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# DETERMINANTS OF VILLAGE POULTRY TECHNOLOGY PACKAGE ADOPTION; LIMITATIONS, CONSTRAINTS AND OPPORTUNITIES IN THE CENTRAL OROMIA REGION, ETHIOPIA

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**ABSTRACT**

This study was conducted to investigate the determinant factors that influence probability of village poultry technology package elements adoption, and to identify major limitations and constraints influencing the technology adoption in the central Oromia Region, Ethiopia. One hundred eighty (180) village poultry technology package participants were selected using multi-stages random sampling method. Structured questionnaire were used for face to face interview data collection. Binary logistic regression model using univariate and multivariate regression analysis procedures were employed. The study revealed the overall village poultry technology elements adoptions were influenced by extension services ($P<0.001$), healthcare services ($P<0.05$) and training services ($P<0.001$). Absence veterinary clinic at proximate distance, unavailability proper chicken feeding and watering equipments were the major limitations that negatively influenced the technology adoption. Similarly, chicken health problem (Newcastle disease), lack of vaccines and medicaments, shortage of improved chicken breeds and lack of balanced chicken ration were the major constraints that affected the extent of technology adoption. Therefore, to increase the probabilities of farmers' decision to adopt village poultry technology package, more attention should be given to extension, healthcare and training services, and technical, financial, managerial and market supports were the majorly needed.



## INTRODUCTION

In Ethiopia, the livestock development extension technology packages have been initiated since 1970's (Ibrahim, 2004) and the new packages approach was started in 1997 (Mekonnen, 2005). The objectives of technology packages were increasing food production, increasing household income, ensuring food security and developing of the national economy (Mekonnen, 2005). Research organizations, Ministry of Agriculture and NGOs have been distributed exotic chicken breeds to rural farmers and urban based small-scale chicken producers to meet the objectives. Millions of improved chicken breeds have been distributed (Yami and Dessie, 1997; Teklewold *et al.*, 2006). The extension programs mainly promote exotic chicken breed distribution that performs better than local breeds in terms of meat and egg production. The scheme involves mainly distributing of 5 pullets and a cockerel to individual farmer with extension follow up and technical support on improved poultry feeding, watering, and housing and disease control (Teklewold *et al.,* 2006). These improved chicken breeds, improved poultry feeding, housing, watering and improved healthcare managements were the elements of village poultry technology package. Village poultry technology package elements adoption may varies across agro-ecologies. Moreover, socio-economic characteristics, inputs supply, technical supports, technology characteristics, limitations and constraints may influence the probability of the technology elements adoption. Understanding of the technology characteristics, limitations, constraints and adoption opportunities may help to improve the technology approach for better successes. Logit regression model can provide empirical estimates of how exogenous variables influence the probability of technology adoption (Nkonya *et al.*, 1997). Even though, efforts have been made by disseminating technology inputs in different agro-ecologies of the country, the determinant factors of village poultry technology package elements and overall technology adoption were not effectively studied so far. Therefore, this study was

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conducted to investigate the determinant factors that influence village poultry technology package elements adoption, and to identify major limitations and constraints that influencing the probability of adoption.

## MATERIALS AND METHODS

### Description of the study areas

This study was conducted in the central part of Oromia Region, Ethiopia located between 3°24'20" to 10°23'26"N latitudes and 34°07'37" to 42°58'51"E longitudes (OBoFED, 2008). The region is characterized by vast geographical and climatic diversity having three major climatic categories called dry, tropical rainy and temperate rainy climates. Wolmera, Ade'a and Boset Woredas (districts) are located between 8°00' to 9°30'N latitudes and 38°00' to 40°00'E longitudes (DPPA, 2006). The districts are majorly characterized by highland, mid-altitude and lowland agro-ecologies, respectively.

### Sampling procedures and data collection

Purposive sampling method was used to select the study Woredas (districts). Based on their agro-ecology and so far poultry technology package interventions (CSA, 2012), three best Woredas (Wolmera, Ade'a and Boset) were purposely selected. From each Woreda, 5 Kebeles (farmer administration areas) were randomly selected based on technology package interventions. Then, using multi-stages random sampling method, 180 male and female village poultry technology participants (12 participants per Kebele) were selected from participant lists and used for the study.

