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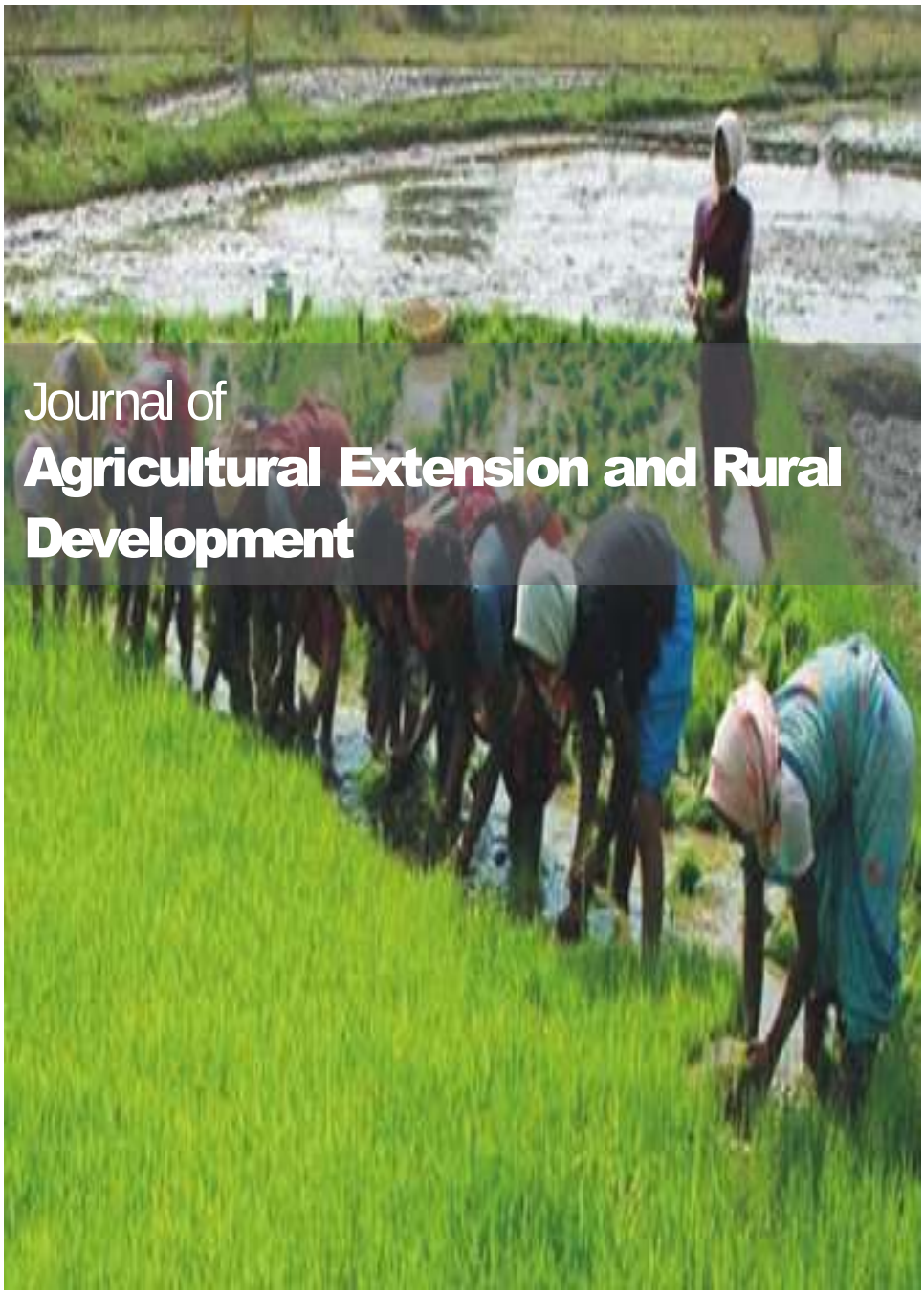

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ACADEMIC JOURNALS

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Full Length Research Paper

Economic valuation of Nile Tilapia (*Oreochromis niloticus*) in Lake Hawassa, Southern Ethiopia

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The purpose of this study is to investigate the economic value of fish (Nile Tilapia) in Lake Hawassa and determine the factors affecting the households' willingness to pay for a quality improved fish product. The survey was conducted through face-to-face interview of 467 households consuming fish caught from the lake. The respondents were aware on the poor quality of the fish due to domestic and industrial effluents discharged into the lake. The consumers stated their preferences on quality improved fish product with the mean value of Birr 57.76 per kilogram, which was equivalent to USD3.20 per kilogram during the survey period. The analysis on the determinants of willingness to participate in the fish quality improvement program shows that education, annual income, frequency of fish consumption, marital status and multiple use of the lake influence the participation on the quality improvement program positively while family-size, residential-land and employee negatively influence the participation on the quality improvement program. The valuation of quality improved fish product shows that households who are aware of the poor quality of the lake, residential-land owners and those who earn high annual income are more likely to attach higher monetary value for the quality improved fish product. Therefore, identification of such variables and their relative importance in the valuation helps to obtain households who are willing to pay maximum level for the fish quality improvement.

Key words: Contingent valuation, fish, Heckman model, Lake Hawassa, willingness to pay.

INTRODUCTION

Fish provide vital and unique nutritional benefits such as protein, vitamins, minerals and micro-nutrients. High per capita consumption of fish has a significant impact on food and nutrition security especially in the lake districts. World per capita fish consumption increased from an average of 14.4 kg in the 1990s to 20.1 kg in 2014 (FAO, 2016). However, the distribution of the increase in fish consumption has been unequal among countries and within countries. For example, the per capita fish consumption in East Africa is below 1 kg. The level of fish consumption in Ethiopia varies among various income classes ranging from 22 g to 1.7 kg, with the average annual per capita consumption of 476 g (FAO, 2011). Since fish has not been integrated into the diet of most of the population, the demand for fish is small. The other factor for low per capita consumption of fish in Ethiopia is limited supply of the product.

The fish productions in major Ethiopian lakes are below the maximum sustainable yields except Lake Hawassa where 140% of its maximum sustainable yield is caught

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from Lake Hawassa (Assefa, 2014). The annual per capita consumption of fish from Lake Hawassa is 1.56 kg. Among the major species of fish in Lake Hawassa, Tilapia (*Oreochromis niloticus*) accounts for more than 90 percent of the landed fish biomass in the lake. About 73% of fish caught from Lake Hawassa is sold in nearby market (FAO, 2011). The factors which trigger demand for fish in Hawassa district include the relatively low price of fish or the increasing prices of its substitutes and religious influences. For example, Coptic Orthodox Christians tend to resort to fish during lent when they abstain from meat and dairy products (FAO, 2016).

The domestic sewages, silts or sediments and industrial effluents have posed pressure on the aquatic lives of Lake Hawassa creating unfavorable environment due to some toxic substances in the effluents. Gebremariam and Desta (2002) observed that the effluents from the nearby factories were acutely toxic to fish, with a higher mortality rate within small wastewater solution within 24 h. The discharges of untreated effluents affect water transparency and gas solubility, which in turn cause damage to the aquatic biota. According to Birenesh (2007), the effluents discharged into the lake contain heavy metals like Mercury (Hg), Cromium (Cr), Lead (Pb), Cupper (Cu) and other metals.

Various combinations of metals and also metals with other substances in domestic and industrial waste waters present a real and potential hazard for aquatic ecosystems. Semenovich (2001) states that the heavy metals have a high degree of accumulation through the food chain and can intensify the toxic effects on humans eating fish products. Whether the resource users are aware of the poor quality of the lake and willing to pay for the improvement of fish quality are not well understood. The valuation of the benefits of the lake from the perception of users is a critical input for implementation of fish quality improvement program. Therefore, are the beneficiaries willing to pay for the improvement of fish quality? If yes, what are the determinants of their willingness to pay for the quality improved fish products? The objective of this study is to analyze the economic value of fish product and determine the factors that affect the consumers' willingness to pay for quality improved fish product with the hypothesis that consumers prefer clean water, which is not in need of purification, to treated water after polluted.

Unfortunately, integrated information about economic values of the water-resources which is important for its conservation has been limited in the region. Those who would estimate the benefit of controlling water pollution face a dilemma because the studies that have valued local water bodies such as lakes are of limited use in determining water quality policy changes due to unreliable data. Unreliable results on the economic value of the water bodies due to lack of quality and sufficient data needed for research have, therefore, contributed little value to the management of local water resources. This study differs from previous studies on Lake Hawassa in quantifying the water-resource use in terms of fish value in monetary terms so as to reduce its degradation more effectively. Hence, it contributes to sustainable resource use providing the necessary economic information of the lake as a source of fish products to develop socially acceptable, environmentally sound and financially feasible water resource management. This study is limited to the use value of the lake as fish product. The other use values of the lake such as recreational value, irrigation water, and the non-use value such as the existence value and bequest value of the lake have not been considered in this study.

LITERATURE REVIEW

Fish production and valuation of fish product

Aquatic animals are sources of protein, minerals such as calcium, iron and phosphorous as well as trace elements and vitamins. Fish, the most important aquatic animals, are main source of protein, especially in the developing world. One billion people rely on fish as their primary protein source, and several hundred million people depend on fish as their main source of income (IFPRI, 2009). Globally, fish represents about 16.6% of animal protein supply and 6.5% of all protein for human consumption (FAO, 2012). In low-income food deficit countries fish account for 20% of animal-derived protein as compared to 13% in the industrialized countries (Delgado et al., 2003).

Fish is usually low in saturated fats, carbohydrates and cholesterol, and provides not only high-value protein but also a wide range of essential micronutrients, including various vitamins and minerals (FAO, 2012). Thus, even in small quantities, provision of fish can be effective in addressing food and nutritional security among the poor and vulnerable populations around the globe. While the global human population continues to increase rapidly, the world's fishing areas have reached their maximal potential for capture fisheries production (FAO, 2014). As a result demand for fish is much greater than the capture fishery can supply. The high demand and good price has therefore led to overfishing, which is environmentally damaging and economically inefficient (Peter, 2006). In Ethiopia, Nile perch and Tilapia show signs of over-fishing in Lake Hawassa and Lake Chamo, and Tilapia in Lake Ziway are probably at full exploitation (Assefa, 2014).

In the analysis of consumer preference and willingness to pay for fish farmed in treated waste water, Solomie et al. (2015) confirm that consumers with children are less likely to pay for fresh Tilapia farmed in treated waste water. This reflects that consumers prefer clean water, which is not in need of purification or other treatment, to water that has been polluted but treated to clean.

According to Solomie et al. (2015), bid negatively influence the households' willingness to pay for fish farmed in treated water. The negative sign for bid implies that the higher the amount requested to pay, the lower the probability a consumer would be willing to pay for the fish farmed in treated waste water. In addition, consumers with higher level of education are less likely to be willing to pay for fresh Tilapia farmed in treated waste water. Education increases consumers' consciousness towards food safety, which implies that postharvest processing of fish might be perceived as safer and thus increases the likelihood of consumers' willingness to pay for smoked fish.

The analysis of the factors that determine consumers' willingness to pay for a given quantity of safely prepared fish reflects a significant association between consumers' attitude and acceptance of food safety measures. The food safety measures include source of production labels and hygienically displaying unit for fish and other food stuff sold in the area (Ehirim et al., 2007). Household income and size of household are positively related with the changes in probability that a consumer will pay for safety than not having it at all. The economic implication of positive and significant influence of income is that consumers are ready to pay more for safety as this could offer a cheaper health care and health security than controlling the health problems due to unsafe food consumption.

Contingent valuation method (CVM)

Economic values are usually distinguished as use and non-use values. Use value is further classified into direct and indirect use values (Turner et al., 1994a). Direct use values of water resources can be extracted, consumed or directly enjoyed. It is therefore known as extractive or consumptive use value (Hawkins, 2003). Direct use values of water resources include the consumption of fish for food, water for drinking, cooking and washing, irrigation, recreation and tourism. Indirect use of water resource services includes energy production and nutrient recycling (Schuyt and Brander, 2004). Non-use values are often intangible and include the value of leaving opportunities for future generations (bequest value) and the value from knowing that the resources exist, which is known as existence value (Chandler and Suyanto, 2005).

For water resource goods and services that are traded in the market place and whose prices are not distorted, market prices can be used as indicators for economic values. Often, however, most of goods and services do not have a market price and shadow pricing techniques can be applied to determine their economic values (Schuyt and Brander, 2004). Among several shadow valuation methods that economic theory distinguishes, a well-known method is contingent valuation, which directly obtains consumers' willingness to pay for a change in the level of environmental good, based on a hypothetical market.

Contingent valuation is the most widely accepted stated preference method used for estimating total economic value, including all types of non-use values (Hajkowicz and Okotai, 2006). The purpose of the contingent valuation method is to elicit individuals' preferences, in monetary terms, for changes in the quantity or quality of nonmarket environmental resources, which have the characteristics of non-excludability and non-divisibility (Perman et al., 2003; Birol et al., 2006). In conducting the contingent valuation surveys acknowledgement of all stakeholders, careful survey design and administration, and post survey debriefings (particularly for examining the reasoning behind irrational responses) help improve the process of valuation of environmental resources (Duberstein and de Steiguer, 2004).

To conduct a CV survey, special attention needs to be paid to the design and implementation of the survey. Focus groups, consultations with relevant experts, and pretesting of the survey are important pre-requisites. Decisions need to be taken regarding how to conduct the interviews; what the most appropriate payment bid vehicle is e.g., an increase in annual taxes, a single-one-off payment, a contribution to a conservation fund, among others as well as the willingness to pay (WTP) elicitation format. The survey may be conducted through face-to-face interviews, telephone or mail surveys. In developing countries, face-to-face interviews are considered the most appropriate because of high rates of illiteracy and defective telephone networks. Fortunately, personal interview is the best approach for reducing sampling bias (McClelland et al., 1993; Turner et al., 2004b; Birol et al., 2006).

The advantage of using Contingent valuation technique over Travel Cost Method (TCM) in valuation of water resources is its ability to capture both use and non-use values. Perman et al. (2003) explains the advantages of CVM over TCM as its ability to deal with both use and non-use values and, in principle, its answers go directly to the theoretically correct monetary measures of utility changes. This technique is enormously flexible in that it can be used to estimate the economic value of virtually anything. For example, using other valuation methods like hedonic pricing and travel cost method will underestimate the benefits people obtain from improved water resources as they measure only use values. In practice, getting more information close to reality through revealed preferences derived from observed behavior is a difficult task in non-market resources.

