



Analysis on Production Potential Of Anchote (*Coccinia abyssinica*) In East Wellega Zone, Oromia, Regional State, Ethiopia

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Abstract

Anchote is endemic root crop of Ethiopia and it is a unique root crop in its uses and the parts consumed. All the three harvestable parts of anchote (i.e. seeds, shoot tips and tubers) are marketable even though the root is the most economic concern in most growing areas of Ethiopia. This study focused on the analysis of Anchote production and utilization in Three district of East Wellegazone (Diga, Jima Arjo and Wayutoka) with specific objectives of analysing the production and utilization of Anchote. Primary data were collected from 150 Anchote producer farmers using structured questionnaires. Descriptive statistics and Probit model were used to analyze the collected data. Results show that the mean age of the respondents was 49 year, and the family size was 5.5%. The average land holding of the sample respondents was 0.16ha allocated for anchote production. The majority (95.56%) of the households perceived that production of Anchote crop is important in the study area. The major importance and utilization of producing Anchote for study households were as source of better income and house consumption needs than other crops in total production, and their major livelihood source. The Probit model showed that producers perception of the importance of Anchote production were found to be statistically and significantly affected by age of households, education level, availability of labour for farm activities, access to credit facilities, average income from Anchote, and Anchote productivity trend through time. Hence, agricultural policy should give emphases at all operational level to exploit more benefit from this crop and production enhancement strategies, so as to bring foreseen change in the lives of producers i. e giving high attention for research and development of anchote, Access to extension services, Access to credit and Market information must include in agricultural policy of the country.

Keywords: Anchote; perception; production; use; Probitmodel; Ethiopia.

1. Introduction

Anchote is the Afan Oromo name for *Coccinia abyssinica*, which is a tuber crop, belongs to the order Cucurbitales, family Cucurbitaceae^[1], indigenous to Ethiopia^[2] widely produced in south and southwestern parts of Ethiopia^[3]. There are about 10 species of *Coccinia* in Ethiopia; however, only *Coccinia abyssinica* is cultivated for human consumption^[4].

The most widely used vernacular names are Anchote, spelt Ancootee in Oromo. It is also called: Ushushu (Welayita), Shushe (Dawuro), and Ajjo (Kafigna).^[5] Anchote is found both cultivated and wild.^[6] The total yield of Anchote is 150-180 quintals/hectare, which is in the range of the total yield of sweet potato, and potato^[7].

According to [8] Anchote is widely cultivated and used in Jimma, Illu-Abba Bora and Wollega areas of the oromia regional state. It is a subsistence crop commonly produced to fill food security gaps during the hunger months (June to September). The production of Anchote has strong cultural ties with Oromo Nation, since it is used as cultural food during the finding of true cross locally called “ Meskel Festival”. According to [9], Anchote has enormous genetic diversity, as it is indigenous and long-stayed in the production systems.

Unlike many other crops, Anchote can be grown with minimal inputs and is able to produce reasonable yields in conditions of low soil fertility, acidic soils or drought and in intercropping with cereals. It is a co-staple crop during the hunger months in certain pocket

areas of western Ethiopia. Despite this fact, Anchote has been historically given low attention in terms of research and production. Anchote can withstand dry conditions and produce food for the poor smallholder farmers when other crops fail to grow. Usually farmers sow Anchote seed in April or May and harvest in July or August. Anchote produces one root per plant, which is usually harvested after 4-5 months of planting when the leaves turn yellow [10.11].

This study was initiated in three district of East Wellega zone(*Diga, Jima Arjo and Wayutoka*) for assessing the current status of the crop on smallholder farming sector focusing on its general production and utilization purpose, and income potential for the farmers and minimized postharvest loss.

