as originally proposed by cragg, 1971) is equivalent to a combination of a truncated regression model and a univariate Probit model.

Statistical Tests of Multicollinearity and Hetroschedasticity Problem

Before executing the econometric model, all the hypothesized explanatory variables were checked for the existence of multicollinearity problem. Different methods are often suggested to detect the existence of multicollinearity problem. Among them, variance inflation factor (VIF) technique will be employed in the present study to detect the existence of multicollinearity in continuous explanatory variables (Gujarati, 2004). Breusch-Pagan / Cook-Weisberg test was used for identifying heteroskedasticity problem.

RESULTS AND DISCUSSION

Demographic Characteristics of the Households

According the study (Table 1), 20.7% of female headed and 79.3 % male headed households are engaged in poultry production. This indicates that the majority of the female headed households are engaged in poultry production as the proportion of female headed households in any kebeles is less than 10%. Most (76.2%) of the households engaged in poultry production were married and the remaining (never married, divorced and widowed) mainly women and youngsters are also engaged in poultry production. Almost all (99.1%) of the poultry producers are Orthodox Christians this is because most of the farmers in the western Amhara Region are Orthodox Christians. The majority of poultry producers (61.3%) are either illiterate or with adult education. while

Table 1. Demographic characteristics of the households

Variables	Attributes	Frequency (%)
Sex	Female	20.7
	Male	79.3
Marital status	Married	76.2
	Single	6.8
	Divorced	13.3
	Widowed	3.7
Religion	Orthodox	99.1
	Muslim	0.5
	Protestant	0.5
Education status	Illiterate	31.8
	Read and write	29.5
	1-4 grade	9.2
	5-8 grade	19.8
	9-10 grade	8.8
	11-12 grade	0.9

Source: own estimation, 2014

Table 2. Household's awareness on exotic poultry breeds

Variables	Category	Frequency (%)
Tried exotic poultry breeds	Yes	84.3
	No	15.7
Which breeds you tried	White leg horn (WLH)	16.8
	Red iland rod (RIR)	18.2
	WLH and RIR	49.3

Source: own estimation, 2014

only 39.7% of the respondents were with modern education.

Awareness on Exotic Poultry Breeds

In the study area producers are aware of two exotic poultry breeds the White leg horn (WLH) and Rod iland rod (RIR). Producers are aware of the WLH breeds before the RIR breeds. Producers are aware of the WLH breeds starting from 1992 GC and adoption of the breed starts from 1995 while for the RIR breed awareness and adoption year is 1996 GC. This indicates that producers took three years from the awareness year to adopt the WLH exotic breed. However, once they start adopting new breeds awareness year and adoption become similar (Table 2)

Exotic Poultry Breed Adoption

Among the total of respondents non adopter, discontinued and adopter account 41.9%, 18.4% and 39.6% respectively. Non adopters indicate those producers who do not try the exotic breeds at all while the discontinued indicates those producers who tried the exotic breeds but totally stopped producing exotic poultry breeds due to some reasons. The adopters indicate those producers who are still in exotic poultry production either in pure or cross breed forms. The main reasons for discontinued in using the exotic poultry breeds are lack of sustainable supply of the breed (43.2%), disease and improved feed problem (48.6%) and predation problem, lack of training and a combinations of the mentioned problems account (8.1%).

Additional Packages Adoption

The use of additional packages in exotic poultry production increases the survival of the breeds. Moreover, the use of improved package improves the productivity and reproductive performance of the breeds. However, in this study only 40.6 % of the exotic poultry breed adopters use additional packages see Table 3.

Perceptions of Farmers on Day Old Chicks (DOCs) Distribution

According to the Amhara Regional Agricultural Office, in Amhara Region attempts have been made at various times to improve local chicken production through introduction of exotic chicken breeds. Distribution of pullets and cockerels has been one of the poultry extension packages accomplished by the Regional Agricultural Office for long periods. However, the method creates a challenge in addressing many areas in short period of time and this method of distribution failed to address the goal of the government as well as interested areas of the region. Thus, the Regional Agricultural Office forced to search a new method of distribution to address wider area which is day old chicks (DOCs) distribution.

