Agricultural Journal 13 (4): 91-97, 2018
ISSN: 1816-9155

Factors Affecting Participation of Households on Cultivation and Collection of Shade Tolerant Indigenous Spices in the South West of Ethiopia

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Abstract: Over forty spices, herbs, medicinal and essential oil plants are still grown in Ethiopia. From 1998-2010 years the average annual growth rate was 25.3% in terms of value and 25.6% in terms of volume and 25-30% of all the *Aframomum angustifolium* grown in South West of Ethiopia. Five districts were purposively selected for this study. About 130 households were randomly selected. Semi-structured questionnaire, key informant and focus group discussion were used. Descriptive statistics such as mean, percentage, frequency and standard deviation were employed. Binary logistic models were used to analyze the factors influencing the involvement of households in shade tolerant indigenous spice cultivation and harvesting from nearby natural forest with the help of STATA Software Version 13. The average age of the sampled households was about 36.4. About 52.31% of the respondents were attended primary school and the rest 33.85, 13.5 and 0.77% were illiterate, secondary and diploma (10+2), respectively. About 56 (43.07%) of respondent households got spice products for different purpose only from nearby natural forests and as the Pearson Chi-square test ($p<0.01$) here there was significance difference among households on place and purpose of harvesting shade tolerant spices products.

Key words: Indigenous spice, subsistence consumption, shade loving, conservation, Chi-square test, illiterate

INTRODUCTION

Spice cultivation and trading in Ethiopia dates back to historical times and is arguably part of the world's first international supply chain (Hull, 2008). Records suggest that the Ethiopian spice use can be traced back to 1500 BC (Fullas, 2009). Over forty spices, herbs, medicinal and essential oil plants are still grown in Ethiopia but the four most important are ginger, turmeric, cumin and *Aframomum angustifolium* with market shares of 65, 15, 8 and 3%, respectively. In export terms the Ethiopia spice export trade is negligible, accounting for <1% of the country's total export earnings. But from 1998-2010 years the average annual growth rate was 25.3% in terms of value and 25.6% in terms of volume (Yimer, 2010). The value of spice exports grew from 3.7-$6.8 m between 2006 and 2010 (Anonymous, 2010).

Hull (2008) Yimer (2010) noted that the most important export markets for all spices are Sudan India, Yemen, UAE, Saudi Arabia and Morocco but for *Aframomum angustifolium*, the main markets are Jordan (44% of market share), Saudi Arabia 19% is rael 14% and Yemen 10%. However, still there are no known figures for the Ethiopian domestic market but since, spices are widely used throughout the country in all cultures it is thought that this market is large (Meaton *et al*., 2012). For instance, 25-30% of the *Aframomum angustifolium* are grown in South West of Ethiopia.

Melaku *et al*. (2014) said that NTFPs played a significant role in household incomes. The contribution from the major NTFPs (forest coffee, honey and spices) accounted for 47% of annual household income. Factors that can influence household dependence on NTFP were also studied by Melaku *et al*. (2014). but they didn't consider the specific spice like shade tolerant spices that are potentially available in the nearside natural forest and recently cultivated in the backyard by some few farmers in the study area.

There are two production systems for *Aframomum angustifolium* in the study area, backyard production or domestication and wild forest collection. Harvesting of *Aframomum angustifolium* from forest has being practicing in the Southern woredas of South Bench and sheko and also in Gesha (North-East) because of the limited areas of forest in these woredas or the predominant use of the forest for coffee cultivation in the South. However, in the Northern woredas of Masha and Anderacha nearly all of the *Aframomum angustifolium* is derived from natural forests (Meaton *et al*., 2012).

Domestication of *Aframomum angustifolium* is a very recent phenomenon in the Northern woredas of Masha

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Anderacha and Gesha (introduced by the NTFP-PFM project) while in some parts of the Southern woredas it is a more than two decades old and much more substantial have been introduced by agricultural office during the 1980's. But still domestication of these forest based spices is not fully practiced throughout study area.

