FOOD SCIENCE & TECHNOLOGY | RESEARCH ARTICLE

Smallholder banana - based farming system dynamics of Arba Minch Zuria District, the case of Gamo Zone, Ethiopia: Qualitative exploration

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Abstract: Different types of crops are produced in different agro-ecological zones of Ethiopia where specific biophysical conditions define the success of their production. This banana-based smallholder farming systems explorative study objective was to explore existing banana-based farming system dynamics and examine push-pull factors accelerating these dynamics. To achieve the objectives of study, three Kebeles of Arba Minch Zuria district were selected purposively. Both primary and secondary data were collected and analyzed using qualitative data analysis method. The results show that cropping systems of the study area have been changed a lot during the last years; going from seasonal crops farming to perennial fruit crops-based farming. An early farming practice of the study area was cultivating seasonal crops like maize, teff, sweet potato, and cotton. Later on farmers have shifted to perennial cash crops like banana and mango. Most farmers in the study area use cow dung, crop residues, poultry droppings, and house cleans to improve soil fertility of their banana field. During establishment of banana farmland, farmers inter-crop vegetable and cereal crops to maximize their farm income. When banana develop three to four suckers per hill and full canopy, farmers make their banana farm monoculture. Access to irrigation water, minimum input requirement

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PUBLIC INTEREST STATEMENT
Farming system inclusive of biophysical and socio-economic perspectives of a given area is dynamic. Thus, no farm is organized exactly like any other. This dynamics expected to either occur with push or pull factors. Banana-based farming system is among perennial crop-based farming system. Farming system of Arba Minch area is changed from annual crops-based production system to banana-based perennial farming system. The case of Arba Minch Zuria district banana produced by smallholders and large investors using supplementary irrigation and the crop is considered both as cash and food security commodity.
nature of perennial crops, market demand, and existence of regular market were considered as pulling factors to shift farming system from seasonal cropping to banana-based perennial farming. Whereas soil salinity, lack of quality planting materials, poor sucker management, banana fruit market fluctuation, rainfall variability, lack of value addition practice, and weak market integration were considered as common pushing factors for banana production and marketing in Arba Minch Zuria district.

Subjects: Agriculture & Environmental Sciences; Horticulture; Fruit & Vegetables;
Keywords: Arba Minch; banana; cropping system; soil salinity; sucker management; value addition

1. Introduction
Farming system is a broad concept that includes biophysical and socio-economic perspectives, such as household characteristics, crop production, livestock rearing, and natural resources management, which convert key factors of production (land, labor and capital) into usable products (Agajie et al., 2018). Biophysical components like soil nutrient, water balance, and socio-economic features like gender role, food security, and cost-effectiveness are also taken into consideration in the system (Dixon et al., 2001). Currently, all biophysical and socio-economic determinants of farming system are changing rapidly (Agajie et al., 2018).

Agricultural production system of Ethiopia is mainly characterized as rain-fed agriculture and dominated by smallholder farmers under wider agro-ecological conditions. Thus, different crops are produced throughout the country in different locations, but the achievement of crop yields and welfare outcomes are determined by specific biophysical conditions of the area (Chamberlin & Schmidt, 2011). However, all these locations are dynamic in nature.

South Nations, Nationalities and Peoples (SNNP) regional state is a region with immense ecological and cultural diversity ranging from arid and semi-arid conditions to cool temperate zones (Aregay, 1999). Arba Minch Zuria district is one of the districts found in Gamo zone of SNNP regional state. According to Yadda (2007), cropping pattern of the district was substantially changed through time, particularly, the fruit crops production was increased and fruits became the main cash crops growing in Arba Minch area. According to Central Statistical Agency (CSA) of the Ethiopia (CSA, 2019), about 119,908.57 ha of land is under fruit crops in Ethiopia of which banana contributed about 55.11% area of the fruit crops followed by avocado that contributed 16.48% of the area.

