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Decision Determinants of Rural Households in the Engagement of *A. Senegal* Gum Arabic Collection: Amibara and Liben District, Ethiopia

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Abstract:- One of the non-timber forest product gum arabic can be one of the sources of income to rural households. In the commercialization of gum arabic, the first step is analyzing the factors affecting the rural households' involvement in gum collection. This study examines the decision determinants of the rural households' engagement in A. Senegal gum arabic collection. Data were collected using key informant interviews, focus group discussions, and household surveys. Data for explanatory variables were collected from 441 randomly selected households. Factors affecting the involvement of the households in gum arabic collection were revealed by the logit model. The regression analysis showed household head age (+), household's family size (-), employed in a government job (-ve), income from wage labor (-), crop farming(+), gum market availability(+), households who participate in Productive Safety Nets Program(PSNP)(+) and had training awareness at least once(+) are factors in the decision determinants of the rural households to the engagement in gum collection. In the study area commercialization of sustainable gum arabic appreciated, focused on the decision determinants like gum market availability, training awareness by enhancing technical support and strengthening the communications and capacity of collectors and stakeholders.

Keywords:- *Acacia Senegal, Gum Arabic, Pastoralists, Engagement, Decision Determinants, Gum Collection.*

I. INTRODUCTION

Ethiopia has an extensive amount of Non-Timber Forest Products (NTFPs) resources (Girmay, 2000, Desalegn and Tadesse, 2004, Tadesse *et al.,* 2007). Ethiopia is soundly gifted with over 60 gum and resin-bearing species from Acacia, Boswellia, and Commiphora species (Tadesse *et al.,* 2007). The Acacia genus found in eight regions of Ethiopia including the Afar and Oromia regions. Amibara and Liben are the two administrative districts in the Afar and Oromia regions of Ethiopia respectively where this study carried out. Gum arabic product is obtained from *Acacia Senegal* (L.) wild var. Senegal tree i.e. also one of the most important NTFPs from the oldest and best known of all-natural gums (Tadesse *et al.,* 2007).

Gum arabic is a product traded worldwide in the gum and resin sector with diverse uses in food, beverages, pharmacology, adhesives, and cosmetics industries (Lemenih *et al.,* 2003). Gum production and collection is performed and carried out by peasants and pastoralists while performing other activities like firewood collection and livestock grazing by gathering exudates from trees in the forest by random harvesting (Tadesse *et al.,* 2007).

Even if in Ethiopia there is a wide distribution of natural stand of Acacia Senegal (source for gum arabic), commercial exploitation is inhibited by lack of tapping and development techniques (Abtew *et al.,* 2014). The export of gum and resin sector in Ethiopia on trade volume and the value generated was gradually increasing from time to time (Lemenih and Teketay, 2004); but at world-scale Ethiopia's gum/incense export share is still negligible (1%) and 28% of total Africa's export (Lemenih *et al.,* 2003).

Gum and resin production is playing an enormous socio-economic role in Ethiopia both at the local and national level from the perspective of creating jobs and generating income with offers off-farm employment opportunities for thousands of local people (Lemenih *et al.,* 2003; Tadesse *et al.,* 2007). However, its' commercialization development outcomes are created by a range of interconnected geographical and socioeconomic factors (Abtew *et al.,* 2014).

The country is collecting and exporting only the crude gum resin resources and again imports with foreign currencies their various final products from developed countries. In the near future, the country has to focus on devising mechanisms to promote the countries potential to value the addition and industrialization of gum resin products. In the meantime, the country has to focus on strengthening the quality production mechanisms, increases the benefit of rural households' and expands the commercialization of the products.

Gum arabic production potential and actual production difference are enormous in Ethiopia. The first step before the commercialization of gum arabic analyzes the existing situation and future prospects of gum arabic production in the study areas. Like identification of determinant factors on the engagement of gum arabic collection, identification of

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major stakeholders, and market linkages. This study is also a part of realizing the existing situation with the objective to investigate factors determining the rural households' engagement in *Acacia Senegal* gum arabic collection in the study sites.