Meaton *et al.* (2012) reported that harvesting of these shade tolerant spices occurs between October and February and in some area it is from July-February. This variation is caused by the higher temperatures (due to lower altitude) and the longer dry season in the South. Forest harvesters travel up to three hours on foot to access the fruits of spices from naturally established plants, often combining such visits with other tasks such as hanging beehives in the forest. Because of the distance and the dangers of the forest, women rarely participate in this activity, although, some do engage in backyard domestication. In the Northern woredas commercial harvesting from the forest has also practiced by marginalized groups of communities, called "menjo" who are an indigenous forest dwelling group.

They also mentioned that good quality *Aframomum angustifolium* can only be achieved if the ripe (red) fruit is picked. Although, harvesters understand this, many continue to pick the unripe, green fruits. This is largely due to the perceived need to harvest before their competitors (a problem typical of common pool resources).

Shade tolerant spices such as *Aframomum angustifolium* and pepper capense are found as indigenous wild species in the Sheka, Kaffa and Bench Maji forests (Beer *et al*., 1998; Aerts *et al*., 2011; Melaku *et al*., 2014; Geta and Kifle, 2011; Edossa, 1998; Hailemichae, *et al*., 2016). Similarly, Aerts *et al*. (2011) and Cerdan *et al*. (2012) reported that this spice and coffee mixed forest are considered as semi wild coffee based agroforestry ecosystem. For instance, a marketing survey conducted in 2004 revealed that 90% of the households in Bench Maji, Kaffa and Sheka zones were engaged in harvesting and production of Non-Timber Forest Products (NTFPs) including forest wild and semi-wild coffee forest honey, wild forest spices (Ethiopian cardamom, long pepper and turmeric) and bamboo (Beer *et al*., 1998; Aerts *et al*., 2011). Whereas these three zones of Ethiopia are one of the few areas commonly known with high forest cover of natural forest resources (Eshete, 2013). Household participation on cultivation and harvesting of medicinal and forest based spices can enhance biodiversity conservation and utilization (Awas, 2007). However, those economically important indigenous spices are not domesticated and cultivated in an appropriate way to secure spice demand gap in the local and national market levels.

Therefore, to provide empirical and compressive information for decision maker regarding about spice domestication and increasing productivity to secure local and national spice demand, this research was initiated with the following research questions.

What are factors influence farmers on cultivation and collection of shade tolerant indigenous spices production. What is local communitie's perception on forest based spices production. Who is more responsible in the conservation and management activities of spice what are/is the major threats to shade tolerant spice conservation and management.

