Banana (*Musa Spp.*) Production System, Utilization and Constraints in Major Banana Growing Regions of Ethiopia

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Abstract

The study was undertaken to assess the production system, utilization and major constraints of bananas in Ethiopia; and forward recommendations. Multistage purposive and random sampling techniques were employed to select 201 households from eight districts in Oromia, Sidama, and SNNP regions. Data were collected through the application of Participatory Rural Appraisal techniques; and analyzed using descriptive statistics. Majority of banana farmers were male, middle-aged, educated at least first level of primary education and with an average of 17 years of experience in banana production. They owned a small piece of land (1.06 ha), of which 0.67 ha was allocated for bananas. Even though all family members involve in banana production and marketing, husband shared much of the work loads. Most agronomic management practices had not been applied by majority of farmers except weeding and cultivation. Limited technical and financial supports were given to banana production. The majority of harvested banana fruits (74%) were used for income generation, and almost all farmers (98.8%) consume banana as dessert fruit. Banana leaves and pseudostems were used for various purposes. Own garden was the source of planting material for most of banana producing farmers (56%), and others (26%) got from neighboring farmers. Bananas are also used as animal feed. Diseases, land shortage, irrigation water, and adverse weather condition, were mentioned as first priority constraints; and possible suggestions like use of improved technologies were indicated to overcome the constraints. Therefore, identifying local cultivars, creating awareness and promoting both cooking and dessert types would be important to increase the significance of bananas.

Keywords: Banana, agronomic management, planting materials, constraints

Background and Justification

Banana and plantains (*Musa* spp.), generally referred as bananas, are important crops in the world. Bananas are believed to be the earliest plant species to be domesticated (Denham *et al.*, 2003). They are largely grown by smallholders and play major role in food security and income generation for millions of rural poor worldwide. Bananas are the fourth most important food crop in the world after rice, maize and wheat (Molina *et al.*, 2004). The total world production of bananas in 2021 was estimated about 125.0

million tons, from which 18.4% was produced in Africa (FAOSTAT, 2021).

In most developed countries banana is considered as dessert fruit, while in many developing countries cooking bananas are being utilized. Banana fruits can be consumed raw or cooked, processed into flour and fermented to produce beverages such as banana juice, beer, vinegar and wine (Pillay *et al.,* 2002). Bananas are rich in starch, sugar and vitamins A and C, potassium, calcium, sodium and magnesium but low in fat content. It is also believed that bananas help to fight depression, kidney cancer and diabetes (Dodo, 2014).

As a staple, bananas contribute to the food security of millions of people in much of the developing world, and when traded in local markets, they provide income and employment to rural populations (Arias *et al*., 2003). It is major component of Africans' daily diet (INIBAP, 2000). People living in Eastern Africa maintain a high population density based on the intensive cultivation of bananas as their staple food that they grow on home gardens under a long-term regime of continuous cropping (Komatsu, 2010). Research results confirmed that bananas are important and are commonly used in people's day-to-day diets throughout the region (Gold *et al*., 2002, Abele *et al*., 2007). Year-round fruiting habit ensures banana to be a source of food and income throughout the year, making it a primary component of food security of the region.

About 539.0 thousand tons of bananas were produced on 66.8 thousand hectares of farmland during 2019/20 cropping season in Ethiopia. About 3.5 million smallholder farmers were engaged in producing bananas for home consumption and income generation in the same year. The majority of bananas have been produced in Southern Nations, Nationalities and Peoples (SNNP) and Oromia regions that cover 70.4% and 26.2% of total production in the country, respectively (CSA, 2020).

Banana has been produced mainly in lowland ("Qolla") and mid-altitude ("Woinadega") ecological zones, which are more favorable for its production (Daniel, 1998; Dawit and Asmare 2008; CSA, 2020). In these parts of the country, though population density is considerably high, people have not been seriously affected by drought, as compared with those in northern and eastern Ethiopia, mainly due to the use of banana and root crops such as 'enset' (a relative of banana) (Seifu, 1999).

The current characteristics of banana producers and the major production constraints are not identified. Assessing the type of cultivars available on farmers hands and identifying farmers' variety selection criteria would also be important to

develop sustainable variety development strategy. Except some limited and localized surveys, a wide assessment, addressing the major banana growing areas, has not been undertaken in Ethiopia. Generating reliable information on the points indicated above would have great contribution to develop research and development strategy that help expand good practices and address constraints for banana production in the country. That is why the study was conducted assess the production system, utilization and constraints of bananas in Ethiopia and this paper is aimed to avail information for scientific communities in the country and worldwide.

Materials and Methods

Study area

Survey was conducted in major banana growing three administrative regions of Ethiopia: Oromia, Sidama and SNNP. Four zones were selected based on area coverage according to annual survey reports of the Central Statistical Authority of Ethiopia (CSA), their long tradition in cultivating banana and high production potential of the crop. From each zone, two major banana growing districts (a total of eight districts: Arbaminch Zuriya, Mirab Abaya, Dilla Zuriya, Wenago, Seka Chekorsa, Shebe, Aletawendo and Dale) were selected purposively based on information obtained from the Departments of Agriculture of the respective zones on cultivation and distribution of the crop (Figure 1).