II. METHODOLOGY

2.1. *Description of the study area*

The study was conducted within the Amibara and Liben districts of Ethiopia (Fig.1). Amibara is one of the districts within the Afar region. Amibara could even be a component of the chief zone 3, bordered on the south by Awash Fentale, on the west by the Awash River which separates it from Dulecha, on the northwest by the chief zone 5, on the north by Gewane, on the east by the Somali region, and on the southeast by Oromia region. A whole population of 63,378 of whom 35,378 are men and 28,004 men with a neighborhood of two, 007.05 square kilometers over 68.86% of were Muslim (CSA, 2007).

Liben is one among the districts of the Oromia region located altitude ranges from 1120 to 1600m.a.s.l about 630 km south of Addis Ababa. An area of the Guji zone, Liben is bordered on the south by the Dawa River which separates it from the Borena zone, on the west by Odo Shakiso, on the northwest by Adolana Wadera, on the north by the Ganale Dorya River which separates it from the bale zone, and on the east by the Somalia region. Consistent with CSA (2007), a whole population of 138,813of whom 70,130 were men and 68,683 was women majority of them was Muslim (59.45%), while 21.07% of the normal beliefs. Species like *Combretum, Terminalia, Acacia, Pistacia, Commiphora, Lannea, Euclea, and Olea* are common within the studied area (Amanuel *et al.*, 2019).