Banana production in the Arba Minch Zuria district of Gamo zone started in early 1980s and the modern banana production was also started in the district at that time (Fanos, 2014). During that time, seasonal crops such as maize, cotton, and sweet potato were the dominant crops that occupied the fields of smallholder farmers (Fanos, 2014). However, currently perennial fruit crops (banana and mango) are the major commodities produced in the district. Due to the absence of studies conducted in the case of Arba Minch Zuria district why cropping system of the area was changed from seasonal crop production to perennial banana based farming, this study was intended to explore existing banana-based farming system dynamics and examine its push–pull factors of the district.

2. Research method

2.1. Descriptions of the study area
Arba Minch Zuria is a district located in the Gamo Zone of the SNNP regional state, about 500 km south of Addis Ababa, at an elevation of 1285 m. The district is bordered on the south by the
Dirashe special district, on the west by Bonke, on the north by Gacho Baba district, on the northeast by Mirab Abaya, on the east by the Oromia Region, and on the southeast by the Amaro special district. This district also includes portions of Abaya and Chamo lakes and their islands. The district has 18 Kebeles (smallest administrative unit in current Ethiopian Government structure) with different agro-ecology and farming system. The district received average rainfall of 892 mm with maximum and minimum temperature of 30.4 and 15.6°C, respectively, in the last ten years (Data obtained from Arba Minch Meteorological station, Arba Minch Branch, Arba Minch, Ethiopia). Moreover, the map of the study area is shown in Figure 1 for visual observation.

2.2. Sampling, types of data, and methods of data collection
Among eight banana-producing Kebeles, three Kebeles namely; Lante, Shara, and Genta Kanchama were selected purposively due to their high banana production potential and easy access to transportation facility, proximity to Arba Minch town and dynamics of shifting from seasonal to perennial cropping system.

Both primary and secondary data were collected for this study. Primary data were collected from three selected Kebeles of Arba Minch Zuria district through Focus Group Discussions (FGDs) from randomly selected banana-producing farmers using checklist. Forty (40) farmers from each Kebele were selected randomly and four (4) FGDs were held at each Kebele with ten (10) participants per FGD session. Totally, 120 farmers were participated in FGDs from all the three Kebeles.

Secondary data were collected from each Kebele Agricultural Office reports, Central Statistical Agency of the Ethiopia (CSA) website, Arba Minch Zuria district Agricultural office reports, rainfall data from Arba Minch Meteorological station and studies conducted on banana production and marketing in the study area and throughout the country.

2.3. Method of data analysis
Collected data were analyzed using descriptive and explanatory data analysis methods. Descriptive data analysis methods specifically percentage and mean were used to analyze quantitative data like banana production shares and land coverage among fruit crops produced in study area, regional and national levels. Explanatory data analysis method was used to analyze qualitative data collected through FGD participants, while summarized and cross-checked with previous study conducted on banana production and marketing results in the study area.
3. Results and discussion

3.1. Banana production trends in Ethiopia and study area

In Ethiopia, banana production is increased from time to time. The SNNP and Oromia regional states are the two major regions where banana is largely produced in the country. In Arba Minch area, small-scale farmers mainly cultivate banana and some large-scale investors produce it. However, banana management practices are varied among small-scale farmers and large-scale investors. Amibara (former Arba Minch state farm) and Lucy, which are found near to Shara and Ganta Kanchama Kebeles, respectively, are among the large-scale banana farms found in the district. Amibara large-scale banana farm was the initial source of planting materials and experience of banana production for the current banana producers of the district. Banana production system of Ethiopia ranges from small-scale to large-scale commercial farms (Alemu, 2017; Woldu et al., 2015).

Focus group discussion (FGD) participants reported that application of inorganic fertilizer on banana field is not practiced in Arba Minch area; instead, banana growers apply cow dung, crop residue, poultry droppings, and house cleans to improve soil fertility of their banana field though application rate is not based on soil test and crop need. Study conducted by Dawit and Asmare (2008) confirmed that banana growers of Arba Minch Zuria district do not use artificial fertilizer for banana cultivation; however, some farmers use organic fertilizer like compost. In most of the major banana-producing areas like Arba Minch, supplementary irrigation is provided to the banana field from December to March (dry months) at least once per month. Banana fields are maintained up until the time when yield starts declining and then shifted to another land and re-establish new banana farm.