Table 3. Additional packages used by the households

Package type used	Frequency (%)
Improved feeding	1.8
Improved health (vaccination and medication)	3.0
Hey box brooder	0.9
Improved housing	1.9
Improved feeding and improved housing	6.9
Improved feeding and improved health	8.5
Improved feeding, improved housing and improved health	15.3
All of mentioned packages	2.3

Source: own estimation, 2014

Table 4. Sources of information related to poultry production

Type of participation related to poultry	Category	Frequency (%)
Extension package	Yes	28.1
	No	71.9
Research activity	Yes	4.6
	No	95.4
Workshop	Yes	6.9
	No	93.1
Training	Yes	12.9
	No	87.1

Source: own estimation, 2014

Despite the huge effort to address wider area using day old chick's distribution, the method is highly criticized by smallholder poultry producers. All (100 %) of the farmers do not like DOCs distribution and only 7.98% of distributed DOCs reach to young chickens (2 month age) at smallholder level. There are so many problems associated with this lower survival rate such as no electric facility in rural areas, lack of training, poor feeding and management chicken production system at smallholder level.

Exotic Poultry Production and Management Systems

The study indicated that 59.4% of exotic poultry breeds are managed under free scavenging systems. Producer's mange exotic breeds like that of indigenous breeds as they have lower awareness on improved management systems. The remaining 40.6% of exotic poultry breeds are managed under free scavenging systems with supplementations. This study confirms that the majority of poultry breeds reared by small holder farmers are indigenous breeds accounting 71.6% from the total population. The cross breeds and exotic breeds account 20.6% and 7.8% respectively.

Training and Extension Services

The majority of small holder poultry producers do not have access to trainings and extension services (Table 4). None of the producers have accessed a training or extension service focused on poultry production system. Those producers who have got the service took the training and extension services together with disciplines such as crop and animal production.

Access to Inputs for Improved Poultry Production

Sustainability of improved poultry production is highly associated with continuous supply and accessibility of the inputs to the smallholder producers. The most important inputs in improved livestock production include supply exotic breed, improved feed, vaccine and medicaments and credit. According to the study 100% of the farmers say there is problem in accessibility of inputs in terms of timely availability, the required quality and the required amount.

Factors Affecting Adoption of Exotic Poultry Breeds

Before executing the econometric model, all the hypothesized explanatory variables were checked for the existence of multicollinearity problem using variance inflation factor (VIF) and also Breusch-Pagan / Cook-Weisberg test was used for identifying heteroskedasticity problem. In this data set there was no observed multicollinearity and heteroskedasticity problem.

Out of the twelve variables hypothesized to affect adoption decision only seven variables are significant (Table 5). sex of the household head significantly affects the exotic breed adoption decisions. Female headed households have 17.1% predicted probability to adopt exotic poultry breed this might be due to the fact that females in the area mainly found in home and take care of the chickens. Family size has also a significant effect

Table 5. Factors affecting adoption of exotic poultry breeds

Probit regression		Number of obs.= 217		
		Wald chi2(12) = 54.77		
Log pseudo likelihood = -88.478		Prob > chi^2 = 0.0000		
		Pseudo R^2 = 0.3232		
Variables	**Coeff.**	**Marginal effect**	**Std.Err**	**Z-value**
Sex	-.440***	-.171	.287	-3.53
Education level	.190	.071	.234	0.82
Age	-.002	-.0006	.0009	-0.17
Family size	.078*	.029	.046	1.72
Distance from road	- .208*	-.078	.107	-1.95
Distance from town	-.092*	-.034	.053	-1.74
TLU	-.040	-.015	.025	-1.56
Number of poultry soled	.346**	.298	.456	2.07
Management system /add. package/	1.469***	.554	.240	6.11
Membership in formal organization	-.166	-.063	.286	-0.58
Access to training	.051***	.019	.240	4.20
Access to credit	.113	.042	.285	0.40
Constant	-.033	-	.663	-0.07

Note: *, ** and *** means significant at 10%, 5% and 1% probability levels
Source: own estimation, 2014