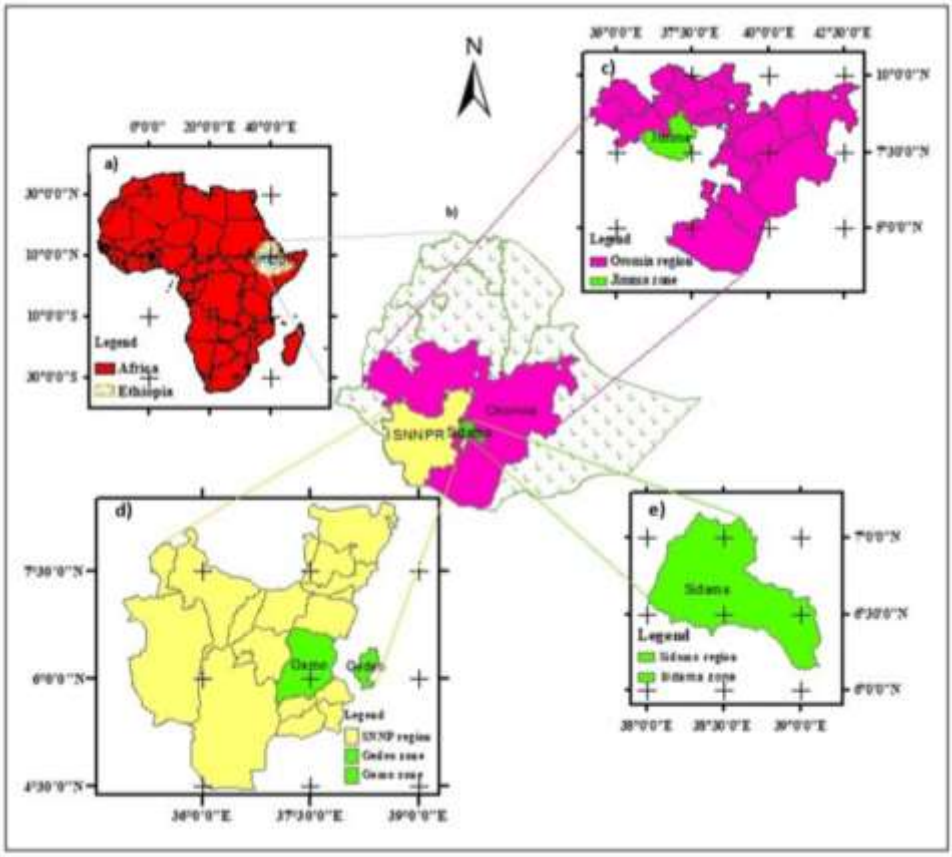

Figure 1: Position of Ethiopia in Africa continent's map (a), map of Ethiopia showing three selected regions (b), admirative zones where banana survey was conducted in Oromia (c), SNNP (d) and Sidama (e) regions.

Sampling techniques

Multistage purposive and simple random samplings were employed to collect the necessary data. A multistage purposive sampling technique was employed to select sample zones, districts and '*kebeles*' (the smallest unit of public administration); while a random sampling technique was used to select household farmers for interview. From each zone, two districts, and from each district one to two '*kebeles*' were purposively selected. In each of the selected *'kebele'*, banana producing farmers were randomly selected from a list of the districts' banana producing households. The selection process was assisted by the district agricultural office head, horticulture experts and agricultural extension workers. Two hundred one household heads or family members, who were involved in banana production, were interviewed to collect data (Table 1).

Table 1: Selected banana producing zones and districts for the survey

Region	Zones	Districts	*Kebeles*	No of farmers
SNNP	Gamo	Arbaminch Zuriya	*Lante, Kachema Ochole*	30
		Mirab Abaya	*Delbo, Mole*	29
	Gedeo	Dilla Zuriya	*Gola, Chicho*	30
		Wenago	*Tulama Chiracha, Kara Soditi*	22
Oromia	Jimma	Seka Chekorsa	*Guyo Kechema, Shashemene*	31
		Shebe	*Kishe, Shebeqa Wale*	22
Sidama		Aletawendo	*Dobe Sadeqa*	15
		Dale	*Duba*	22
	Total			201

Data collection

Data were collected through the application of Participatory Rural Appraisal (PRA) tools and techniques: individual interview, focus group discussion and direct observation. Semi-structured questionnaire was developed based on a template used for similar studies (Mulualem, 2016; Yemataw, 2018) with some modifications. After briefing the objective and contents of the questionnaire, agricultural extension workers in respective districts served as assistant enumerators and translators of local languages. Interviews were conducted with the head of the household or member of a family responsible for banana field management. Data or information of the locations, respondent's identity, banana production system, banana diversity and management, and banana use and marketing were recorded from May 2019 to January 2020. Farmers were asked to tell their experience in using bananas and other parts of banana plant.

In addition, focus group discussions were carried out at the district level with key informants such as zone or district horticulturists, development agents and model farmers. The discussions were free and open-ended to allow the respondents to express their ideas freely. Finally, banana fields of interviewed farmers were visited to perceive banana types and record more information through direct observation.

Data analysis

Data were analyzed by descriptive statistics (frequencies, percentages or means) to generate summaries, tables and graphs at different levels (zone or district) by the help of Microsoft Excel 2010 and Statistical Packages for Social Sciences (SPSS) version 23 (IBM corporation 2015).

Result and Discussion

Demographic and Socio-Economic Characteristics of Banana Growers

Demographic characteristics of banana growers is presented in Figure 2. From randomly selected farmers about 83.6% were male and 16.4% were female (Figure 2a). As shown in the figure 33 female farmers are participating as first responsible persons in major activities of banana production. This implies that most of banana growers in Ethiopia are male. This result is different from the case of banana growers in Uganda; as Karamura *et al.* (2004) report. In Uganda all activities of banana orchards management were handled by women. For their postharvest assessment at a banana local market in Jimma town, Yetenayet and Chala (2018) reported that 72% of respondents were female, which showed that the females were involved much in banana marketing contrary to banana production.

Regarding positions of respondents in their household, 189 (94%) farmers were household heads; and the remaining were wives and sons of the household farmers, which were 3.5% and 2.5%, respectively (Figure 2b). From those, 17 households were female-headed, indicating most of banana farmers in Ethiopia were male-headed. Since most of the farmers interviewed in this research were household heads, it is believed that they better know about their banana-growing activities, and information gathered from them would be confidently true.

The majority of farmers (47%) were in the age range between 31 and 45 years, and farmers with age 45 to 60 years were 44 (22%). Youth farmers aged between 18 and 30 were 19% while old farmers with age above 60 years were 12% (Figure 2c). This result showed that farmers growing banana in Ethiopia are dominantly middle-aged, and they have good potential to handle field activities.

The highest proportion of farmers (32%) learned from grades five to eight. About 41% of farmers learned either grade one to four or grade nine to twelve, with equal proportion. Limited numbers of farmers (5%) were graduates; out of which one farmer was first-degree holder, four were with diplomas and five with certificates. The remaining 22% of farmers did not learn any formal education (Figure 2d). This indicated that majority of banana growers were with formal education level above primary education, which could have positive impact for farming activities. Most farmers could easily understand and capture trainings or advices, at least with their local languages.