In the valuation of improved water quality for recreation in East Lake, Yaping (1998) applies both contingent valuation and travel cost methods. The multivariate analysis of travel cost method reveals income and education are insignificant factors affecting demand. Furthermore, travel cost method shows that income is

inversely related to demand for East Lake, which implies that the lake is inferior good. However, the East Lake is still regarded as a luxury good (Yaping, 1998). Whereas, the contingent valuation method of the same lake shows that education and income are significant at 1% level. The comparison of the values from TCM and CVM shows that the net addition of consumer surplus due to quality improvement with TCM is RMB¥18.09/m^2 at swimming level while the total WTP in the recreational area with CVM is RMB¥21.41/m^2 if water becomes clean enough for swimming (Yaping, 1998). This finding reflects that CVM value is higher than that from TCM.

Despite the strengths of this technique over others regarding its ability to estimate both values (use and non-use) and evaluate irreversible changes, contingent valuation method is criticized for its limitations in addressing full services and functions of the environmental resources. The valuation of environmental resources benefits is imperfect and in need of improvement. For instance, CVM is criticized for its lack of validity and reliability (Mathews, 1999; Birol et al., 2006). As this technique is survey-based and all relevant stakeholders are not included in valuing resource for reaching effective resource management, outcomes of contingent valuation may, however, be less accurate (Duberstein and de Steiguer, 2004).

Since the contingent survey instrument is of a hypothetical market, the data is criticized for its bias, some of which are hypothetical bias and strategic bias (Birol et al., 2006; Krantzberg and de Boer, 2006). Hypothetical bias is caused by the hypothetical market nature of the contingent valuation. Hypothetical bias is created when respondents are not capable of knowing the environmental resource values without participating in a market in the first place in spite of their well preparation to reveal their true values (Turner et al., 2004b).

Strategic bias means that people purposively state a higher or a lower price than what they are willing to pay; in this way the resource will be either underestimated or overestimated and someone else will bear the over- or underestimated cost (Bulov and Lundgen, 2007). For instance, respondents may deliberately understate their WTP when they believe that the actual fees they will pay for provision of the environmental resources will be influenced by their response to the CV question. Conversely, realizing that payments expressed in a CV exercise are purely hypothetical, respondents may overstate their true WTP hoping that this may increase the likelihood of a policy being accepted (Birol et al., 2006).

In the social sciences, bias in the estimated effects from any given study is very difficult to rule out, no matter how intuitively appealing the methodology. There is, unfortunately, no statistical silver bullet. Sometimes the Heckman Model as an approach is applied to observational data for the purpose of estimating an unbiased causal effect (Briggs, 2004).

METHODOLOGY

Description of the study area

Lake Hawassa is located at 6°33' – 7°33'N and 38°22' – 39°29'E in the southern Ethiopia. The surface area of the lake on average is 93.5 km^2 with maximum depth of 32.2 m and the average depth of 13.6 m. The seasonal variation of the lake water level ranges from 0.09 to 1.57 m with an average of 0.66 m (Halcrow Group Limited and Generation Integrated Rural Development, 2009). Unlike other closed lakes with alkaline characteristics, Lake Hawassa is one of the few fresh closed lakes with its electrical conductivity of 802 µS/cm, and pH=8.6 (Tenalem et al., 2007). The freshness of the lake water could be justified as water from Lake Hawassa catchment can flow to lakes of lower altitude (Yemane, 2004).

Survey design and development

A contingent valuation survey instrument was designed as the scenario informs the change in the resource under valuation. It explains clearly how that change would come about; how it would be paid for; and the larger context that is relevant for considering the change. The question was phrased using the payment vehicle of price increment per kilogram for quality improved Nile tilapia (*Oreochromis niloticus*). Such payment form was assumed to empower the respondents to decide freely on the resource management. It was also assumed that the society might not accept other payment forms particularly 'tax' relating it with the actual tax increment without resource improvement. With the aim of contingent valuation survey to display the attitudes and perceptions of a study population, the design was made to ensure the values expressed by the respondents would be those held for the fish quality improvement.

According to Whittington (2002), the job of training enumerators on the administration of contingent valuation surveys includes two related but distinct tasks. The first is to ensure that the enumerators understand the objectives of the survey and the subject matter contained in the CV scenario. The second is to provide enumerators with the skills to conduct a high-quality in-person interview. Following this advice, the enumerators were carefully instructed about the objectives of the survey and the concept of CV scenario like the contextual concept of the survey, the resource condition and the need for management, the content of the survey and how to measure the respondents' annual income and others especially for those who would be interviewed in the rural areas, and other relevant concepts of the survey instrument. The questionnaires were administered using a face-to-face interview technique.

Based on stratified random sampling technique, 467 respondents were selected from fish consumers combining the formula: $n > 104+m$, where n = sample size, and m = the parameters that are expected to affect the willingness to pay for water quality improvement, and the advice that for regression equations using six or more predictors, an absolute minimum of 10 participants per predictor variable is appropriate. However, if the circumstances allow, a researcher would have better power to detect a small effect size with approximately 30 participants per variable (Van Voorhis and Morgan, 2007). To make the sample representative of the whole population, the sample size obtained using the above formula was critically examined in line with the proportionality of the sample to total population. The questionnaire was designed to consist three sections. The first section was about the respondents' knowledge, attitudes, and perception about the resource and its environmental problems, which provide an explanation of the environmental issue of interest together with information on the change in quality. The second section was about the contingent

valuation scenario created for the resource improvement program and the respondents' willingness to pay in support of the proposed improvement. The third section was about the respondents' socio-economic characteristics like information on the respondents' educational level, income, and other socio-economic and demographic characteristics, which enable analysis and verification of the validity of responses on willingness to pay given by respondents.

According to Bateman et al. (2002), protests are non-responses in which the genuine WTP are not provided. That means respondents either responded with a zero value or with an unrealistically high value instead. These responses do not represent the households' honest value of the nonmarket good as they are protesting to an aspect of the hypothetical scenario, such as mistrust for the institution that manages the funds, or the belief that protection of resource is a government responsibility. Hence, such respondents could also be termed as scenario rejecters. To critically examine whether the responses of the respondents who preferred to remain neutral in the proposed improvement program were protests or genuine responses, the CV survey instrument was designed to state why the respondents would not participate in the proposed program.

Empirical model specification

The Heckman's two step model was employed in the analysis of the survey data. When the population of the study area is quite large with no boundaries, sampling can only define the scope that is selected by the researchers. It is possible to insert irrelevant variables or not to include associated variables in the sample, which may cause sample selection bias. Heckman's two-step model explicitly resolves potential sample selection bias (Zhang et al., 2014). The Heckman two-step model examines the two steps leading to respondents' decisions in a single model while distinguishing the influence of different factors between these two steps. That means it investigates the factors influencing willingness to pay along with payment level in a single model. It also prevents the disturbance of respondents whose willingness to pay (WTP) is zero. It is a two equation model: the regression model and the selection model.

Selection equation

$$\text{Participation} = Z_i\gamma + u_i \quad (1)$$

Regression or observation equation

$$\text{WTP} = \beta X_i + \varepsilon_i \quad (2)$$

From the first stage (Participation), Mill's inverse ratio was constructed and then regressed by Ordinary Least Squares (OLS) as:

$$\text{WTP} = \beta X + \rho_{\varepsilon u}\sigma_\varepsilon \lambda_i(-Z_i\gamma) \quad (3)$$

Since the correlation between two disturbance terms was different from zero ($\rho_{\varepsilon u} \neq 0$), the OLS estimates were biased as it did not account for estimation of γ, which is an additional term that depends on the inverse Mill's ratio evaluated at $Z\gamma$. This omitted variable, $\lambda(\boldsymbol{z\gamma})$, was correlated with X (Wooldridge, 1999). Under the assumption that the error terms were jointly normal, we had

$$\text{WTP} = \beta X + \rho_{\varepsilon u}\sigma_\varepsilon \lambda_i(-Z_i\gamma)$$

Where, $\rho_{\varepsilon u}$ is the correlation between unobserved determinants of propensity to support (u) and unobserved determinants of WTP (ε), σ_ε is the standard deviation of ε, and λ is the inverse Mills ratio evaluated at $-Z_i\gamma$.

The WTP equation was estimated by replacing γ with probit estimates from the first stage, constructing the λ term, and including it as an additional explanatory variable in linear regression estimation of the WTP equation. The Inverse Mill's ratio [$\lambda_i(-Z_i\gamma)$] was calculated using the formula:

$$\lambda_i(-Z_i\boldsymbol{\gamma}) = \frac{\varphi(-Z_i\gamma)}{1-\phi(-Z_i\gamma)} \quad (4)$$

Where, φ denotes the standard normal density function, and ϕ denotes the standard normal cumulative distribution function.

The Heckman model can help social work research by providing researchers with methods of detecting and correcting sample selection bias (Cuddeback et al., 2004). In other words, the application of Heckman's sample selection model shows efficiency and robustness of controlling for selection bias through a two-stage process (Gou, 2009). This model allows using information from non-supporting individuals to improve the estimates of the parameters in the regression model. Hence, the Heckman selection model provides consistent, asymptotically efficient estimates for all parameters in the model.

Generally, the selection equation is estimated by maximum likelihood as an independent probit model to determine whether to participate and pay using information from the whole sample of supporters and non-supporters. A vector of inverse Mills ratios (estimated expected error) can be generated from the parameter estimates. The WTP amount, *y*, is observed only when the selection equation equals 1 (that is, individuals support the quality improvement program) and is then regressed on the explanatory variables, *x*, and the vector of inverse Mills ratios from the selection equation by ordinary least squares. Therefore, the second stage reruns the regression with the estimated expected error included as an extra explanatory variable, removing the part of the error term correlated with the explanatory variable and avoiding the bias.

To estimate the economic value of the lake and the factors that determine the willingness to pay for fish consumption, the frequency of fish consumption, number of years that households consumed fish caught from the Lake Hawassa, awareness of the households on the poor quality of the lake, gender, age, marital status, family size, education, employment status, ownership of permanent asset (land) in the watershed, duration of the households in the watershed area, household's annual income, type of uses that households benefit from the lake, residential location, and distance from the resource were considered. Taking into account the factors that significantly affect the households' willingness to pay for the quality improved fish product, the equation for parametric mean WTP was derived as:

$$\text{WTP} = \beta_0 + \beta_1\text{frequency of fish consumption} + \beta_2\text{poor quality} + \beta_3\text{age} + \beta_4\text{marital status} + \beta_5\text{emplyee} + \beta_6\text{busines man} + \beta_7\text{residential land} + \beta_8\text{duration} + \beta_9\text{income} + \beta_{10}\text{mills inverse} \quad (5)$$

Description of explanatory variables and expected impacts

(1) ***Freqconfish*****:** It stands for the frequency of fish consumption. The sign for this variable is expected to be positive. The assumption is that the respondents who use fish more frequently express their willingness to pay for the quality improvement to keep on using the improved fish product. In addition, these people understand the change in quality and size of fish due to various activities in the watershed, and hence reflect their participation in the resource improvement program. Gempesaw et al. (1995) reflect positive correlation between frequency and willingness to pay for the resource improvement.

(2) ***Fishconsdurn*:** It refers to how long the households have used the fish caught from Lake Hawassa. The sign for this variable is expected to be positive because those who used the fish for many years would observe the trend of changes of fish products in terms of size and quality, and hence reveal their willingness to participate in the proposed improvement program, if other factors remain constant.

(3) **Poor-quality:** This stands for the perception of poor quality of the lake. It refers to the overall condition of the water resources in the watershed, that is, whether its quality has got worse or not, the small size and low quality of fish product. It is a dummy variable taking 1 for those who perceive the quality of the resource has got worsen; 0 otherwise. Generally the households who realized that the resource has degraded could pay much attention to its improvement, and they become more responsible to reduce its deterioration. Thus, its sign is expected to be positive (Mallios and Latinopoulos, 2001; Benson, 2006; Gupta and Mythili, 2007).

(4) **Sex:** This is a dummy variable taking 1 if the respondent is male and 0 for female. In the rural side of the lake, males are more dominant in decision making process since they have more access to resource control compared to females, in which case the sign is expected to be positive. This expectation is consistent with the finding of Tiwari (1998). On the other hand, women are more attentive than men to link between the environment and the things they value. Birol et al. (2006) also state that females are more likely to attach higher values to non-use values of wetlands. According to these arguments, the sign for sex is expected to be negative. For this study, the impact of sex on WTP is mixed, which is in line with the findings of Brown and Taylor (2000).

(5) **Age:** This refers to the age of the respondents. It is continuous variable. The sign of the coefficient on age variable is not possible to predict a priori. The hypothesis is that young generations are relatively more educated than older people, and they have better understanding on the resource improvement (Imandoust and Gadam, 2007). On the other hand, older people have indigenous knowledge and they are more sensitive to the environmental protection and natural resource management. In such a case, it is positively related to determine the willingness to pay for the resource management. This implies that as people get older, their experience with the benefits and services increases so that they support the improvement program, in which case the sign for age would be positive (Holmes et al., 2004; Benson, 2006).

(6) **Marital-status**: This refers to marital status of the respondent. It is a dummy variable taking 1 if the respondent is married; 0 otherwise, and it is expected to have positive sign. It is assumed that married respondents could help each other in contributing for the fish quality improvement program. It is also assumed that married people would be more responsible to keep their environment and natural resource in a sustainable way. This might be because they would attach the bequest and existence values to the resource in addition to their current benefits they derive from the resource. This expectation is similar to the findings of Solomon (2004).

(7) **Family-size:** This refers to family size of the respondents. It is a continuous variable. The sign for family size is expected to be negative. This is due to the fact that as the family size increases, the welfare distribution in the family members would be reduced. Therefore, their willingness to pay for the fish quality improvement program could relatively be lower (Tiwari, 1998; Tang et al., 2013). This implies that households with large family sizes allocate their limited income to their relatively large number of family members and hence face financial constraint to allocate for the fish quality improvement program as compared to households with smaller family sizes.