Structured questionnaire were used for face to face interview. The questionnaire were pre-tested and adjusted prior to the actual survey. The selected explanatory variables for data collection were: sex, age, family size, annual income, education level, agro-ecology, landholding, crop production, chicken farming experience, technology experience, frequency of technology received, credit service, extension services, distance of veterinary clinic, healthcare services, training and market distance. Agricultural development agents (DAs) who work in the Kebeles were trained and involved as enumerator together with the participation the researchers. Face to face interview method was used to collect information from each respondent.

### Statistical analysis

Categorical data sets were analyzed using SPSS version 20.0 software package. Ranked variables were analyzed by SAS version 9.0 using NPAR1WAY Wilcoxon procedure of Kruskal Wallis test and ranked means were analyzed using SAS means procedure. To locate the significant difference among means, LSD mean comparison tests was used. Similarly, chi-square test was used to test the significance level of categorical variables.

### *Theoretical framework*

This study hypothesized that social-economic characteristics of the respondents, accessibility of technology inputs, technical services and characteristics of technology might influence the probability of village poultry technology package elements and the overall technology adoption. The respondent sex, age, family size, annual income, education level, agro-ecology, landholding, crop production, chicken farming experience, technology experience, frequency of technology received, credit service, extension services, distance of veterinary clinic, healthcare services, training and market distance might influence the decision of the respondent to adopt the technology. Logit regression model can provide empirical estimates of how these exogenous variables influence the probability of technology adoption (Nkonya *et al.*, 1997).

### *Analytical framework*

In the current study, the response variable is dummy variable (adopter =1 or non-adopter =0). If the farmer adopted each of the technology element and the overall elements of the technology, he or she was defined as 1 otherwise 0. Since the response variable is dummy variable, binary logistic regression model was used to assess the influence explanatory variables on technology adoption because binary logistic model does not make assumption of linearity between dependent and independent variables; moreover, the model does not require normally distributed variables (Jera and Ajayi, 2008). Prior to regression analysis, correlation analysis between explanatory variables was done to see whether there is any multi-collinearity problem existed between variables. The binary logistic regression model used in the study was adopted from Quddus (2012) as follows:

$$P = P\left(Y = {}^{1}/_{X}\right) = \frac{e^{\beta_o + \sum_{i=1}^{17} \beta_i X_i}}{1 + e^{\beta_o + \sum_{i=1}^{17} \beta_i X_i}} \quad \text{………… (1)}$$

And

$$1 - P = P(Y - 0/X) = \frac{1}{1 + e^{\beta_o + \sum_{i=1}^{17} \beta_i X_i}} \quad \text{…………. (2)}$$

The logit transformation of the probability of adoption, P(y=1) can be defined as:

$$\text{LogitP} = \log\left[\frac{1}{1-P}\right] = \beta_o + \sum_{i=1}^{17} \beta_i X_i \quad \text{……….. (3)}$$

In the model:

$Y_i$ : Adoption level of the technology element: 0= non-adopter, 1 =adopter;

$\beta_0$ = The intercept; $\beta_1 \dots \beta_{17}$ = Regression coefficients; *e* = The base of natural logarithm;

$\chi_1$: Sex: 1=Male, 2= Female; $\chi_2$: Age: 1= Up to 30 years, 2=31-40 years, 3=41-50 years, 4= >50 years; $\chi_3$: Family size:1= <4, 2=4-6, 3= > 6; $\chi_4$: Annual income: 1= <25,000Birr, 2=25,000-50,000 Birr,3= >50,000 Birr; $\chi_5$: Education level: 1=Illiterate, 2=Basic education, 3=Elementary education,4=Secondary education and above; $X_6$:Agro-ecology: 1=Highland, 2=Mid-altitude, 3=Lowland; $X_7$: Landholding:1=0-1ha, 2=1.1-2ha, 3= >2ha; $X_8$: Crop production affects the technology adoption:0=No, 1= Yes; $X_9$: Chicken farming experience: 1= up to15 years, 2=16-30 years, 3= >30 years; $X_{10:}$ Technology experience: 1= Up to 5 years, 2=6-10 years, 3= >10 years; $X_{11}$: Frequency of technology received: 1=Once, 2=Twice, 3= More than twice; $\chi_{12}$: Get credit service: 0=No, 1=Yes; $\chi_{13}$: Get appropriate extension services: 0=No, 1=Yes; $\chi_{14}$:Distance of veterinary clinic:1= Up to 10km, 2=11-20km, 3= >20km; $\chi_{15}$:Get appropriate health care services: 0=No, 1=Yes; $\chi_{16}$: Get training before starting the technology: 0=No, 1=Yes; $\chi_{17}$: Market distance: 1=Up to 7km, 2= 8-14km, 3= >14 km