Experience of farmers in eight districts for banana production was ranged from 11.6 to 23.9 years with an overall

average of 17.0 years. Farmers in Dale district of Sidama region were with the highest average experiences (23.9 years), followed by Wenago district of Gedeo zone (20.4 years) and Mirab Abaya of Gamo zone (18.5 years) (Table 2).

The total land size and land occupied by banana were 1.06 ha and 0.67 ha, respectively (Table 2). Among the districts surveyed, the largest total land size (1.59 ha) was recorded for banana producing farmers at Shebe district in Jimma zone, while the smallest total land size (0.57 ha) was recorded for those farmers at Dilla Zuriya district in Gedeo zone. Regarding land size occupied by banana, farmers in Mirab Abaya district have owned the largest average land size per farmer (1.20 ha), followed by farmers in Arbaminch Zuriya (0.85 ha), both districts are from Gamo zone. Farmers in these districts allocated large proportion of their land for banana production as compared to other districts, 88.9% and 57.4%, respectively. At Wenago district of Gedeo zone farmers allocated the smallest land size (0.02 ha) for banana production, which was 1.9% of total land owned by the farmers for all crop production.

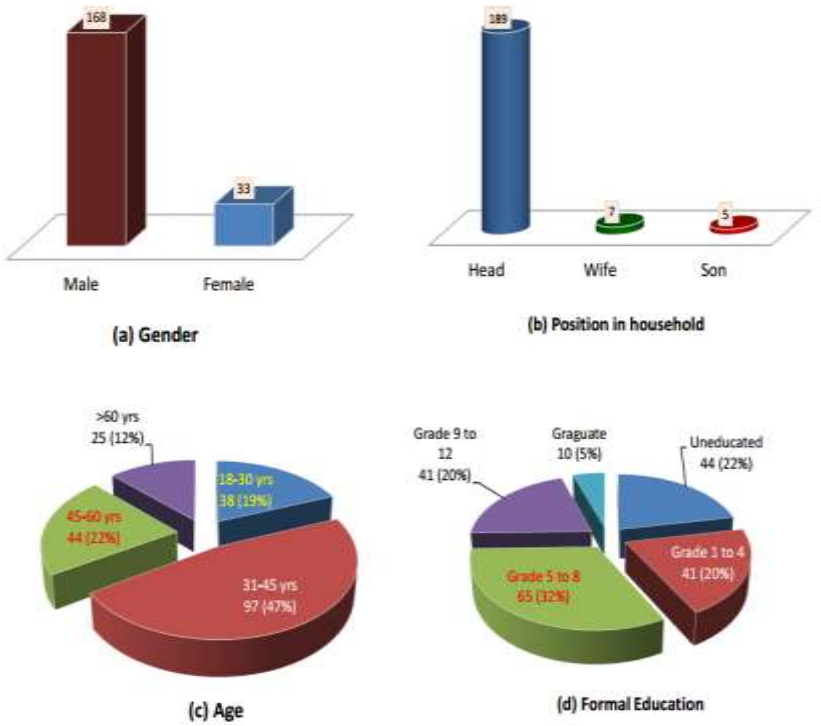

Figure 2: Demographic characteristics of banana growers; gender (a), position in household (b), age (c) and formal education level (d)

Thus, among surveyed districts, banana is produced as a primary crop or main cash crop in Mirab Abaya and Arbaminch Zuriya districts (Gamo zone) since they had allocated a major proportion of their land for banana. While in other districts, it is produced as a secondary crop.

The result is in line with other survey reports in Ethiopia. According to Zenebe *et al.* (2015), production of banana in most parts of the country had limited to backyard and small-scale production to supply fruit produce to local markets. Mohammed (2018), in his survey report indicated that in South Omo and West Arsi zones in Ethiopia, the average land-holding size was 0.41 to 0.76 'timad' (equivalent to 0.10 to 0.19 ha) from which banana occupied only small portions. In other African countries also, banana was produced in small piece of land; for example, in Uganda, East African highland, banana was mostly produced in small plots, less than 0.5 ha (Gold *et al.*, 2002).

Table 2: Experiences in banana production and land size of respondent farmers

Region	Zone	District	Experience		Total land size (ha)		Land occupied by banana (ha)		
			Mean	SD	Mean	SD	Mean	SD	%
SNNP	Gamo	Arbamich Zuriya	15.4	6.1	1.48	1.12	0.85	0.54	57.4
		Mierab Abaya	18.5	8.9	1.35	0.7	1.20	0.84	88.9
	Gedeo	Dilla Zuriya	18.2	13.5	0.57	0.43	0.10	0.13	17.5
		Wenago	20.4	12.5	1.06	0.76	0.02	0.01	1.9
Oromia	Jimma	Seka Chekorsa	15.7	12.3	0.97	0.65	0.05	0.1	5.2
		Shebe	12.2	7.2	1.59	0.93	NA	NA	NA
Sidama		Aletawendo	11.6	7.0	0.75	0.43	0.09	0.1	12.0
		Dale	23.9	9.5	0.67	0.32	0.12	0.09	17.9
		Over all	**17.0**	**9.6**	**1.06**	**0.67**	**0.35**	**0.26**	**28.7**

NA= data not available; SD = standard deviation

Field Activities and Sharing Responsibility

Various field activities were practiced by banana-growing farmers (Table 3). Almost all banana growing farmers practiced weeding and cultivation of banana plantations 2.8 and 2.5 times per year, respectively. Weeding was commonly applied in the early stage of banana growth since in later stages; banana plants suppress weed growth by themselves. Weed was also controlled by mulching with chopped banana pseudostem and leaves after fruit harvest.

About 51% of farmers applied soil fertilizers for banana, and average of 2.7 times per year (Table 3). Majority of them used as organic fertilizers such as manure and composts, while small holder farmers in the assessed regions rarely used chemical fertilizers. It was reported that the use of commercial fertilizers on banana field was not practiced by small-scale banana producers in the country except random applications of farmyard manure, animal dung and household refuses (Dawit and Asmare, 2008; Zenebe *et al.,* 2015). This could be because most farmers are growing local cultivars or landraces, which are usually adapted to be grown using very little inputs (IBC and FAO, 2012).