(8) **Education:** This stands for educational level of the respondent in years of education. It is continuous variable. The idea with education in determining the resource improvement program is that more years of education would, generally, give them better understanding on the values of the environmental resources. Therefore, educational level attained by the respondents is expected to have positive sign, indicating households with higher level of literacy have better chances of maximizing their utility and welfare from consuming and getting access to improved fish products. In addition, when people are more educated, their perception on non-marketed benefits of the environment and natural resources increases, and hence their willingness to pay for resource quality improvement plan becomes higher than those with lower educational levels (Holmes et al., 2004; Benson, 2006).

(9) **Employment-status:** This is the variable referring to the profession of the respondents. This includes farmer, employee (both governmental and non-governmental institutions), and businessman (self-employed and investors). In the estimation, the variable 'farmer' was taken as a reference category while others were included as dummy variables as follows:

(i) Employee: This refers to the occupation type of the respondents who work in governmental or non-governmental institutions. It is a dummy variable taking 1 for workers and 0 otherwise. The sign for employee is indeterminate. The hypothesis is that since the workers are expected to get better understanding on the resource quality improvement program including non-use value of the lake with reference to farmers, they attach higher monetary value for fish quality improvement program. In such a case, the sign is expected to be positive for employee. On the other hand, the positive sign for this variable can be explained with the ability to pay for the quality improved resources (Hite et al., 2002). So, if farmers earn high income as compared to employee, they would attach high monetary value for quality improved fish product, in which case, the sign for employee is expected to be negative.

(ii) Businessman: IT is a dummy variable taking a value of 1 for the respondents who get income running their own business, and 0 otherwise. Its sign is expected to be positive. The assumption for the variable to positively influence the resource improvement program is that businessmen can obtain more income as compared to other employment status. Since income has positive relationship with willingness to pay for normal goods, individuals who are engaged in such activities are expected to pay more money for the proposed improvement (Gupta and Mythili, 2007).

(iii) Land type: this refers to land type of the respondents owned in the watershed areas. This includes categories: agricultural land, residential land type, and no land owned in the area. This variable is represented with dummy variables, with the 'agricultural land' type serving as a reference for fish consumers. The first dummy variable taking 1 for agricultural land; 0 otherwise. Agricultural land includes houses and farms in the rural areas. Agricultural landowners, particularly riparian landowners benefit from the resource irrigating their farms in addition to fish products. This variable is expected to take positive sign in support of the improvement program. This implies that since 'agricultural land' is reference variable, the positive sign for 'agricultural-land' means the negative signs for 'no-land' and 'residential-land' in the proposed improvement program. The second dummy variable takes 1 for no land; 0 otherwise. The sign of this variable is expected to be negative reflecting the assumption that individuals with no landownership would place lower value for the resource management as compared to agricultural land owners. The general assumption in land type is that respondents with fixed assets will

support the resource improvement program because of their wide-ranges of benefits of the resources. Therefore, landowners are expected to be more responsible for the improvement program. However, for riparian restoration program, property owners along the lake might show negative sign for the improvement program associated with land use restrictions in riparian buffers (Holmes et al., 2004; Angella et al., 2014). In such a case, the sign for residential-land owners is expected to be negative.

(iv) Duration: this variable refers to the length of the respondents' stay in the watershed area. It is a dummy variable taking 1 for longer than 10 years, and 0 otherwise. The sign of the coefficient on variable 'duration' is not possible to predict a priori because the residents who stayed near the resource for longer period of time can give much attention for fish product and recreational value of the lake. This is because they have consumed fresh fish and visited the lake frequently for relatively longer period of time with minimum travel and other related costs to get into the fish market and recreational site of the lake. In addition, the households who stayed longer in the watershed areas can understand the trend of quality changes brought about by various activities in the watershed areas and therefore would be willing to participate in the restoration program of the resource (Angella et al., 2014). This implies that respondents who stayed longer period near by the lake resource might be willing to pay more money for the quality improvement program. In such a case, the sign for 'duration' would become positive. On the other hand, respondents who stayed longer in some other areas where there is no such beautiful natural resources that would have benefited them with fish products and other aesthetic services but have recently come to Hawassa city, which is endowed with its natural beauty, could give much attention to the management program of lake Hawassa as these respondents have practically experienced the impact of natural resource loss in their lives. Hence, these respondents might be willing to attach more monetary value to the resource management program. In this case, the sign for 'duration' would become negative.

(v) Income: This variable refers to the annual income of the households. The variable 'income' indicates the respondents' ability to pay. Economic theory reveals positive relationship between quantity demand and income for normal goods. Since fish product is normal good, it implies the positive relationship between income and demand for fish and related environmental quality improvement program. Therefore, the sign for this variable is expected to be positive (Holmes et al., 2004; Benson, 2006; Gupta and Mythili, 2007; Zakaria et al., 2013).

(vi) Distance: It is the variable that measures distance of the lake resource from homestead. It is a dummy variable taking 1 for the households near to the resource site, 0 otherwise. Its sign is expected to be positive (+). It is assumed that the households near to the resource would be more willing to pay for its improvement than those of the distant residents. This is because households who are in relatively farther distance from the resource are assumed to get less access to fish product as compared to the closer ones. This implies that as the distance of the households from the resource increases, they would be relatively less responsible for managing the resource, other things kept constant. This expectation is similar with the finding of Angella et al. (2014).

(vii) Use: This variable refers to the purpose that households benefit from the lake resource. It is a dummy variable taking 1 for the respondents who use the lake for multiple purposes; 0 otherwise. That means households with more access to use the resource for recreation, fishing, irrigation, exploring, and other purposes, are generally expected to pay high amount for the project ensuring the sustainable use of resource. Therefore, the sign is expected to be positive (Benson, 2006; Gupta and Mythili, 2007).

(viii) Location: This stands for the residential area of the respondents. This is a dummy variable taking 1 for urban; 0 for rural area. Its sign is uncertain since the resource benefits both residents in various forms. That means the residents of urban areas are assumed to give higher value from the recreational benefits of the lake to fish consumption while those in rural areas are assumed to value the resource mainly in terms of irrigation and water supply for livestock as compared to fish product.

RESULTS AND DISCUSSION

Descriptive analysis of the respondents on fish consumption

The respondents were found to fall in the age range of 18 to 87 with the majority of them were in between 18 and 35 years. From the total respondents, about 79% were married and the family size was from 1 to 10 with the average size of 4.6. The gender composition of the respondents was 76.7% males and 23.3% females. The respondents were found to participate in various economic activities like farming, governmental and non-governmental works and private businesses. The educational background of the respondents shows that about 55% had attained secondary or tertiary level, and only 2.6% had no formal education. The majority of the respondents earned annual income ranging from Birr[1] 40,000 to Birr 80,000 (Table 1).

About 70% of total respondents had fixed assets like agricultural, residential or commercial land in Hawassa watershed. The majority of them had lived for more than 10 years in the watershed areas. Whereas the respondents who had no permanent assets in the watershed area revealed they stayed in the watershed areas for short period of time. The respondents explained that they had used the lake resource for various purposes like fishing, exploring, wildlife watching, and related benefits.

The households' valuation for fish consumption

From the total respondents, nearly 78% revealed their interests in participation for the resource improvement program. These respondents stated their WTP from Birr 20 to Birr 100 per kilogram of fish caught from Lake Hawassa. Birr 18 was equivalent to one USD during the survey period. The majority of the respondents stated their preferences to be Birr 50 for one kilogram of fish, which is similar to the average value of fish calculated from the respondents who voted in favor of the lake quality improvement program. About 33 percent stated the monetary value more than Birr 50 for one kilogram while nearly 35% preferred to pay less than the average

[1] 1US$ = 18 Birr

Table 1. Socio-economic characteristics of fish consumers.

Variable		Absolute figure	Percentage
Gender	Male	358	76.7
	Female	109	23.3
Age	18 – 35	283	60.5
	36 – 50	164	35.2
	51 and above	20	4.3
Marital status	Married	370	79.2
	Not married	97	20.8
Family size	1 – 5	325	69.6
	6 – 10	142	30.4
Education level	No formal education	12	2.6
	Elementary school	199	42.6
	Secondary school	165	35.3
	Higher level	91	19.5
Occupation	Employee (GOV/NGO[2])	145	31.0
	Self-employed	137	29.4
	Farmer	185	39.6
Household annual income (Birr)	35,000 – 40,000	47	10.0
	40,001 – 60,000	184	39.4
	60,001 – 80,000	182	39
	> 80,000	54	11.6

Source: Summary of own data.

[2] GOV = Government; NGO = Non-Governmental Organization

value of the respondents voted in support of the proposed program (Figure 1).

The majority of the respondents who stated the higher value was found to be using the fish for more than ten years and realized the current and previous size and quality of fish in Lake Hawassa. They explained that the size and quality of fish decreased as compared to the previous years. These respondents stated that they use the lake for many purposes like fish consumption, wildlife watching and exploring. They were also found to frequently use the fish caught from Lake Hawassa. However, due to the low quality of the lake, they did not use the lake for swimming purpose. These respondents stated that the industrial and city sewages were the main problems that put pressure on the living organisms including the fish in the lake. Stating higher value for fish can be their interest to see the lake clean and yield fish free from any toxic substances. The respondents who preferred to remain neutral in the improvement program stated that they could not afford any contribution at the time of survey period. These respondents were found to earn low annual income but administer large family size. Some of the respondents who preferred to remain neutral reflected their doubt on the implementation of the improvement program as stated in the scenario.

Econometric analysis of contingent valuation for the improved fish product

The coefficient on inverse Mill's ratio, which was bias. The Heckman two step estimates were therefore implemented to correct the selection bias. According to Heckman (1979), the sample selection model triggers both a rich theoretical discussion on modeling selection bias and the development of new statistical procedures that address the problem of selection bias. The likelihood ratio (LR) test indicated that the correlation was very significant. Thus the two-step selection model was appropriate for estimating the participation and valuation

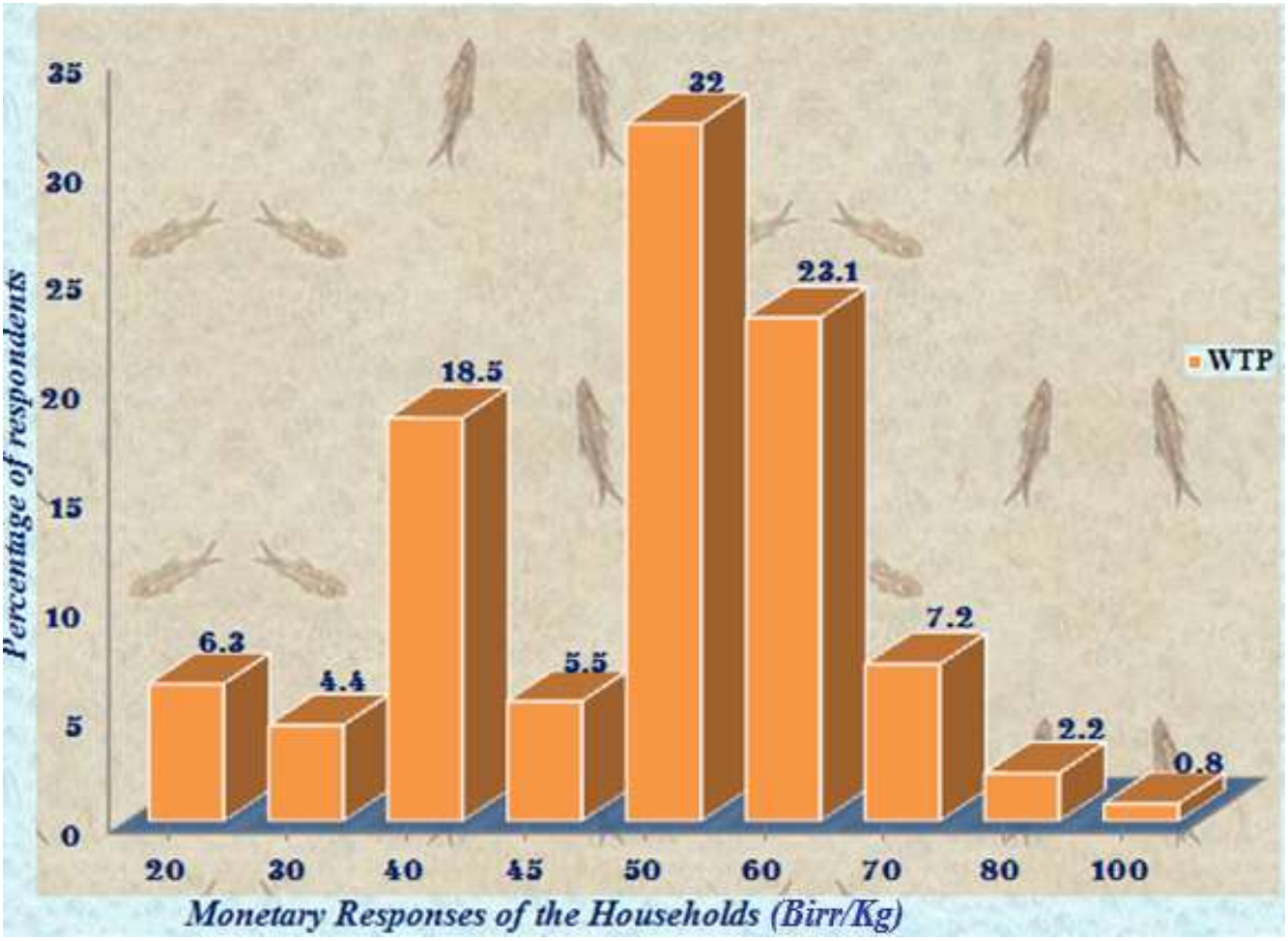

Figure 1. The monetary responses of the households for fish consumption.

for the quality improved fish product.

The LR chi square that measures the overall significance of the model with the null hypothesis that all coefficients were zero was rejected at 1% significance level to reflect that at least one of the coefficients was different from zero. The pseudo R^2 (0.6527) reveled 65.27% of the variation in the participation was explained by the variables included in the model. The regression result with the Mills' inverse ratio as additional explanatory variable indicated that 48.73% of the variation in WTP amount was explained by the variables incorporated in the model. The result of adjusted R^2 (46.05%), which had only small variation from R^2 (48.7%), revealed the relevance of the explanatory variables included in the regression.

