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Willingness to pay for church forest conservation: a case study in northwestern Ethiopia

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Abstract: Church forests provide a safe habitat for plants and animals, sources of food and traditional medicine, seed bank for native tree species, reduce soil erosion and rich in biodiversity. But the economic values of these important benefits of church forests were not well documented. Therefore, this study was conducted to estimate the mean and total willingness to pay for church forest conservation using open-ended and double bounded contingent valuation formats. In doing so, both cash and labour contributions were used to measure the respondents' willingness to pay. Primary data were collected from 300 randomly selected households and analyzed using descriptive statistics and bivariate probit model. The estimated mean willingness to pay from the double bounded format (239.79 Ethiopian Birr) is higher than from the open-ended format (178 Ethiopian Birr). Similarly, the estimated mean willingness to contribute labour was also 71.51 and 94.34 man-days for the open-ended and double bounded contingent valuation format, respectively. The comparison indicated that the mean and total willingness to pay from the double bounded format is higher than in the open-ended format. Therefore, researchers, policymakers, and forestry experts should give special attention to the double bounded format rather than to the open-ended format to elicit respondents' willingness to pay for the conservation of church forests.

Keywords: bivariate probit; double bounded; open-ended; South Gondar; total willingness to pay

The Ethiopian Orthodox Church is one of the earliest churches in the world (Mulat 2013) which has a long history of planting and protecting trees around churches (Wassie, Demel 2007). These tree species surrounding religious sites have a relationship with the term sacred groves (Abiyou 2015). The combinations of these trees form forests that grow in the surroundings of the church. The church community perceives these forests as holy places in a religious, social and institutional sense (Wassie 2002). As discussed by Cardelús et al. (2012), church forests (Church forest is categorized under the private ownership structure because the forest is owned and managed by the Ethiopian Orthodox Tewahido Church) are found all over the world including Japan, Morocco, India, Ghana, and Ethiopia. In Ethiopia, significant forest patches are found in and around churches, monasteries, graveyards, mosque compounds and other sacred sites (FAO 2012). Especially church forests in northern Ethiopia support the highest richness of trees and animal species that have almost disappeared in most parts of northern Ethiopia (Wassie 2002; Aerts et al. 2006). *Juniperus procera*, *Podocarpus falcatus*, *Olea europaea L.*, *Ficus vasta Forssk*, *Ficus sur Forssk*, *Hagenia abyssinica*, and *Dovyalis abyssinica* are common native trees grown in church forests. However, they have been

https://doi.org/10.17221/154/2019-JFS

threatened by many social and economic changes (Reynolds et al. 2015; Klepeis et al. 2016).

Moreover, Woods et al. (2017) compared tree species richness, tree density, seedling species richness, seedling density and human disturbance of South Gondar church forests with and without a wall. Their results demonstrated that tree species richness, tree density, seedling species richness, and seedling density are significantly higher in church forests with a wall than without a wall, but human disturbance is lower in church forests with a wall than without a wall.

This indicates that church forests are decreasing both in size and density, with visible losses in biodiversity (Wassie et al. 2010). As a result, the conservation of church forests is important for the conservation of biodiversity in areas threatened by deforestation and fragmentation (Cardelús et al. 2013; Cardelus et al. 2017) because they comprise many rare and unique species that make the preservation of these forests crucially important (Yadav, Eyasu 2013).

According to Wassie (2002), out of 125 woody species that have been registered for the South Gondar natural forests, 81 species occurred in eight church forests in South Gondar. Moreover, Wassie et al. (2010) reported that a total of 168 woody species (100 trees, 51 shrubs, and 17 liana species) representing 69 families were recorded in 28 church forests.

But these patches of natural forest have survived as a result of the traditional conservation effort of the Ethiopian Orthodox Tewahido Churches (Klepeis et al. 2016; Reynolds et al. 2017). Consequently, Bongers et al. (2006) confirmed that a large number of forests need to be protected to conserve indigenous trees species.

Even though these church forests are threatened by anthropic and natural factors, they serve as safe habitats for plants and animals, sources of food and traditional medicine, seed banks for native tree species, provide shade and conditioned atmosphere for religious festivals, sweet and pleasant smell around churches, reduce soil erosion, are rich in biodiversity, grace for the church and harbour pollinator species (Wassie 2002; Aerts et al. 2006; Reynolds et al. 2015; Klepeis et al. 2016; Reynolds et al. 2017). But the economic values of these important benefits of church forests were not well documented. The economic value of the church forests answers the question why we should be concerned about the conservation of church forests. The findings of the research on economic valuation provide indispensable information about the monetary values of church forests which serve as a reason to conserve church forests. Therefore, it is a key exercise in economic analysis (Abila et al. 2005).

To do this, economists have employed different techniques which are called economic valuation of natural resources. Economic valuations are techniques which economists apply to estimate the economic value of market and non-market goods. According to Pearce and Özdemiroglu (2002), non-market goods refer to those goods which cannot be directly bought and sold in the market place. Consequently, the benefits of church forests are categorized under non-market goods because the market has no bid to estimate the monetary value of these goods and services. As discussed by Philcox (2007) and Snowball (2007), Contingent Valuation Method (CVM) is currently the only method of measuring the values of non-market goods and services because the market bid does not exist or reflect their value. As a result, CVM enables people to directly state their willingness to pay for non-use values rather than inferring them from observed behaviours in regular market places (Albertini, Cooper 2000).

Although the open-ended contingent valuation format is unlikely to provide a reliable result of the willingness to pay (Arrow et al. 1993), Amare et al. (2016) estimated households' willingness to pay to restore church forests in northwestern Ethiopia using the open-ended contingent valuation format. The authors employed cash only to measure the respondents' willingness to pay though the area faces a chronic cash shortage.