Among interviewed banana farmers, only about 33% applied irrigation water in dry periods, showing the majority of banana production in the country is under rain-fed. Even the ones who were using irrigation were applying almost only once a month because of shortage of water (Table 3). The results are in line with Mohammed (2018) and Zenebe *et al.* (2015), who reported that most of banana producers in Ethiopia grow banana using natural rain only. Most banana and plantain in Africa are grown under low levels of crop management in which water is a primary limitation in most rain-fed cropping systems (Lorenzen *et al.*, 2009).

About 68% of farmers applied sucker management practices and removed excess suckers; however average numbers of banana plants they kept per mat were too many (8.1), which is far more than the recommendation (3 to 4 per stool). Similar indicated that most small-scale growers do not apply the right agronomic practices, such as maintaining appropriate spacing and sucker management to their bananas (Zenebe *et al.*, 2015). Sucker management and fertilizer application showed a significant positive impact on the yield and quality of banana (Seifu, 1999). Optimum yield and fruit size were obtained by keeping three or four plants of different age per hill (Asmare and Derbew. 2013).

Table 3: Major banana field activities practiced by farmers

Activities	Farmers practicing (%)	Frequency per year
Weeding	94%	2.8
Cultivation	95%	2.5
Fertilization	51%	2.7
Irrigation	33%	1.1*
Desuckering	68%	8.1**

**Irrigation frequency per month; ** suckers per hill*

All family members in a household of banana producing farmers participated in banana production activities. On average, husband, wife, and children undertook 44.1%, 27.7% and 17.7% of different banana production activities, respectively. In most cases, husband shared much of the works load, from land preparation to the marketing of banana fruits. Wives or women are also involved in all activities with less proportion as compared to the husbands, except for marketing banana fruits, 54.4%, was covered by wives. Wives and children equally participated during land preparation. On average, 10.2% of field activities of banana production was covered by hired laborers, but they rarely (0.4%) were involved for the marketing of banana fruits. Some farmers were assisted by their fathers and mothers for land preparation, agronomic management and marketing (Table 4).

The proportion of sex participation of banana growers in Ethiopia seems different from the case of in Uganda, where banana is a top food security fruit crop. Karamura *et al.* (2004) reported that women have always been in charge of the management of banana orchards, and they were responsible for the day-to-day management of banana gardens up to 100%. Yetenayet and Chala (2018) stated that females were involved dominantly in banana fruits marketing in Jimma local market which is contrary to the case of banana production.

Table 4: Share of responsibility by family members and others involved in banana production activities

Field activity	Husband	Wife	Children	Hired labour	Others	Total
Land preparation	46.3%	18.2%	18.2%	17.0%	0.3%	100.0%
Sucker collection	53.0%	20.1%	17.5%	9.4%	0.0%	100.0%
Planting	46.1%	18.9%	20.7%	14.3%	0.0%	100.0%
Agronomic mang.	43.2%	24.3%	20.2%	11.8%	0.5%	100.0%
Harvesting	44.2%	30.5%	16.8%	8.5%	0.0%	100.0%
Marketing	31.8%	54.4%	13.0%	0.4%	0.4%	100.0%
Average	44.1%	27.7%	17.7%	10.2%	0.2%	100.0%

Source of Planting Materials

The source of planting materials for the majority of banana growing farmers was their own garden (56%) and from neighboring farmers (26%). Some farmers (9%) obtained banana planting materials from their own

garden and neighbors. A few farmers (2%) accessed the suckers from Bureau of Agriculture. Rest of the farmers (7%) found from other sources such as research centers, universities, churches, investors, or their relatives. According to respondents, farmers rarely purchased or sold banana suckers to other farmers; rather they exchanged them free of cost. Only 6.5% of the farmers purchased banana suckers from the market or from other farmers and about 8.0% of them sold banana suckers (Figure 3). This could indicate limitation in supply of planting materials. The result is similar to that of Mohammed (2018), who reported that majority of farmers in some parts of the country got banana suckers from their own banana farm. Karamura *et al.* (2004) described that the majority of banana farmers in Uganda selected and collected banana planting materials from their own gardens or from their neighbor's garden.

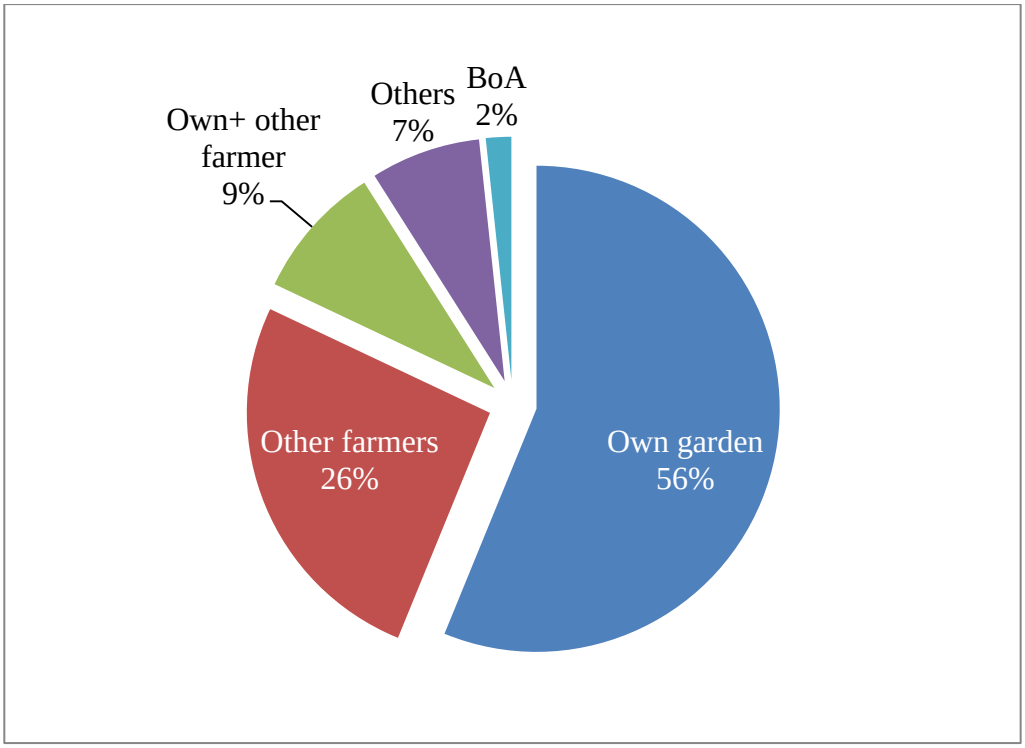

Figure 3: Source of banana planting materials (suckers)