Cross-tabulation analyses were used to identify the reference for each explanatory variable category. Two stages logistic regression analyses procedures were used to assess the influence of explanatory variables on technology elements adoption. First univariate logistic regression analysis was performed. According to Hosmer and Lemeshow (2000) and Bursac *et al.* (2008), explanatory variables having P<0.25 were selected as candidate variables for multivariate analysis. Secondly, multivariate logistic regression analysis was carried out. In multivariate analysis, first all the predictors were taken into the model and backward likelihood (BL) elimination procedure with Hosmer and Lemeshow goodness-of-fit test. If Hosmer and Lemeshow goodness-of-fit test was not significant (P>0.05) and if the intercept was significant (P<0.05), the model was fit well to the data according to Peng *et al.* (2002). Finally, significant and confounder variables were kept for the final model.

## RESULTS AND DISCUSSION

### Socio-economic characteristics of the respondents

The respondents used in this study were 65.6% male and 34.4% female farmers. The age of the respondents ranges from 19-74 years with a mean of 42 years, where most (35.0%) of the respondents were under 31-40 years of age category. The family size of the respondents ranges from 1-12 with a mean of 6 family sizes per household, where most of the respondents (48.9%) have a family size of 4-6. About 30.6%, 33.3% and 36.1% of the respondents have total annual income of <25,000, 25,000-50,000 and >50,000 Ethiopian Birr, respectively. Regarding educational level, most (75.1%) the respondents attended either elementary or above education. About 39.9% of the respondents hold no or less than 1 hectare farmland. About 70.6% of the respondents received village poultry technology package inputs twice and more times. About 53.9% the respondents have 6 and more years of technology participation experiences but only 3.3% of the respondents got credit service for the technology. About 39.4% and 60.6% of the respondents were adopter and non-adopters of the technology, respectively.

### Determinants of technology elements adoption

The Pearson square correlation analysis result shows that the correlation coefficient between explanatory variables ranges from -0.26 to 0.56. The correlations existed between most explanatory variables were very weak. However, there were significantly (P<0.01) average correlations existed between landholding and age (0.54), chicken farming experience and age (0.56) and frequency of technology input received and technology experiences (0.50). Therefore, there was no multi-collinearity problem existed between explanatory variables.

### *Determinants of improved chicken breeds adoption*

Multi-vitiate logistic regression result shows that the probability of improved chicken breeds adoption was significantly and positively influenced by agro-ecology, technology experience of the farmer, frequency of technology received, extension services, training and healthcare services (Table 1). In agreement, Teklewold *et al.* (2006) reported that extension contact and poultry technology experience of farmers positively influenced exotic chicken breed adoption. Similarly, Zanu *et al.* (2012) reported that improved pig technology adoption was associated with extension contact, scientific orientation and training, and Dehinenet *et al.,* (2014) reported that extension services were positively associated with crossbred dairy technology adoption. In the current study age couldn't significantly influenced the probability of improved chicken breeds adoption. In contrary, Teklewold *et al.* (2006) reported that farmers' decision to adopt of exotic chicken breed negatively influenced by age of household head.

Technology participants found in the highland agro-ecology 3.2 times more likely (P<0.05) decided to adopt improved chicken breeds as compared to farmers found in the lowland agro-ecology. Technology experiences and frequency of technology received were interrelated with chicken breed adoption and they significantly influenced the likelihood of chicken breed adoption. In agreement, Quddus (2012) reported that technology experience had interrelation with dairy technology adoption. In the current study, respondents who had more than 10 years technology experiences (P<0.01) 8.4 times more likely decided to adopt improved chicken breeds as compared to farmer who had up to 5 years technology experiences. The probability of improved chicken breed adoption was 6.5 times (P<0.01) influenced as a result of getting healthcare services. Generally, the in model Psuedo $R^2$ (Nagelkerke $R^2$=0.544) estimation implies the variables in the model could explain about 54.4% of the probability farmer's decision to adopt or not to adopt improved chicken breeds.