Particularly, estimation of mean willingness to pay using a bivariate probit model, valuation of church forest conservation using labour contribution, comparison of cash payment and laboor contribution to value church forest, estimation of total willingness to pay, and comparison of the open-ended and double bounded format were not studied. Therefore, this study was conducted to estimate the farm households' mean and total willingness to pay for church forest conservation practices using double bounded and open-ended contingent valuation format and to compare the mean and total willingness to pay obtained from double bounded and open-ended contingent valuation format.

https://doi.org/10.17221/154/2019-JFS

MATERIALS AND METHODS

Study area. South Gondar Zone of the Amhara Region, particularly *Fogera, Dera* and *Farta woredas* were the areas for this study. Geographically, the South Gondar Zone is found between 11°02'–12°33'N and 37°25'–38°41'E with an altitudinal range of 1 500–4 231 m (Figure 1). The average annual rainfall varies between 700 and 1 300 mm, with an average annual temperature ranging from 9.3 to 23.7°C. The South Gondar Zone has an area of about 14 300 km^2. The total forest cover is 20 882 ha, of which 16 660 ha are natural forests and 4 222 ha are man-made plantations. The forest cover accounts for 1.4% of the total area of which 50% is attributed to 1 404 church forests (Wassie et al. 2005; Wassie, Demel 2007; Wassie et al. 2010).

Church forests in the South Gondar Zone are often small, fragmented and situated in agricultural landscapes (Bhagwat, Rutte 2006). The regeneration potential and the recruitment of seedlings in church forests are threatened due to the high degree of fragmentation, the isolation from seed sources, human disturbance, edge effects and the small size of the forests (Cardelús et al. 2013). Therefore, the forest size is a large determinant of forest resilience because small size forests (1 to 10 ha) are characterized by high edge effect, tree mortality and low regeneration capacity (Laurance et al. 2011). The majority of the church forests in the South Gondar Zone are tiny fragments with an average area of 5.42 ha (Bongers et al. 2006; Woods et al. 2017). As a result, forests with low regeneration capacity and strong edge effect have high canopy tree mortality, which leads to a complete loss of the church forest. This could threaten religious practice, biodiversity and ecosystem services (Cardelus et al. 2017).

Additionally, the results from the Wassie et al. (2009) study conducted in the South Gondar Zone church forests indicated that seed germination, seedling survival, and seedling growth were higher in forests that excluded livestock by building fenced enclosures than in forests that allowed livestock access. Supplementary to this, Cardelus et al. (2017) found that "shadow conservation" of church forests may not be enough in this era of high deforestation as well as selective logging. This implies that the church forests in the South Gondar Zone require well-designed conservation practices to minimize the vulnerability of the forest to degradation due to the small size of the forest and its associated effects as well as different threats to the forest.

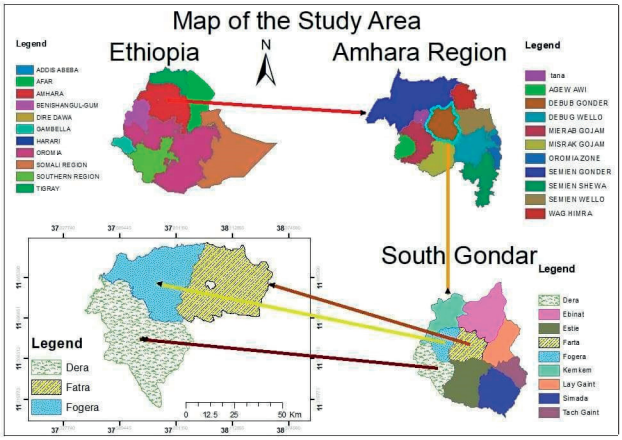

Figure 1. Map of the study area

Sampling procedure. The South Gondar Zone was selected as a study area based on three major reasons: different scholarly pieces of literature reported that the forests are threatened by anthropic and natural factors (Wassie 2002; Bongers et al. 2006; Klepeis et al. 2016); to fill information gaps of previous studies because almost all of the studies conducted in church forests are focused on the biological part of the forest (Wassie 2002; Cardelús et al. 2012; Abiyou 2015; Cardelus et al. 2017). But studies regarding household's willingness to pay for church forest conservation are almost nil (Amare et al. 2016) and different international projects have been attracted by the church forests found in the South Gondar Zone and the need for conservation practices. Therefore, a multistage random sampling technique was employed for this study. In the first stage, three woredas, namely Dera, Fogera, and Farta woredas, were selected. In the second stage, five church forests were randomly selected from each woreda. In the third stage, sample respondents were stratified based on headship, i.e. male- and female-headed households. The study conducted by Klepeis et al. (2016) indicated that church forests are managed by the church councils, but the involvement of the church council only is not sufficient to protect the forest. Besides the church council, the participation of the church community takes the lion's share to conserve their local church forests because the additional financial source and the labour force are key factors to conserve church forests. So, understanding the willing-

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ness of the church community to participate in the conservation practices of their local church forests has great importance to design and implement different conservation practices. Consequently, this study assessed how much they are willing to pay in terms of cash and labour to conserve church forests. In this case, WTP in terms of cash and labour refers to a payment to the church in order to design and implement church forest conservation practices so as to protect the forest from degradation. For this purpose, a total of 300 households were selected from all religious followers representing 3 000 target population. Finally, systematic random sampling was applied to draw sample respondents from each stratum.

Data Collection. Primary data were collected using a carefully designed contingent valuation (CV) survey questionnaire besides focus group discussion and key informant interview. Referendum format CV studies are preceded by a pretest survey of a small sample population. The discussion by Hoyos and Mariel (2010) underscored that the pretest survey with open-ended questions can help to provide some information on the bounds of respondents' willingness to pay. As a result, a series of focus group discussions and pretest surveys of the draft questionnaire were conducted before the actual survey. For this purpose, 15 households were randomly selected for the pretest survey besides 10 focus group discussions and 20 key informant interviews. Based on the pretest survey, focus group discussion and key informant interview report, starting bid sets were determined, a draft questionnaire was customized under local conditions and enumerators were equipped in administering a final CV survey. Accordingly, the three most frequent bids in terms of cash and labour were selected as a starting bid for a double bounded format. These are 51 (€1.56), 102 (€3.12) and 153 (€4.68) Ethiopian Birr per annum and 24, 48 and 72 man-days per annum. Using these starting bids, the follow-up bid is set on the basis of the response to the first bid. In a double bounded format, if the response is "yes" to the first bid, the second bid is somewhat higher than the first bid. If the initial response is "no," the second bid is somewhat lower than the first bid (Trudy, John 1994; Michael, Kanninen 1996; Cooper et al. 2002; Hoyos, Mariel 2010). In the case of open-ended format, respondents are asked the question "how much are you willing to pay?" to determine the exact amount of the respondents' willingness to pay.