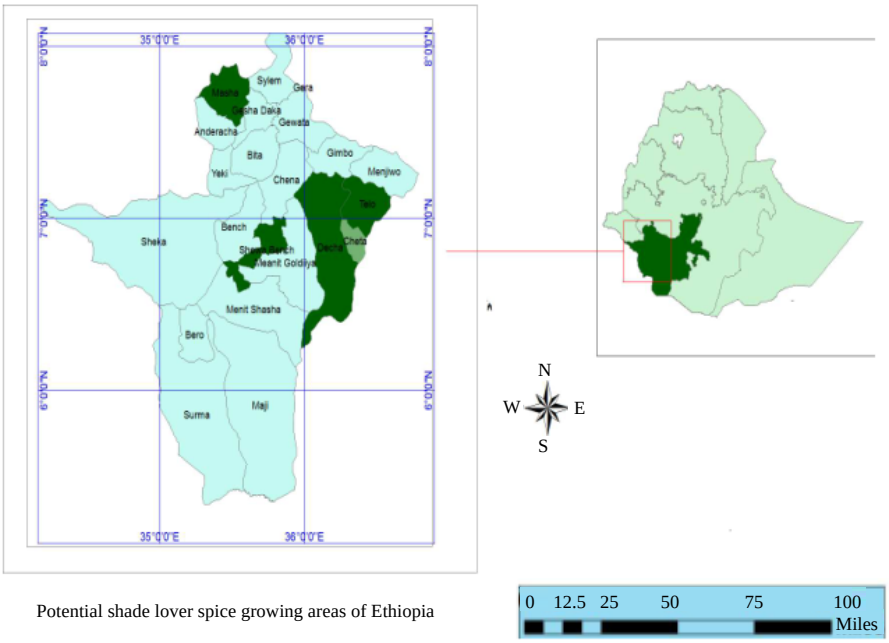
MATERIALS AND METHODS

Description of the study area: This study was conducted in three administrative zones (Kaffa, Sheka and Bench-Maji). It is located at south west of Ethiopian (Fig. 1 and 2).

Sample selection techniques: This study was conducted in five districts. Three districts (Menit Gold, Shay bench and Debub bench) were selected from Bench Maji zone. Dacha and Masha Districts were selected from Kaffa and Shaka zones, respectively. From all three districts, six sub-districts (Kuti, Dishi, Boba gachet, Uwa, Gada and Beto) and 130 households were considered through stratified random sampling techniques. Individual's household survey were conducted through face to face interview.

Some rules-of-thumbs were suggested for determining the minimum number of households required to conduct multiple regression analyses. We adopted the rule-of-thumb that: $N = 50+8\times m$ where N is the minimum number of households and m is an explanatory variable (Green, 1991). The explanatory variable was eight. Hence, the minimum sample size was: $N = 50+8\times 11 = 114$. Then 130 households were randomly selected based on the number of farm households in sub-districts and, so that, all sample units would have equal chances of being selected. To verify the reliability of information obtained through individual household survey, observation, key informant interview and focus group discussions were also made.

Data analyses: Both descriptive and econometric analyses were employed. The collected data were analyzed using STATA Version 13 and micro-Excel 2010. Descriptive statistics such as mean, percentage, frequency and standard deviation were employed. Determinants of participation of households in the cultivation and/or collection of shade tolerant spices were estimated by using a binary logistic model. The logistic



Potential shade lover spice growing areas of Ethiopia

Fig. 1: Location of study area

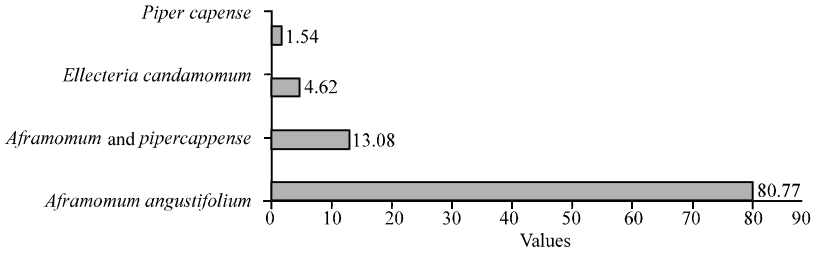


Fig. 2: Naturally grown shade tolernt indigenous spice in the Southwest of Ethiopia

function was used because it closely approximates the cumulative normal distribution and is relatively simple from a mathematical point of view and lends itself to meaningful interpretation. The logistic distribution function (Hosmer and Lemeshew, 1989) for identifying participant and non-participant in cultivation of shade tolerant spices was defined as:

$$p_i = \frac{1}{1+e^{-zi}} \quad (1)$$

where, P_i is the probability of being cultivating or in backyard and harvesting for the ith respondent Z_i is a function of N explanatory variables (X_i) denoted as:

$$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + , \ldots , + \beta_n X_n \quad (2)$$

Then multiplying both side by natural logarithm :

$$hp_i = In\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 x_1 + \ldots + \beta nxn + u_i \quad (3)$$

where, h_{pi}, household's participation in the cultivation of shade tolerant spices in the backyards, β_0 is the intercept and β_i is the slope parameter in the model. The slope describes the logarithmic change in probability of being cultivating shade tolerant spice as independent variables change. Since, the conditional distribution of the outcome variable follows a binomial distribution with a probability given by the conditional mean P_i interpretation of the coefficient will be understandable if the logistic model can be re-written in terms of the odds and logarithm of the odds (Gujarati, 2004).

