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Economic Value of Black Cumin (*Nigella sativa L.*) Conservation at Bale Zone of Oromia Region, Ethiopia

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Abstract

Black cumin seed for local consumption and other importance, such as oil and oil rosin for medicinal purposes, export market, crop diversification, income generation, reducing the risk of crop failure and others made black cumin as a best alternative crop under Ethiopian smaller land holdings. Thus, for sustainable use of this crop, the producers demand for conservation through utilization needs economic value estimation. Therefore, the objective of this study was to estimate households' willingness to pay (WTP) value for conservation black cumin and analyze the determining factors that affects willingness of households to participate in the conservation of black cumin in the study area. To attain the stated objectives contingent valuation survey questionnaires were distributed to elicit farmers WTP for improved conservation of black cumin. A total of 180 households' were randomly selected from 8 kebeles of two Woredas of the study Zone. The result indicated that 172 (95.55%) were willing to pay, while the rest 8 (4.44%) were not willing to pay (contribute) for black cumin conservation. Logistic regression model result shows that the statistically significant determinants of WTP for the participation in black cumin conservation in the study area were availability of labor for farm activities, distance from market, households' livestock holding, initial BID1 offered and productivity of the land at 5% significance level, and total farm l income and perception about the importance of black cumin conservation at 1% level. The mean willingness to pay for the sampled respondents was 85.32 ($213.30) labour day per year. Hence, the aggregate economic value of black cumin conservation is 3,119,469.84 ($7,798,674.57) person days per annum. Therefore, policy should give emphases at all levels for production, conservation and sustainable utilization of black cumin farm variety.

Keywords

Black Cumin, Economic Value, WTP, Conservation, Ethiopia

1. Introduction

Black cumin (*Nigella sativa* L.) belongs to the family Ranunculaceae. The crop is native to the Mediterranean region and it has been used for thousands of years by various cultures and civilizations. Black cumin is an annual flowering plant. The fruit is a large and inflated capsule composed of 3–7 united follicles, each containing numerous seeds. The seed is used as spice [4; 16]. Black cumin is used as a whole or in crushed form for various pursues. Black cumin is one the most revered medicinal seeds in history. Since 1959, over 200 studies at international universities and articles published in various journals have shown remarkable results supporting its traditional uses recorded almost 1400 years ago [4; 6]. Dioscoredes, a Greek physician of the century recorded that black seeds were taken to treat headaches, nasal congestion, toothache, and intestinal worms. They were also used, he reported, as a diuretic to promote

menstruation and increase milk production [15; 14]. Black Cumin has a long history of uses for food flavors, perfumes and medicinal values. Oil has been used for bringing smell to some medicines, sterilizing of surgical operation fiber, production of some veterinary and agricultural medicines and plastic components [2]. Black Cumin seeds have an aromatic odor and bitter taste. They are used as an essential ingredient in soup component, sausages, cheese, cakes and candies. The Ethiopian variety of cumin seed accumulate up to 50% thymol, a monocyclic phenolic compound. The presence of this compound makes cumin valuable source for health care Industry [5] and medicinal purposes [3]. In Ethiopia, it is commonly used in Amharic "Berbere" in which it tends to reduce its hotness [12].

Black cumin is used principally to flavor food, either as whole grain, in powdered form or as an oleoresin extract. It is also used in gripe water and other herbal medicines. Within Ethiopia its main use is as a spice, which is typically ground and mixed with other spices. There is also some use in traditional medicine. The vast majority of Ethiopia's black cumin exports go to Arabic countries, which, together with other predominantly Muslim countries, accounted in 2008 for some 98% of national exports. Sudan overtook Saudi Arabia as the main export destination in 2007 and by 2008 it accounted for almost one half of all official exports. It is uncertain how reliable this market is and whether exports can be maintained at current levels. Value-adding to cumin in Ethiopia is low, with all exports being made in the form of whole grain [13].