Arba Minch is major banana production area among banana growing areas at regional and national levels. Currently, Cavendish type banana varieties such as Dwarf, Medium, and Gaint Cavendish are widely produced by small-scale farmers while few investors in the district produce improved banana varieties such as Poyo, Grande Naine, and Williams-1. On average about 11,000 ha of land is estimated to be covered by banana in Arba Minch (Ambisa et al., 2019). The livelihood of farmers and traders in Arba Minch area mainly depends on banana and hence it is an important cash-generating commodity in the area (Gebre & Rik, 2016). Four crop production periods CSA time serious data analysis (2015/16 to 2018/19) show that on average banana shares more than 60% of both farmers participation and total production as compared to other fruit crops produced in Ethiopia (Table 1). The CSA (2019) data analysis result also shows that banana alone shares 55.55 and 60.92% of total area coverage and total production, respectively, from all fruit crops produced at national level in 2018/19 cropping season (Table 2). As shown in Table 2, in terms of area coverage and smallholder farmers’ participation, banana share is the highest as

| Production trend indicators                           | Production years |
|-------------------------------------------------------|------------------|
|                                                       | 2015/16 | 2016/17 | 2017/18 | 2018/19 |
| Percentage of participating farmers                   | 64.00    | 62.67   | 59.39   | 64.00   |
| Percentage of Area covered                            | 58.13    | 58.59   | 56.79   | 55.55   |
| Percentage of total production share                   | 64.75    | 67.94   | 63.49   | 60.92   |
| Yield quintal per ha                                  | 39.39    | 85.16   | 83.24   | 75.97   |

Source: Authors computation based on CSA (2015/16 to 2018/19) data, 2020
Table 2. Smallholder fruit crops production at national and regional levels during 2018/19 cropping season

| Crops      | Number of holders | Area in Ha | % share of crop coverage | Production in quintal | Percentage of production |
|------------|-------------------|------------|--------------------------|-----------------------|--------------------------|
|            | National | SNNP region | National | SNNP region | National | SNNP region | National | SNNP region | National | SNNP region | National | SNNP region |
| Fruit crops | 4,787,354    | 2,243,727   | 119,909   | 66,360       | 100.00    | 100.00       | 8,343,562 | 5,311,656    | 100.00    | 100.00       |
| Avocado    | 1,909,095    | 1,221,177   | 19,759    | 12,377       | 16.71     | 18.65        | 847,937   | 554,309      | 10.37     | 10.44        |
| Banana     | 3,050,798    | 1,584,324   | 66,081    | 41,543       | 55.55     | 62.60        | 5,015,286 | 3,529,707    | 60.92     | 66.45        |
| Guava      | 287,283      | 48,762      | 2,759     | 283          | 2.31      | 0.43         | 32,746    | 2,994         | 0.40      | 0.06         |
| Lemon      | 208,025      | 81,523      | 1,848     | 276          | 1.24      | 0.42         | 94,477    | 17,764        | 1.05      | 0.33         |
| Mango      | 1,589,983    | 664,009     | 19,498    | 8,339        | 16.21     | 12.56        | 1,337,049 | 723,105       | 15.81     | 13.61        |
| Orange     | 606,142      | 192,897     | 5,417     | 1,145        | 4.18      | 1.72         | 412,499   | 116,046       | 4.16      | 2.18         |
| Papaya     | 706,180      | 361,598     | 4,010     | 1,897        | 3.34      | 2.86         | 592,051   | 356,325       | 7.15      | 6.71         |
| Pineapple  | 36,114       | 30,601      | 536       | 501          | 0.46      | 0.75         | 11,517    | 11,406        | 0.14      | 0.22         |

Source: CSA (2019). SNNP: South Nations, Nationalities and Peoples regional state.
compared to other fruit crops produced in SNPN regional state. Numerically, its share is 62.60% of area covered and 66.45% of total production among eight fruit crops produced in the region in 2018/19 production period (Table 2). Both national and regional level production trends show that banana is the most important commodity and major cash crop among other fruit crops cultivated in Ethiopia.