Household incomes were calculated based on their annual disposable income. For the reason of

Table 1: Descriptive statistics for the model variables

Explanatory variable	Mean	SD	Min.	Max.
Sex(1 = female)	0.2230769	0.41792	0	1
Income	8023.323	4633.366	1400	25000
Hsize	4.938462	2.410423	2	12
Age	36.39231	10.63889	18	80
Educ	2.538462	3.355324	0	12
Lndarea	2.374615	1.458708	0.125	8
Distafo	3.831846	5.619184	0.10	30
Before5	0.5153846	0.5016966	0	1

difficult to get clear market price, subsistence incomes like incomes from firewood, spice used for their consumption and other similar items were not considered. Descriptions of all variables in model were mentioned in the (Table 1).

RESULTS AND DISCUSSION

Demographic and socio-economic characteristics of households: Among the respondents, 93.85 and 6.15% were male and female, respectively. The average family size of the respondents was 4.94 (Table 2). The average age of the sampled household heads was about 36.4. About 52.31% of the respondents were attended primary school and the rest 33.85, 13.5 and 0.77% were illiterate, secondary and diploma (10+2), respectively. The average educational level of the respondents was 2.5 years.

Land is a major fixed asset of the farmers in the study area. Mean, maximum and minimum land holdings of the respondents were 2.37, 8 and 0.125 ha, respectively (Table 2). About 93.85% of respondents got their land through inherited from their parents and 6.15% obtained through other means.

Participation of households in cultivation and harvesting of shade tolerant spices: This area is hotspots for many biodiversity species including medicinal plants and spice (Awas, 2007). Many spices were domesticated and cultivated at southwest of Ethiopia (Girma). Among that ginger, turmeric Aframomum angustifolium, hell pepper capense, black pepper and vanilla are the major introduced and domesticated from nearby natural forest in the backyards as other agricultural crops. Aframomum angustifolium and pepper capense are indigenous spices that naturally available in the natural forest of Southwest of Ethiopia. About 80.77% of respondents were involved only on cultivating and collecting of *Aframomum angustifolium* and followed by those involved in both *Aframomum angustifolium* and pepper capense (13.08%) also moredetail in Fig. 2. About 95.38% of households have been cultivated *Aframomum angustifolium* and pepper capense under the shade of different tree species in their backyards and 4.62% were cultivated on the shade free fields. About 95.38% of household were involved in the cultivation or harvesting of spice products. About 12 (9.23%) household were collected spice products for commercial purpose from nearby natural forest. While 34 (26.15%) were collected from natural forest for subsistence consumption and additional incomes. About 56 (43.07%) of respondent households were collected spice products for different purpose only from nearby natural forests and as the Pearson χ^2 test ($p<0.01$) here, there was significance difference among households on place and reason of harvesting shade tolerant spices products (Table 3).

Table 2: Place and reasons of harvesting shade tolerant spices products

	Reason of cultivation or harvesting				
Place of harvesting	Commercial	subs.cons.+ additional income	Only subs. consumption	Traditional value	Total
Both	24	8	0	6	38
Backyard	17	3	3	1336	
Natural	12	34	8	2	56
Total	53	45	11	21	130

Pearson χ^2 (6) = 50.2292 Pr = 0.000

Table 3: Binary logistic regression of household participation in the cultivating and harvesting of forest based spices