Technical and Financial Support

The majority of banana growing farmers received neither technical support (56.7%) nor financial or input support (79.6%) from any institutions. About 39.3% and 17.4% of the farmers were supported by the Bureau of Agriculture (BoA) for technical and financial or input supports, respectively (Table 5). Research centers and universities supported a few farmers; but their support directly to farmers was very limited may be because they work with other institution such as BoA and NGO that transfer technology to farmers. Other bodies mentioned by farmers that were involved in supporting them for banana production and marketing were NGOs and the Farmers Union. Relatively better technical support by governmental and non-governmental organizations was reported in Arbaminch Zuriya and Miraba Abaya districts (Gamo zone), where banana is grown as a commercial crop, as compared to other surveyed districts. In general, farmers were getting very limited technical and financial support for banana production. This implies that most farmers had been producing bananas by applying their indigenous knowledge. Hence, concerned stakeholders need to support farmers for better and improved banana production and marketing. The result is in line with that of Zenebe *et al*. (2015) who stated that very limited attention had been given to banana research, extension services, investment and value-chain management in Ethiopia.

Table 5: Level of technical and financial support (%) by stakeholders to banana production

Institution	Technical support	Input or financial support
BoA	39.3%	17.4%
Research Center	0.0%	0.5%
University/Collage	0.5%	0.0%
Others	3.5%	2.5%
None	56.7%	79.6%

Utilization of Fruits and Other Plant Parts

Banana fruits

The majority of banana growers (96.0%) had been using banana fruits for home consumption and market or income generation purposes (Figure 4a). Only a few proportions of farmers used bananas either for home consumption (3.5%) or for market (0.5%). This result has confirmed that banana is largely grown by smallholders to play a significant role in food security and income generation for millions of rural poor in the country. The majority of interviewed farmers from West Arsi, and all the farmers of the South Omo agro-pastoralists considered banana as a food security crop (Mohammed,

2018).The result is in line with the report by Yetenayet and Chala (2018) in which banana played an important role in feeding and providing income for low-income families. The use of banana as a food crop for household consumption and income generation was reported in many banana producing areas of southern and southwestern Ethiopia (Molla, 2017).

From total harvested banana fruits, 74% were used for marketing or income generation purposes, 24.5 % were used for home consumption and 0.6 % gift for neighbor or others (Figure 4b). This implies that banana production in Ethiopia was used more for income generation, hence it could be considered as a cash crop. Banana was found in small shops, and large supermarkets showing that it has become very important not only in rural areas but also in cities and towns (Dawit and Asmare, 2008). The result has deviated from Girma *et al.* (2020) who reported the contribution of banana fruits in Ethiopia for home consumption and income generation with equal proportion.

Almost all interviewed farmers (98%) liked to consume banana fruits as dessert (Figure 4d), and they consumed banana at least for two days in a week and three banana fingers per day (data not shown). By taking weight of a banana finger as 100 to 170 g, it could be roughly estimated that farmers consumed 0.6 to 1.0 kg per week; which would become 31 to 52 kg per head per year. The farmers consumed higher amount than that the country's average but significantly lower than that of the highlands of East Africa, whose consumption reached 250 kg per head per year (Kinde, 2021).

Only 13% of farmers understood the difference between dessert banana and cooking banana or could distinguish the two types from one another (Figure 4c). This clearly indicated that utilization of cooked banana was almost negligible in the country. Similar result was also reported by a number of authors; Dawit and Asmare (2008) sated that there is no tradition to use it in different form in Ethiopia and unlike other East African countries banana is consumed only as dessert. Yetenayet and Chala (2018) also said almost all types of bananas produced in Ethiopia are consumed fresh. Therefore, the use as a cooking type has been rarely reported in Ethiopia; however Mohammed (2018) indicated that some people in South Omo had been consuming cooked banana during the food shortage period only.

Generally, banana could be used as a dessert, boiled, roasted or fermented to provide a diversified diet. East African highland cooking banana (EAHB) has significantly contributed to feeding rapid population growth in Eastern and Central Africa countries. It is the most important staple food in Uganda, and parts of Burundi, the Democratic

Republic of Congo, Kenya, Rwanda and Tanzania (Gold *et al.*, 2002). Komatsu (2010) listed southwest part of Ethiopia as part of growing area for East African Highland banana which are known as unique type of cooking bananas in the region. However, in Ethiopia, any banana types (desserts, cooking or beer) are consumed as dessert; and cooking types are considered poor-quality types (Seifu, 1999). Ethiopia could not feed its ever increasing population only by usual way, hence alternate crops and utilizations have to be in place. Cooking banana has great potential to address food security due to many reasons. Firstly, since Ethiopia is part of the secondary diversity of East African Highland bananas, diversified cooking banana clones have been produced by local farmers may be for centuries. It is already in the production system in most banana-growing areas. Secondly, cooking banana, particularly East African types, are adapted to mid and highland agro-ecology where most of the Ethiopian population are dwelling. Only some effort would be needed to promote improved varieties and utilization methods for cooking bananas. Therefore, banana cultivars in production system should be studied to distinguish whether they are dessert or cooking type. Farmers and consumers should be trained about the utilization methods of available and new varieties.