Table 6. Factors affecting intensity of adoption of exotic poultry breeds

Tobit regression			Number of obs = 87		
			LR chi2(12) = 67.36		
Log likelihood = -126.7419 Pseudo R2 = 0.210			Prob > chi2 = 0.0000		
Variables	**Coeff.**	**dy/dx**	**Std.Err**	**t-value**	
Sex	-.109**	-.109	.157	-2.70	
Education	.054	.054	.137	0.39	
Age	-.0008	-.0008	.005	- 0.16	
Family size	.008	.008	.026	0.32	
Distance from road	-.0048**	-.0048	.022	-2.18	
Distance from town	-.021**	-.021	.031	-2.66	
TLU	.016	.016	.015	1.06	
Poultry sold	.038***	.037	.182	3.21	
Management system /add. package/	.90***	.899	.140	6.42	
Training	.001***	.0014	.142	3.01	
Access to credit	.051	.052	.162	0.32	
Year of adoption	0.021**	0.02	0.001	2.16	
Constant	-.697	-	.324	-0.15	

Note: *, ** and *** means significant at 10%, 5% and 1% probability levels
Source: own estimation, 2014

on adoption. Households having higher family size have the probability to adopt the exotic breeds.

Distance to roads and town have a significant and negative impact on the predicted probability of adoption of exotic poultry breeds. The reason is that this factors are highly associated with access to information and market. Thus, farmers who have access to information and market are more likely to adopt exotic poultry breeds. Numbers of poultry sold in the market per year have also a significant effect on adoption of the exotic breeds. Every increase in the number of poultry sold increases the predicted probability of adopting exotic breeds by 29.8%.

The use of additional packages is also one of the significant variables affecting adoption. It increases the predicted probability of adopting exotic poultry breeds by 55.4%. This is because the use of additional packages such as improved feeding, housing, vaccination and medication improves the survival as well as reproductive performances of exotic poultry breeds. Access to training has also a significant impact on the probability of adopting exotic breeds. Those farmers who have accessed training are more likely to adopt the breeds the reason is that training increases the knowledge of producers which in turn helps them to undertake informed decisions.

Factors Affecting Intensity of Adoption of Exotic Poultry Breeds

Out of the twelve variables hypothesized to affect intensity adoption of exotic poultry breeds only seven variables are significant (Table 6). Sex of the household head significantly affects the intensity of exotic breed adoption.

Female headed households increase the expected proportion of exotic poultry breeds by 10.9%. Distance to roads and town have a significant and negative impact on the expected proportion of exotic poultry breeds. Number of poultry soled have also a significant effect on adoption of the exotic breeds. Every increase in the number of poultry sold increases the expected proportion of exotic poultry breeds by 3.7%.

The use of additional packages is also one of the significant variable affecting intensity of adoption. It increases the expected proportion of exotic poultry breeds by 89.9%. Access to training has also a significant impact on the expected proportion of exotic poultry breeds. Year of adoption has also a significant and positive impact on intensity of adoption. It increases the expected proportion of exotic poultry breeds by 2%.

CONCLUSION And RECOMMENDATION

The study was conducted in Western part of the Amhara region, the study consider all East Gojjam, West Gojjam, Awi and South Gondar zones. The main objective of the study focused on finding factors affecting the adoption of exotic poultry breeds in the Region. A multi-stage random sampling technique was employed. Both descriptive and econometrics analysis were used. For the econometric analysis double hurdle model was used. Despite the huge effort by the government as well as NGOs to improve traditional poultry production through introduction of exotic poultry breeds with full packages, adoption of exotic poultry breed is very minimal accounting only 7.8% of the population from the total chicken production. The reasons for low adoptions are lack of sustainable supply of the breed, disease, predation, feed problem, poor awareness on breeds, lack of extension service, lack of training and market problem. Among the distributed DOCs only 7.98% of the DOCs survived to become 2 months of pullet while the remaining died before being pullet of age 2 months. This indicates that under smallholder condition DOCs distribution is not effective.

Among the hypothesized factors only sex, family size, distance from road, distance from town, management system /additional packages such as improved feeding and management /, number of poultry sold per year in the market and access to training significantly affected households decision to adopt exotic poultry breeds. Among the hypothesized factors only sex, distance from road, distance from town, management system, number of poultry soled, access to training and year of adoption significantly affected the intensity of adoption exotic poultry breeds. Therefore this study recommends provision of training and extension service about breed, management, feeding and health aspects before technology distribution, improving sustainable supply of the exotic poultry breed, distribution of technologies (exotic poultry breed) for women and resource poor farmers, distribution of technologies for market accessible areas. Finally, this study strongly recommends pullets (2 months age exotic poultry breeds) distribution either through out-growers model or poultry multiplication centers rather than investing much on the less effective DOCs distribution.

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