Depending on the above explanations, this study employed both open-ended and double bounded contingent valuation format to compare the mean and total willingness to pay obtained from these two CV formats. Therefore, two types of questions were asked. The first, open-ended, directly asked the maximum amount he/she would be willing to pay for the conservation of their local church forests; and the second was an iterative binary question asked for different bids until settling at a maximum offered bid.

Analytical techniques. Both descriptive statistics and bivariate probit model were used to analyze the data using the statistical software STATA (Version 14). The bivariate probit model was initially introduced by (Cameron, Trivedi 2005). It was argued that when the individuals are asked two questions, the respondents may reconsider their willingness to pay (WTP), and the distribution of WTP may change from the initial question to the follow-up question. The bivariate probit model allows for the possibility of different distributions of WTP across the initial and follow-up questions. In the bivariate probit model, the two dichotomous choice responses are simultaneously modelled as single-bounded, i.e. two correlated WTP equations with jointly distributed normal error terms (with the correlation coefficient, ρ). To identify the factors simultaneously determining the two WTP dependent variables, the bivariate probit model for an individual *i* can be specified as follows (Haab, McConnell 2002):

$$WTP_{1i} = x_{1i} + \beta_{1i} + \varepsilon_{1i} \quad (1)$$

$$WTP_{2i} = x_{2i}\beta_{2i} + \varepsilon_{2i} \quad (2)$$

where:

i – ith respondent's WTP;

β_{1i}, β_{2i} – unknown parameters to be estimated in the first and second responses, respectively;

x_{1i} – explanatory variables that can affect amounts of offered prices;

WTP_{1}, $_{2}$ – unobservable random components in the first and second responses, respectively;

ε_1, ε_2 – normally distributed variables with mean zero and respective variances σ_1 and σ_2, and they have a bivariate normal distribution with the correlation coefficient ρ.

Four possible outcomes arise with different probabilities as follows : (*i*) both answers are 'yes'; (*ii*) a 'yes'

https://doi.org/10.17221/154/2019-JFS

followed by a 'no'; (*iii*) a 'no' followed by a 'yes'; and (*iv*) both answers are 'no'. Following Hanemann et al. (1991), the probability that the respondent answers to the initial bid and follow-up bid is obtained by:

$$pr(no,no) = pr(WTP_{1i} < t^1, WTP_{2i} < t^2) = \quad (3)$$

$$= pr(no,yes) = pr(WTP_{1i} < t^1, WTP_{2i} \geq t^2)$$

$$x_i\beta_{1i} + \varepsilon_{1i} \quad < t^1, x_i\beta_{2i} + \varepsilon_{2i} < t^2)$$

$$= pr(x_i\beta_{1i} + \varepsilon_{1i} < t^1, x_i\beta_{2i} + \varepsilon_{2i} \geq t^2) \quad (4)$$

$$pr(yes,no) = pr(WTP_{1i} \geq t^1, WTP_{2i} < t^2)$$

$$= pr(x_i\beta_{1i} + \varepsilon_{1i} \geq t^1, x_i\beta_{2i} + \varepsilon_{2i} < t^2) \quad (5)$$

$$pr(yes,yes) = pr(WTP_{1i} \geq t^1, WTP_{2i} \geq t^2$$

$$= pr(x_i\beta_{1i} + \varepsilon_{1i} \geq t^1, x_i\beta_{2i} + \varepsilon_{2i} \geq t^2) \quad (6)$$

where:
t^1 – initial bid;
t^2 – second bid price.

This specification is called a bivariate discrete choice model which assumes normally distributed variables with mean zero and respective variances σ_1 and σ_2, and they have a bivariate normal distribution with the correlation coefficient ρ. Following the estimation of the bivariate probit model, the mean willingness to pay (MWTP) is calculated using the formula specified by (Haab, McConnell 2002). The equation can be expressed as (Eq. 7):

$$MWTP = -\alpha/\beta \quad (7)$$

where:
α – coefficient for the constant term;
β – coefficient of bid values.

For an open-ended contingent valuation survey the responses from maximum willingness to pay figures reported by the respondent can simply be averaged to produce an estimate of mean WTP (Eq. 8).

$$\text{Mean WTP} = 1/n \sum_{i=1}^{n} y_i \quad (8)$$

where:
n – number of sample households;
y_i – maximum WTP amount.

RESULTS

The data were collected from 300 respondents, but only 284 respondents were used for the statistical analysis. This study employed both cash and labour variables to measure the respondents' willingness to pay for the conservation of their local church forests. The analysis was done separately in cash and labour. Before the application of the double bounded contingent valuation method, 'yes' and 'no' questions were presented to the respondents to assess their willingness to pay for the conservation of their local church forests. Finally, the result indicated that 68.3% of the respondents were willing to pay in terms of cash; on the other hand, 80.3% of the respondents were willing to contribute labour for the conservation of church forests. Following this, the initial bid and follow-up bid were presented to the respondents to elicit their willingness to pay. The result revealed that 58.1% of the respondents accepted the initial bid in terms of cash. On the contrary, 41.9% of the respondents rejected the initial bid. According to their response to the initial bid, the next maximum and minimum bids were presented to elicit their willingness to pay. Therefore, 55.1% of the respondents answered 'yes' to the follow-up bid; whereas, 44.7% of the respondents responded 'no' to the follow-up bid. Similarly, 48.9% of the respondents were willing to pay the initial bid in terms of labour contribution; whereas, 51.1% of the respondents rejected the initial bid. Conversely, 54.9% of the respondents replied 'yes' answer to the follow-up bid; whereas,45.1% of the respondents replied 'no' answer to the follow-up bid (Table 1).