2. Materials and Methods

2.1 Description of the Study Area

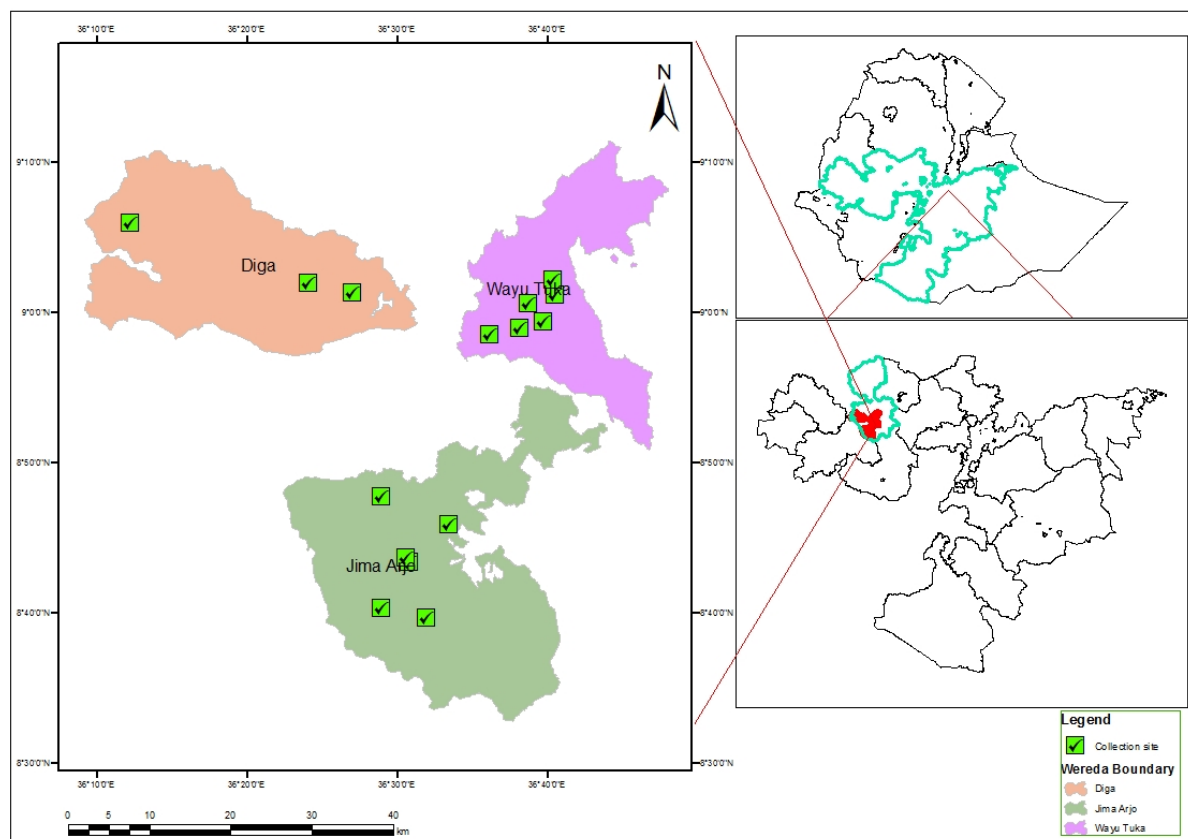


Fig 1 map of the study area

The study was done in three District of East Wellega zone of Oromia regional state of Ethiopia. The study area towards west, about 350 km away from of Addis Abeba the capital city of Ethiopia. This administrative division acquired a latitude and longitude of 9°5'N 36°33'E and an elevation of 2,088 meters. The 1995 national census reported a total population for this Zone of 1,253,432 in 252,821 households, of whom 616,565 were men and 636,867 women; 138,736 or 11.07% of its population were urban dwellers at the time.. The majority of the inhabitants professed Ethiopian Orthodox Christianity, with 61.74% of the population having reported they practiced that belief, while 16.44% of the population said they were Protestant, 12.44% held traditional beliefs, and 8.27% were Muslim