More recently a great deal of attention has given to the seed and oils yields of black cumin. Due to this, their consumption has thus increased and black cumin is the second cash crop exported next to ginger in Ethiopia. Ethiopian annual production of black cumin seed is 18000 metric tons 2014/15 [8] and the national average of black cumin productivity is 0.79 tons per hectare [9]. However, the crop is produced on fragmented land and soils having long cereal cropping history where crop residues are removed for various purposes without any chemical fertilizer application. Additionally, information regarding its response to fertilizer is insufficient in the country.

Moreover, the production and land coverage of black cumin has been increasing; the productivity is still less than 300 kg haG. Several problems including lack of improved seed, recommended fertilizer rate, lack of knowhow on postharvest handling; improved agriculture practices and extension system, marketing system, etc. are accountable for the continued low productivity and production of black cumin [17]. Due to the increased demand of black cumin seed for local consumption and other importance, such as oil and oil rosin for medicinal purposes, its export market, its potentiality in crop diversification, income generation and its importance to reduce the risk of crop failure and others made black cumin as a best alternative crop under Ethiopian smaller land holdings.

Thus, for sustainable use of this resource, the users demand for conservation through utilization needs economic value estimation. There are different types of economic value estimation –for non-marketed environmental and public goods. Hence, in this study researchers were applied the Contingent Valuation Method which normally is used to elicit Willingness to Pay (WTP) for non-marketed environmental resources/ goods. Despite the country's favourable environmental condition for its production, the black cumin economic valuation estimation for the conservation crop through utilization was remained unevaluated. Moreover, the households willing to pay value for suitable conservation of this crop in the study area was not yet studied. Besides, the determining factors for conservation of black cumin were also not identified. Therefore, this study was aimed at filing this gab particularly in the study area since the study Woredas are one of the potential area production. Therefore, the objectives of this was to estimate households willingness to pay value for conservation black cumin and analyze the determining factors that affects willingness of households to participate the conservation black cumin in the study area.

2. Materials and Methods

2.1. Description of the Study Area

Bale zone is one of the 18 administrative zones in Oromia national regional state which is located in south-eastern Ethiopia. It has borderlines with Arsi, Guji, West and East Hararge zones as well as Somali and Southern Nations and Nationalities and Peoples' Regional States. It has 18 districts out of which nine are located in highland agro-ecology whereas the remaining nine are located in mid and lowland respectively. The area receives an average annual rainfall of 400-2500mm and min and max temp 3.5°C and 35°C and altitude ranges from 300 to 4377masl. Based on the figure from [7] report Bale zone has an estimated total population of 1,741,197 out of which 881,559 are male and 859,638 are female.

Goro and Ginir are the Woredas in the Bale zone of Oromia Region of Ethiopia. Goro is bordered on the Southwest by Guradamole, on the west by Berbere, on the Northwest by Sinanana Dinsho, on the Northeast by Ginir, and on the Southeast by the Somali Region; it is separated from Guradamole and Berbere by the Gestro River (or Weyib River). Ginir is bordered on the south by the Gestro River (or Weyib River) which separates it from Goro, on the west by Sinanana Dinsho, on the Northwest by Gaserana Gololcha, on the Northeast by Seweyna, and on the East by Raytu.