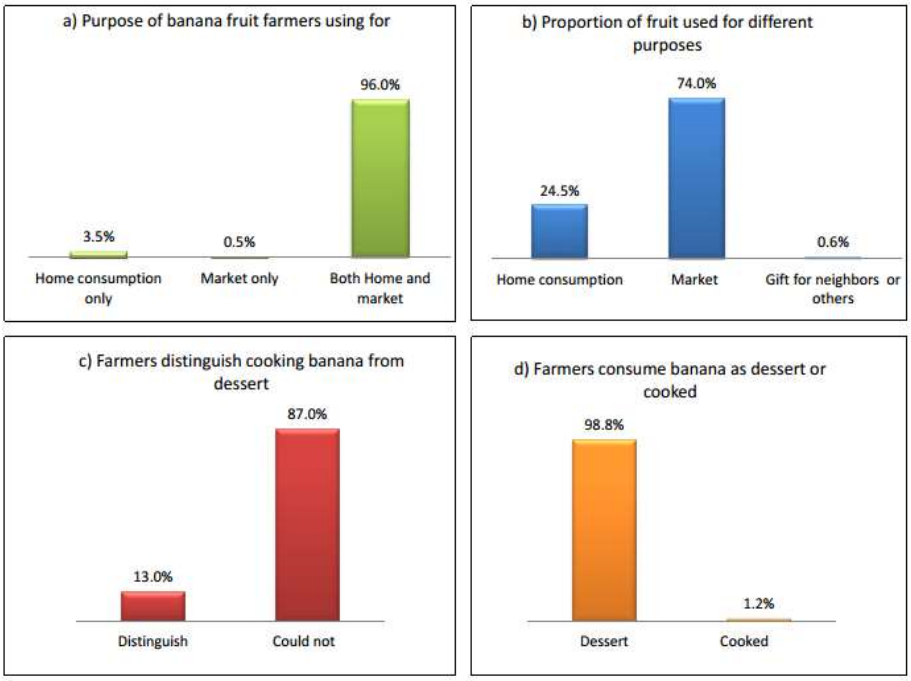

Figure 4: Use of banana fruits, identification of banana types and consumption method: a) purpose farmers use banana fruit; b) proportion of fruit used for different purposes; c) farmers distinguish cooking banana from dessert; and d) farmers consume banana as dessert or cooked

Income from banana fruits

Income from banana sell showed great variation in the two zones (Gamo and Jimma). Farmers in the two districts of Gamo zone, known semi-commercial banana production area in the country, had been generating relatively higher annual income from selling banana fruits (Table 6). Annual income from banana fruit sell of farmers in Arbainch Zuria ranged from 3,500 to 240,000 with average of 58,519.00 Ethiopian Birr. While it was ranged from 3,000 to 300,000 with an average of 46,552.00 Ethiopian Birr for the farmers in Mirab Abaya district. In both districts of Gamo zone, banana fruits were sold to the whole collector at the farm gate, or farmers union. Collected fruits were transported to domestic marker to different parts of the country, including regional cities and the capital city, Addis Ababa. Zenebe *et al.* (2015) reported that 60-90 truckloads of banana bunches, each truck carrying five to nine tons (ISUZU or FSR trucks), was dispatched every day only from Arbaminch Zuriya and Mirab Abaya districts of the Gamo zone that comprised over 65% of domestic market share in the country. Arbaminch district alone covered over 80% of Addis Ababa market, which is the biggest domestic market in the country (Girma *et al.*, 2020).

For farmers in the Gamo zone, banana was produced as the main cash crop and their livelihood was entirely dependent on the income from this crop. They covered the expenses of all members of the household; men, women and children, from the income generated from banana. Major expenses covered by banana sell were purchasing food items, school fees for children, payment to laborers, house construction, furnishing their home, fencing living houses and production fields, clothing, social expenses, saving, paying tax, and water and electric service costs. Molla (2017) stated that farmers in Arbaminch Zuriya district were able to maintain three meals per day using the income generated from banana production which otherwise would have been impossible. They had high purchasing power and experienced better life style as compared to other farmers. Even some farmers transformed into moderate investors.

Farmers in two districts in Jimma zone had been generating relatively less income from banana sell (Table 6). Annual income of the farmers in Seka Chokorsa district ranged from 200 to 750 with an average 352.94 Ethiopian Birr. While it was ranged from 200 to 1,000 with an average 606.77 Ethiopian Birr for farmers in Shebe district. For both districts, market destination was mainly markets in their locality or nearby streets; and a small proportion to domestic market, commonly for the closest town. Banana was not grown as a major crop

for farmers in Jimma zone but they produced it as secondary crop for home consumption and income generation. It seems that main income source for the farmers in both districts in Jimma zone was not banana. But still, farmers covered some expenses from money obtained from the sale of banana fruits, including supplementary food items (e.g. salt, 'shiro', and pepper powder), child food, some home goods, soap and cosmetics. Women were responsible for bringing banana fruits for sell and purchase different items for family consumption.

It could be observed that Ethiopia has a double advantage with regard to banana production, food security using East Africa highland banana (EAHB) and income generation, including earning of hard currency from export of Cavendish banana. Banana could contribute to food security, especially if EAHB could be promoted and cooking techniques adopted. On the other hand, production of Cavendish type, dessert banana, could be expanded to the lowland parts of the country, especially around Awash River and Rift Valley lakes. Since most banana production is being practiced without applying chemical fertilizers and pesticides, organic banana fruits could be supplied to Near East, Far East and European markets. The government and other concerned bodies need to work jointly to exploit the potential of banana production in the country. Many farmers in Southern Ethiopia confirmed banana as their number one cash crop, contributing a lot for the household food security, income generation and creation of employment opportunities for the youth (Molla, 2017).

Table 6: Annual income generation, market destination and common purposes of investing income from banana

Region	Zone	District	Annual income		Market destination	Purposes
			Range	Average		
SNNP	Gamo	Arbaminch Zuriya	3,500 -240,000	58,519.00	domestic	food items, school fee for children, labor, housing, furnishing, fencing, clothing, social expenses, saving, tax, water and electric service cost
		Mirab Abaya	3,000 -300,000	46,552.00		
Oromia	Jimma	Seka Chekorsa	200 -750	352.94	locality	Supplementary food items (e.g. salt, 'shiro', pepper powder), child food, home goods, soap, cosmetics
		Shebe	200 -1000	606.77		

Other banana plant parts

Not only banana fruits but also other parts of banana plant do have different uses; in this regard, banana could be considered as a multipurpose crop. The majority of

farmers had been using green leaves, dried leaves and pseudostem for various purposes (Table 7). However, old banana corms were rarely used but mostly remained in the soil after harvesting the fruits. A few farmers fed corms to their animals by adding some salts. Some farmers discarded it from the production field.