2.2 Sampling Techniques and Sample Size

In this study, a multistage sampling technique was used. In the first stage, from Oromia regional state, East Wellega Zone was selected purposely based on the production potential of the Anchote crop. In the second stage, from East Wellega Zone, Three Districts (Diga, Jima Arjo and Wayutoka) were selected based on production potential of Anchote. In the third stage, Nine (9) rural Kebeles were selected randomly from the existing Kebeles of Diga, Jima Arjo and Wayutoka Districts. Fourthly, farm households were selected by using the probability to proportional to size using simple random sampling technique from selected kebles of the Three Districts. Finally, a total of 150 households were 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 face to face interview by structured questionnaire, focus group discussion and field observation. The questionnaires included were the socio-economic characteristics, institutional factors, biophysical factors and other related issues with the production, marketing and utilization of anchote. Secondary data was collected from agricultural office, kebele administration office, books, and journals. Finally, office documents were also consulted to supplement the whole of the perception on the importance of producing anchote, perceived it as important or not, we applied a discrete choice Probit model for binary choice (yes, no) responses to the importance anchote production

perception question. Probit model is a statistical probability model with two categories in the dependent variable [12]. Probit analysis is based on the cumulative normal probability distribution. The binary dependent variable y takes on the values of zero and one [13]. The Probit analysis provides statistically significant findings of which demographics increase or decrease the probability of consumption.

In the binary Probit model, perceived it as important to produce was taken as 1, while not perceived it as important as 0. It is assumed that the i^{th} household obtains maximum utility; it has perceived it as important to produce rather than not to produce the crop. The probability π_i of choosing any alternative over not choosing, where Φ represents the cumulative distribution of a standard normal random variable [14]:

$$\pi_i = \text{prob}[Y_i = 1|X] = \int (2\pi)^{-1/2} \exp(-\frac{1}{2}\beta'X)^{-1} dt \dots (1)$$

$$= \Phi(X_i \beta) \dots (2)$$

The relationship between a specific variable (x_i) and the outcome of the probability is interpreted by means of the marginal effect, which accounts for the partial change in the probability. The marginal effect associated with continuous explanatory variables X_k on the probability $P(Y_i = 1 | X)$, holding the other variables constant, can be derived as follows [14]:

$$= \partial X_i \beta (3)$$

The marginal effect on dummy variables should be estimated differently from continuous variables. Discrete changes in the predicted probabilities constitute an alternative to the marginal effect when evaluating the influence of a dummy variable. Such an effect can be derived from the following [14]:

$$\Delta = \Phi(\beta, = 1) - \Phi(\beta, = 0) (4)$$

The marginal effects provide insights into how the explanatory variables shift the probability of frequency of anchote production. Using the econometric software Stata 13, marginal effects were calculated for each variable while holding other variables constant at their sample mean values.

3. Results and Discussion

3.1 Socio-Economic Characteristics of Study Farmers

Out of the total of the 150 respondents, 124 (82.7%) were males and the rest 26 (17.3%) were females. The range of age of the respondents was between 18 and 79 years. Among these, 49 respondents (32.7%) were found between 31 and 40 years of ages (the dominant age group). The majority of the respondents (123) were married (82.%) and with average family size of 5.5 (15.1%). Out of the respondents, 72 have an educational level coded as illiterate (48.%) dominating the other groups. Their livelihood depends on farming (143, 95.3%), and others (7, 4.7%). The preferred anchote Variety of round shape 100%, The reasons for their preferences to Variety to produce are high price, early maturity (141. 94) and for food (9, 6%) and 82.9% of the respondents said that their average

annual production was 16.12 tone/ha Of the total respondents, 149 (99.3%) are convinced that their farm and its natural resources are not properly managed, lack of planting materials due to high price, pest and disease are also cause the loses of anchote , but the remaining 1 (0.7%) believed otherwise. The major problems listed by those who believe that their farm is not properly managed include lack of land (107, 71.3%), lack of planting materials (11, 7.3%) and deforestation and soil erosion (32, 21.4 %). 144 (96%) of the respondents strongly agree that the anchote farming is under severe pressure and its yield is declining, while 6 (4%) of the respondents disagree with the ideas of the former. 12 (8%) of the respondents did not know that anchote is endemic to Ethiopia, but the remaining 138, (92%) knew already that the crop is endemic. Almost all of the respondents know the production technic of anchote.