Explanatory variables	Coefficients	SE	Wald test(Z)	p>Z
Sex	1.625	1.508	1.080	0.281
Income	-0.000	0.000	-2.670	0.008**
Hsize	0.405	0.305	1.330	0.184
Age	-0.011	0.047	-0.220	0.822
Educ	-0.316	0.196	-1.610	0.107
lndarea	1.240	0.671	1.850	0.065*
Distafo	-0.828	0.319	-2.590	0.009**
Before5	2.304	1.255	1.840	0.066*
Constant	-0.688	2.834	-0.240	0.808

Significant at 0.01 and * is significant at 0.1 significance levels; Log likelihood = -15.889937; Number of Obs = 130; LR $\chi^2(8)$ = 148.16; Prob>χ^2 = 0.0000; Pseudo R^2 = 0.8234

Determinants of participation in forest based spice production: We ran a logistic regression with dummy variable of household's participation in the cultivation and harvesting of forest based spices as major income activities against socio-economic variables of the household and some contextual variables (Table 1). The results were shown after six iteration. As the Table 4 indicates that participation of households in cultivating and harvesting of forest based spices was explained about 82.34% by hypothesized independent variables. Probability of household participation has positive relation with family size, long time spice cultivating experiences and total land areas. In line with (Melaku *et al*., 2014; Jain and Sajjid, 2016) reported that household dependency on NTFP has positive relation

Table 4: Threats on shade tolerant indigenous spices

Factors	Frequency	Percentage	Cumulative
Disease and animals	47	36.15	36.15
Lack of spice seedlings	33	25.38	61.54
Lack of spices knowledge	9	6.92	68.46
Degradation of natural-habitat of spices	29	22.31	90.77
Low production	8	6.15	96.92
Shortage of farm land	4	3.08	100
Total	130	100	

with family size and total farm land area. While age, distance from nearby natural forest and incomes negatively determines the participation of households on cultivating and collecting of forest based spice for their livelihood purpose. The change in the log-odds of households participation in collecting and or cultivating of forest based spice products is decreased in disposable income is 0.000313 and the change could be as little as-.0005396 or as much-.000083 with 95% confidence. Disposable incomes and distance from the nearby existing natural forest significantly ($p<0.01$) influence the household participation. However, among hypothesized explanatory variables, sex, family size age and education levels have no significant influence on household participation at 0.1 significance level (Table 4). (Melaku *et al*., 2014) reported similar finding on household pareticipation on honey production.

Many researchers (Alphons and Gu, 2009; Chhetri, 2014; Kamanga *et al*., 2009) those reported total land area belongs to households has negative impact on forest resource dependency. Since, involvements in both spice cultivation and collecting from nearby natural forest were considered it need excessive land to cultivate spice rather than other agricultural crops. In this study positive relation due to spice cultivation need land.

Variables descriptions:

- Major = dummy variable (1 for respondents cultivating or harvesting spice from nearby natural forest as major source of income and 0 otherwise)
- Sex = dummy variable (1for female and 0 otherwise)
- hsize = number of household size (continuous variable)
- Age = age of respondents in years(continuous variable)
- Income = households annual disposable incomes measured in Ethiopian currency(birr)
- Edu = education level of respondents in years (continuous variable)
- lndarea = total land area belongs to respondents in hectares (continuous variables)

Table 5: Farmer's perception on the domestication status of shade tolerant spices

Status of spices cultivation	Frequency	Percentage	Cumulative
Decreasing	19	14.62	14.62
Increasing	88	67.69	82.31
Irregular	18	13.85	96.15
no change	5	3.85	100
Total	130	100	-

Table 6: Responsible person in the family members for conservation and management activities

Responsible person	Frequency	Percentage	Cumulative
All	50	38.46	38.46
Boys only	5	3.85	42.31
Husband only	28	21.54	63.85
Husband+boys	9	6.92	70.77
Husband+wife	32	24.62	95.38
Wife only	6	4.62	100
Total	130	100	

- Distafo = distance from nearby natural forest in an hour taken for walking on foot (continuous variable)
- Before 5 = dummy variable (1 for households planted or domesticated tree shade tolerant spice before five years and 0 otherwise)