The households who frequently consume fish, married individuals, those who earn high annual income, the households who use the lake for multiple purposes, and households with more years of education were found to participate in the lake quality improvement (Table 2). Whereas, the households with large family size, and those who were employed in governmental and non-governmental organizations were less likely to participate in the quality improvement as compared to the households with small family size and farmers, respectively. The households who have residential land type were less likely to participate in the proposed improvement as compared to those who have farmlands under irrigation using the lake.

The valuation of improved fish product reveals the households who realized the poor quality of the lake, older households, households with residential land (houses) in Hawassa city, and individuals with higher annual income were found to attach higher monetary value for quality improved fish per kilo gram. Whereas, the households who frequently consume fish, married individuals, employees and businessmen with reference to farmers, and households who stayed longer in the watershed areas were found to pay low amount for the improved fish products per kilogram.

Freqconfish: It stands for frequency of fish consumption.

Table 2. Heckman's two step estimates for fish consumption in Lake Hawassa.

Parameter	Participation model [coefficient (S.E)]	Valuation model [coefficient (S.E)]
	Heckman's two-step (Probit)	***Heckman's two-step (OLS)***
Freqconfish	1.2964*** (0.2593)	-0.1395* (0.0807)
Fishconsdurn	0.0239(0.0215)	-0.0014(0.0028)
Poor-quality	-0.4587(0.2502)	0.2289*** (0.0397)
Sex	-0.4926(0.3723)	0.0137(0.0336)
Age	0.0283(0.0184)	0.0048* (0.0026)
Marital-status	0.6244** (0.2838)	-0.0882* (0.0530)
Family-size	-0.3003*** (0.0788)	-0.0131(0.0184)
Head	0.8768(0.3507)	–
Education	0.2925*** (0.0489)	-0.0028(0.0172)
Employee	-0.7808** (0.3911)	-0.1757*** (0.0648)
Businessman	0.0981(0.3309)	-0.1782*** (0.0382)
Residential-land	-1.2972** (0.6165)	0.1871* (0.1100)
Noland	-0.9170(0.6728)	0.1506(0.1018)
Duration	0.2729(0.2302)	-0.0613* (0.0590)
Income	0.6417*** (0.1648)	0.0683* (0.0458)
Distance	0.1396(0.4209)	0.0803(0.0590)
Use	0.4894* (0.2974)	-0.0321(0.0458)
Location	0.8800(0.5479)	-0.0113(0.0947)
Millsinverse	–	3.8531* (2.2986)
Constant	-4.5572*** (0.9502)	3.5470*** (0.2570)
Sample size	467	363
Log likelihood	-85.9999	–
R^2	0.6527	0.4873
Adjusted-R^2	–	0.4605

***1% significance level, **5% significance level, *10% significance level with two tailed tests.

The positive sign and significant level for this variable reveal the households who frequently consume fish caught from Lake Hawassa are more likely to participate in the lake quality improvement. It is found to be significant at 1% of significance level. However, the valuation of households who are willing to participate in the lake quality improvement shows that households who frequently consume fish attach less monetary value for fish products per kilogram. The negative sign and significant level for frequent fish consumption can be explained by the fact that households who buy fish many times from the fish market might face financial shortage to attach higher value per kilogram.

Poor-quality: The households who realized the poor quality of the lake likely attach higher monetary value for the quality improvement of the lake in terms of increased fish price per kilogram. It is found to be positive and significant at 1% level. This can be explained by the fact that the households who perceived the poor quality of the lake are interested in restoring the lake quality and decide the higher price for one kilogram of fish when the proposed improvement comes to true. Understanding low quality of the lake reflects significant effect on attaching monetary value for fish product per kilogram. Obiero et al. (2014) reflect that quality ensured fish provide balanced and nutritious diets, and prevent disease occurrence, which implies that households who perceived the poor quality of the lake are willing to pay for the resource quality improvement. In the study of consumers' willingness to pay for sustainable seafood made in Europe, Zander and Feucht (2018) find a positive attitude of participants toward sustainability in fisheries stating that protection of endangered species, no pollution, and absence of drugs and hormones in production and fishing are the most important issues from the consumer perspective. In the study of households' willingness to pay for fish product in Vietnam, Danso et al. (2017) find that households are willing to pay 65% (USD 1.42 per kg) above the prevailing market price for certified fish, which supports the notion of households' concern over the safety of consuming wastewater-raised fish.

Age: age has positive relationship with high value attachment for the improved fish per kilogram. It is significant at 10% level though it has no effect on

participation in the proposed improvement of the lake. Households with older age might compare the current low quality of the lake with the previous years of big size and good quality of fish caught from the lake. These households are therefore motivated to restore good quality of the lake expressing their willingness to pay high amount for quality improved fish product per kilogram. This result is in agreement with that of Salim (2014) who states age to positively influence the willingness to pay for quality improved fish product. In the study of WTP for fish farmed in treated waste water, Solomie et al. (2015) find that older households are less likely to prefer fish farmed in treated waste water. This supports the hypothesis that households prefer clean water, which is not in need of purification or other treatment, to water that has been polluted but treated to clean. In the analysis of factors affecting fish landing price around Lake Victoria, Tanzania, Sambuo et al. (2019) reveal age significantly influence the landing price of fish.

Marital-status: this factor is found to positively influence the participation for the lake quality improvement. It is significant at 5% level. The positive influence of marital status on the consumer preferences for the quality improved fish product is similar with the findings of Li et al. (2000). However, married individuals are less likely to pay high price for the improved fish per kilogram. This can be related to the family size where married individuals are responsible to administer their families. Hence, they may experience financial limitation to buy the fish at higher price. As a result, their monetary value for improved fish per kilogram is relatively lower as compared to unmarried respondents.

Family-size: households with large family size are less likely to participate in the resource quality improvement program as compared to households who administer small family size. It is found to be significant at 1% level. This finding is in agreement with that of Salim (2014) who explains that family size negatively influence willingness to pay for fish indicating that for every ten percent increase in the family size, the WTP decreases by 1.7% from the mean level, ceteris paribus.

Education: The sign for education is positive. It is significant at 1% level. The positive sign and significant level of education imply that educated households might give much attention to non-use value besides the use value of the lake. This finding is similar with that of Polanco et al. (2008) and Salim (2014). Solomie et al. (2015) find education to be negative and significant at 10% level for fish farmed in treated waste water. This implies that educated people prefer fish farmed in clean water, which is in need of other treatment. That means households with more years of education are willing to pay for the lake quality protection. Obiero et al. (2014) explain that education enlightens consumers about the health and other benefits of fish consumption, hence positively influences the preference of consumers.

Employee: This variable is negatively influencing the participation in the resource quality improvement and the valuation of improved fish products as compared to farmer. Since farmers are benefited from the lake in terms of irrigation, watering animals, household consumption of the lake water after boiling, fish, and other related benefits, farmers are more likely to participate in the proposed improvement as compared to employees. Employee is significant at 5% significance level for participation and 1% significance level for the valuation of the improved fish product per kilogram with reference to farmer.

Businessman: This variable is found to negatively influence the valuation for the improved fish products with reference to farmer. It is significant at 1% implying that businessmen are likely to pay 17.82 percent less than the value that farmers pay for one kilogram of quality improved fish product. This variable is, however, insignificant in the participation of the lake quality improvement program.

Residential-land: It is found to negatively influence the participation for the lake quality improvement with reference to farm land. However, the comparison of the valuation among the respondents who were willing to participate in the proposed improvement shows that households who have residential land (house) in Hawassa city are found to pay higher monetary amount for the improved fish product per kilogram with reference to households who owned farm land in the watershed. This can be explained by the fact that households in urban areas have more knowledge on nutritional value of fish product and hence attach higher amount for one kilogram of quality improved fish as compared to the farmers.

Duration: The households who stayed for longer period in the watershed are likely to pay small amount for the improved fish product as compared to those who stayed for less than ten years. The valuation for the improved fish product shows that this variable is negative and significant at 10 percent. This might be due to the fact that the households who stayed for relatively short period in Hawassa watershed probably had lived in other areas with low natural resources before coming to Hawassa watershed, and hence appreciated the beautiful nature of the watershed (Lake Hawassa). As a result they attached high amount for improved fish per kilogram. However, this variable is found to be insignificant to influence the participation for the lake quality improvement.

Income: The positive sign and significant effect on both participation and valuation for the improved fish product

are as expected. Households with higher annual income are more likely to participate in the resource improvement and also attach higher value for the quality improved fish per kilogram. The participation result shows that this variable is significant at 1% level while on the valuation (WTP amount) it is significant at 10% level. This positive and significant effect of income reflects the households' ability to pay higher monetary value for the proposed improvement. In addition, it explains that fish product is normal good where for normal goods willingness to pay increases when the annual income of households increases. So, the higher annual income the higher value is attached for the improved fish product. This result is similar with the findings of Ehirim et al. (2007), Polanco et al. (2008), Salim (2014), Sharma et al. (2017) and Tohmo (2017).

Use: The households who are benefited from the lake in multiple uses like fish, recreations, irrigation and related valuable benefits of the lake are likely participate in the quality improvement program. It is found to be positive and significant at 10% level. However, it has no influential effect on determining the valuation for the improved fish product.

Parametric willingness to pay estimates for fish consumption

Unlike the non-parametric approach, the parametric WTP estimate is based on the determinants that affect the households' willingness to pay for the quality improved fish product. This approach provides more economic information considering the socio-economic characteristics in the calculation of mean willingness to pay for the proposed improvement. Taking into account the factors that significantly affect the households' willingness to pay for the quality improved fish product, the equation for parametric mean WTP is written as:

$$\text{WTP} = \beta_o + \beta_1 \text{frequency of fish consumption} + \beta_2 \text{poor quality} + \beta_3 \text{age} + \beta_4 \text{marital status} + \beta_5 \text{emplyee} + \beta_6 \text{businessman} + \beta_7 \text{residential land} + \beta_8 \text{duration} + \beta_9 \text{income} + \beta_{10} \text{mills inverse} \quad (6)$$

The parametric mean WTP is calculated to be Birr 57.76 per kilogram of fish caught from Lake Hawassa. This mean value is greater than the market price of fish in the status quo by 44.4%. As compared to non-parametric mean WTP (Birr 50), the parametric approach yielded relatively higher mean WTP. Since the parametric approach considers the socio-economic characteristics of respondents, which are common to the whole society of the study area, the parametric mean WTP is preferred to estimate the price of fish caught from quality improved lake. The Heckman selection model employed in parametric approach provides consistent, asymptotically efficient estimates for all parameters in the model. This model allows us to use information from non-participating households to improve the estimates of the parameters in the regression model. Mills inverse ratio was additional explanatory variable generated from the selection model that comprised information from non-participating households. Hence, the price for fish caught from Lake Hawassa is preferably estimated to be Birr 57.76 per kilo gram, which is equivalent to USD3.20.

Conclusion

The urban residents have better understanding on the nutritional value of the fish and therefore incorporate the fish product into their diets. These people are also aware of the low quality of the lake and hence support the quality improvement program. They express their willingness to pay for the resource improvement attaching higher monetary value for the quality improved fish per kilogram. The households are willing to pay on average Birr 57.76 (USD3.20) per kilogram for the fish caught from the quality improved lake.

The households who frequently consume the fish, married individuals, educated households, those who earn high annual income and the households who use the lake for multiple purposes are more likely to participate in the lake quality improvement. The factors that determine households' willingness to attach high value for the quality improved fish product per kilogram are awareness of the poor quality of the fish caught from the lake, the households' age, residential land type with reference to agricultural land type and households' annual income. Whereas, the frequency of fish consumption per year, marital status, the employment status and duration in the watershed are the factors that influence households' willingness to pay amount for the quality improved fish product.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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Factors determining crop farmers' willingness to pay for agricultural extension services in Tanzania: A case of Mpwapwa and Mvomero Districts

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This study assessed crop farmers' willingness to pay for AESs and identified factors influencing their willingness to pay for AESs. Data were collected from 292 randomly selected crop farmers' households between December 2017 and February 2018 using a questionnaire through face-to-face interviews. Data were analyzed using frequency counts, percentages and Tobit regression model. The study found that 92% of the respondents are willing to pay for AESs. It was also found that farmer's age, education attainment, farming experience, distance from farm to the nearest important road, income (both farm and nonfarm) and attitude towards AESs are significant determinants of farmers willingness to pay for AESs. The study recommends that these variables be given proper policy consideration by the government and other stakeholders in the design and the implementation of a workable fashion of privatizing extension services for the expected impact of improving extension services and farmers' productivity hence improved quality of life.

Key words: Extension services, willingness to pay, crop farmers, Mpwapwa, Mvomero

INTRODUCTION

The importance of Agricultural Extension Services (AESs) in agricultural and rural development is widely acknowledged, particularly in a developing country like Tanzania. Mutimba (2014) opined that agricultural extension is a vehicle for modernizing agriculture in many sub-Saharan African countries. The author adds that it is that discipline of agriculture charged with the responsibility of, as the late 1970 Noble laureate, Norman Borlaug said, 'taking it to the farmer'. Through an educational process, AES provides farmers with the agricultural information in the form of knowledge and skills to build their capacities and influence their attitude so as to enable them take effective farm management decisions regarding their daily agricultural practices (Swanson and Rajalahti, 2010; URT, 2013). According to Birner et al. (2006), agricultural extension entails training of farmers, dissemination of

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Table 1. Initiatives taken by the government to improve the agricultural sector.

Policy initiative	Time frame	Area of focus
KILIMO KWANZA	2009–No time bound	Ten Pillars: National Vision; financing; Institution reorganization; Paradigm shift; Land; Incentive; Industrialization; Science and Technology; Human resource improvement; Infrastructure and Mobilizing Tanzanians
SAGCOT	2010-2030	It seeks to focus on public and private intervention to engage the smallholders in commercial farming
BRN	Originally three years 2013-2016	Three KPI: Promoting 25 commercial farming deals; Enhancing 78 smallholder rice irrigation schemes; and 275 COWABAMA
ASDP II	2016/17-2024/25	Increase productivity, profitability and farm incomes; Promote private sector investment; and address cross-cutting issues

new technologies, assisting farmers to organize themselves, market their agricultural products and create networks with various institutions in order to improve productivity in agriculture and livelihoods. Additionally, AES links farming communities with research where farmers' problems are brought to the attention of research and solutions communicated back to farmers.