Table 1: Demographic and socioeconomic characteristics of respondents

Variables		Frequency	Percent
		N=150	N=150
Religion	Muslim	9	6
	Protestant	65	43.33
	Orthodox	76	50.67
Sex	Male	124	82.67
	Femal	26	17.33
Education level	Illiterate	72	48
	Read and write	19	12.67
	Primary (1-4)	26	17.33
	Junior (5-8)	23	15.33
	Secondary (9-10)	8	5.33
	Preparatory (11-12)	2	1.34
Marital status	Married	123	82. %
	Widowed	20	13.33
	Divorced	7	4.67
	Total	150	
Age	Mean	49 (32.7%)	
Family size	Mean	5.5 (15.1 %)	

Source: Own computation, 2016

3.2 Land Characteristics of Anchote Producers

Land related characteristics are important features for the farmers as a whole.. These characteristics of land include soil fertility status and productivity of land; that is important factors influencing agricultural production in general and Anchote production in particular. The majority (80.67%) of the respondents responded that their land soil fertility status was Low fertile , followed by Medium status. Only few respondents (4.%) said that their land categorized as Very fertile . Therefore, this result implies that, in study area, if the farmer's got land , extension

services and planting materials ,there is a good opportunity to increase the Anchote crop production and utilization. Also, most (78%) of the respondents revealed that the productivity of land was declining through time and about 6.67% said that their land productivity was increasing through time. Moreover,10% of respondents were responded that their land productivity might increase or decrease depending on their farm work activity, rainfall availability and input usage. Only few (5.33%) respondents said that there was no change in productivity of land over the time (Table 2).

Table 2. Land characteristics of the sample producers of the Anchote

Variable	Frequency		Percentage
Soil fertility status	Low fertile	121	80.67
	Medium	23	15.33
	Very fertile	6	4
	Total	150	
Productivity of land	Declining	117	78
	No change	8	5.33
	Increasing	1	6.67
	Increase or decrease	15	10
	Total		

Source: Own survey, 2016

3.3 Access to Extension and Credit for Producers of Bread wheat

Access to agricultural information services makes farmers to be aware of and get better understanding and ultimately leads to decision to take risk for improved agricultural practices. It helps in disseminating new innovations and ideas that emerges from research findings and improves better understanding of technologies that benefit farmer's production and productivity. In addition, access to agricultural extension services helps to facilitate dissemination and adoption of improved technologies and ensure the local availability of these technologies for the majority of smallholders.

The result in Table 3 below indicated that 34% of respondent farmers have access to agricultural extension services Only very few (7.33%) respondents received seeds in terms of credit. Additionally, factors like access to market and distance from the market are crucial for farmers to sell and buy agricultural products and inputs. The result revealed that most of (62.67%) respondents had access to market. The majority (57.33.%) of sampled respondents revealed that the average distance from the market to their home was 10 to 30 minutes and which followed (24) % by 31 to 60 minutes.

Table 3. Access to different institutional services for the sample farmers

Variable		Frequency	Percentage
Contact by Extension agents	Yes	51	34
	No	99	66
	total	160	100
Access to Credit	Yes	11	7.33
	No	139	92.67
	total	150	
Market access	Yes	94	62.67
	No	56	37.33
	total	150	
Average distance of market from residence	<10min	13	8.66
	10-30min	86	57.33
	31-60min	36	24
	>60min	15	10.01
	Total	150	100
Perceive the distance of market from your residence	Near	114	71.25
	Far	44	27.5
	Very Far	2	1.25
	Total		100

Source: Own survey, 2016

3.4 Anchote Producer's Farm Input Usage

Fertilizer application is one of the most important agricultural practices that are used by Anchote growers in the study area. Moreover, proper application of the recommended fertilizer rate is important to obtain the required production and marketable supply. However, farmers in the study area apply varying fertilizer rate, which is below the blanket recommendation rate given by Agricultural

Research Centre. The result revealed that only few farmers use fertilizer (11.33%).

Seed distribution remains largely informal and farmer-to-farmer exchanges account for as much as 90% of the seed trade. Result in Table 4 below indicated that 90.87% of respondent farmers have used Anchote farmers varieties and 88.67% of the respondent not use fertilizer.