Both open-ended and double bounded contingent valuation formats were used to compute the mean willingness to pay and to compare the open-ended and double bounded results. In the case of open-ended format, the maximum number of respondents who are willing to pay to conserve their local church forests were asked to elicit the respondents' willingness to pay in terms of cash and

Table 1. Joint responses to initial and follow-up bid

Payment mechanism	Bid presentation	Accept		Reject	
		Frequency	Percent	Frequency	Percent
Cash	Initial bid	165	58.1	119	41.9
	Follow-up bid	157	55.3	127	44.7
Labour	Initial bid	139	48.9	145	51.1
	Follow-up bid	156	54.9	128	45.1

Source: own survey, 2018

https://doi.org/10.17221/154/2019-JFS

labour contribution. The open-ended contingent valuation result demonstrated that the respondents' willingness to pay ranges from 10 (€0.31) to 550 (€16.84) Ethiopian Birr (ETB) to conserve their local church forests. The mean and median of their willingness to pay were 178 (€5.45) and 160 (€4.90) ETB, respectively. As the result indicated, the mean of the respondents was higher than the median. This implies that the respondents were willing to pay less than the average WTP.

The maximum contribution of man-days for the conservation of church forests was elicited using open-ended questions. The result revealed that the respondents' willingness to contribute labour ranges from 12 to 180 man-days per year. The mean and median of labour contribution was calculated based on the survey data. The result indicated that the mean and median of their willingness to contribute labour were 71.51 and 72 man-days per year, respectively. This result indicated that the respondents were willing to pay close to the average willingness to contribute labour per year.

Table 2. Parameter estimates of the bivariate probit model from the double bounded format

Payment	Variables	Coef.	Std. Err.	Z-value	$P > z$
Cash	Bid1	–0.0039	0.0006	–6.4	0.000
	constant	0.92776	0.1196	7.76	0.000
	Bid2	–0.003	0.00059	–5.21	0.000
	Constant	0.88469	0.12398	7.14	0.000
	/athrho	0.59684	0.11467	5.20	0.000
	Joint probability of success				0.528
	Joint probability of failure				0.18442
	Mean WTP				239.79
	Likelihood-ratio test of rho = 0				31.3186***
Labor	Bid1	–0.0037	0.0012	–2.97	0.003
	constant	0.3478	0.1095	3.18	0.001
	Bid2	–0.0026	0.0015	–1.73	0.084
	Constant	0.3005	0.0998	3.01	0.003
	/athrho	0.3664	0.1005	3.65	0.000
	Joint probability of success				0.2582
	Joint probability of failure				0.1379
	Mean WTP				94.34
	Likelihood-ratio test of rho = 0				13.81***
	Observations				284

Source: own survey, 2018; *** significant at $P < 0.01$, z = z-value

In addition to the open-ended format, the mean willingness to pay was computed from the double bounded contingent valuation format following the bivariate probit estimation (Haab, McConnell 2002; Bogale, Urgessa 2012; Temesgen 2015). The likelihood ratio test of the model confirms the interdependence between two probit equations at less than a 1% significance level. This indicated that the two equations estimated concurrently. Moreover, the joint probability of success was computed for a cash payment (52.8%) and labour contribution (25.8%) following the bivariate probit estimation. As the model result indicated, both the initial and the follow-up bid had a statistically significant and negative effect on responses to the stated bids at less than a 1% significance level. This implies that an increase in the number of bids decreases the respondents' willingness to pay both in terms of cash and labour. Then, the mean willingness to pay in terms of cash and labour was estimated following the bivariate probit model estimation. The mean willingness to pay in terms of cash was 239.79 (€7.34) ETB per annum (Table 2). Similarly, the mean willingness to pay in terms of labour was calculated and converted into cash equivalent based on the zone average wage rate (25 ETB/day or €0.77/day). The model result revealed that the mean willingness to pay in terms of labour was 94.34 man-days per year equivalent to 2 358.25 (€72.18) ETB per year. The result indicated that the mean willingness to pay for church forest conservation from the double bounded format (239.79 ETB) was higher than in the open-ended format (178 ETB). This clearly shows that the mean WTP for the double bounded format is 35% higher than for the open-ended format.

Total willingness to pay estimation is the final step in contingent valuation studies. Therefore, the total willingness to pay in cash and labour was estimated using open-ended and double bounded contingent valuation formats. The total households' willingness to pay for the conservation of church forests was estimated based on the proportion of willing households in the survey result. As a result, the total households of the sample kebele were estimated based on these ratios (68.3% and 80.3%). The data obtained from the agriculture office of *Fogera, Dera* and *Farta woredas* indicated that a total of

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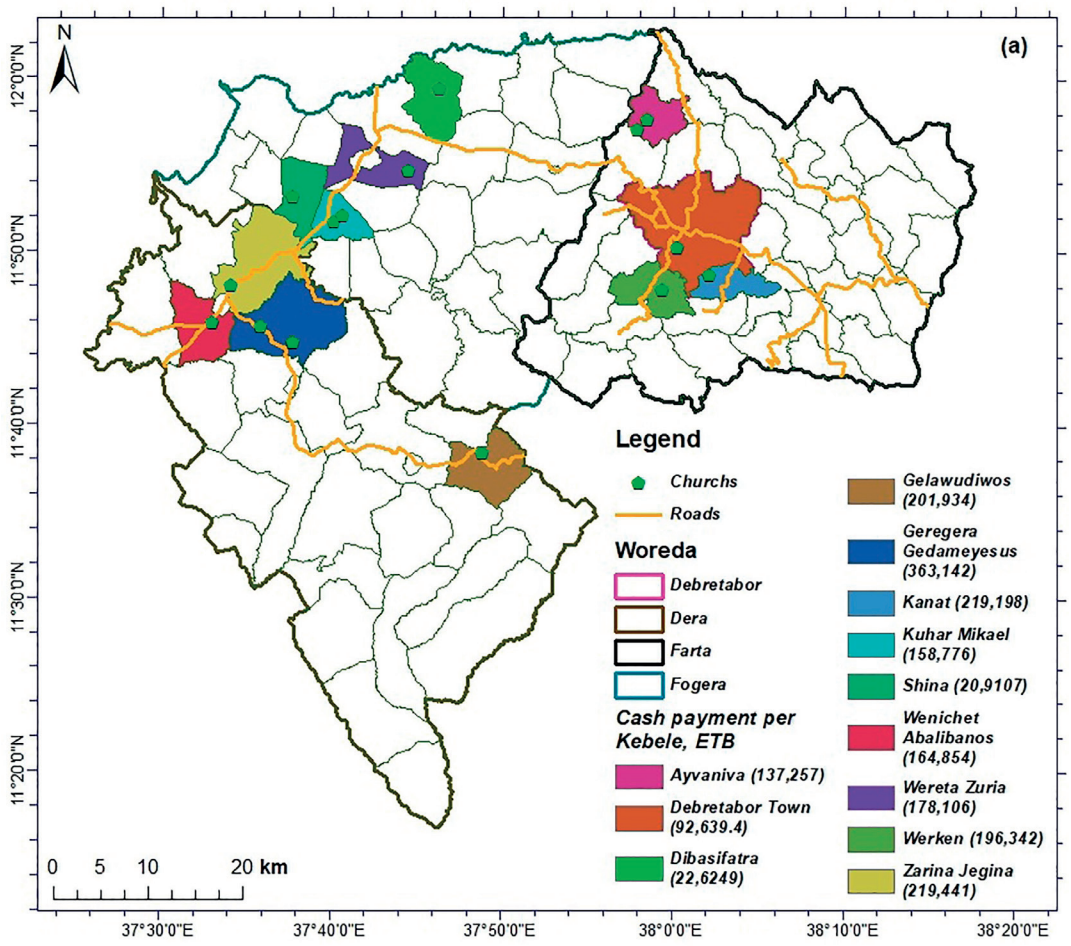