Financing and delivery of AESs

In most of developing countries, AES has in the past been, and still remains, almost entirely financed by the public sector, although this may vary from purely public to nearly private services (Ameur, 1994). As more governments face severe financial difficulties, funds are curtailed for support services to agriculture, including extension. In such circumstances, decision-makers usually opt for one or both of the following: (i) to save on the overall cost of public extension; and/or (ii) to gradually privatize extension services, leaving the private sector and users to take on increasing responsibility including covering the cost of service provision (Agbamu, 2000; van den Ban, 2000; Katz, 2002).

Agricultural extension in Tanzania: History and reforms

Agricultural extension service in Tanzania dates back to British colonial rule and has been funded and delivered by the government since independence in 1961 (Mvuna, 2010). Since then several agricultural extension systems and approaches have been implemented which include the gradual improvement in farming methods, the transformation approach, the settlement scheme and the Training and Visit (T&V) system (1980s-1990s). Thereafter, in 1999, Local Government Authorities (LGAs) were decentralized to AESs (Rutatora and Mattee, 2001). In addition, several initiatives have recently been taken by the government to improve the agricultural sector as indicated in Table 1.

Privatization of extension services in Tanzania

Although not formalized, experience shows that farmers in some areas of Tanzania are, in one way or another, already paying for or contributing to the cost of providing AESs. Isinika (2000) reported some examples on attempts to commercialize/privatize AESs: (i) The use of paraprofessionals as an extension strategy. The Mogabiri Agricultural Training Center in Tarime District uses paid (in cash or in kind) Farmer Motivators to assist village extension officers to train groups of farmers. (ii) In Mbozi District under the Agricultural Development Project Mbozi Trust Fund, costs for food are shared where farmers contribute to the cost of training programmes by providing maize flour while the project contributes beans. (iii) In Kondoa District, the Establishment of Plant Protection Brigades project trained young farmers who charged for service provided to other farmers; and (iv) FAIDA-SEP project that is supported by SNV which trains farmers on business awareness and charges them a subsidized rate of 2000/= per course as a cost sharing policy. A more recent study by Lameck (2017) reported that extension agents in Morogoro Municipal and Hai District Councils charge for their services in terms of recovering the cost for transport and the drugs the extension agents use when treating livestock and controlling crop diseases.

According to Schwartz (1992), commercialization of traditionally publicly provided AESs raises several related issues including whether the "fee for service" system would necessarily lead towards greater efficiency and equity. Similarly, Katz (2002) posits that a decision to introduce financial participation should be preceded by a thorough assessment of its feasibility and desirability, which include assessing users' willingness to pay (WTP) for the service. Although several studies have assessed farmers' WTP for AESs in different countries (Abraham et al., 2012; Temesgen and Tola, 2015; Uddin et al., 2016; Aydogdu, 2017) information on crop farmers' WTP for AESs and types of services they are willing to pay for is not well documented in Tanzania. This study therefore aimed at assessing crop farmers' WTP for AESs. Specifically, the study described crop farmers'

demographic characteristics, ascertained farmers' willingness to pay for AESs and the amount they are willing to pay, and identified the factors influencing farmers' WTP for AESs.

MATERIALS AND METHODS

Study area

The study was conducted in Mvomero, a District in Morogoro Region located and Mpwapwa, a District in Dodoma Region. Selection of the study sites was informed by criteria such as agricultural potential and climatic conditions of the two Districts. Mvomero District has a higher agricultural potential while Mpwapwa District has a relatively lower agricultural potential (Phelan et al., 2011). The difference in agriculture potentiality is associated with the difference in agro-ecological zones, Mpwapwa in a semi-arid zone characterized by rolling plains and low fertility susceptible to water erosion and Mvomero in a mixture of highlands and mountains, miombo woodland and Savannah River basin zones, which allow the production of wide range of food and cash crops. Equally important, the main economic activity in both districts is agriculture; so the majority of people are farmers (Sife et al*.,* 2010). This study therefore aimed to establish if there exists any differences in terms crop farmers' feelings about AESs and hence their WTP for the services based on agricultural potential.

Sampling procedure and sample size

The study adopted a multi-stage sampling technique. First, the two districts were purposively selected (reasons stated above). One ward was randomly selected form each of the two districts, Dakawa and Lupeta in Mvomero and Mpwapwa Districts respectively. Thereafter, in each ward one village was randomly selected, Wami-Luhindo in Dakawa and Makutupa in Lupeta. 300 households were randomly selected using sampling proportional to size. That is 137 and 163 from Wami-Luhindo and Makutupa village respectively. The sampling unit was the household while the target respondent was the household head.

Instrumentation and data collection procedure

This study adopted the interview guide (semi-structured questionnaire) as the main data collection instrument. The study followed a Contingent Valuation Method (CVM) using open-ended elicitation technique through face-to-face interviews with heads of household. The CVM uses survey questions to ask respondents to directly value the good or service in a hypothetical market, which, by means of an adequately designed questionnaire, is described where the good or service in question can be traded (Guo et al*.,* 2006). Crop farmers' WTP for AESs was determined by the amount each respondent is willing to pay for a particular item associated with extension service. Any amount other than zero indicated WTP. The items included: agent's travel cost, advice on control of crop diseases, advice on control of crop pests, advice on crop value addition, and advice on crop marketing. A respondent was considered to be willing to pay for AESs if he/she stated the amount other than zero for at least one of the assessed items. A comparison was made between food and cash crops as defined by respondents in the study area.

Data analysis

The collected data were summarized, coded and entered in the International Business Machines (IBM SPSS) Statistics Version 20 and STATA version 12 for analysis. Descriptive statistics such as mean, percentages, minimum and maximum, and standard deviations were computed while Tobit regression model was used to determine the factors that influence crop farmers' WTP for AESs. Tobit model, according to Tobin (1958), is designed to estimate linear relationships between variables when there is either left-or-right-censoring in the dependent variable. In our case, the respondents were to express their WTP for transport cots of extension agent and each of the five categories of extension services (advice on general practices of crop production, disease control, pest control, crop value addition and marketing of crops). A respondent was free to choose to pay for none or any number out of the six choices, making an index score ranging from 0 to 1.

The Tobit model was based on the hypothesis that the likelihood of willingness to pay, y_i depends on a vector of known variables (X_i) and a vector (β, coefficient) of unknown variable.

The standard Tobit model is defined as

$$y_i^* = \boldsymbol{x_i}\beta + \varepsilon_i \ldots\ldots \quad (1)$$

$$y_i = \begin{cases} a \quad if \ y_i^* \le 0 \\ y_i^* \ if \ a < y_i^* < b \\ b \quad if \ y_i^* \ge b \end{cases} \ldots\ldots. \quad (2)$$

where; the subscript i = 1,.., N indicates the observations, y_i^* is an unobserved ('latent') variable, x_i represents vector explanatory variables, β_i is a vector of unknown parameters, ε_i is the error term which is assumed to be independently normally distributed: $\varepsilon \sim N$ (0, σ) (and therefore $y \sim N$ (Xβ, σ)), a is the lower limit of the dependent variable, b is the upper limit of the dependent variable.

Estimation of the model

The Tobit model is usually estimated by the Maximum Likelihood (ML) procedures (Verbeek, 2008). Assuming that the error terms are normally distributed with mean 0 and variance σ^2, the log-likelihood function of the model is

$$logL = \sum_{n=1}^{N} \left[I_i^a log\Phi\left(\frac{\boldsymbol{a}-\boldsymbol{x_i\beta}}{\boldsymbol{\sigma}}\right) + I_i^b log\Phi\left(\frac{\boldsymbol{x_i\beta}-\boldsymbol{b}}{\boldsymbol{\sigma}}\right) + \left(1 - I_i^a - I_i^b\right)\left(log\phi\left(\frac{\boldsymbol{y_i}-\boldsymbol{x_i\beta}}{\boldsymbol{\sigma}}\right) - log\sigma\right)\right] \quad (3)$$

where: $\boldsymbol{\phi}$(.) and Φ(.) denote the probability density function and the cumulative distribution function, respectively, of the standard normal distribution, and I_i^a and I_i^b are indicator functions with

$$I_i^a = \begin{cases} 1 \ if \ \boldsymbol{y_i} = a \\ 0 \ if \ \boldsymbol{y_i} > a \end{cases} \quad (4)$$

and

$$I_i^b = \begin{cases} 1 \ if \ \boldsymbol{y_i} = b \\ 0 \ if \ \boldsymbol{y_i} < b \end{cases} \quad (5)$$

Note that the log-likelihood function of the censored regression model can be maximized with respect to the parameter vector (β', σ)' using standard non-linear optimization algorithms (Gujarati, 2004). The variables included in the Tobit model and their expected relationships are subsequently discussed in the paper. Selection of these variables was based on the review of relevant theories and studies similar to the present study. The description of variables and their hypothesized effects are presented in Table 2.

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

As indicated in Table 3, of all the 292 respondents,

Table 2. Variables description, coding and expected sign of relationship.

Variable name	Variable description	Expected sign
WTP	**Dependent variable (yes/no response to items of WTP). This is continuous variable taking values ranging from 0 to 1**	
Age	Age of respondent in years	-
Sex	Sex of respondent. 1 if respondent is male, 0 otherwise	+
Education	Was a dummy variable indicating whether a respondent had attended formal education or not (1 if attended formal education, 0 otherwise)	+
HHSize	Number of individuals in the household	+
HHLand	Total household land in hectares own by the household	+
FarmExp	Number of years the household has been engaged in crop production	±
FarmDistance	Distance in kilometers from farm to nearest important road	-
HHIncome	Total annual net income of household in Tanzanian shillings	+
ComCrop	Degree of commercialization of crop enterprise - proportion of crops sold	+
Attitude	Attitude towards AESs. Dummy variable taking value of 1 if favourable and 0 otherwise	+

Table 3. Demographic characteristics of respondents (n=292).

Variable		Distribution of respondents by district						χ^2	ρ-value
		Mvomero (n=133)		Mpwapwa (n=159)		Total (n=292)			
		F	%	F	%	F	%		
Sex	Male	110	79.7	115	74.7	225	77.2	1.187	0.276
	Female	28	20.3	39	25.3	67	22.8		
Age (years)	Below 28	12	9.0	8	3.1	20	5.8	8.515	0.074**
	28 to 38	34	24.1	54	34.6	88	29.8		
	39 to 49	46	34.6	54	35.2	100	34.9		
	50 to 60	25	19.5	31	18.9	56	19.2		
	Above 60	16	12.8	12	8.2	28	10.3		
Marital status	Unmarried	12	9.0	11	6.9	23	7.9	10.315	0.016*
	Married	91	68.4	131	82.4	222	76.0		
	Divorced	17	12.8	13	8.2	30	10.3		
	Widowed	13	9.8	4	2.5	17	5.8		
Education level	No formal education	7	5.3	15	9.4	22	7.5	6.365	0.095**
	Primary school	112	84.2	135	84.9	247	84.6		
	Secondary school	13	9.8	6	3.8	19	6.5		
	Beyond secondary	1	0.8	3	1.9	4	1.4		

*, ** means significant at the 5 and 10% levels respectively; F = Frequency.

77.2% were males while 22.8% were females. These results are slightly lower than the national statistics which indicated that female-headed households (FHHs) in Tanzania account for 25.0% of households nationally and for 24.0% in rural areas (FAO, 2014). This indicated that majority of crop farming households in the study area were headed by males. This is common in most African countries, where male farmers culturally dominate as the heads of families from the hierarchical pattern of family structure. This provides males the opportunity most times to embrace new innovations when they are introduced in the community more than their fellow female counterparts. It is argued by Tolera et al. (2014) that demanding advisory services on payment requires sufficient resources, such as land, livestock, etc., which female headed households usually lack. Comparison of sex distribution of respondents between the two districts did not indicate a significant difference (χ^2 = 1.187, ρ =0.276).

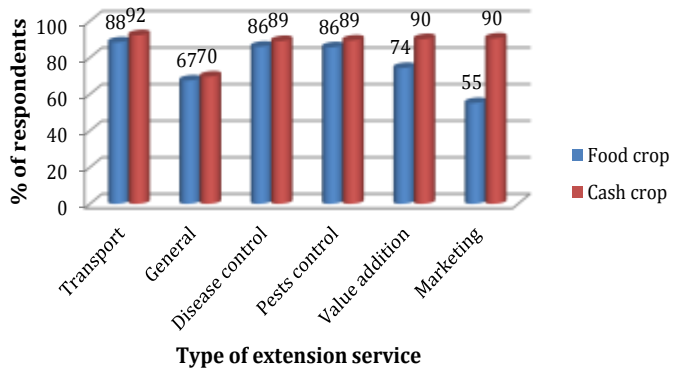

Figure 1. Percentage distribution of respondents by their WTP for AESs.

Respondents' age ranged between 21 and 75 years, with mean and standard deviation of 44.5 and 12.43 respectively indicating wide variation in the age of respondents. Findings reveal that a large proportion (about 70%) were 49 years old or less (Table 3). The higher percentage of young to middle-aged farmers showed that most farmers were still energetic to carry out the strenuous activities that accompany farm work in Tanzania where the hand hoe is still the dominant farming tool. Farmers' mean age of 44.5 years further attest to the fact that they were still active. Ogundele and Okoruwa (2006) asserted that only those farmers within the productive age group of 20-50 years are likely to possess the necessary strength to carry out farming operations. However, chi-square analysis revealed that age distribution of respondents slightly differed significantly between the two districts at 10% level of significance ($\chi^2 = 8.515$, $\rho = 0.074$).

Over two thirds (76.0%) of respondents were married, 10.3% divorced, 7.9% unmarried, and 5.8% were widowed. Distribution of respondents by marital status varied significantly between the two districts at 5% level of significance ($\chi^2 = 10.315$, $\rho = 0.016$). The findings show that there were more married respondents in Mpwapwa (82.4%) than in Mvomero (68.4%) and more widowed respondents in Mvomero (9.8%) than in Mpwapwa (2.5%). Marital status determines an individual's decision to demonstrate a mark of social responsibility and also indicates a readily available source of labour input (Adah et al., 2016). Adegeye and Dittoh (1985) declared that small-scale farmers could only be successful if they were married especially when they had to rely on family labour.

With regard to education, the findings show that majority of respondents (93%) had formal education and therefore probably were able to read and write, an attribute that enables them to understand issues and therefore can make informed decisions including a decision regarding paying for extension services (Sebadieta et al., 2007). Tolera et al. (2014) suggest that farmers who learned more may need farm specific information to manage their farm effectively on fee-for-service basis rather than confining themselves to general public goods.