***Green leaves*:** More than 90% of farmers used green banana leaves for animal feed in all districts. In most districts, farmers used green leaves for mulching and compost making or as organic fertilizer to conserve moisture and improve soil fertility. Banana fruits were covered using green leaves after harvest until transportation to market. This was commonly practiced in areas where banana was produced for commercial purposes, especially Gamo zone Leaves were also used baking bread.

Dried leaves or leaf sheath: The majority of farmers (84.6%) responded that they had been using dried leaf or leaf sheath for various purposes. It was used for compost making and mulch to improve soil fertility, or they left it in the soil ground to decompose. Dried banana leaves could be used to cover mature green bananas to induce ripening and cover ripe banana to protect them from damage during transportation to market. According to farmers, sometimes dried banana leaves or sheaths were used for rope making, coverage of honey bee shelter, and as firewood in rural areas.

Pseudostem: Significant number of farmers (91.8%) used banana pseudostem for several purposes. They used it by chopping for mulching soil to protect evaporation or making compost (organic fertilizer) to improve soil fertility. It was commonly used as animal feed in all surveyed districts, especially during the dry season when green pastures were lacking for grazing. Farmers feed their animals sometimes mixing with salt. Few farmers did not use it for any. Many interviewed farmers responded that not all banana types are palatable for their animals, but a clone set with a light green or whitish pseudostem color, known as *Ferenjite, Keniya* or *Nech muz* was stated as the best one. Similar result was reported by Mohammed (2018) that only pseudostem of 'Keniya type' banana was used for feeding livestock.

Bananas are also serving as a source of feed for animal at household level (Molla, 2017**).** Daniel (1998) stated that leaves and other parts of the crop are cut down and decompose into the soil, which again contributes to its fertility. Farmers do not apply fertilizers to bananas; instead chopped banana leaves around the clamps which help maintain the fertility of the soil (Zenebe *et al.*, 2015).

Table 7: Use of other banana plant parts

Banana plant part	No of farmers who used it (N=201)	Percentages (%)
Green Leaf	176	90.3
Dried leaf/ Leaf sheath	165	84.6
Pseudostem	179	91.8
Corm	33	16.9

Production Constraints of Banana

Thirteen constraints that negatively affected banana production system were identified by banana growing farmers (Table 8). The farmers categorized these constraints into three based on priority of negative effect on banana production. The top four that were mentioned as first priority banana constraints included disease, farming land shortage, lack of irrigation water and adverse weather condition. Other constraints that farmers listed as second priority constraints for banana were lack of improved variety, market related problems, financial problem, wild animals and lack of awareness for improved techniques. Third priority banana constraints were theft problem, labor shortage, high fertilizer price, and wind damage. In line with the current investigation, Girma *et al.* (2020) mentioned a list of constraints that banana farmers had been facing, including farm size, finance, market information, skill and lack of knowledge, price volatility and pests and diseases.

Diseases

Many farmers (48.3%) responded that diseases as major constraints for their banana production activity (Table 8). The farmers mentioned number of disease symptoms such as yellowing and wilting of leaves, rotting of fruits, rotting of pseudostem, drying of leaves and browning of fruits. Yellowing and wilting of leaves eventually lead to death of the whole plant, though sometimes it may regrow. The farmers gave several different names for the disease causing the above-mentioned symptoms. The disease of similar symptoms was given similar name in most growing areas or zones but different names in some cases. They call it *Wella* in Gamo zone; *We'llo* or *Kolera* in Gedeo zone; *Kolera* in Jimma and *Shame* in Sidama region. In most cases, the meaning of this disease was "rotting" to probably indicate wilting will eventually end with rotting of whole plant. Yellowing start from tip of the banana plant and continues to rest of plant part. A few farmers mentioned that the disease had also been transmitted to enset. Symptoms of the disease, described by farmers, most likely seem to be symptoms of fusarium wilt (Dita *et al*., 2018). There could be bacterial wilt diseases which had commonly been

reported both for banana and enset (Yemataw, 2018). Bacterial wilt was the most common disease which occurs in South Omo and West Arsi zones (Mohammed, 2018). According to respondents, all cultivars were not equally susceptible to the wilting disease. A cultivar, known as *Keniya* or *Ferenj*, was the most susceptible, while Cavendish type was not affected by this disease. Mostly, farmers used no control measure, except they discarded affected plant and burnt remains of diseased plants. The result is in line with that of Mohammed (2018), who reported the 'Keniya type' was the most susceptible and the disease occurs every year at the beginning of the rainy season. Other disease symptoms mentioned were premature fruit ripening and color change to yellow, while fruits were too hard to be consumed and sometimes flesh appeared black color. There was also a blackening of fruit tips at immature stage; this could probably be a symptom of cigar-end rot.

According to Dawit and Asmare (2008) diseases and insect pests were not serious in banana in Ethiopia except nematodes and cigar-end rot that was observed in some areas. However, Mohammed (2018), reported that disease and moisture stress were among the main challenges to banana production encountered by farmers next to lack of improved varieties and disease-free banana planting materials. Banana fruits were affected by many postharvest diseases, including anthracnose and crown rot, which are caused by *Colletotrichum* spp. and *Fusarium* spp., respectively. These diseases significantly affected the quality and shelf life of the fruit. *Fusarium* spp. were identified as the most important fungal pathogens causing fruit loss in Jimma town of Bishishe market (Yetenayet and Chala, 2018). Implementation of integrated disease management options, including development of disease resistant or tolerant varieties is crucial to minimize effect of the disease on banana production and marketing in Ethiopia.