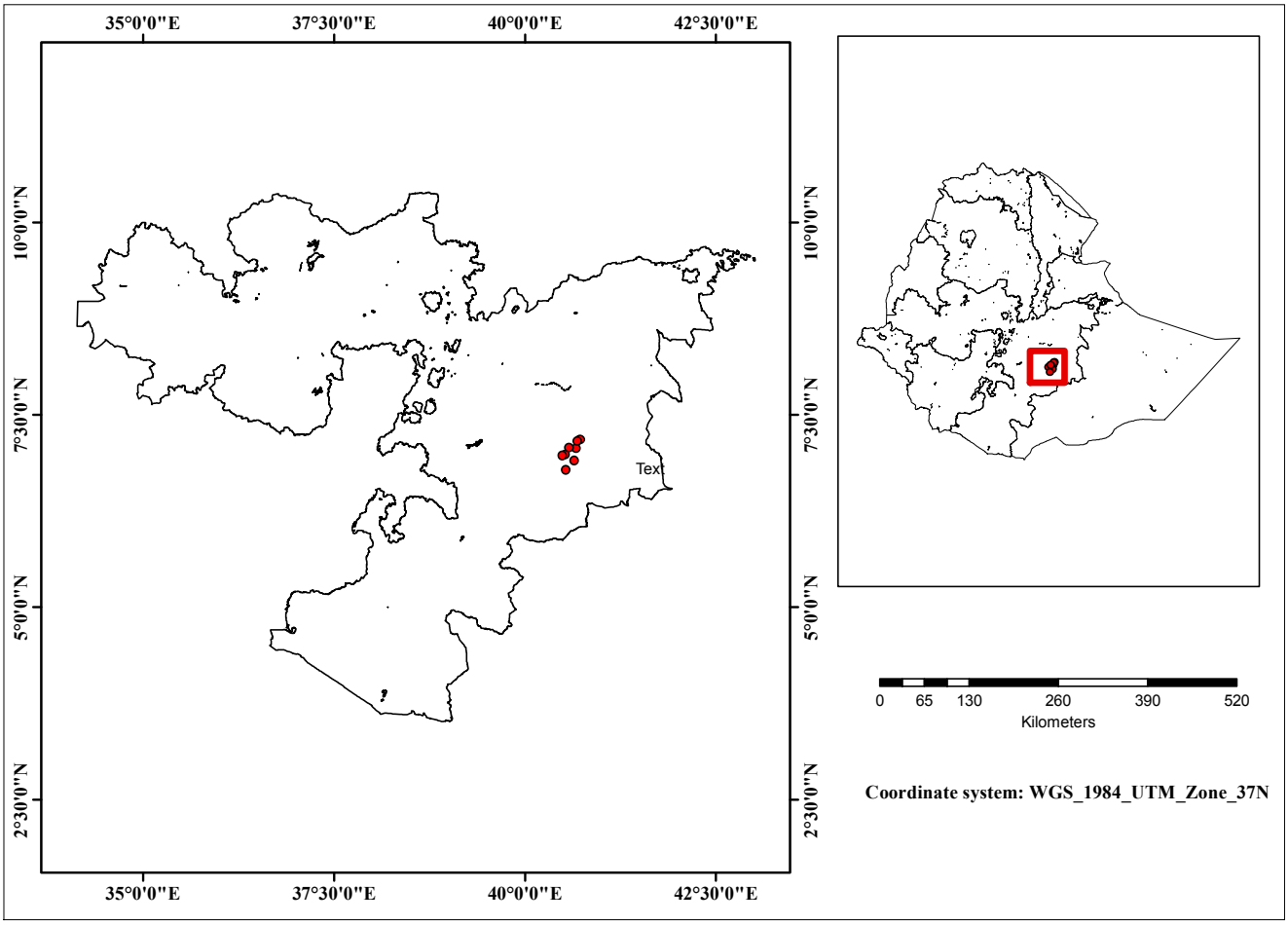

Figure 1. *Map of the study area.*

2.2. Sampling Techniques and Sample Size

In this study, a multistage sampling technique was used. In the first stage from the Bale Zone two Woreda (Ginir and Goro woredas) was selected purposively based on production potential of Black cumin. In the second stage, 8 rural Kebeles were selected randomly from the existing Kebeles of the Ginir and Goro woredas. Thirdly, farm households was selected using the probability proportional to size using simple random sampling technique from selected kebles of the two Woredas. Lastly, a total of 180 households was randomly selected for the analysis this study.