### *Determinants of improved chicken feeds and feeding adoption*

The probability of improved chicken feeds and feeding technology adoption was more likely influenced by educational level of farmers, frequency of technology received and getting training service before starting the technology (Table 2). Farmers who educated elementary education by 2.2 times more likely and farmers who educated secondary and above education by 5.7 times were more likely decided to adopt improved chicken feeds and feeding technology as compared to the illiterate farmers. In lined with this, literate household heads were more likely to adopt the utilization of commercial concentrates for small ruminants in the highland of Ethiopia (Legesse *et al.,* 2013) and Zanu *et al.* (2012) reported that improved pig technologies adoptions in Ghana were associated with education. Farmers who received the technology more than twice 3.4 times more likely (P<0.05) decided to adopt improved chicken feeds and feeding technology as compared to those farmers who received the technology only once. Similarly, providing training service before farmers started the technology (P<0.001) increased the probability of village poultry feeding technology by 12.3 folds.

**Table 1. Multivariate logistic regression analysis result of improved chicken breeds adoption**

| Variable | β | SE | Wald | P | OR | 95% CI |
|---|---|---|---|---|---|---|
| Agro-ecology | | | | | | |
| Lowland | | | | | 1 | |
| Mid-altitude | 0.386 | 0.536 | 0.520 | 0.471 | 1.471 | 0.515-4.203 |
| Highland | 1.164 | 0.536 | 4.724 | 0.030 | 3.203 | 1.121-9.148 |
| Technology experience | | | | | | |
| Up to 5years | | | | | 1 | |
| 6-10years | 0.086 | 0.541 | 0.026 | 0.873 | 1.090 | 0.378-3.148 |
| >10years | 2.132 | 0.713 | 8.947 | 0.003 | 8.429 | 2.085-34.070 |
| Frequency of technology received | | | | | | |
| Once | | | | | 1 | |
| Twice | 1.642 | 0.595 | 7.625 | 0.006 | 5.164 | 1.610-16.560 |
| >Twice | 1.877 | 0.735 | 6.516 | 0.011 | 6.531 | 1.546-27.589 |
| Get extension services | 1.452 | 0.481 | 9.103 | 0.003 | 4.270 | 1.663-10.966 |
| Get healthcare services | 1.876 | 0.470 | 15.953 | 0.000 | 6.530 | 2.600-16.399 |
| Get training before | 1.569 | 0.524 | 8.957 | 0.003 | 4.804 | 1.719-13.427 |
| Constant (intercept) | -5.358 | 0.899 | 35.508 | 0.000 | 0.005 | |

CI= Confidence interval; OR= Odds ratio; P=probability; β=Regression coefficient; SE=Standard error; Model summary: Nagelkerke $R^2$=0.544; Hosmer and Lemeshow test: $\chi^2$=5.173; P=0.739

**Table 2. Multivariate logistic regression result of improved chicken feeds and feeding adoption**

| Variable | β | SE | Wald | P | OR | 95% CI |
|---|---|---|---|---|---|---|
| Educational level | | | | | | |
| Illiterate | | | | | 1 | |
| Basic education | 0.608 | 0.936 | 0.422 | 0.516 | 1.837 | 0.293-11.496 |
| Elementary | 0.800 | 0.862 | 0.862 | 0.353 | 2.226 | 0.411-12. 057 |
| Secondary + | 1.732 | 0.848 | 4.169 | 0.041 | 5.650 | 1.072-29.783 |
| Frequency of technology received | | | | | | |
| Once | | | | | 1 | |
| Twice | 1.142 | 0.517 | 4.877 | 0.027 | 3.134 | 1.137-8.638 |
| >Twice | 1.225 | 0.555 | 4.873 | 0.019 | 3.404 | 1.147-10.098 |
| Get training before | 2.541 | 0.638 | 15. 842 | 0.000 | 12.343 | 3.632-44.365 |
| Constant (intercept) | -4.934 | 1.109 | 19.831 | 0.000 | 0.007 | |

CI= Confidence interval; OR= Odds ratio; P=probability; β=Regression coefficient; SE=Standard error; Model summary: Nagelkerke $R^2$=0.371; Hosmer and Lemeshow test: $\chi^2$= 8.659; P=0.372

### *Determinants of improved chicken housing adoption*

The technology participants were recommended by professionals to construct appropriate chicken house and to practice proper housing systems. The probability of improved chicken housing adoption was significantly influenced by annual income, landholding, getting extension, healthcare and training services (Table 3). As the farmer's annual income increases, the likelihood of farmer's decision to adopt improved chicken housing increases too. This indicates, a farmer who gets a better annual income can have a better probability to buy chicken house constructing materials and can construct the recommended house.