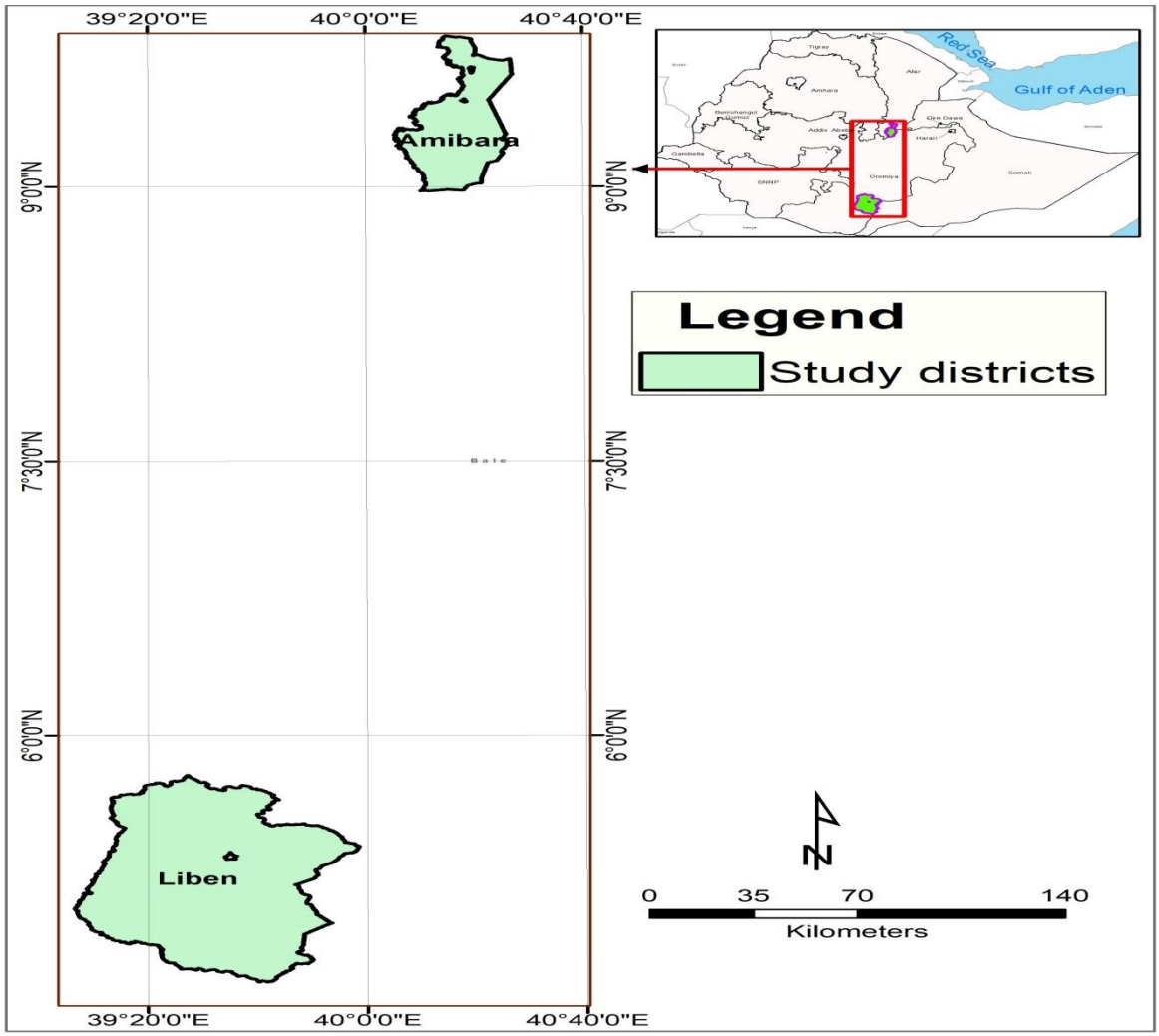

Figure 1: Map of the Study Area

2.2. *Sampling methods and data collection*

Households from the data collection area were selected randomly based on households living around the resource area of gum tree Acacia Senegal. 121 households from Liben district from five administrative kebeles (peasant associations): Boba, Melka Guba, Bulbule, Adessa, and the Korati were selected. Four focus group discussions were undertaken by two men and two women at Melka Guba and Boba kebeles. The data collection time was in May 2016.

Two times data from Amibara district from eight administrative kebeles (Andido, Bedulale, Serkamo, Awash

Arba, Angelele, Keleat Buri, Sidha fage, and Halay dege) were taken. The first data were collected from 120 households in April 2016. Besides, four focus group discussions were undertaken by two men and two women at Adido and Seidha fage kebeles. The second data were collected from 200 households in May 2017. In addition, six focus group discussions were undertaken by three men (Bedulale, Awash Arba, and Halay dege kebeles) and three women (Angelele, Serkamo, and Keleat Buri kebeles).

The study depicts the responses to the survey questionnaire which was administered to the respondents in Amibara and Liben districts kebeles. A standardized semi-structured questionnaire was administered to the respondents through face-to-face interviews, conducted by enumerators. Below there are the description and definition of variables and their measurement of how the latter variables were operationalized in this study.

Family size: measured as a continuous variable the total number of family members living in the household head house. Sex: measured as a dummy variable to assign 1 if the sex of the household head is male 0 otherwise. Age: continuous variable the actual number of years lived by the household head. Education: a dummy variable 1 if the household head education literate, 0 if illiterate. Marital status: = 1 if the household head marital status is married and 0 otherwise. Land owned (in ha): the amount of farm size the household owned by the household in a hectare. Distance to gum Forest (in hrs): the distance to gum arabic forest resource measured by walking hours. Distance to nearest Market: the distance to the nearest market measured by walking hours. Distance to Extension office: the distance to the extension office measured by walking hours. Distance to Asphalt road: the distance to asphalt road measured by walking hours. Distance to Electric grid: the distance to the electric grid measured by walking hours.

House with Corrugated Iron sheet: = 1 if home roof made corrugated iron sheet; 0 otherwise. Asset Accumulation in Birr: measured the household equipment and tools owned in birr. Training Awareness at least one: a dummy variable whether the household head attained at least one training and awareness forum in the last three years yes= 1; no =0. Market Availability (yes/no): = 1 if the household facing any problem in marketing gum product (yes), 0 (zero) otherwise (no).