Figure 2. Estimated total willingness to pay from the open-ended format (ETB)

19,470 households live in the selected church forests. Based on this, 13,298 and 15,634 households were willing to pay for the conservation of church forests in cash payment and labour contributions, respectively.

The total number of willing households in each *kebele* was obtained by multiplying the ratio of sample households in each *kebele* by the total number of households of the sample *kebele*. Then, the total willingness to pay of the total households in the sample kebeles was calculated by multiplying the total number of willing households by the mean WTP. Finally, the grand total willingness to pay was obtained by adding the willingness to pay of the total households in each *kebele*. In terms of cash payment, the total willingness to pay is equal to 2 367 046 and 3 188 730 ETB for the open-ended and double bounded format, respectively. On the other hand, the total willingness to contribute labour was 1 118 016.66 and 1 474 950.24 man-days for the open-ended and double bounded format, respectively (Figures 2 and 3).

Additionally, the mean and total willingness to contribute labour converted into cash equivalent based on the zone average wage rate (25 ETB/day or €0.77/day) was computed. The result indicated that the mean cash equivalent of labour contribution was 1787.75 (€54.72) ETB and 2358.50 (€72.19) ETB from the open-ended and double bounded format, respectively. Similarly, the total willingness to contribute labour from the open-ended and double bounded format was 27 950 417 ETB (€855 537.7) and 36 873 756 ETB (€1 128 673), respectively. From this result we can conclude that the mean willingness to pay in cash payment from open-ended and double bounded formats is lower than the mean la-

[1]In 1993, National Oceanic and Atmospheric Administration (NOAA) appointed a panel of leading social scientists, chaired by Kennet Arrow and Robert Solow, to assess the reliability of CV results and to prepare guidelines for CV studies.

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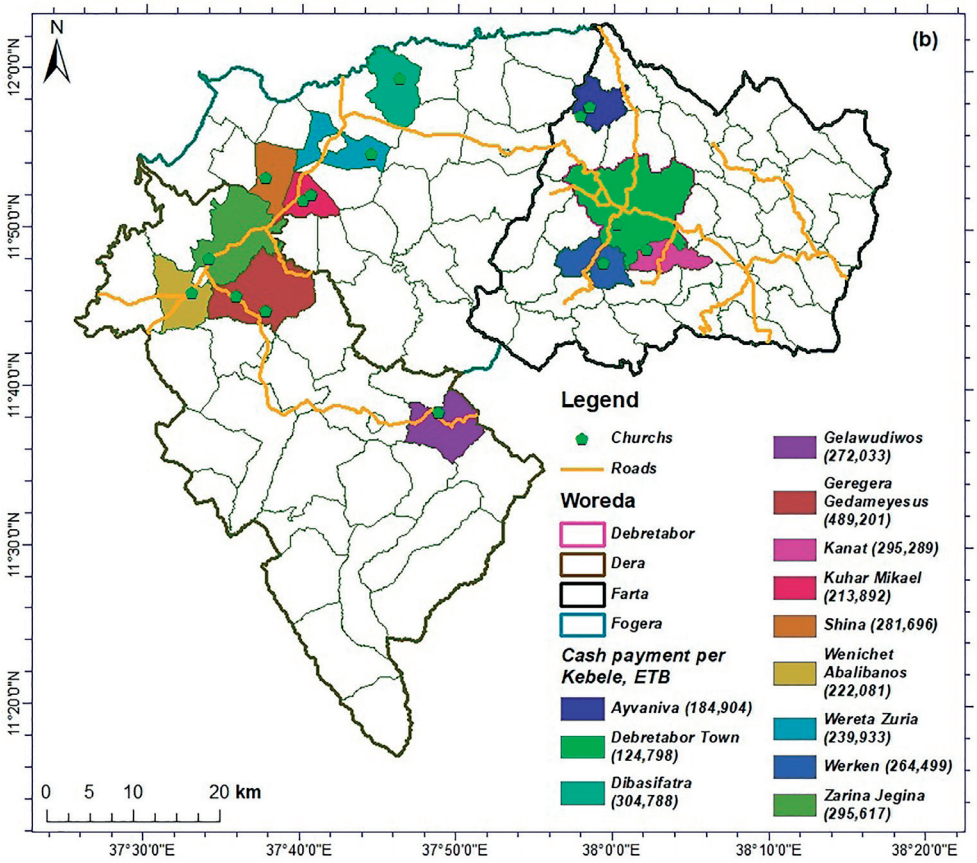

Figure 3. Estimated total willingness to pay from the double bounded format (ETB)