2.3. Types and Method of Data Collection

Both primary and secondary data were used for this study. The primary data was collected from sample respondents through a structured questionnaire, via face to face interview. Secondary, data was collected from agricultural office, kebele administration office, books, journals and documents was also be consulted for supplementing the whole work.

2.4. Data Analysis

In order to analyses the data, both descriptive analysis and econometric analysis was employed. Econometric model was applied for the estimation of contingent valuation (CVM). Following this binary Logistic model was applied for contingent valuation survey of this study.

Contingent valuation Method (CVM): is a well-established technique to measure the benefit from changes in the quality of the environment. Respondents to a contingent valuation survey represented with a realistic but hypothetical scenario and asked questions about the maximum amount of money that they would be willing to pay (WTP) for an amelioration from a status quo.

The "yes/no" response to the willingness to pay (WTP) questions, the offered amount and the additional information about the respondents' characteristics are used to fit binary response models such as Probit/Logit [10]. Farmers' decision to pay or not to pay for better conservation Black cumin at any time is influenced by a complex set of socio-economic, demographic, institutional and biophysical actors. Modeling farmers' response to black cumin preservation is important both theoretically and empirically.

WTP value is in form of binary choice dependent variable, either 1 for 'YES' response or 0 for 'NO' response. Also, the bid amount is varied across respondents and the only information obtained from each individual is whether his/her maximum WTP is above or below the bid offered. Following [11], logistic regression model was used to estimate WTP. Considering the WTP estimation in logistic distribution

function, the probability of accepting the offered bid is estimated as:

$$P = (1\text{-}e^{-z})^{-1} \quad (1)$$

Where pi the probability of accepting the offered bid is estimated as:

$$Zi=\beta o + \sum \beta ixi + ui \quad (2)$$

Where, P is the probability of accepting the price, z is a vector of explanatory variables (xi) including the bid offered, socio-economic variables and potential motivation variables, β0 is the intercept, βi is the coefficient of estimated parameters and εi is the random error.

3. Result and Discussions

3.1. Socio-economic Characteristic of Sample Respondents

The survey result indicated that the mean age of the respondents was 39.68 year, education level in year of schooling was 4.92 and the family size was 7.53 in number. The average land holding of the sample respondents was 2.37 hector and the livestock in TLU was 4.96. Furthermore, the total mean ofagriculture income was 59,802.97 ETBfor the study respondents.

3.2. Households Willingness Pay for Different Bid Values

Table 1. *Households Willingness to Pay for the First and Follow up Bid Value.*

WTP	$WTPBID_1$		$WTPBID_2$	
	Number	Percentage	Number	Percentage
Yes	163	90.55	130	72.22
No	17	9.55	50	27.78
Total	180	100	180	100

Source: Own Survey, 2018

Households were asked to state whether they are willing to pay or not for conservation of black cumin by providing on the hypothetical market scenario on the black cumin production and conservation activities for the next coming five years. Commensurately, in this study there were three initial bid values (24, 48, and 72) among this values the respondents were asked to state their willingness to pay by giving the randomly offered initial bids in equal proportion. In this case, if the respondents accept the randomly offered initial bid, the follow up bid was doubled and if they were not accept the initial bid the follow up bid became halved. As a result, most (90.55%) of the households accept the randomly offered initial bid and the remaining 9.55% were not willing to pay the initial bid closed ended questionnaire. In addition, 72.22% of the households willing to pay the follow up bid value, the remaining 27.78% were not willing to pay the follow up bid value for conservation of black cumin.

The result shows that out of 180 respondents 172 (95.55%) were willing to pay, while the rest 8 (4.44%) were not willing to pay (contribute) the for black cumin conservation for open ended questionnaire. The households who protest (not willing to pay) were rejected from further analysis of the study. The reasons of unwilling households were their unavailability of labour and also some said that they have very small land holding to conserve the black cumin.