Employed in government job: = 1 if the household head is employed in government organization (yes), 0 (zero) otherwise (no). Crop farming (yes/no): = 1 if the household head is carrying out crop farming activities (yes), 0 (zero) otherwise (no). Livestock production (yes/no): = 1 if the household head is performing in livestock production activities (yes), 0 (zero) otherwise (no). Sale of firewood or charcoal: = 1 if the household head is selling firewood or charcoal (yes), 0 (zero) otherwise (no). Income from wage labor (yes/no): = 1 if the household head is getting income from wage labor (yes), 0 (zero) otherwise (no). Food for work (yes/no): = 1 if the household head is participating in food for work (yes), 0 (zero) otherwise (no). Cash for work (yes/no): = 1 if the household head is participating in cash for work (yes), 0 (zero) otherwise (no). Productive Safety Nets Program (PSNP): = 1 if the household head is participating in Productive Safety Nets Program (PSNP) (yes), 0 (zero) otherwise (no). Income from NGOs assistance: = 1 if the household head is getting income from NGOs assistance (yes), 0 (zero) otherwise (no).

2.3. *Data analysis*

Statistics and Data Statistical Software Package (STATA) version 13 and Statistical Package for Social Scientists (SPSS) version 20.0 software were employed to analyze the household survey data. Descriptive statistics like mean, percentage, and frequency distribution were used to describe the demographic characteristics of the sampled households. Qualitative data generated from key informant interviews and focus group discussions was analyzed and interpreted on spot.

On the other hand, one of the econometrics models binary logistic regression which helps to analyze the dependent variables with only two categories or values was used. In this study, the outcome variable (engagement in gum collection) was regressed against selected explanatory variables: family size, sex, age, education, marital status, land owned, distance to gum forest, distance to the nearest market, distance to the extension office, distance to the asphalt road, distance to the electric grid, a house with corrugated iron sheet, asset accumulation in birr, training awareness at least one, market availability, employed in a government job, crop farming, livestock production, sale of firewood or charcoal, income from wage labor, food for work, cash for work, Productive Safety Nets Program (PSNP) and income from NGOs assistance. These variables were used as a proxy for decision determinant factors of the households on the engagement of gum collection. The variables were chosen mainly because they cut across the social and economic domains; hence, they will provide a comprehensive insight into the pattern of household engagement of gum collection. The outcome variable engagement in gum collection was measured as a dichotomous response occupying the value of 1 or 0, where 1 if a household engaged in the gums-resins collection and 0 if not. A binary logistic regression model was used (Hosmer *et al.*, 2013) to reveal the decision determinant factors of the households on the engagement of gum collection.

$$\text{Logit}\,(Y) = \left(\frac{\pi}{1-\pi}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 \qquad (1)$$

Therefore

$$\pi = \text{Probability}\,(Y = \text{outcome}/X_1 = x_1, X_2 = x_2) = \frac{e^{\alpha+\beta_1 X_1+\beta_2 X_2}}{1+e^{\alpha+\beta_1 X_1+\beta_2 X_2}} \qquad (2)$$

Where π denotes the probability of an outcome, α is the Y-intercept, β's are the regression coefficients, X's are the set of explanatory variables, and e = 2.71828 (natural logarithms base).

III. RESULTS

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3.1. *Demographic characteristics of sampled households*

The structured household survey was undertaken from a total of 441 households'. Of this, the socio-economic demographic information showed that majorities of the sampled household head were 71.9% was male and the rest was female (Table 1). Moreover, the mean respondents' age was 39 with a minimum and maximum of age 18 and 100 respectively. Regarding the literacy level, 70.3% are illiterate and the rests are literate. This shows the penetration of formal education is still low i.e. less than half of the sampled households' only 29.7%. Although the educational background of the household head believed, to be one of the decision determinants for the engagement of households' for gum collection. In addition, 83.9% of the sampled households' religion is Muslim; 14.3% are Wakefeta (religion especially in Guji Oromo ethnic group) and the rest were in other religions.

Furthermore, 85.5% of the interviewed household heads are married. The mean family size is 6 with a minimum and maximum of 0 and 26 respectively (Table 1). The result showed, the majority of the households interviewed were engaged in livestock production i.e. 81.0% and only 29.3% of the households were participating in crop farming (Table 1). This showed the majority of the interviewed households in the study area are pastoralists. The mean land owned by the households interviewed was 1.01 with a maximum of 33ha. The mean livestock holding of the households interviewed were 43.92 in TLU (Tropical Livestock Unit) with minimum and maximum of 0 and 6001.10 respectively (Table 1).