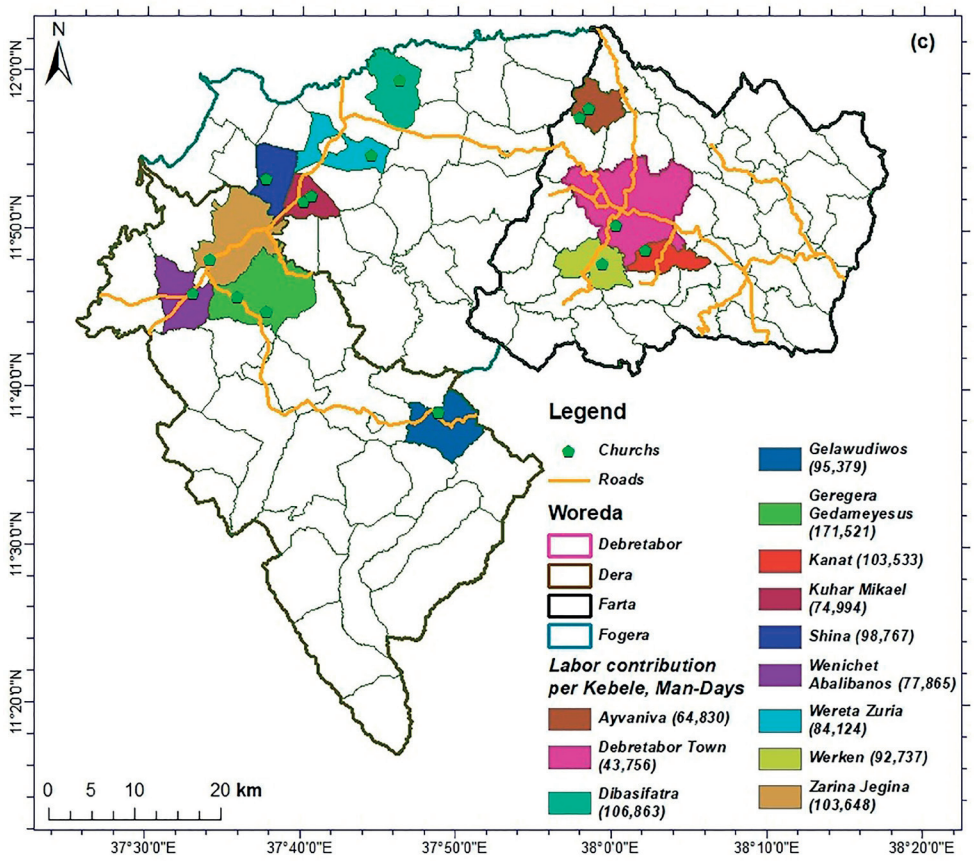

Figure 4. Estimated total willingness to pay from the open-ended format (Man-Days)

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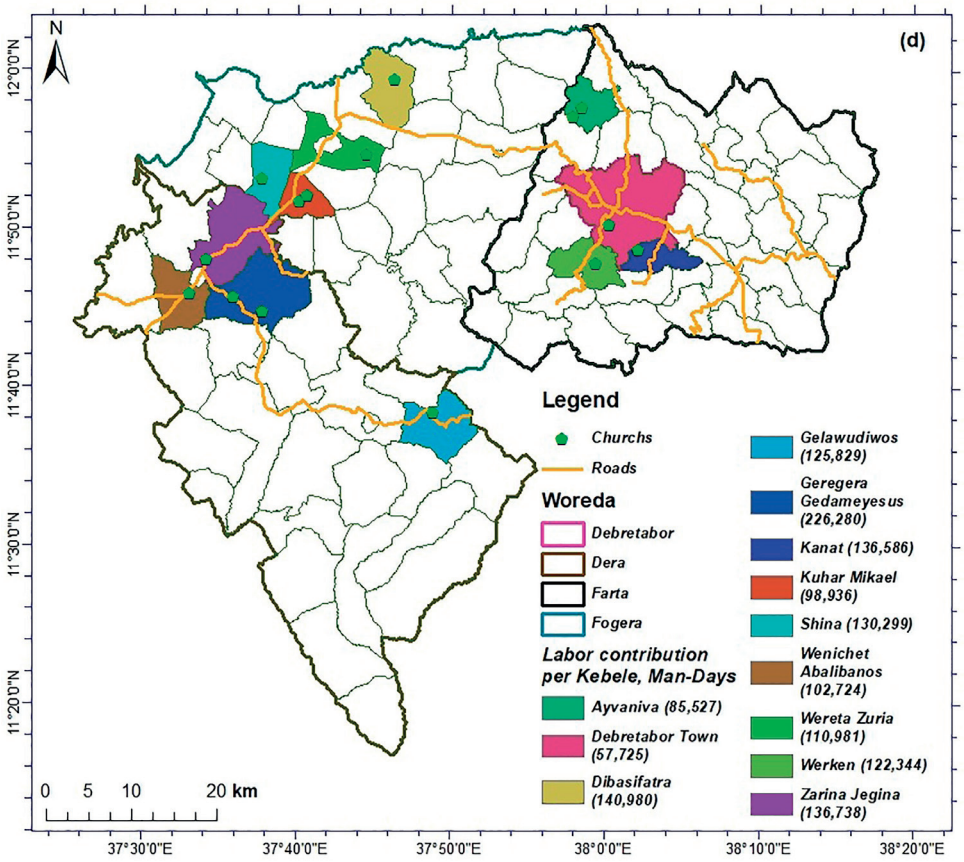

Figure 5. Estimated total willingness to pay from the double bounded format (Man-Days)

bour contribution from the open-ended and double bounded formats (Figures 4 and 5).

DISCUSSION

The result indicated that the joint probability of success was higher than the joint probability of failure (Table 2). This implies that using two successive binary questions simultaneously improves the result of the willingness to pay estimation. From this we can conclude that the double bounded contingent valuation format provides a better result as compared with single bounded and open-ended contingent valuation formats. This finding is in line with the 1993 CVM guidelines of the National Oceanic and Atmospheric Administration (NOAA) panel[1]. As discussed by Arrow et al. (1993) in a double bounded format, two successive binary questions are used to elicit respondents' willingness to pay in which the follow-up bid depends on the response to the first bid. These successive questions improve the efficiency of willingness to pay estimation because more information is elicited in the double bounded format as compared to open-ended and single bounded formats (Hanemann et al. 1991). Moreover, different CV studies reported that the double bounded contingent valuation format yields more efficient welfare measures because it requests more information from the respondents about the distribution of willingness to pay; consequently, this finding is in line with previous studies (Trudy, John 1994; Cooper et al. 2002; Hoyos, Mariel 2010; Temesgen 2015).