Farm land shortage

About 28.3% of banana growing farmers mentioned land area shortage as one of the major constraints in banana production (Table 8). Total land size per household in surveyed districts ranged from 0.57 ha to 1.59 ha in Dilla Zuriya district of Gedeo zone and Shebe district of Jimma zone, respectively. They used this piece of land for a range of crops. The farmers allocated from 1.9% (Wenago) to 88.9% (Mirab Abaya) of their landholding to grow banana (Section 3.1). Although most farmers were interest to expand banana production, a small area of land or farm land shortage appeared great challenge that limited expansion of the banana production. Similar results were reported by several authors (Dawit and Asmare, 2008; Yishak Baredo, 2013). Dawit and Asmare (2008) reported

that land allocated for banana per household in Ethiopia ranged from 0.5 to 2.0 ha. Yishak Baredo (2013) mentioned as the average irrigated land holding per household varied from 0.15 to 1.32 ha of land. Since farm land is limited resource, farmers have to give attention to using improved varieties and technologies to maximize productivity of banana in unit area of land thereby increasing the amount of total production. Expansion of bananas to the new areas, especially to the low land parts of the country, might be another alternative to increase production.

Irrigation water

Farmers (18.4%) described irrigation water shortage as one of the major production constraints for bananas (Table 8). About 67% of the interviewed farmers produced bananas using only natural rain, and they did not have access to irrigation water. Similarly, most of the smallholder banana growers in South Omo zone reported a shortage of moisture during the dry seasons (Mohammed, 2018). Farmers in Arbaminch Zuriya district were constrained by shortage of irrigation water, especially during dry season (Alemu, 2017). Zenebe *et al.* (2015) also reported shortage of irrigation water as a main bottleneck for banana production in most growing areas in Ethiopia. Since banana requires ample soil moisture in the root zone throughout the year, securing irrigation water for the dry season would be crucial. Banana growing farmers and concerned stakeholders have to look for alternate irrigation water sources to improve production and productivity of the crop.

Other constraints

Adverse weather conditions such as occasional frost, burning leaves due to high light intensity, rainfall shortage and water logging during the rainy season were other factors constraining banana production in the country (Table 8). Farmers indicated that occasional frost and burning of leaves had frequently been occurring in past recent years. This could be due to climate change which is a global challenge. Information on agro-ecological adaptation of cultivars before banana establishment could minimize the risk of the different effects of adverse weather conditions that might be occurring due to climate change.

Interviewed farmers also listed challenges related to market as one of second-degree constraints to banana growers in Ethiopia (Table 8). They mentioned several points related to the market, including low price, weak market linkage and broker interference to set market price. Small scale farmers had no much control over market price for their produce, and unregulated marketing practices and inappropriate marketing facilities were large because of the absence of strong marketing institutions (Zenebe *et al.*, 2015).

Lack of improved variety and low productivity or yield reduction was also mentioned as another challenge in banana production in the country (Table 7). Most farmers had been producing local varieties, and only 24.5% of farmers were producing improved varieties (Section 3.5). Low productivity could be because most farmers did not plant improved variety, while yield reduction of their existing variety could be due to loss of soil fertility or other constraints like diseases. The provision of improved varieties and soil conservation activities deserve due attention.

Some farmers (6.8%) indicated a finance shortage as a constraint to banana production, due to which some important activities might be left behind (Table 8). Thus, collaboration with some financial institutions has to be made to facilitate money credit services. The extension system for horticultural crops, particularly for banana has to be strengthened through different tools such as training and experts' advices to increase awareness and share experience.

Table 8: List of banana production constraints as described by farmers

No.	Main constraints	Number of responded farmers	Constraint priority by number respondents (N=201)		
			1st	2nd	3rd
1	Diseases	97	83 (41.3%)	12 (6.0%)	2 (1.0%)
2	Farming land shortage	57	33 (16.4%)	22 (10.9%)	2 (1.0%)
3	Irrigation water shortage	41	26 (12.9%)	15 (7.5%)	-
4	Adverse weather conditions	32	16 (8.0%)	12 (6.0%)	4 (2.0%)
5	Lack of improved variety	20	8 (4.0%)	10 (5.0%)	2 (1.0%)
6	Market problems	20	7 (3.5%)	9 (4.5%)	4 (2.0%)
7	Financial problem	12	5 (2.5%)	7 (3.5%)	-
8	Wild animals	10	1 (0.5%)	6 (3.0%)	3 (1.5%)
9	Lack of awareness and experience	10	1 (0.5%)	6 (3.0%)	3 (1.5%)
10	Theft problem	9	2 (1.0%)	-	7 (3.5%)
11	Labor shortage	3	-	1 (0.5%)	2 (1.0%)
12	High fertilizer price	3	-	1 (0.5%)	2 (1.0%)
13	Wind damage	1	-	-	1 (0.5%)

Conclusion and Recommendation

Banana fruits were used for both consumption and income generation for the farmers in all study areas. The current study also confirmed that banana is a very important fruit crop in Ethiopia for developing other products such as organic soil fertilizers and animal feed. The majority of the farmers did not apply improved agronomic management practices. Mostly farmers had been producing banana by their own indigenous knowledge since very limited technical and financial support were given for

banana production. There was also a limitation in the supply of planting martials, hence a formal and informal seed systems should be established to provide alternative improved varieties for farmers.

Diseases, farming land shortage, lack of irrigation water, and adverse weather conditions were listed as first priority constraints limiting banana production. Implementation of integrated disease management options, use of improved technologies and expansion of banana to a new area especially to lowland parts could be possible measures to overcome the constraints. Since farmland is a limited resource, farmers have to use improved varieties and technologies to maximize banana productivity in unit area of land, thereby increasing the amount of total production. Most farmers preferred local cultivars over the improved varieties which might indicate existence of potential local banana cultivars in the major growing areas. Since Ethiopia is part of the secondary diversity of East African highland bananas, diversified cooking banana clones have been produced by local farmers for years. Thus, collection, characterization and evaluation of local banana cultivars would be important to identify and maintain potential cultivars.

Ethiopia has a double opportunity concerning banana production; firstly food security using East African highland banana and secondly income generation, including earning of hard currency from export of Cavendish dessert bananas. Emphasis has to be given to identify potential local cultivars, create awareness and promote methods of utilization particularly for cooking banana types. This would assist the country in addressing food security for its ever-increasing population as the alternate crops might not be secured otherwise. Cavendish dessert bananas, on other hands, have to be extended in semi-commercial production areas like Gomo zone. Thus, governmental organization and other concerned bodies need to work jointly to exploit the potential of bananas production in the country.

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