Table 1: Socio-economic characteristics of the sampled households

Socio-economic characteristics	***Descriptions***
Gender (1 if male, 0 female)	Male 71.9% and female 28.1%
Age	Mean 39.76 and ranges 18-100
Marital status(1 if married and 0 others)	Married 85.5% and others 14.5%
Literacy level(Education)	Illiterate 70.3% and literate 29.7%
Family size (in No.)	Mean 6.46 and ranges 0-26
Land owned (ha.)	Mean 1.01 and ranges 0-33
Religions (%)	Muslim 83.9%, Wakefeta 14.3%, others 1.8%
Livestock holding (in TLU)	Mean 43.92 and ranges 0 - 6001.10
Livestock production(yes/no)	Yes 81.0% and no 19.0%
Crop farming(yes/no)	Yes 29.3% and no 70.7%
Employed in government (yes/no)	Yes 27% and no 73%

TLU:-Tropical livestock unit

3.2. *Decision determinant factors of household's engagement in gum collection*

Before estimation of the logit model, data were checked for the presence of both multicollinearity and heteroskedasticity problems. Checking the estimation data with a Variance Inflation Factor (VIF) indicates that there is no collinearity among the continuous variables (i.e. VIF<10). Moreover, heteroskedasticity was checked using the Breusch-Pagan test, and the result shows that the null hypothesis of homoskedasticity was not rejected (P=0.7376). This indicates that there is no heteroskedasticity problem on the data and it is possible to perform the econometric estimation.

The estimation results of the logit model used to predict engagement in gum collection (Table 2). The value of the likelihood ratio chi-square test is 136.53 and is statistically significant at less than 1%. This suggests the null hypothesis that all the explanatory variables included in the model jointly have no effect is rejected. In this respect, the explanatory variables included in the model have explained about 22% of the total variation in the dependent variable.

The likelihood of households to engagement in gum collection decreases as family size increases while engagement in gum collection decreases as the households' employed in government jobs and participated in income from wage labor. On the other hand, the likelihood of the households' to engage in gum collection increases as the households' participated in training awareness at least one. If there is market availability in the area, the household is more likely to engage in gum collection. When the household head age increases by one the household are more likely to engage in gum collection. The likelihood of the household to engage in gum collection increases as the households are engaged in crop farming. When the household is participating in the Productive Safety Nets Program (PSNP) the household is more likely to engage in gum collection.

Table 2: Logit Estimates of Engagement in gum collection.

Variable	Coefficient	Z-value	P-value
Family size (HhSIZ)	-0.08 (0.04)	-1.83	0.067*
Household head Sex (HhSEX)	-0.32 (0.27)	-1.18	0.238
Household head Age (HhAge)	0.02 (0.01)	1.94	0.052**
Household head Education (HhEdu)	0.39 (0.30)	1.31	0.192
Marital status (HhMTS)	0.07 (0.33)	0.20	0.839
Land owned (LandOwn)(in ha)	-0.02 (0.05)	-0.41	0.680
Distance to gum Forest(DISTFOR)(in hrs)	-1.81(2.71)	-0.67	0.503
Distance to nearest Market(DISTMARK)	0.93(0.97)	0.95	0.341
Distance to Extension office (DISTEXT)	1.49 (2.60)	0.57	0.566
Distance to Asphalt road(DISTASP)	0.21(1.48)	0.14	0.887
Distance to Electric grid(DISTELEC)	-0.05(2.10)	-0.02	0.981
House with Corrugated Iron sheet(HOUSECI)	0.30 (0.47)	0.63	0.529
Asset Accumulation in Birr(ASSET)	-0.00 (0.00)	-0.60	0.550
Training Awareness at least one(TRAIN)	0.72(0.29)	2.84	0.013***
Market Availability(MARKET) (yes/no)	1.88(0.36)	5.19	0.000***
Employed in government job(GOVJOB)	-0.38(0.29)	-1.31	0.191*
Crop farming (CROPFARM) (yes/no)	0.52(0.30)	1.76	0.079*
Livestock production(LIVESPROD) (yes/no)	0.14(0.32)	0.44	0.663
Sale of fire wood or charcoal (FIRECHARKOL)	-0.12(0.83)	-0.15	0.883
Income from wage labour (LABOUR) (yes/no)	-0.78(0.59)	-1.30	0.193*
Food for work (FOODWORK) (yes/no)	0.07(0.47)	0.16	0.876
Cash for work (CASHWORK) (yes/no)	-0.41(0.70)	-0.59	0.558
Productive Safety Nets Program (PSNP)	0.92(0.27)	3.40	0.001***
Income from NGOs assistance (NGOASSI)	0.23(0.94)	0.25	0.806
Constant	-1.99(0.60)	-3.33	0.001***
Pseudo R^2	0.2278		
Prob > chi^2	0.0000		
LR $chi^2(24)$	136.53		
Log-likelihood	-231.34308		
Number of observations	441		