Crop farmers' willingness to pay for agricultural extension services and the amount they are willing to pay

Willingness to pay for AESs

Of the 292 respondents, 88.0% were willing to pay for AESs associated with food crop production while 92.0% were willing to pay for AESs associated with cash crop (Figure 1 and Table 4). These findings are in line with other studies conducted in different parts of the world. Ackah-Nyamike (2003), for example, in a similar study conducted in Ghana reported that 82.0% of farmers were willing to pay for extension services while a study by Ozor et al. (2007) reporting that 80.6% of farmers in Nigeria were positively disposed to cost sharing in Nigeria.

However, these findings differ from some other studies. For example, in a study conducted in the three states of India, Sulaiman and Sadamate (2000) found that about 48.0% of farmers expressed a WTP for agricultural information. In Zimbabwe, Foti et al. (2007) found that only 4.6% of farmers were willing to pay for extension service, and 95.4% of the farmers were not. Ali et al. (2008) in Iran reported that only 24.7% of farmers were willing to pay for extension services and 75.3% were not willing to pay. Similarly, Francis et al. (2010) indicated that in Uganda, 35.0 and 40.0% were willing to pay extension services related to crops and animal husbandry respectively. These findings show that the willingness to pay for AESs was higher for crop farmers in Tanzania compared to their fellow counterparts in these other countries. This could be attributed to various strategies and initiatives taken by the government to improve the agricultural sector for the recent years.

Considering the six items that were assessed, although the difference might not be significant, findings show that more farmers were willing to pay for advice on value addition and marketing as compared with other items (Figure 1). Also, farmers are more willing to pay for services targeting cash crop than food crop indicating that farmers attach more value to cash crops than they do to food crops. This demonstrates that there is a conceptual change among the farmers from production orientation to market orientation. This sends a signal for AESs to cover the whole agricultural value chain. These findings are congruent with what is suggested by Chapman and Tripp (2003) that an important issue for the future of privatized extension is an understanding of exactly what type of service is to be provided. The authors add that no matter what the future of privatized extension, it is widely acknowledged that the traditional model of top-down, uniform instruction on crop

Table 4. Respondents' stated WTP amount (Tanzanian Shillings-TAS).

Parameter	Type/category of extension service											
	Extension agent's transport costs		General agronomic practices		Diseases control		Pests control		Crop value addition		Marketing of crops	
Type of crop	Food	Cash	Food	Cash	Food	Cash	Food	Cash	Food	Cash	Food	Cash
Frequency	258	261	197	197	251	252	250	253	217	255	161	256
Percent	88.4	92.2	67.5	69.6	86.0	89.0	85.6	89.4	74.3	90.1	55.1	90.5
Mean (×100)	34.22	34.08	35.43	33.45	37.31	36.98	37.90	38.21	35.52	42.92	34.88	45.82
Minimum	1000	1000	1000	1500	1000	1000	1000	1000	1000	1500	1000	2000
Maximum (×100)	60	60	100	100	150	150	150	150	100	100	200	200
SD × 100	13.30	12.92	21.14	17.01	25.39	23.22	26.34	25.30	19.80	27.21	26.02	30.60

N = 292 (food crop) and 283 (cash crop); SD = Standard deviation.

management recommendations (characteristic of much public extension) is far from the requirements of today's farmers.

Amount crop farmers are willing to pay

The willing respondents were also asked to state the amount of money they would be willing to pay for AESs (Table 4). The cost for AES was estimated per visit made by the extension agent. Zero was not considered as the amount but rather as an indication of unwillingness to pay hence not included in the computations. On average, farmers are willing to pay between 3422 and 4582 Tanzanian Shillings (TAS) per visit by extension agent for each of the six items associated with AESs. These findings reveal that farmers attach a certain value to extension service and at least are willing to pay something for the service. It is important therefore for extension administrators in Tanzania to actually estimate the total cost of providing extension service and then reconcile it with the amount farmers are willing to pay as revealed in this study in order to come out with a meaningful, achievable and sustainable figure prior to the introduction of a full-scale cost-sharing approach as a government policy.

Factors influencing crop farmers' WTP for AESs

WTP was regressed against a set of independent variables as indicated in Table 3. A Tobit regression model was estimated using STATA 12 computer programme. Robustness test results (Table 4) for the Tobit model revealed that the log-likelihood value (-246.62492), the pseudo R^2 (0.0559), and the chi-square value (28.95) were significant at $P \leq 0.0003$. The smaller p-value from the Likelihood Ratio (LR) test would lead us to conclude that at least one of the regression coefficients in the model is not equal to zero.

Seven out of ten factors were found significantly influencing farmers' WTP (Table 5). They include age of household head ($p \leq 0.034$), formal education attainment ($p \leq 0.039$), farming experience ($p \leq 0.001$), distance from farm to the nearest important road ($p \leq 0.000$), total household income ($p \leq 0.002$), commercialization of crop enterprise ($p \leq 0.037$) and attitude towards AESs ($p \leq 0.003$). Age was found to have a negative association with farmers' WTP for AESs which means that as the farmer grows older, his/her WTP for AESs decreases. These results conform to other studies (Gautam, 2000; Mezgebo et al., 2013). It is believed that older people prefer to keep tradition and therefore they are less likely to support the idea of paying for innovation. The implication of this is that if change is not required then there is no need for improved extension services and therefore no need to pay for it.

Findings (Table 5) show a positive association between attendance to formal education and WTP. These findings are according to what was hypothesized and are consistent with other studies (Ulimwengu and Sanyal, 2011; Ajayi, 2016). It is assumed that an educated farmer knows the importance of AESs hence should be more willing to pay than the uneducated one. Likewise, Tolera et al. (2014) argues that educated farmers may need farm-specific information to manage their farms effectively on fee-for-service rather than confining themselves to general public free goods.

Farming experience was positively associated with WTP for AESs, indicating that WTP increases

Table 5. The maximum likelihood estimates of the Tobit model.

Variable	Coefficient	Standard error	t	p>|t|
Age	-0.009526	0.003540	-2.69	0.034**
Sex	-0.04597	0.152584	-0.30	0.763
Education	0.462554	0.1907644	2.06	0.039**
HHSize	0.015322	0.018974	0.81	0.420
Landsize	0.003833	0.004318	0.89	0.375
FarmExp	0.024759	0.007225	3.43	0.001*
Distance	-0.657281	0.172043	-3.82	0.000*
HHIncome	0.45201	0.142917	3.16	0.002*
ComCrop	0.401422	0.160132	2.51	0.037**
Attitude	0.500259	0.166638	3.00	0.003*
_cons	1.421772	0.339317	4.19	0.000
/sigma	0.7786914	0.068409		
Model chi-square value	40.09			
Log likelihood	-246.625			
Prob>Chi^2	0.000			
Pseudo R^2	0.0559			

*,** Significant at 1 and 5%.

with farming experience. These findings contradict Tolera et al. (2014) who reported that the average years of farm experience were 21.9 and 28.6 for the willing and non-willing respondents respectively. Possible explanation for this could be that experienced farmers have accumulated more knowledge that they would not be ready to spend their money for something they already know. Our study did not predict a priori the direction of relationships between experience in growing crops and WTP because farming experience can have different effects to the farmer's decision to pay for AESs.

Willingness to pay was negatively associated with distance from farm to nearest important road. This is consistent with Francis et al. (2010) and Mwaura et al. (2010) who reported that WTP for AESs was less for those residing furthest from the main road. Possible explanation for this could be that farmers find it more expensive to cover transport costs for extension agent as he or she visits distant farm than it is for the near farm.

Income was positively associated with WTP meaning that household's WTP for AESs increased with total annual income. These findings are in line with prior expectation and consistent with many other studies (Tolera et al., 2014; Temesgen and Tola, 2015; Ajayi, 2016; Aydogdu, 2017). Possible explanation for this could be that more income means that a farmer has more funds to spend and can decide to experiment with the idea of sharing the cost of extension delivery. Also, available income for the household is expected to reduce household's poverty and thus increase its ability to pay for AESs. On the other hand, poverty reduces a household's willingness and ability to invest in agricultural technologies (Holden and Shiferaw, 2002).

Degree of commercialization for crop enterprise and attitude towards AESs were both positively associated with an increased probability of WTP. This implies that farmers are more willing to pay for extension if they derive greater benefits from the services. Umali and Schwartz (1994) argue that demand for agricultural extension services depends upon the expected net benefits from investment in new information. This also means crop farmers' WTP for AESs increases as their attitudes towards AESs changes from unfavourable to favourable state. The person's attitude towards an item is important in determining a person's intentions to or not to purchase the item (Ajzen and Fishbein, 1980). Findings further show that sex, household size and land size are not among the factors that influence crop farmers' WTP for AESs.

CONCLUSION AND RECOMMENDATIONS

This paper assessed the factors that influence crop farmers' WTP for AESs in Mpwapwa and Mvomero Districts. It concludes that farmers are willing to pay for AESs and their willingness is positively influenced by education, farming experience, income and attitude towards AESs and negatively influenced by age and distance to the nearest important road. Therefore designing of initiatives for paying for extension service for sustaining the AESs should pay attention to these factors. Farmers' WTP for extension service therefore is an indication that the introduction of fee-for-service AESs is feasible in Tanzania, especially in the study area.

The study recommends that: the government through

AESs should design and implement an effective adult education program in order to increase the farmers' level of education; and through TARURA should ensure rehabilitation of rural roads especially feeder roads that connect crop farms to the main roads. It addition, the government in partnership with other stakeholders should design programmes that are targeted at increasing the farmers' household incomes so that they can pay for extension services; through AESs, it should work on improving service delivery in order to ensure farmers' positive attitude AESs.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Assessment on rural poultry production and marketing system of Horro chicken ecotypes in Western Ethiopia

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A cross-sectional study was conducted to assess production and marketing system of Horro chicken ecotypes, and to determine poultry health and marketing constraints across different agro-ecologies of western Ethiopia. A total of 360 householders were interviewed for the survey in Horro area (western Ethiopia) where the Horro chicken ecotypes are mainly found; the sample size was determined using proportionate sampling technique. Household characteristics studied indicated that 87.45% household heads were males and about 90.32% of householders' age group were between 20 and 60 years. Household heads whose ages lie below 20 and above 60 yrs were very small (9.68%). The low proportion of these age group might be because of the age category below 20 yrs and above 60 yrs are age groups before marriage and after retirement, respectively. The mean and standard deviation of the family size of the study area was 6.19±2.16; where a mixed crop-livestock production system was the main stay in the area. Agricultural landholding ranges between 0 and 10 hectares and per-household landholding was 1.68±1.50. The mean per household landholding in the highland agro-ecology is 2.36 ±1.59; however, the mean chicken flock size was the least. The large per household landholding at highland matches the largest mean cattle herd size (10.64 ± 4.93) as opposed to chicken flock size. This might be because of the use of cattle for cropland preparation. About 90.85% producers rear chickens for sale, which was for an immediate income generation and savings. Horro chickens in addition to low productive performance were constrained with poor housing (where only 7% of producers had separate poultry houses), insufficient feed supplement and poor health management. Chickens were exclusively scavenging for feed and about 83.82% of poultry producers interviewed responded that they were not satisfied with veterinary services delivery.

Key words: Agro-ecology, chicken-ecotypes, Ethiopia, Horro chicken, traditional-management.

INTRODUCTION

Human population in 2050 is estimated to be 7.96–10.46 billion (UNPD, 2008). Protein shortages is a well-known problem in Africa, and poultry is by far the largest group of livestock species contributing about 30% of all animal proteins consumed in the world (AGRA, 2014). The world poultry population has been estimated to be about 16.2

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billion, out of which 71.6% were found in developing countries, producing 67, 718,544 metric tons of chicken meat and 57,861,747 metric tons of hen eggs (Gueye, 2003).

The impact of village chickens in the national economy of developing countries and its role in improving the nutritional status, income, food security and livelihood of many smallholders is significant owing to its low cost of production and plays a complementary role in agriculture (FAO, 1997; Gondwe, 2004; Abdelqader, 2007; Abubakar et al., 2007). In Africa, village chickens contribute over 70% of poultry products and 20% of animal protein intake (Kitalyi, 1998). In East Africa in particular, over 80% of human population live in rural areas and over 75% of these households keep indigenous chickens. Some of the characterized and designated chicken ecotypes (native chickens) of Ethiopia are; Tilili, Horro, Jarso, Tepi, Gelila, Debre-Elias, Melo-Hamusit, Gassay/ Farta, Guangua and Mecha (Halima, 2007). Ethiopia with the annual estimated production of 41,000 tones of eggs and 61,840 tones of chicken meat contributed only 0.1% share of the global production and 9.7% egg and 11.73% chicken meat of the East Africa respectively, (FAOSTAT, 2016).

Human population in Ethiopia shows an increasing trend with alarming rate that in turn increases the demand for food, especially of livestock origin (Hadera, 2002). The rural and urban population of Ethiopia is estimated to be 80.5 and 19.5%, respectively (FAO, 2016). Rural poultry in Ethiopia represents a significant part of the national economy in general and the rural economy in particular that contributes 98.5 and 99.2% of the national egg and chicken meat production, respectively (Tadelle and Ogle, 1996; Abera, 2000). However, the per household number of chicken flocks in most Ethiopian rural communities was small; constituting an average of 7-10 (Tadelle and Ogle, 2001) and average of 7.3 (Matiwos, 2013). The economic contribution of the sub-sector is not still proportional to the 60.5 mill. Chicken population in Ethiopia (CSA, 2016) is attributed to the presence of many production, reproduction and marketing constraints.

In recent years, an emerging middle-class urban society and urbanization with better income and more purchasing power has increased the demand for chicken and chicken products. This has led to the expansion of poultry production particularly within urban and peri-urban areas. Compared to performances reported on-station, village chicken productivity in the smallholder system was inefficient and it is characterized by high reproductive wastage and low productive performance (Tadelle and Ogle, 2001; Pedersen, 2002). Thus, production and productivity of the village chicken system should be improved through the type of chicken breed used, management and husbandry practices applied. This calls for designing poultry research strategy aiming at assessing the rural poultry production and marketing system, and indigenous Horro chicken ecotypes for chicken breed improvement measures to be undertaken. This research was therefore, aimed at assessing rural poultry production and marketing system, and Horro chicken's production and health constraints under traditional management.