The survey result indicated that banana has the largest share of all annual and perennial crops produced in the selected Kebeles of Arba Minch Zuria district. Banana shares 52, 53, and 64% of cropland of Genta Kanchama, Shara, and Lante Kebeles, respectively, during 2018/19 cropping season (Table 3). Also on average 0.39, 0.77, and 1.24 ha is allocated for banana per household in Genta Kanchama, Shara, and Lante Kebeles, respectively. Study conducted by Dawit and Asmare (2008) reported that land allocated for banana per household ranges from 0.5 to 2 ha. These big variations of percentage in cropping land share and average land allocation confirms Ruthenberg (1971) statements, which say “no farm is organized exactly like any other.” Variation would be observed from place to place and over time. When we compare the Kebele level distribution, there is significant variability in land allocation for banana production. This might be due to the nearness of irrigation water source to the farmers’ field as banana in the study area is typically produced by using supplementary irrigation. When irrigation water reaches largest area of farmland, farmers allocate large area for banana from their farmland.

In the case of Arba Minch Zuria district, both Male-headed household (MHHH) and Female-headed household (FHHH) are participating in banana production. When we examine entire activities of study area from gender role viewpoints, males/husbands in MHHH usually carry out field agricultural production-related works like land clearing, ploughing, planting, crop management, harvesting, and transporting of harvested farm produces from field to marketing and storage areas. Females/spouses job is limited to reproductive (biological like child bearing, breast feeding, and management) and non-remunerative household job like kitchen works, house cleaning, collecting fire wood, fetching water, etc., while in the case of FHHH, females engaged both field agricultural production activities (productive gender role), which helps them generate income and reproductive activities (both biological and household management role).

3.2. Banana-based farming system and input utilization of the study area

The case of study area crop selection depends on food consumption habit of the locality, land suitability, and adaptability of crops, and access to market while farmers that are far away from irrigation water source growth diversified crops to reduce risk of mono-cropping (Yadda, 2007). Focus group discussion participants reported that cropping systems of these villages have been changed a lot during the last years, going from annual cropping to perennial farming. Early farming practices in Lante, Shara, and Genta Kanchama were cultivating maize, teff, sweet potato, and cotton. Later on farmers have shifted to cash crops like mango and banana, which are the most important crops now present in the area, but banana is the major income-generating fruit crop. Nowadays, the focus is clearly on cash crops, which are financially more beneficial for the farmers.

Furthermore, FGDs and field observations confirmed that during establishment stage of banana farmland, farmers use either mixed or intercropping of seasonal crops like maize, tomato, cotton, beans, hot pepper, etc., under banana field. This practice is done at least for two cropping seasons until banana develops three to four suckers per hill and full canopy that shade the field. This practice suppresses weed growth, efficient use of space, and helps better banana establishment in addition to increase household income. Moreover, banana-seasonal crop mixed inter-cropping system is used for no more than two consecutive cropping seasons depending on sucker development and canopy growth of banana, which depends up on planting space, available soil moisture, and soil fertility status of the field. Banana field age-related yield declination could be minimized through good sucker management, inter-cultivation, integrated soil fertility management, and re-planting.
Table 3. Selected Kebeles banana production trends during 2018/19 cropping season

| Kebeles       | Total cultivated land in ha | Banana area coverage in ha | % of area covered by banana | Number of banana producing households | Average banana land per household (ha/HH) |
|---------------|-----------------------------|-----------------------------|----------------------------|---------------------------------------|------------------------------------------|
|               |                             |                             |                            | MHHH  | FHHH  | Total |                             |
| Genta Kanchama| 720                         | 372                         | 51.66                      | 932   | 25    | 957   | 0.39                         |
| Shara         | 1359                        | 724                         | 53.27                      | 863   | 72    | 935   | 0.77                         |
| Lante         | 1106                        | 707                         | 63.92                      | 441   | 125   | 571   | 1.24                         |
| Total         | 3185                        | 1803                        |                             | 2236  | 222   | 2463  |                             |

Source: Three Kebeles Agricultural Offices, 2020. MHHH: Male-headed household; FHHH: Female-headed household.
As indicated in Figure 2, during establishment stage of banana farm in Arba Minch Zuria district, banana growers intercrop vegetable crops like tomato with banana and then, when banana starts developing canopy, they intercrop maize and cotton together on single banana field. As indicated in Figure 3, three crops mixed farming is commonly observed in single field at early growth stage of banana. Until banana develops three to four suckers per hill, banana-maize mixed cropping is common in banana production areas of the district (Figure 4).