Threats and local communitie's perception towards conservation and management of indigenous shade tolerant spices: Six factor were identified as threats on sustainability of shade tolerant indigenous spices in the study area (Table 5). We identified that disease and animals (36.15%) destruction was the top threats and followed by lack of spice seedlings. As they said during our interview some disease which is previously not common at study area was frequently occurring on the spices. Particularly, during their early stage of seed maturity and some animals like monkey and domestic animal feed on it. This may lead to prevent fall of matured seed that can be used for regeneration in the future and reduce quality and quantity of spice products. There was no government organization, NGOS and even private commercial enterprises working on raising spices seedlings and distributing for local communities. Even, if the majority of these spices product have been collected from where it available naturally in the natural forests (Table 6) there was high degradations on existing forests (22.31%) due to overgrazing, illegal cutting, agricultural land expansion and on farm investment that converting forest land to other land use types. Whereas shortage of farm land may affect shade tolerant spice production in two ways one may be through converting spices habitat in to agricultural land for production of other agricultural crop and the second is if the land scarcity is there no one

could cultivate low production spice on their small land. 6.15% respondents reported that, due to low productions of these spice, there was low motivation to domesticate these spices.

However, increasing of market price of spices from time to time make more farmers participating in the domestication of these spices through collecting its propagation material from naturally existing places (natural forests) to their backyards (Table 5). While 14.62% respondents, said due to its low production, shortage of farm land and time consuming for collection of its propagation materials from natural forests, cultivation of these spices were decreasing. About 13.85 and 3.85% of farmers have irregular and no change perception of farmers on the status of shade tolerant spice in the study area, respectively.

Additionally, there were other opportunities for the sustainability of shade tolerant spice in the study area Table 6. There were no age and sex classification family members on the conservation and management activities of these spices in the study area. About 50 (38.46%) of respondents said all age class and sex equally responsible on conservation and management activities details. This may indicate sound practices for the sustainability of these species. Because if knowledge or participation of youth numbers on ethno-botanically useful species like medicinal plants are decreased it may indicate that decreasing of those species and knowledge has been affected by modernization (Awas, 2007; Abebe, 1986, 2001).

CONCLUSION

Generally in this study four shade tolerant indigenous spices that cultivated and harvested from nearby natural forest for commercial, subsistence consumption and traditional values were identified and documented. More these spice products were collected from natural forests. Participation of households on cultivation and collection of spices products for different purpose was influenced by a number of factors. Total land holding (+), disposable income (-) long time experience on cultivation (+) and access to existing natural forests (+) have significance inference on households participation and other factors like age of household head (-) gender, education levels and family size have non significance relation with household participation on cultivating and collecting of shade tolerant spices in the study area. Frequent occurrence of disease, wild animals and livestock, lack of spice seedlings and degradation of natural habitat of spices were the major threats for the sustainability of spice production in the natural habitats. Based on the findings of this study the following points were recommended.

RECOMMENDATIONS

All sectors working on conservations and management of indigenous spices should give more emphasis to minimize natural forest degradation and deforestation.

To increase household's participation on the shade tolerant indigenous spices indigenous species conservation and management related policy maker should work very well on activities related to family size, improving agricultural crop production to minimize extensive agricultural systems that can cause deforestation of existing natural forest.

Improving spice production through minimizing disease and pest problem and providing enough spice seedlings to local communities may improve sustainability of indigenous shade tolerant spices in the study area.

ACKNOWLEDGEMENTS

We would like to thank the rural communities and Kafa, Shaka and Bench Maji Zone's Agricultural staffs for their uncountable support, participation and hospitality during the time of this study. Similarly, we extended our thanks to districts and sub-districts agricultural staffs for their unlimited support and encourage us in different ways on our study. We also would like to give unforgettable grateful to Tepi National Spice Research Center for their logistic support and Ethiopian Environment Forest and Research Institute for their financial support.

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