MATERIALS AND METHODS

Description of the study area

The study was conducted in Horro Guduru Wollega, East Wollega and West Shewa zones of western Oromia Region of Ethiopia, where the Horro ecotypes chickens are mainly distributed. The study area was selected considering agro-ecology, socio-economic importance of chicken production and population of indigenous Horro chickens based on the atlas published jointly by IFPRI and CSA (2016) and Dana (2010). The Livestock population (in millions) of the three zones was about 3.7 cattle; 1.4 sheep; 0.7 goats; 0.7 equine and 3.5 chickens (CSA, 2016). The study area is situated within the geographical coordinates between 08°29´N and 37°49´E, and at altitude range of approximately 667 - 2602 m.a.sl., where a mixed crop-livestock agriculture was the main stay. The area experiences an extended rainy season, which frequently begins in March and extends to mid-October with annual rainfall ranging from 1500-1800 mm per annum; the monthly mean temperature varies between 11.5 to 27.5°C, the average humidity varies between 49-89% (Olana, 2006).

Sampling method and sample size determination

Three districts namely Horro, Leka-Dulecha and Bako-Tibe were selected from three zones of western Oromia, in Ethiopia. The districts represented three agro-ecologies namely [Highland, Mid-altitude and Lowland] for the characterization of poultry production and marketing system. The three zones namely (Horro Guduru Wollega, East Wollega and West Shewa zones) were purposively selected for the study as the zones share many social, cultural, and livestock and agricultural product marketing. The area was classified into climatically homogenous strata. Based on the traditional method of classification, the lowlands lie between 500 to 1,500 m a.s.l and have temperature range of 20 to 27.5°C, midland range between 1,500 to 2,300 m with a temperature range of 17.5 and 20°C. The highlands range between 2,300 to 3,200 m, and within temperature range of 11.5 to 16.0°C. After farmers, who rear poultry were listed on a flipchart from nine 'kebeles' (the smallest administrative structure in Ethiopia) three 'kebeles' from each district, a total of 360 householders were identified for the questionnaire survey using a proportionate sampling technique (Bellhouse, 2005):

$W = [A/B] \times N_o$.

Where, A = total no of households per single selected agro-ecology.
B = Total sum of households living in sample agro-ecology and rearing chicken.
N_o = the total required calculated sample size.

Methods of data collection

Semi-structured questionnaire was prepared in English and administered in 'Afan-Oromo' (local language of the study area); 36 farmer respondents, six enumerators, zonal and district experts were selected for the questionnaire pretest. Finally household survey was conducted to collect data on general households'

Table 1. Household (HH) sex, level of education and age characteristics.

Household head characteristics	Frequency (No of HH)	Percent
Sex		
Male	271	87.45
Female	39	12.55
Level of education		
Illiterate	87	28.06
Elementary	175	56.46
High school and above	48	15.48
Age		
< 20 yrs	3	0.97
21-30 yrs	36	11.61
31-40 yrs	118	38.06
41-50 yrs	89	28.71
51-60 yrs	37	11.94
> 60 yrs	27	8.71

NB. The educational level classification was based on the current Ethiopian educational level classification where: Illiterates were those who didn't join school, Elementary schools were grade 1-8 and high school and above was for grade 9 and above.

demography, livestock composition, poultry production and marketing system employed, and chicken management, and major chicken health constraints.

Data on family's demography, land and livestock holding, educational status, family members' responsibility in poultry production and marketing and income administration were collected through interview. Data on poultry house type and housing system, flock size and structure by age, sex and breed, management system such as breeding and hatchery management, egg storage, health care, feeding and watering and technological inputs use for poultry improvement were assessed. Data on poultry health constraints, health facilities locally available, and marketing system and market constraints encountered were gathered using survey questionnaire and key informant interview. Veterinary clinical case books were referred to and veterinarians of respective districts were consulted on disease prevalence, veterinary services available and technological interventions implemented.

Statistical data analysis

Survey data were entered into Microsoft Excel program for data clearance, which then was exported to *Statistical Package for Social Sciences (SPSS) for windows, version 20.0*. Descriptive statistics was used to analyses the means, standard deviations, minimum and maximum values of the quantitative data frequencies and percentages values. For quantitative variables such as data on household family size, land holding, livestock holding, chicken flock structure, generalized linear model (GLM) in SAS version 9.3 (2014) was employed.

RESULTS

Households' characteristics and demography

Characteristics of household studied are presented in Table 1. Most of the households are headed by males; male and female headed households were 87.45 and 12.55%, respectively. Level of literacy indicated that, most households (56.46%) interviewed had elementary education followed by illiterates (28.06%), and only 15.48% of households attended high school and above. The major age group (90.32%) of rural households of the study area lies in between 20 and 60 years; the households whose age was under 20 and above 60 years were few which was only 9.68%. Even though the households in the study area were mainly male headed, women play a significant role in poultry husbandry than their men counterparts. Very small number of young households (< 20yrs age) and old (>60yrs) participate in poultry production, which might be because, this age groups respectively, are the ages before marriage and after retirement from major agricultural activities.

Cropland and livestock holdings

Family size, livestock population and chicken flock structure are presented in Table 2. The mean and standard deviation of the family size of the study area were 6.55 (1.99), 6.34 (2.33) and 5.77 (2.1) for Horro, Bako-Tibe and Leka-Dulecha districts, respectively. Agricultural landholding studied was mainly rain fed where landholding ranges between 0 to 10 hectares per household; the mean was largest for Horro (highland) (2.36 ±1.59) followed by Bako-Tibe (lowland) (1.51±1.63); the least was Leka-Dulecha (mid-altitude) (1.25 ± 1.06) consecutively. Cattle, sheep, goats, equines and

Table 2. Cropland, livestock holding and poultry flock structure.

Study-zones	No of HH	Family size	Cropland holding (hectar)	Livestock holding (in Number)				Poultry flock structure (in number)					
				Cattle	Sheep	Goats	Equine	Chicken	Chicks	Cockerels	Pullets	Hens	Roosters
		Mean ± Sd	Mean ±Sd	Mean ±Sd	Mean ±Sd	Mean ±Sd	Mean ±Sd	Mean ±Sd	Mean ±Sd	Mean ±Sd	Mean ±Sd	Mean ±Sd	Mean ±Sd
Highland (Horro area)	100	6.55 (1.99)	2.36 (1.59)	10.64 (4.93)	6.73 (3.75)	2.86 (2.97)	3.19 (1.98)	10.46 (4.76)	4.63 (3.01)	0.58 (1.17)	0.88 (1.86)	3.40 (1.76)	1.36 (0.84)
Lowland (Bako area)	92	6.34 (2.33)	1.51 (1.63)	7.92 (7.44)	0.43 (1.32)	0.47 (1.99)	0.65 (.80)	13.26 (7.14)	5.59 (5.17)	1.54 (1.63)	1.53 (2.02)	3.65 (2.91)	1.01 (0.74)
Midland (Leka dulecha area)	118	5.77 (2.1)	1.25 (1.06)	6.58 (4.83)	4.30 (4.55)	0.24 (1.03)	0.78 (1.0)	10.09 (6.03)	3.06 (3.77)	0.92 (1.42)	1.70 (1.90)	3.72 (1.60)	1.13 (0.88)
Total	310	6.19 (2.16)	1.68 (1.50)	8.29 (5.99)	3.94 (4.37)	1.15 (2.41)	1.52 (1.78)	11.15 (6.16)	4.31 (4.16)	1.00 (1.46)	1.39 (1.95)	3.60 (2.12)	1.17 (0.84)

* N= number of householders interviewed.

chickens were the common domestic livestock reared in the area where cattle were the first in the rank of preference and level of importance. Chicken population had no direct relation with the mean per household landholding. This implies that area of land possessed had no effect on chicken population. It was rather the productivity of chicken that determines population. Landholding mainly cropland holding had more direct relation with cattle population as these animals were used for cropland preparation.

Chicken flock structure

The chicken flock in the study area was mainly composed of chicks followed by hens. Overall mean and standard deviation chicken flock size per household was 11.15±6.16, where the values for chicks, hens, pullets, cockerels and roosters were 4.31±4.16, 1.46±1.00, 1.95±1.39, 3.60±2.12 and 1.17±0.84, respectively. Even though the population of chickens was large and considered as important source of immediate income; they were not the first preferred livestock in order of importance compared to other livestock (Table 2). However, they are sometimes more preferred to equine and small ruminants by some rural and landless households. Chicken population, mainly the number of chicks was highly fluctuating with season of production. Producers did not let their hens to incubate during summer (wet) season of the year due to high disease prevalence during the wettest season of the year mainly from June to August and predators mainly cat-family predators and birds rob chicks during summer when they luck other preys to feed. The population of cockerels and pullets calculated from this study were 8.9 and 12.47% respectively, which implies the low survival rate of chicks produced under traditional management, and the challenge in getting hold of replacement stock.

Chickens in this study area were reared mainly for sale (90.85% producers) to generate immediate income and savings, where only 3.27 and 1.96% of them are reared for consumption and holyday sacrifices, and breeding and multiplication, respectively. The result also revealed that 29.22 and 26.95% chickens were owned by husbands and wives (as a common property) and by the whole family, respectively. The remaining 11.27, 13.31 and 17.86% chickens' ownership in particular goes to separate holding to family head, spouse and children, respectively.

Poultry keeping uses family labour in general and that of house wives in particular, who often look after and own the family flocks as major beneficiaries. Children particularly school boys and girls who are supported by their family, particularly by their mothers use the income and savings to buy school materials, clothing. Grown up children (boys and girls), who own and oversee chickens and their income by themselves use it to manage chicken, their school and other expenditure independently.

Income generation from live chicken and egg sale was the primary goal of family poultry keeping and was followed by production for savings (Table 3). Eggs can provide a regular, very small income

Table 3. Objective of poultry production and ownership characteristics.

Objective of production		Frequency	%	Rank
Consumption		10	3.27	3
Sale		278	90.85	1
Saving		12	3.92	2
Breeding		6	1.96	4
Chicken Ownership				
	Householder's	39	11.27	5
	Spouse's	41	13.31	4
	Children (Boys and Girls)	55	17.86	3
	Whole families'	83	26.95	2
	Husband and wife's	90	29.22	1
Source of initial Capital				
	Agriculture	261	87.58	1
	Private loan	10	3.35	3
	Family & friends	26	8.73	2
	Cooperative-finance	1	0.34	4

while the sale of live birds provides a more cash which can cover most home expenditures as required by house wives. The income obtained from sale of chicken was used for children's school fee, purchase of home consumptions and sometimes for purchase of agricultural inputs. The initial capital for poultry production in the study area was mainly obtained from agriculture (87.58%); gifts from family and friends, private loan and micro-finances (extension services) constitute the remaining sources.

Poultry production and management characteristics

The major feed resources, feeding practices and frequency of feed offering, and housing management assessed during this study are presented in Table 4. The predominant feeding practice in the study area was supplementation of scavenging chicken with feeds from home source, purchased grains and kitchen leftover. This result showed that 94.19% producers offer supplementary feed mainly composed of grains (46.23) obtained from farmers' home. About 73.52% of chickens in the current study area perch during night at different sites in the residence of family. Only 19.51, 3.14 and 3.83% of producers keep their chickens in kitchen, under the ceiling of living house and in baskets/cartons respectively; the remaining 7% producers constructed separate poultry house. Personal observation during the current study also showed that some of the producers in the study area tie chickens in house (Figure 2) during the day to protect the animals from robbing cultivated crops, and feed and malt grains kept under sun heat for flouring. Chicks mainly during their early age were kept in underground pits covered with different materials, in woven baskets and under tree shades so that they are protected from preying birds. All chickens, irrespective of their age and sex, move freely forming subgroups in and around the households and neighborhoods that give chance for hens to mate indiscriminately with own flock and/or neighbor flock roasters which leads to uncontrolled breeding.

Among chicken flocks in the current study; 82.94, 95.15 and 81.43% were indigenous breeds of Horro (highland), Bako-Tibe (lowland) and Leka-Dulecha (mid-altitude), respectively; the remaining chicken breeds were commercial layers, broilers and exotic dual-purpose chickens or hybrids (Table 5). New breeding stock establishment and replacement was through hatching, purchasing (pullets and cockerels), sharing with, and sometimes gifts from family and friends. The annual mean and standard deviation of chicken sold and slaughtered for consumption exceeds those replaced by hatching and purchasing. This might have been because producers cull chicken whenever disease outbreaks occur (Table 5). The offer of chicken mainly hens for share is a common practice in Ethiopia and it is a system people use to support their poor relatives. By this process, a share giver is the one who either wants to support his poor relative or has no space or time to rear chickens. The mother hen therefore will remain the property of the share giver where the egg produced and the chicks reared will be shared for the two parties (Table 6).

Poultry production, marketing and Health constraints

Due to disastrous chicken disease outbreaks and epidemics, producers may loss the whole flock or sometimes the majority of their flock at a time. About 88.6% of chicken holders interviewed responded that

Table 4. Feeding, Housing and hatchery management of chicken.