In agreement, farmers who have better income could more likely decide to adopt resource conserving agricultural technologies (Grazhdani, 2013) and according to Sanzidur (2003) the Chayanovian peasant economy theory, the higher subsistence pressure increases the tendency to adopt new technology. Farmers who hold small farmland or rented farmland could 4.4 times more likely (P<0.001) decided to adopt improved chicken housing as compared to farmers who hold more than 2 ha farmland. In agreement, (Grazhdani, 2013) reported that farmers having farm size between 1 and 2 ha significantly adopted resource conserving agricultural technologies as compared to farmers who have more than 2 ha farmland. This indicates agricultural technologies intensification on the available farmland. Farmers who had better farm size might focus on farming activates that can need large area of farmland. Therefore, if better technology opportunities will be given for farmers who had no or less farmland, they can conduct intensive chicken production using the small available farmland.

### *Determinants of chicken healthcare adoption*

Agro-ecology, frequency of technology received, getting extension, healthcare and training services and distance of veterinary clinic were the determinant factors that significantly influenced of the probability of chicken healthcare adoption (Table 4). The probability of chicken healthcare adoption was influenced by 4.1 folds through getting extension services (P<0.05). In lined with this study, access to extension information could influence a farmer's decision to adopt a new technology (Degu, 2012). Also Zanu *et al.* (2012) reported that extension contact, farm education exposure and training positively influenced the likelihood of pig technology adoption. The likelihood of farmer decision to adopt chicken healthcare was better in the highland and mid-altitude. Technology participants found in the mid-altitude by 13.4 folds more likely (P<0.001) adopted chicken healthcare as compared to technology participants found in the lowland agro-ecology. This might be the proximity of Ade'a Woreda to poultry production belt areas of the country, better farmers' awareness levels, accessibility of chicken vaccines, drugs and availability of experienced professionals.

**Table 3. Multivariate logistic regression analysis result of improved chicken housing adoption**

| Variable | β | SE | Wald | P | OR | 95% CI |
|---|---|---|---|---|---|---|
| Annual income | | | | | | |
| <25,000 Birr | | | | | 1 | |
| 25,000-50,000 Birr | 0.540 | 0.458 | 1.391 | 0.238 | 1. 717 | 0.699-4.213 |
| >50,000 Birr | 1.181 | 0.484 | 5.944 | 0.015 | 3.258 | 1.261-8.421 |
| Landholding | | | | | | |
| 0-1ha | 1.492 | 0.462 | 10.443 | 0.001 | 4.444 | 1.798-10.982 |
| 1.1-2.0 ha | 0.866 | 0.496 | 3.045 | 0.081 | 2.376 | 0.899-6.282 |
| >2.0 ha | | | | | 1 | |
| Get extension services | 0.785 | 0.398 | 3.886 | 0.049 | 2.192 | 1.005-4.785 |
| Get healthcare services | 0.846 | 0.387 | 4.777 | 0.029 | 2.331 | 1.091-4.979 |
| Get training before | 1.450 | 0.461 | 9.906 | 0.002 | 4.263 | 1.728-10.515 |
| Constant (intercept) | -3.658 | 0.728 | 25.242 | 0.000 | 0.026 | |

CI= Confidence interval; Ha=Hectare; OR= Odds ratio; P=probability; β=Regression coefficient; SE=Standard error; Model summary: Nagelkerke $R^2$=0.409; Hosmer and Lemeshow test: $\chi^2$= 9.555; P=0.298

**Table 4. Multivariate logistic regression analysis result of chicken health care adoption**

| Variable | β | SE | Wald | P | OR | 95% CI |
|---|---|---|---|---|---|---|
| Agro-ecology | | | | | | |
| Lowland | | | | | 1 | |
| Mid-altitude | 2.593 | 0.744 | 12.133 | 0.000 | 13.374 | 3.108-57.540 |
| Highland | 0.894 | 0.634 | 1.987 | 0.159 | 2.445 | 0.705-8.474 |
| Frequency of technology received | | | | | | |
| Once | | | | | 1 | |
| Twice | 0.136 | 0.670 | 0.041 | 0.839 | 1.146 | 0.308-4.258 |
| >Twice | 1.221 | 0.704 | 3.003 | 0.083 | 3.389 | 0.852-13.479 |
| Get extension services | 1.401 | 0.615 | 5.180 | 0.023 | 4.058 | 1.215-13.556 |
| Get healthcare services | 1.637 | 0.497 | 10.867 | 0.001 | 5.142 | 1.942-13.613 |
| Get training before | 1.563 | 0.698 | 5.012 | 0.025 | 4.775 | 1.215-18.768 |
| Veterinary clinic distance | | | | | | |
| Up to 10 km | 1.859 | 0.591 | 9.889 | 0.002 | 6.417 | 2.014-20.440 |
| 11-20km | 1.894 | 0.918 | 4.256 | 0.039 | 6.644 | 1.099-40.164 |
| >20km | | | | | 1 | |
| Constant(intercept) | -7.179 | 1.280 | 31.467 | 0.000 | 0.001 | |