Table 4. Respondents' farm input use

Variable		Frequency	Percentage
Fertilizer use	Yes	17	11.33
	No	133	88.67
	total	150	100
Local seed	Yes	51	90.87
	No	109	9.13
	total	100	100

Source: Own survey, 2016

3.5 Anchote production

The crop has been contributing much to the diet of the rural societies in its growing areas since its domestication [15]. As its protein, calcium, iron and carbohydrate contents are better than other root crops, it could be an excellent source of macro- and micronutrients. But, its agriculture needs to be modernized and scaled up. As native biological resources are adapted to local conditions, due attention should be given to such crops [16]. Traditional indigenous crops have the potential to diversify and expand the diet of the local societies in particular, and the world, in general [17]

Therefore, it is a good opportunity for marginal farmers to cultivate and earn more income from this crop. Thus, this confirms that in both of the study the study area there is potential for anchote production. Hence, this paves the way for the inclusion of this crop in agricultural policy to exploit more benefit, sustainable use and production enhancement strategies. Besides, the result indicates that the higher mean annual income earned from crop and followed by livestock and its products sales. The size of mean income from non-farm activities was found next to livestock and its products. Thus, these imply that, in the study area, the major livelihood and/or income source for households was crop production activities

Table5 . Farm land allocated and Productivity of anchote

Variables (N=160)	Mean	Std. Deviation
Area allocated for Anchote in 2015/18 in hectare	0.16	0.29
Productivity of anchote ton/ per hectare in 2014/2015	16.12	10.33

The result of study indicates that on average respondents allocated 0.16ha for Anchote which is 12.70% of their total average landholding. On average, a farmer .The average productivities of the crop were 16.12ton/ha.

3.6 Anchote utilization in the study area

The total yield of anchote is 150-180 quintals/hectare, which is in the range of the total yield of sweet potato and potato [18]. Anchote is propagated exclusively from seeds and harvested in 4 months. Anchote can be safely stored under the ground, which thus gives added food security to the population in times of main crop failures. Like many other roots, anchote is rarely eaten raw. It undergoes some form of processing and cooking before consumption. The roots are cleaned superficially, or peeled with knife and then cooked in boiling water or grated. Cooked anchote is served usually with kochkocha, a fermented side-dish prepared from ground green pepper with green leafy varieties of spices like coriander (*Coriandrum sativum*), sweet basil (*Ocimum basilium*), ginger (*Zingiber officinale*), garlic and salt. Anchote when sliced, dried in the sun and ground, its flour remains in good conditions for a long time. The flour is used to prepare a soup when boiled with bone-marrow from animals. Such soup is particularly served to patients with broken or fractured bones or sick people. A stew locally called anchoteIttoo is prepared on festive

occasions solely from sliced anchote with sufficient butter.

More than its other uses, anchote is getting popular because of its medicinal value even with the non-Oromos [19] The high medicinal value of the anchote tuber seems to be because of its high calcium as compared to other common and widespread root and tuber crops [19]. Possibly its calcium content is important in repairing damaged bones. Juice prepared from roots of anchote has been used in Ethiopian traditional medicine. Spiced and flavored anchote paste is recommended for people suffering from bone fracture and displaced joints [8,15, 20 ,21].

According to [19], juice of anchote root is used to treat cancer, tuberculosis, skin eruptions and gonorrhoea by traditional medicine practitioners of Ethiopia. Anchote has a special place in the traditions and customs of the Oromo people in the anchote growing areas. According [19]), the inclusion of anchote in dishes served at ritual ceremonies is prestigious. Anchote dishes in different forms are usually served in special occasions such as the 'masqal' celebration in September, weddings, marriage ties (betrothals), circumcision, birth days and thanks giving days at the start of a New Year, or harvest time. During such occasions and/or at times of physical injuries, a neighbour that has no anchote for that season may get a present of anchote tubers from those who have it.

This is done to share their happiness and strengthen social relationships. So, anchote has considerable social importance in the anchote growing societies.