3.3. Economic Value of Black Cumin Conservation

An important concept related to the measurement of economic value using WTP is aggregation of benefit. There are four important issues to be considered regarding sample design and execution in order to have a valid aggregation of benefits: population choice biases, sampling frame bias, sample none response bias and sample selection bias [1]. Random sampling method was used in this study using a list of households. A face to face interview method was used and Protest zero responses were excluded from the analysis and possibility of Protest zeros was accounted in the estimation of the aggregate benefit. Hence, none of the above biases was expected in the analysis.

Households were also asked to express their maximum willingness to pay for black cumin conservation in open-ended questions. Therefore, the mean maximum willingness to pay for black cumin conservation was obtained: $MeanWTP= \sum \frac{MxWTP}{N}$and Mean MWTP= 14, 676 /172= 85.32 labour day per year.

Where, Mean MWTP is mean maximum willingness to pay, MWTP is summation of maximum willingness to pay of the sampled households and N is number of sampled households. The mean willingness to pay for the sampled respondents was 85.32 labour day per household per year, which ranges from a minimum of 12 to a maximum of 192 labour day per household per year from open-ended question. They provide the maximum about 192 in year, which is 16 days in month. The relational behind thin high figure is in the study area the crop is produced year twice and most of the study farmers were engaged the production of this two season production of black cumin.

Table 2. *Economic value of the Black cumin conservation in the study woredas.*

Sampled Kebeles (8)	Total HH in selected kebeles	Sampled HHS With valid response	Sampled HHs With invalid response	Expected total HHs with invalid response	Expected total HHs with valid response	Mean WTP	Total WTP[1]
Total	6360	180	8	284	6076	85.32	518,404.32

Source: Own survey computation, 2018

1The figures are in person days per year at the time of surveyand the minimum wage rate per day was 2.5 USA dollar in the study area

Mean was used as a measure of aggregate value of black cumin conservation in this study. In Table 2 above, the aggregate WTP was calculated by multiplying the mean WTP by the total number of households who are expected to have a valid response in the selected rural kebeles.

Following this, in this study the aggregate WTP for black cumin conservation activities was computed 518,404.32 (1,296,010.8 USA dollar) [2] person days per year in the selected eight rural kebeles from the open ended questions. This shows that there is high level of willingness to pay for black cumin conservation in the study area.

There are 38,271 households in the study area (Ginir and GoroWoreda). It is also possible to calculate the total economic value of black cumin conservation for the whole Woredas. After deducting the protest zeros (1709) [3] the expected total households with valid responses are 36,562 households. The total willingness to pay in the whole study area (Ginir and Goro Woredas) is simply the multiplication of the respective means and the number of expected households to have valid responses. Hence, the aggregate economic value of black cumin conservation in the study area from the open ended formats was 3,119,469.84 ($7,798,674.57) person days per annum for five years.

3.4. Econometric Model Result

Under this section, the Logistic regression model analysis result for determining factors of WTP for conservation and sustainable utilization black cumin in study area was interpreted and discussed. Logistic regression model result was indicated in Table 3. The maximum likelihood estimates of the logistic regression model shows that, from twelve variables hypothesized as determinants of WTP participation in black cumin conservation seven variables were found to be statistically significant, while the remaining were less significant in explaining the variations in the dependent variable. These significant variables include availability of labor for activities, distance from market and productivity of the land of at 5% significance level, and total farm income and perception about the importance of black cumin conservation at 1% level.

Marginal effect (dy/dx) reveals that as the availability of labour for farm activity increases by one unit (number), the probability of participation in WTP for black cumin conservation and production for next five years will increases by 17.25%. This is plausible since a households with high number family member within working age group may not faced the problem of labour availability and engaged in agricultural activities than small size family member in working age group, and hence able to participate in WTP for black cumin conservation and production.

Similar with the earlier expectation, the initial bid offered (BID1) has a negative and significant effect on the WTP for Black cumin conservation practices. The marginal effect indicates that the probability of increasing one person day for the contribution of the proposed improvement of conservation of black cumin reduces the probability of willingness to pay by nearly 5.98%.