CI= Confidence interval; OR= Odds ratio; P=probability; β=Regression coefficient; SE=Standard error; Model summary: Nagelkerke $R^2$= 0.473; Hosmer and Lemeshow test: $\chi^2$= 6.218; P=0.623

**Table 5. Multivariate logistic regression result of provision of water adoption for chicken**

| Variable | β | SE | Wald | P | OR | 95% CI |
|---|---|---|---|---|---|---|
| Educational level | | | | | | |
| Illiterate | | | | | 1 | |
| Basic education | -0.302 | 0.998 | 0.092 | 0.762 | 0.739 | 0.104-5.232 |
| Elementary | 0.831 | 0.872 | 0.908 | 0.341 | 2.295 | 0.416-12.671 |
| Secondary+ | 1.841 | 0.861 | 4.579 | 0.032 | 6.306 | 1.167-34.060 |
| Family size | | | | | | |
| <4 | 1.638 | 0.671 | 5.955 | 0.015 | 5.147 | 1.381-19.191 |
| 4-6 | 0.294 | 0.412 | 0.510 | 0.475 | 1.342 | 0.598-3.012 |
| >6 | | | | | 1 | |
| Frequency of technology received | | | | | | |
| Once | | | | | 1 | |
| Twice | 1.177 | 0.493 | 5.694 | 0.017 | 3.245 | 1.234-8.535 |
| >Twice | 0.668 | 0.547 | 1.492 | 0.222 | 1.951 | 0.668-5.703 |
| Get extension service | 1.151 | 0.442 | 6.782 | 0.009 | 3.161 | 1.329-7.516 |
| Get health care services | 1.173 | 0.414 | 8.022 | 0.005 | 3.232 | 1.435-7.279 |
| Get training before | 0.899 | 0.453 | 3.393 | 0.047 | 2.457 | 1.011-5.969 |
| Constant (intercept) | -4.591 | 1.027 | 19.995 | 0.000 | 0.010 | |

CI= Confidence interval; OR= Odds ratio; P=probability; β=Regression coefficient; SE=Standard error; Model summary: Nagelkerke $R^2$= 0.412; Hosmer and Lemeshow test: $\chi^2$= 9.980; P=0 .266

In agreement, the extent of new agricultural technologies adoption can be mainly determined by the area and use of various inputs (Jain *et al*., 2009). Getting health care services increased the likelihood (P<0.001) of chicken health care adoption. The probability of chicken health care adoption more likely increased as the veterinary clinic more proximate.

### *Determinants of provision of water adoption*

As indicted in Table 5, the probability of proper way of water provision adoption was influenced by educational level, family size, frequency of technology received, extension, health care and training services. The probability of proper way of water provision adoption increased with educational level. Technology participants who attended secondary and above education 6.3 times more likely (P<0.05) decided to adopt provision of water for chicken. In agreement, Grazhdani (2013) reported that education measures human capital development that enables an individual farmer to assess information and to make decision. Technology participants who had less than 4 family sizes were 5.1 times more likely

(P<0.05) decided to adopt water provision for their chicken as compared to who had more than 6 family sizes. This indicates large family size doesn't mean more labor force for technology. Only few responsible family members might handle the activities of the technology. In agreement, Mwamuye *et al.* (2013) revealed that family size as proxy for labor could have been misleading as not all household members participated in dairy technology activities. Labor availability never identified the family members who contributed directly to the dairy activity but focused on the total family members as a proxy to labor which could have given a misleading inference. In contrary, Teklewold *et al.* (2006) reported that as a good source of labor for poultry production, households with more family size are more likely to be exotic chicken adopters than families with lower family size. Similarly, Mekonnen *et al.* (2010) reported that the larger the family sizes, the higher the adoption levels of dairy technologies.