Factors Feeding management	Label of application	Frequency	Percent
Offer feed supplement	Yes	292	94.19
	No	18	5.81
Source of feed supplement	Grain from home	135	46.23
	Concentrate	12	4.11
	Kitchen leftover	5	1.71
	Grain from market	7	2.4
	Grain from home and Market	76	26.03
	Grain and kitchen leftover	57	19.52
Housing management			
Separate house for chicken	Yes	23	7.44
	No	286	92.56
Alternative House for chicken	Kitchen	56	19.51
	In family house	211	73.52
	Under home ceiling	9	3.14
	In Basket or cartoon	11	3.83
Hatchery management			
Was chick brooding season based?	Yes	295	95.16
	No	15	4.84
Storage of egg for incubation	one-week	3	0.97
	two-weeks	56	18.18
	10 days	25	8.12
	till hens sit to brood (not collected)	224	72.73

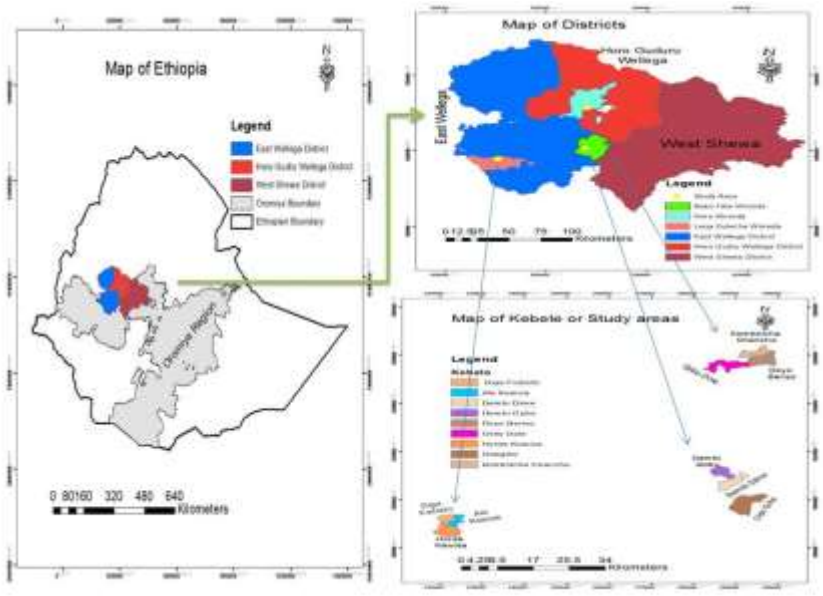

Figure 1. Map of study area (East Wollega, Horro Guduru Wollega and West Shewa zones of western Oromia, in Ethiopia).

Figure 2. Some of the Chicks' and Chicken's Housing and management systems used: left is a pit to rear chicks, middle is a kitchen and cattle barn where chicken bed during night and right is how chicken were tied during the day to protect them from crops at back yard.

Table 5. Chicken breed composition, marketing and source of replacement.

Factors	Variables	Study agro-ecologies (districts)						Overall means and standard deviations	
		Horro (highland)		Bako-Tibe (Lowland)		Leka-Dulecha (mid-altitude)			
		N	Means± Std	N	Means± Std	N	Means± Std	N	Means± Std
Breed of Chicken	Local	100	9.31(4.972)	89	13.39(6.999)	117	9.34(6.111)	306	10.51(6.308)
	Commercial	99	1.915 (0.69)	87	0.468 (0.11)	117	1.43 (0.650)	303	1.45 (0.510)
	Hybrids	97	0	87	0.214 (0.02)	115	0.78 (0.160)	299	0.50 (0.070)
Marketing and source of replacement	Chicken sold in six months	100	3.65(1.817)	92	1.924(1.760)	118	2.43(2.423)	310	2.63(2.224)
	Chickens Consumed in 12 months	100	1.93(0.868)	92	1.62(1.212)	118	0.91(0.730)	310	1.38(1.125)
	Chickens bred for replacement	100	0.901(0.420)	92	1.073(0.550)	118	2.21(2.040)	310	1.74(1.080)
	Obtained by gift to produce	100	0	92	0.179(0.030)	118	0.26(0.050)	310	0.19(0.031)
	Obtained for share	100	0	92	0.885(0.170)	117	0.16(0.030)	309	0.50(0.060)
	Males bought for replacement	100	0.544(0.370)	92	0.584(0.290)	118	0.71(0.250)	310	0.62(0.03)
	Females bought for replacement	100	0.613(0.260)	92	0.62(0.613)	118	1.97(1.530)	310	1.84(0.850)

N = number of respondents interviewed.

Table 6. Chicken ownership and Poultry product income utilization.

Family member	Chicken owner		Family member who use income from egg sale		Family member who use income from chicken sale	
	Frequency	%	Frequency	%	Frequency	%
Household head	35	11.29	22	7.10	39	12.58
Spouse	77	24.84	113	36.45	73	23.55
Children	78	25.16	54	17.42	53	17.10
Whole family	87	28.06	91	29.34	104	33.55
Husband and wife	33	10.65	30	9.68	41	13.22

Table 7. Production, marketing and health constraints.

Attributes	Label	Agro-ecologies (Study Districts)						Overall	
		Highland(Horro)		Lowland(Bako)		Midaltitude (Leka-Dulecha)			
		N	%	N	%	N	%	N	%
Was disease out-break occurred in your flock	Yes	97	97	88	96.7	87	74.34	272	88.6
	No	3	3	3	3.3	30	25.66	35	11.4
Chicken group affected more	Chicks	38	38.38	22	25.58	7	7.78	67	24.36
	Growers	0	0	4	4.56	1	1.11	5	1.82
	Layers	8	8.08	1	1.16	8	8.89	17	6.18
	Adults	2	2.02	0	0	3	3.33	5	1.82
	Chicks and layers	47	47.47	59	68.60	71	78.89	177	64.36
	Whole flock	4	4.04	0	0	0	0	4	1.45
Is vet service available in your area	Yes	58	58	52	56.52	84	71.19	194	62.58
	No	42	42	40	43.48	34	28.81	116	37.42
Is vet. service efficient	Yes	8	8	18	19.56	24	20.51	50	16.18
	No	92	92	74	80.43	93	79.49	259	83.82

they faced severe poultry disease outbreaks during their production practices. Concerning animal groups affected among the chicken flocks, chicks and layers together were the most affected (64.36%) followed by death of only-chicks (24.36%).

Chicken disease and lack of efficient veterinary services were among the major poultry health constraints in the study area (Table 7). Animal vulnerability was studied by categorizing chickens into layers, adults, chicks and layers, and whole flock. It is indicated that they faced severe poultry disease outbreaks during their production practices. Concerning animal groups affected among the chicken flocks, chicks and layers

Table 8. Chicken and egg marketing and market structure.

Market opportunities used	Marketable products			
	Chicken sale/marketing		Egg sale/marketing	
	Frequency	%	Frequency	%
Sale at home	5	1.62	25	8.09
Village-market	110	35.60	175	56.63
Middle-men	25	8.09	12	3.88
Nearby-town	169	54.69	97	31.39

Figure 3. Chicken transporting and marketing system commonly practiced in the study area.

together were the most affected (64.36%) followed by death of only-chicks (24.36%). Chicken disease and lack of efficient veterinary services were among the major poultry health constraints in the study area (Table 7). Animal vulnerability was studied by categorizing chickens into layers, adults, chicks and layers, and whole flock. It is indicated that 62.58% of respondents interviewed could get veterinary services in their surroundings; however, 83.82% of the respondents interviewed reported that they were not satisfied by the veterinary services efficiency.

Marketing live birds and eggs was run mainly at either village and/or nearby towns (district) market, which would take the major part in poultry marketing in the study area (Table 8). The marketing system in the area was unimproved, which may expose the animals to physical injury, meat bruise, contamination with disease agents and sometimes death due to suffocation (Figure 3). The transporting system used mainly for the chickens bought for resell was by carrying birds on shoulder. Marketing was undertaken mainly at secondary markets that took place on roads, travelling home to home, and selling to hotels and restaurants through an informal contractual agreement.

Poultry market in the study area was mainly primary market where marketing takes place at farm gate, to intermediaries, village market and district markets. Intermediaries in the study area were those traders who collect live chicken and egg from producers at home gate or standing on ways to market to transport that mass to secondary markets or end users. Chickens mainly (54.89%) were sold at district (nearby) town which might be because of the fair price and/or lack of chicken market at village/surrounding they may obtain. However, eggs were sold mainly (56.63%) at village markets.

DISCUSSION

Majority of household heads in the study area were male among which 56.46% had attended elementary school. This is somehow contrary to the report by Getu and Berhan (2014), in North-west Ethiopia, who documented 10% of respondents who went through elementary school. About 93% of the household heads were between 20 and 60 years age, which implies that it is the working class in general and householders with significant family size that engage in poultry production. The mean chicken holding per household (11.15±6.16)) in the current study is lower than the overall mean holding 16.43 (± 0.92); however, it is in accordance with the report of Guèye (1998), Tadelle and Ogle (2001) and Tadelle (2003), who documented almost every village household keeps

domestic fowl (on average between 5 and 20 birds). The result of the current study was found higher than the average holding 7.3 chicken reported by Matiwos (2013). Though poultry was the highest in mean population among livestock holdings, cattle are reported as most important as they are used for both draft and milk production purpose.

The most common chicken production system practiced in the study area was back yard extensive production system where chickens rely mainly on scavenging types of feeding. Chickens were integrated with other livestock and crop production. This agrees with the findings of other studies (Sonaiya, 1990; Kitalyi, 1998). The overall mean family size (6.19 ± 2.16) in the study area was in agreement with the report by Mekonnen (2007) who documented 6.9 mean family size in southern Ethiopia. However it is higher than the 5.2 national average reported by Moreda et al. (2013) and the 5.77 ± 0.57, 6.10 ± 0.44 and 6.73 ± 0.48 persons for Quara, Alefa and Tach Armachiho districts respectively, average family size reported by Getu and Berhan (2014) in northwestern Ethiopia. The agricultural landholding per household identified in the current study (1.68 ±1.50) is lower than the highest holding 5.20 ± 0.90 in Quara but in agreement with the lowest 1.7± 0.25 ha/hh from Alefa district of Amhara National State in Ethiopia, reported by Getu and Berhan (2014).

Chickens in the study area are mainly kept during night in family homes, in the kitchen, under the ceiling and eves of living homes and at some corner in other livestock barns. Only few householders (7.44%) who own larger number of chicken and trying to modernize production system build separate chicken houses. Chickens even though, are higher in mean population among the livestock composition reared in the study area, they were the least preferred with respect to level of importance in the livelihood of the farming society. However, for some households who do not have cropping lands and do not engage in off-farm duties, chickens may take better level of importance among other domestic animals.

The purpose of chicken production for about 90.85% producers interviewed was for sale. The income collected from sale of chicken and eggs was used to satisfy home expenditure and school fee, used as a source of initial capital for chicken production; mainly 87.58% was agriculture where both poultry production and agriculture complement each other. Chicken ownership according to this study was for whole family, husband and wife in common, spouse, children and sometimes exclusively for husband in a descending order. According to the result of this study women took the main part in chicken control and product management since they often stay at home during the day. This is in agreement with the report by Bradley (1992), Bishop (1995), Riise et al. (2004); however, they did not take the main part for ownership. This report, therefore, is in contrast with the report of Mcainsh et al. (2004) and Abubakar et al. (2007), where in several African countries, approximately 80% of the chicken flocks are owned and largely controlled and managed by rural women. However, in male headed households, whole family in general, wife and husband in particular, were the major owners of chickens. Decisions on egg consumption and chicken slaughtering, poultry product sale and utilization, and breeding stock selection were undertaken by the consult of husband and wife where income collected from egg sale was utilized by housewives. Children sometimes were also allowed to sell their own chicken and eggs to use income collected to cover expenses for school, to purchase clothes and save for further businesses.

Farmers make use of income generated from chicken sale for purchase of agricultural inputs, which include: fertilizer and seeds, farming-land renting, children's school fee, purchase of food items (mainly sauces) and as initial capital for investment to purchase other livestock mainly small ruminants. The result agrees with the report by Moreki et al. (2001), Tadelle and Ogle (2001) and Gueye (2003). Chickens also have social heritages that families and relatives offer breeding pullets for their poor relatives as a foundation stock and the distribution of hens for share could also strengthen the social bond among the share givers and takers.

The per household percent chicken breed calculated for; exotic chicken in the current study indicated for either commercial layers, hybrids or dual-purpose chickens was higher than the report by Dana (2010), who documented more than 95% of the total chicken populations of Ethiopia comprise the indigenous genotypes. The higher percentage of exotic chicken ecotypes reported in the current study might be because there was a project run in the area by "Ethio-chicken" that distributes a day old chicks to farmers and grower organizations that temporarily had lift up the number of exotic chicken in the area.

The major constraints in poultry production in the study area were poor management, high disease prevalence (mainly New Castle Disease and fowl typhoid) and low access to inputs (mainly improved chicken breeds, commercial concentrated feeds, veterinary services). Lack of sustainable market and marketing structure was also the market constraint facing in the area where the result is in accordance with the report by Kondombo (2005); Nigussie et al. (2003) and Wilson et al. (1987). The market price was fluctuating with cultural and religious festivals, season of the year and disease occurrence where it gets higher during holy days, dry season of the year and when there is no disease outbreaks as compared to regular market days. Disease epidemics and chicken predators were also among the major constraints in chicken production in the area. Producers lose the whole flock of their chickens when diseases such as New Castle Disease and Fowl typhoid occur. This report agrees with the report documented by Nigussie et al. (2003); Tadesse et al. (2005) and Nwanta et al. (2008), where the disease spreads rapidly through

the flock and mortality could reach up to 100%.

CONCLUSION AND RECOMMENDATIONS

Poultry production system in the study area was an integrated system that agriculture is a mixed crop-livestock production system where livestock; such as cattle, sheep, goats, equines, chicken, and for some households honeybee colonies and fishponds were part of their production system. Chicken holding in the area was from none to many and households who do not possess chickens were those who might have lost their flock due to disease outbreaks while those who had large size chicken flock were those who were trying to improve poultry production.

Poultry feeding system was scavenging type where no regular supplementations was practiced with grain from home and market, kitchen leftover and concentrate to a limited extent, and housing was mainly in family homes. Poultry housing with no variation among the agro-ecologic differences was mainly in the family homes and feeding system was scavenging in its character. Poultry production therefore was constrained by low productivity mainly because of less productive genetic performance and poor management, recurrent disease outbreaks, traditional marketing system and unorganized market structure. Chicken production and breed improvement were facing challenges of improved chicken breed input supply problems, high cost of concentrate feeds, vulnerability of exotic chicken breeds to different chicken diseases and inconvenient environment.

The integrated crop-livestock production system and complementarities among chicken and other livestock production is the best opportunity for improvement of rural chicken production as crop left over, cow dung and decomposition of animal manure and crop residues are best sources of complete feeds to the birds. In addition, farmers can improve chicken feeding system by using home produced grains and family feed leftover. Proper use of veterinary services and use of vaccination in the area and improvement of housing system (mainly use of hay-boxes for brooding) could reduce risk of loss of chicken flock by disastrous diseases and predators (prey birds and cats). Marketing system practiced in the area was very primitive that prone chicken to muscle bruise and sometimes death, which was also tiresome to market practitioners. Further research is recommended for identifying Horro chicken ecotype production potential and strategic approach for breed improvement through selection and crossbreeding with appropriate exotic chicken breeds.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests

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