Notes: Dependent variable (engagement in gum collection) equals 1 if a household engaged in gums collection and 0 if not. Standard errors in parenthesis. *, ** and *** indicate statistical significance level at 10%, 5 and 1% respectively.

IV. DISCUSSION

The finding demonstrated that the engagement of the household in gum collection is very variable and influenced by the socio-economic status, occupation, gum market availability and training awareness created. To exemplify more on family size when family size increase by one the household engagement on gum collection negatively affected this might be the household's might not need their household member to gather gum or the household is engaged in family management(like women). This is often almost like studies from India within the Periyar Tiger Reserve (Gubbi and MacMillan, 2008). This finding is additionally according to Garekae *et al.,* (2017) and contrary to other studies' observations (Mamo *et al.*, 2007; Córdova *et al.*, 2013; Fonta and Ayuk, 2013; Kabubo- Mariara 2013; Adam and EL Tayeb, 2014).

Besides household head age have positive pressure on the engagement of gum collection. this suggests the more the household head becomes elder the more they engage in gum collection (i.e. having knowledge about gum from culture and age). This finding is inconsistent with other studies conducted on forest dependency in Chobe Enclave, Botswana Garekae *et al.* (2017) which discovered there's an inverse relationship between age of household head and forest dependency. During this study case, the elderly people had more understanding of gum use (i.e. like medicinal uses) than youth and therefore the forest product (gum collection) doesn't labor-intensive and need physical strength of the collector (i.e. the most reason why the youth aren't participating within the engagement of gum collection).

Moreover, the finding revealed that household employment (occupation) had variable persuade on the engagement of gum collection (i.e. there's a negative association between employment and engagement in gum collection). Furthermore when the households have different employment state e.g. employed during a government job and income from wage labor have a negative influence on the engagement of gum collection. Noticeably employment

and other regular paid activities might offer more income than engagement in gum collection. The results according to other studies that NTFPs have more role in subsistence economic livelihood support while households aren't employed (Hegde and Enters 2000; Mamo *et al.,* 2007; Tieguhong and Nkamgnia 2012; Garekae *et al.,* 2017). On the opposite hand, being involved in crop farming and therefore the Productive Safety Nets Program (PSNP) features a positive influence on the engagement of gum collection. This might be within the way of those activities they're going to engage in gum collection.

On the opposite side gum market availability opportunity and therefore the household's participation in training and awareness creation activities within the last three years has also influenced the engagement of the household in gum collection. Households participating in training and awareness creation activities a minimum of in one and had market availability within the area had a positive influence on the engagement of gum collection. This could be the household's shares information about gum during the meetings in training and awareness creation activities.

V. CONCLUSIONS

The result suggests that the decision determinants of the household's engagement in gum collection in this study area are determined by the socio-economic status on the demographic characteristics of the household, gum market availability opportunity, and participation in training and awareness creation activities. In this study demographic characteristics that determine the decision of the household engagement on gum collection are age, family size, and employment (government employed, crop farming, participation in Productive Safety Nets Program (PSNP) and income from wage labor)).

In the study area commercialization of sustainable gum arabic appreciated, focused on the decision determinants like gum market availability problem, training awareness by enhancing technical support and strengthening the communications and capacity of collectors and institutions.

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