The mean and total willingness to pay for the church forest conservation from the double bounded format is higher than from the open-ended format. This result was compared with the results of previous studies and CV guidelines. For example, Bamlaku and Yirdaw (2015) estimated willingness to pay for improved soil and water conservation practices among smallholder farmers using a double bounded and open-ended valuation format. The findings of their study conclude that the mean and total willingness to pay for soil and water conservation from double bounded format was higher than in the open-ended elicitation format. Similarly, Gebrelibanos (2012) elicited households' willingness to pay for soil conservation practices in Adwa woreda, Ethiopia using open-ended and

https://doi.org/10.17221/154/2019-JFS

double bounded valuation formats. The result of his study shows that the mean willingness to pay estimated from the double bounded valuation format was higher than in the open-ended format. Additionally, Temesgen (2015) estimated the mean willingness to pay for community-based forest landscape restoration using a bivariate probit model and compared it with the mean willingness to pay from the open-ended format. Finally, his result reported that the mean willingness to pay from the double bounded contingent format was higher than from the open-ended format. Consistently, the 1993 NOAA panel CV guideline recommends the double bounded format instead of using the open-ended contingent valuation format because the double bounded format has gained popularity due to its significant advantages in avoiding many of the biases known to be common in other contingent valuation formats. Additionally, the statistical efficiency of contingent valuation studies can be increased by asking the respondents follow-up questions based on their response to the initial bid (Michael, Kanninen 1996; Trudy, John 1994; Cooper et al. 2002; Hoyos, Mariel 2010). This indicated that the double bounded format is more efficient than other contingent valuation formats. Additionally, the open-ended contingent valuation format produces a high non-response rate due to starting point bias and lack of follow-up questions which would make the survey results unreliable to estimate the respondents' willingness to pay. This indicated that the findings of this study are consistent with NOAA panel guidelines and previous CV studies (Hanemann et al. 1991; Arrow et al. 1993; Bamlaku, Yirdaw 2015; Temesgen 2015).

The mean willingness to pay in cash payment from the open-ended and double bounded format is lower than the mean cash equivalent of labour contribution from the open-ended and double bounded format. This is due to the fact that farm households in Ethiopia are willing to contribute labour more than cash payment for environmental conservation practices (Temesgen 2015) because labour is inexpensive and more easily available than cash. Similarly, rural households are constrained by chronic cash shortage to purchase inputs of production and to fulfil basic needs at the household level. For example, the annual income of the respondents in the study area ranges from 5600 ETB (€171.41) to 67,000 ETB (€2050.81) with an average income of 14767.97 ETB (€452.04). This shows that the average income of the respondents in the study area is lower than the international extreme poverty line ($1.9 per day) (Jolliffe and Prydz 2016). This clearly indicated that the respondents' willingness to contribute labour is higher than in cash payment. This finding is consistent with previous studies (Asrat et al. 2004; Gebremariam, Edriss 2012; Erango et al. 2017).

CONCLUSION

The study indicated that the double bounded format provides a better result than the open-ended format. Consequently, special attention should be given to the double bounded format rather than to the open-ended format to elicit respondents' willingness to pay for the conservation of church forests. Moreover, the mean and total willingness to contribute labour was calculated and converted into cash equivalent based on the South Gondar Zone wage rate to compare its result with cash payment. From this result we can conclude that the mean willingness to pay in cash payment from the open-ended and double bounded format was lower than that of the mean labour contribution from the open-ended and double bounded format. Hence, researchers, policymakers, and the South Gondar Zone forest experts should target labour contribution rather than a cash payment for the conservation of church forests.

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REFERENCES

Abila R., Diafas I., Guthiga P., Hatfield R., Kiragu S., Ritho C. (2005): Economic valuation and environmental assessment. Center for Development Research (ZEF) and IUCN-The World Conservation Union-Eastern Africa Regional Office (IUCN-EARO): 125.

Abiyou T., Hailu, T., Teshome, S. (2015): The contribution of Ethiopian Orthodox Tewahido Church in forest management and its best practices to be scaled up in North Shewa Zone of Amhara Region, Ethiopia. Agriculture, Forestry and Fisheries 4: 123–137.

https://doi.org/10.17221/154/2019-JFS

Aerts R., Van Overtveld K., Haile M., Hermy M., Deckers J., Muys B. (2006): Species composition and diversity of small afromontane forest fragments in northern Ethiopia. Plant Ecol, 187: 127–142.

Albertini A.A., Cooper J. (2000): Application of contingent valuation method in developing countries. FAO Economic and Social Development Paper, 146: 68.

Amare D., Mekuria W., Teklewold T.D., Belay B., Teshome A., Yitaferu B., Tessema T., Tegegn B. (2016): Perception of local community and the willingness to pay to restore church forests: the case of Dera district, northwestern Ethiopia. Forests, Trees and Livelihoods, 25: 173–186.

Arrow K., Solow R., Portney P.R., Leamer E.E., Radner R., Schuman H. (1993): Report of the NOAA panel on contingent valuation. Federal Register, 58: 4601–4614.

Asrat P., Belay K., Hamito D. (2004): Determinants of farmers' willingness to pay for soil conservation practices in the southeastern highlands of Ethiopia. Land Degradation & Development, 15: 423–438.

Bamlaku A., Yirdaw M. (2015): Labor as a payment vehicle for valuing soil and water conservation practice: An application of contingent valuation method in Abaro-Toga Watershed, Southern Ethiopia. Journal of Economics and Sustainable Development, 6: 17–25.

Bhagwat S.A., Rutte C. (2006): Sacred groves: potential for biodiversity management. Frontiers in Ecology and the Environment, 4: 519–524.

Bogale A., Urgessa B. (2012): Households' willingness to pay for improved rural water service provision: application of contingent valuation method in Eastern Ethiopia. Journal of Human Ecology, 38: 145–154.