### Determinants of overall technology elements adoption

Sex, age, chicken farming experience, crop production, credit service and market distance couldn't significantly influenced the adoption probability of either of village poultry technology package elements. Educational levels of the farmer, extension, health care and training services were the determinants of the overall technology package elements adoption in the study areas (Table 6). Farmers who educated secondary and above (P>0.05) 3.6 times more likely decided to adopt the overall technology package elements. In lined with the current study Ebojei *et al.,* (2012) reported that farmers who have frequent contacts with extension agents had a higher probability of participation on innovation. Similarly, improved pig technologies adoptions in Ghana were associated with education, extension contact and training (Zanu *et al.*, 2012). Training is the most important factor for adoption of technology (Chi and Yamada, 2002). Moreover, Dehinenet *et al.* (2014) reported that training increases the level of technology adoption through creating awareness on the technology. However, according to Teklewold *et al.* (2006), in Ethiopia village poultry technology packages, there were limited extension follow up and technical advice on improved poultry feeding, watering, and housing and disease control. According to Wabbi (2002), government policies, technological change, institutional factors and delivery mechanism could affect the probability of technology adoption. Generally, the in model Psuedo $R^2$ (Nagelkerke $R^2$=0.533) estimation implies the variables in the model could explain about 53.3% of the probability farmer's decision to adopt or not to adopt the overall technology package elements.

**Table 6. Multivariate logistic regression result of overall poultry technology adoption**

| Variable | β | SE | Wald | P | OR | 95% CI |
|---|---|---|---|---|---|---|
| Educational level | | | | | | |
| Illiterate | | | | | 1 | |
| Basic education | -0.961 | 0.887 | 1.172 | 0.279 | 0.383 | 0.067-2.178 |
| Elementary | 0.196 | 0.767 | 0.065 | 0.799 | 1.216 | 0.271-5.467 |
| Secondary+ | 1.271 | 0.764 | 2.770 | 0.096 | 3.564 | 0.798-15.917 |
| Get extension services | 1.971 | 0.475 | 17.226 | 0.000 | 7.175 | 2.829-18.195 |
| Get healthcare services | 0.868 | 0.438 | 3.920 | 0.048 | 2.381 | 1.009-5.620 |
| Get training before | 2.874 | 0.594 | 23.425 | 0.000 | 17.707 | 5.530-56.703 |
| Constant (intercept) | -4.761 | 0.971 | 24.047 | 0.000 | 0.009 | |

CI= Confidence interval; OR= Odds ratio; P=probability; β=Regression coefficient; SE=Standard error; Model summary: Nagelkerke R2= 0.533; Hosmer and Lemeshow test: $\chi$2= 6.831; P= 0.555

**Table 7. Limitations affected village poultry technology adoption (1=Very important, 4=Least important); Ranked means with standard deviation**

| Limitations | Agro-ecology | | | F value | Pr>F |
|---|---|---|---|---|---|
| | Highland | Mid-altitude | Lowland | | |
| Land size | 3.7±0.93 | 3.8±0.40 | 3.8±0.70 | 2.37 | 0.097 |
| Poultry equipments | 2.3±1.11 | 2.3±0.73 | 2.3±0.95 | 0.08 | 0.928 |
| Veterinary clinic | 1.6±0.80$^a$ | 1.2±0.58$^b$ | 1.4±0.75$^b$ | 5.41 | 0.005 |
| Transportation | 3.3±0.93$^b$ | 3.7±0.42$^a$ | 3.2±0.78$^b$ | 9.95 | 0.000 |

Significant ranked means were compared using LSD significance test; Means in the row with the same letter are not significantly different at P<0.01, P<0.001

**Table 8. Constraints that affected the adoption of village poultry technology package (1=Very important, 10=least important). Ranked means with standard deviation**

| Constraints | Agro-ecology | | | F value | Pr>F |
|---|---|---|---|---|---|
| | Highland | Mid-altitude | Lowland | | |
| Lack of knowledge | 6.0±2.80$^{ab}$ | 6.4±2.48$^a$ | 4.9±2.35$^b$ | 5.92 | 0.003 |
| Lack of advisory services | 7.3±1.93 | 6.6±2.01 | 7.2±1.93 | 3.07 | 0.049 |
| Chicken breeds shortage | 3.7±1.95$^a$ | 2.4±1.75$^b$ | 3.4±1.45$^a$ | 9.42 | 0.000 |
| High input price | 4.4±1.96 | 4.7±1.96 | 4.9±1.87 | 1.02 | 0.363 |
| Credit service | 5.5±2.84$^b$ | 6.5±2.23$^{ab}$ | 6.6±1.89$^a$ | 4.13 | 0.018 |
| Lack of feed | 4.2±2.41$^b$ | 3.6±2.21$^b$ | 5.6±1.94$^a$ | 12.72 | <0.000 |
| Lack of vaccine and drug | 4.3±2.13$^b$ | 5.3±2.12$^a$ | 3.0±1.33$^c$ | 22.97 | <0.000 |
| Health problem | 4.1±2.48$^a$ | 3.7±2.33$^a$ | 1.6±1.09$^b$ | 24.49 | <0.000 |
| Lack of market access | 6.6±2.92$^b$ | 6.3±2.82$^b$ | 8.7±1.00$^a$ | 17.73 | <0.000 |
| Workload | 8.9±2.19 | 9.5±0.87 | 9.1±1.46 | 2.79 | 0.064 |