The residence indicates that the households' residence and market distance has positive and significant relation for in this study for conservation of black cumin. As the household residence near to market by one minute, the probability of WTP for black cumin conservation increases by 10.07%, and this is due to fact that if the producer residence is near to the market they can access market information for the product easily, can get production input with low cost and transport their farm products to the market with low cost.

The result also reveals that, as hypothesized level of livestock holding in TLU and WTP for the conservation of black cumin has negative and significant ration in this study. This means that as households' livestock holding increases by one TLU, the probability of WTP for the black cumin conservation decreases by 2.78%. This might be those individuals who have high number of TLU might not willing to pay conservation and continuous production of back cumin, since the byproduct of black cumin doest used as forage for animals like *Teff* and wheat byproduct. Therefore, households who have animals do not give emphases for black cumin production.

The average income from the total farm activity and participation for WTP black cumin conservation has positive and significant relationship. The result indicates that as mean farm income increases by one birr, the probability of participation on WTP for black cumin conservation and production will increases by 477.00%.

The status of farm land productivity has negatively and significantly affects the WTP of back cumin conservation and production, which was expected in the hypothesis. The marginal effect estimation reveals that as the productivity of farm land status decline though time, the probability of WTP for black cumin conservation and production by allocating more labour time will decline by 2.77%.

Moreover, the model result reveals that the perception of the importance of black cumin conservation has positive and significant relationship with conservation of black cumin. The result indicates that if household perceived that black cumin conservation is important, the probability of WTP for back cumin conservation will increases by 4.49%.

2 Is the monetary value of the person day estimates which was multiplied by 2.5 US dollar Birr

3 Those are households" which are expected to protest against the proposed project in the entire study area, Girnir and GoroWoredas. It was calculated by the multiplication of the percentage of protest sampled households" (1.8%) by the total number of households in the study area. Hence, 4.46%*38,271 = 1709. This number was deducted from the total number of households in the study area for economic value analysis.

Table 3. *Logit model result for determinants of householdsWTP.*

Variables	Coeffients	Stan. D	Z –value	dy/dx
Constant	-4.5524	2.5761	-4.20	
Age	0.0126	0.0219	-0.58	0.0018
Education	0.0454	0.0697	0.65	0.0067
Household size	0.0610	0.0773	0.79	0.0090
Land	0.1741	0.2482	0.70	0.0256
Labour availability	1.1697	0.5322	2.20**	0.1725
Extension agents visit	0.1649	0.4274	0.39	0.0243
BIDI	-1.4059	0.8854	-2.46**	-0.0598
Market distance	0.6827	0.3170	2.15**	0.1007
TLU	-0.1889	0.0919	-2.06**	-0.0278
Average farm income	0.00002	8.0600	3.76***	4.4700
Land productivity	-0.1883	0798	-2.36**	-0.0277
Perception of Black cumin	0.3354	0.1235	2.72 ***	0.0494
Log likelihood	= -79.2585	LR chi2 (11)	=56.07	
Prob> chi2	=0.0000	Pseudo R2	= 0.2613	

Source: Model estimation result, 2018
Where ***, and ** means level of significance at 1% and 5%respectively

4. Conclusion and Recommendations

The finding of this study from Logistic regression model result shows that households WTP for the participation in black cumin conservation were found to be statistically and significant affected by availability of labor for farm activities, initial bid offered, residence distance of farm households from market, total farm income, perception about the importance of black cumin conservation, livestock holding in TLU and farmland productivity through time. Moreover, the mean maximum WTP for black cumin conservation on activities was computed at 518,404.32 ($1,296,010.8) person days per year for five years in the selected eight rural kebeles based on the open ended questions. Therefore, the mean maximum willingness to pay value indicated that the economic value of conserving black cumin is high in the study. Hence, policy should give emphases at national, regional, and other operational levels, so as to bring an anticipated result on lives of producers from conservation and sustainable utilization of black cumin farm variety.

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