Bongers F., Wassie A., Sterck F.J., Bekele T., Teketay D. (2006): Ecological restoration and church forests in northern Ethiopia. Journal of the Drylands, 1: 35–44.

Cameron A.C., Trivedi P.K. (2005): Microeconometrics: methods and applications. Cambridge, Cambridge University Press: 1034.

Cardelús C., Lowman M.D., Eshete A.W. (2012): Uniting church and science for conservation. Science, 335: 915–916.

Cardelús C., Scull P., Hair J., Baimas-George M., Lowman M.D., Eshete A.W. (2013): A Preliminary assessment of ethiopian sacred grove status at the landscape and ecosystem scales. Diversity, 5: 320–334.

Cardelus C., Scull P., Wassie Eshete A., Woods C.L., Klepeis P., Kent E., Orlowska I. (2017): Shadow conservation and the persistence of sacred church forests in northern Ethiopia. Biotropica, 49: 726–733.

Cooper J.C., Hanemann M., Signorello G. (2002): One-and-one-half-bound dichotomous choice contingent valuation. The Review of Economics and Statistics, 84: 742–750.

Erango E., Mekonnen B., Mekdes S., Tesfaye E., Tolera T. (2017): Economic valuation of soil conservation in highlands of Hadiya Zone of Ethiopia: The case of Soro Woreda Ajacho Watershed. Journal of Resources Development and Management 37: 16–23.

FAO (2012): The state of forest genetic resources of Ethiopia. Institute of Biodiversity Conservation, Addis Ababa, FAO: 69.

Gebrelibanos G. (2012): Households' Willingness to Pay for Soil Conservation Practices in Adwa Woreda, Ethiopia: a Contingent Valuation Study. [MSc Thesis.] Oromia, Haramaya University: 109.

Gebremariam G.G., Edriss A.K. (2012): Valuation of soil conservation practices in Adwa Woreda, Ethiopia: A contingent valuation study. Journal of Economics and Sustainable Development, 3: 97–107.

Haab T.C., McConnell K.E. (2002): Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation. Northhampton, Edward Elgar Publishing: 352

Hanemann M., Loomis J., Kanninen B. (1991): Statistical efficiency of double-bounded dichotomous choice contingent valuation. American Journal of Agricultural Economics, 73: 1255–1263.

Hoyos D., Mariel P. (2010): Contingent valuation: Past, present and future. Prague Economic Papers, 4: 329–343.

Jolliffe D., Prydz E.B. (2016): Estimating international poverty lines from comparable national thresholds. Plac of published, The World Bank, 1813–9450.

Klepeis P., Orlowska I.A., Kent E.F., Cardelús C.L., Scull P., Eshete A.W., Woods C. (2016): Ethiopian Church Forests: A hybrid model of protection. Human Ecology, 44: 715–730.

Laurance W.F., Useche D.C., Shoo L.P., Herzog S.K., Kessler M., Escobar F., Brehm G., Axmacher J.C., Chen I.C., Gámez L.A. (2011): Global warming, elevational ranges and the vulnerability of tropical biota. Biological Conservation, 144: 548–557.

Michael H., Kanninen B. (1996): The statistical analysis of discrete response CV data. Department of Agricultural and Resource Economics. Working Paper No. 798. Berkeley, University of California: 1034.

Mulat Y. (2013): The role of Ethiopian Orthodox churches and monasteries in forest management practices in Chilga and Mettema woredas (districts), North Gondar zone. International Journal of Innovative Research and Development, 2: 437–446.

Pearce D., Özdemiroglu E. (2002): Economic valuation with stated preference techniques: summary guide. Plac of published, Department for Transport, Local Government and the Regions London, 1851125698.

Philcox N. (2007): Literature review and framework analysis of non-market goods and services provided by British

https://doi.org/10.17221/154/2019-JFS

Columbia's ocean and marine coastal resources. Vancouver, Canada/British Columbia Oceans Coordinating Committee: 92.

Snowball J.D. (2007): Measuring the value of culture: Methods and examples in cultural economics. Springer Science & Business Media: 226.

Temesgen Y. (2015): Valuing Community Based Forest Landscapes Restoration: The bivariate probit analysis for degraded forest lands in NorthWestern Ethiopia. Journal of Marketing and Consumer Research, 8: 58–63.

Reynolds R., Collins C., Wassie A., Liang J., Briggs W., Lowman M., Sisay T., Adamu E. (2017): Sacred natural sites as mensurative fragmentation experiments in long-inhabited multifunctional landscapes. Ecography, 40: 144–157.

Reynolds T., Sisay T.S., Lowman M., Wassie Eshete A. (2015): Sacred natural sites provide ecological libraries for landscape restoration and institutional models for biodiversity conservation Policy Brief, United Nations: 4.

Trudy C., John Q. (1994): Estimation using contingent valuation data from a. Journal of environmental economics and management, 27: 218–234.

Wassie A. (2002): Opportunities, constraints and prospects of the Ethiopian Orthodox Tewahido Churches in conserving forest resources: the case of churches in south Gonder, Northern Ethiopia. Upsala, Swedish University of Agricultural Sciences: 204.

Wassie A., Demel T. (2007): Ethiopian Church Forests: opportunities and challenges for restoration. [Ph. D. Thesis.] Wageningen, Wageningen University: 204

Wassie A., Sterck F.J., Bongers F. (2010): Species and structural diversity of church forests in a fragmented Ethiopian Highland landscape. Journal of Vegetation Science, 21: 938–948.

Wassie A., Sterck F.J., Teketay D.a., Bongers F. (2009): Effects of livestock exclusion on tree regeneration in church forests of Ethiopia. Forest ecology and management, 257: 765–772.

Wassie A., Teketay D., POWELL N. (2005): Church forests in north Gonder administrative zone, northern Ethiopia. Forests, Trees and Livelihoods, 15: 349–373.

Woods C., Cardelús C., Scull P., Wassie A., Baez M., Klepeis P. (2017): Stone walls and sacred forest conservation in Ethiopia. Biodiversity and Conservation, 26: 209–221.

Yadav R.H., Eyasu M. (2013): Degradation of preserved and isolated church forests in Asebot, Ethiopia. European Academic Research, 1: 529–534.

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