Significant ranked means were compared using LSD significance test; Means in the row with the same letter are not significantly different at P<0.05, P<0.01, P<0.001.

**Limitations and constraints to adopt the technology**

Absence veterinary clinic at proximate distance was the 1st ranked limiting factor that negatively affected the respondents to adopt village poultry technology package in all agro-ecologies (Table 7). For most respondents (51.6%), the veterinary clinic is found at more than 20km. Unavailability proper chicken feeding and watering equipments were the 2nd ranked limiting factors. The limitations of farm size and transportation not to adopt the technology in the study areas were very minimal. Similarly, number of constraints affected farmers' decision not to adopt technology. In highland and mid-altitude agro-ecologies, lack of improved chicken breeds, chicken health problems (Newcastle disease) and lack of balanced chicken feeds were the majorly ranked constraints that negatively influenced the farmer decision to adopt the technology. Similarly, chicken health problems, lack of chicken vaccines and medicaments supplies and shortage of improved chicken were majorly ranked constraints in the lowland agro-ecology (Table 8).

As a whole, chicken health problem, lack of vaccines and medicaments, shortage of improved chicken breeds and lack of balanced chicken rations were the major constraints that negatively affected the extent of adoption across the study agro-ecologies. In agreement, Degu, (2012) reported that chicken diseases, shortage of feed and lack of veterinary services were the major problems of poultry extension packages in southern region of Ethiopia. According to Mengesha *et al.* (2011), many poultry development projects in Ethiopia failed to meet their objectives due to constraints. The opportunities to improve the adoption of the technology, training, technical, financial, managerial and market supports were the majorly needed by the respondents (Table 9).

**Table 9. Supports opportunities of to improve the adoption (1= Very important; 6=Least important). Ranked means with standard deviation**

| Support | Agro-ecology | | | F value | Pr>F |
|---|---|---|---|---|---|
| | Highland | Mid-altitude | Lowland | | |
| Technical | 3.0±1.23[a] | 2.3±1.15[b] | 2.2±0.95[b] | 11.47 | <0.000 |
| Financial | 3.1±1.47 | 3.2±1.30 | 3.4±1.36 | 0.45 | 0.635 |
| Managerial | 3.6±1.11[b] | 4.7±0.98[a] | 4.8±0.98[a] | 27.73 | <0.000 |
| Training | 1.6±0.86[b] | 2.4±1.48[a] | 1.3±0.45[b] | 17.82 | <0.000 |
| Transportation | 5.2±0.97[a] | 5.5±0.79[a] | 4.6±1.13[b] | 14.19 | <0.000 |
| Market | 4.3±1.68[a] | 2.8±1.40[b] | 4.7±1.12[a] | 30.72 | <0.000 |

Significant ranked means were compared using LSD significance test; Means in the row with the same letter are not significantly different at P<0.001.

Dissemination of insufficient quantities of technology inputs (improved chicken breeds) per household, frequent disease outbreaks (Newcastle disease), long time interval between technology inputs supply, less attention of farmers to the technology, inaccessibility of balanced chicken feeds and un-affordability of commercial poultry feeds, expensiveness and unavailability of chicken house constructing materials and less preferred of exotic chicken breed eggs and meat for consumption than local breeds might be the determinants that negatively affected the adoption of the overall technology elements. In agreement, Rahman (2007) reported that socio-personal and economic characteristics can affect the adoption of the technology. The probability of overall technology package elements adoptions were more likely influenced by getting extension, health care and training services. This indicates how these services were very important to increase the probability of the technology adoptions. Therefore, to increase the farmers' decision to adopt technology as a whole, much attention should be given to extension, health care and training services, and training, technical, financial, managerial and market supports were the majorly needed for the technology participants.

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