Table 6. Probit model result of factor affecting the perception producers on the importance of producing

Variables	Coefficients	SD	Z-value	Marginal effect (dy/dx)
Age	.0966	.0202	0.12***	.0168
Education	.1308	.0559	1.34*	.0228
Total family size	.0116	.04957	0.23	.0020
Land holding	.0492	16130	0.31	.0085
Labour availability	.6600	.35984	0.93*	.1150
Extension services	-.2242	14924	-1.50	-.0391
Access to credit	1.1145	.6352	1.79*	.1943
Market distance	.2747	.1987	1.38	.0479
TLU	-.0637	.0598	-1.06	-.0111
Anchote income	.0054	.00001	0.43***	.00062
Productivity trend	1663	.07107	0.87**	.0289
Market demand	-.0979	16292	-0.60	.0170
Land productivity	-.06769	.055019	-1.23	-.0118
Constant	-7.6762	1.9282	-2.09***	
Number of obs = 150 Log likelihood = -58.5191				
LR chi2(13) = 93.73 Pseudo R2 = 0.4447				
Prob > chi2 = 0.0000				

***, ** and * means statistically significant at 1%, 5% and 10% level

4. Conclusion

Traditional Anchote farmers contributed, for thousands of years, to the wealth of variation available in farmer variety that was used to improve Anchote and adaptation in different parts of the Country. We identified large level of variation in an Anchote farmer variety managed by subsistence farmers and grown under marginal Anchote production environment. We suggest that farmers grow and maintain highly variable Anchote farmer variety to lower the risk of failure under marginal production conditions and to increase food security of isolated communities. However, additional information on the factors contributing to the private value which farmers assign to Anchote farmer variety is needed and may help to identify a strategy for ensuring the conservation of their genetic resources; such information is needed to assess the likelihood that particular farmers will continue to maintain farmer variety. The study attempted to investigate the production states of Anchote in three districts of East Wellege zone (the birth place of Anchote)

Out of the respondents, 82.7% and 17.3% were male and female household heads respectively. The minimum and maximum age of the respondents were 18 and 79 years respectively with mean age of 49 years. The average family size in the study area was 5.5 (15.1%). The minimum and maximum sizes of landholding of the respondent farmers were 0.03 and 2.7 hectares respectively with mean landholding of 0.16 hectares. Respondents allocated most of their plots for wheat and barley plantation which was 0.36 hectares on average out of total holding.

Provision of adequate services for the communities enhances the communities' socioeconomic development in general and the well-being of individuals in particular. It has important contribution in improving production and productivity and thereby increasing marketable surplus and ultimately for increasing the income of smallholder farmers. The most important services that are expected to promote production and marketing of Anchote in the study area include access to credit, access to extension service, and access to market information. Anchote producer farmer's market major sources of information were friends/neighbour farmers and traders.

The result also showed that 7.33% of the respondents have access to credit. Extension service in agriculture is indispensable and it provides assistance for farmers in improvement of production and productivity, it also enables flow of information and transfer of knowledge and scientific findings to practice. Out of the interviewed farmers, 34.% have access to extension services delivered by different stakeholders in the study area. On average a farmer household produces 16.12ton/ha.

Inputs used by farmers of the study area are fertilizer and seed. These inputs are supplied to farmers either by cooperative/unions and private traders. The survey result indicated that all sample respondents applied little amount of DAP (Di Ammonium Sulphate) and only 11.33% of them used DAP fertilizer on their Anchotefield. Seed distribution remains largely informal and farmer-to-farmer exchanges account for as much as 90% of the seed trades.90.87% of the respondent uses local seeds.

When we came to the utilization in E/Wollega, people use over stayed (over matured) Anchote tuber when they face a problem of bone-fracture and when women give birth, due to the fact that Anchote is supposed to contain high Ca and Fe [9, 23]. In other words, the local people believe that Anchote has medicinal value in healing many maladies.

5. Recommendation

Due to the low attention given to the research and development of anchote, there is no variety so far developed and released. As anchote is an endemic and potential root crop, further research should be done for the development and release of anchote variety. Cultivation of anchote should be introduced to anchote non-growing areas of the country, as it is rich sources of protein, carbohydrate, calcium, iron and potassium; it can play its role in ensuring food security. The following recommendations are made based on the experiences faced during the study In order to solve shortage of improved varieties seed, improving farmers' knowledge in quality seed production through training is important. Improving knowledge of farmers on production of quality seed by themselves will solve shortage problem and save expenditures incurred by farmers.

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