Focus group discussion participants assured that when banana develops more than four suckers per hill and full canopy, they make their banana farm monoculture (Figure 5). In addition, banana producers of the study area inter-cultivate their banana field three to four times per year.

3.3. Banana fruit harvesting and marketing of study area
According to FGD participants based on soil fertility, irrigation water supply, season and manures applied to the farm, banana harvested three to four times per year, while banana fruit supplied to the market year round in the study area. This low harvesting frequency of banana might be due to poor sucker management in association with other factors. Focus group discussion participants also reported that the current productivity of banana in the study area is 5405 kg/ha/year, which is around 5.41 ton/ha/year. This is extremely low as compared to the crop potential. In contrast to this result, Dawit and Asmare (2008) reported that farmers harvest banana on average once per two months and the productivity of the crop is in between 10 and 20 t/ha under farmers' condition, but the study confirmed year round banana fruit supply in Arba Minch. Study conducted by Fanos (2014) reported declination of banana yield per unit area in Arba Minch, but study not yet quantified tones of declination per unit area. Significant declining of soil fertility, poor sucker
management, climate change, occurrence of diseases (e.g., sigatoka), soil salinity, and age of banana are the possible contributing factors for banana yield reduction per unit area and season in the study area.

According to FGD participants, the role of banana growers is limited to production and they have no much control over the price that they receive from their banana fruit sales. After harvesting green mature banana bunches (Figure 6), they sell it to former cooperatives (Lante and Genta Kanchama farmers), or directly to traders who purchase green banana bunches at farm gates, to local market retailers, and roadside vendors based on size of bunches and fruit physical quality. This shows that banana marketing takes place with different channels (follow different routine to reach final consumers). Those traders who purchase green matured banana from farmers at farm gate load green banana bunches on ISUZU truck (Figure 7) and dispatch it to different regional towns (Hawassa, Adama, Dire Dawa, Harari, Jigjiga, Woldeya, Bahir Dar, Mekelle, Aksum ... etc) and Central market at Addis Ababa, capital of Ethiopia. Farmers who are not members of farmer cooperatives (all Shara Kebele banana producers) sell bananas to local collectors at farm gate and then, sell it to wholesalers either transporting it to roadside or across regional towns and
central market at Addis Ababa. Wholesalers mostly sell the green matured fruits of banana to retailers. The retailers keep the green fruits of banana until ripe and then after the ripened, fruits are ready to sell to the final consumers. It is common to see many ISUZU trucks that loaded with banana bunch and distributed every day from Arba Minch area. This proves with Woldu et al. (2015) who reported that depending on season, 300 to 810 tons of banana dispatched daily from Arba Minch area to all market outlets in Ethiopia.

3.4. Banana-based farming system dynamics pull-push factors of study area
Agricultural activity is year round job in Arba Minch Zuria district because most farmers are cultivating both annual and perennial crops. In addition, most banana growers have access to irrigation water from year round flowing rivers like Baso in Lante, Hare in Shara, and Sile River in Genta Kanchama Kebeles. The water from these rivers is diverted into different smaller canals leading to the fields by dams made of plant material or mud and some has well-developed canals made from cement and metal. The system is set up to provide water to every plot. Each farmer allowed to get three hours of water in the rainy season and four hours of water in the dry season to irrigate his/her banana field regardless of banana water requirement Figure 8.
According to FGD participants, the presence of irrigation water is one of the pulling factors to shift farming system from seasonal cropping to banana-based perennial farming system. In addition, FGD participants stated that perennial crops like banana, mango, etc., requires minimum input cost, which helps to earn maximum amount of income compared to seasonal crops like maize, teff, cotton, and beans. As a result, currently seasonal crops cultivation fields are now occupied by banana if there is access to irrigation water. Also as of they use organic fertilizers, there is no periodic input cost like cost of inorganic fertilizer. Therefore, perennial crops reduced input need to replant crops from year to year is considered as pulling factors for shifting the farming system from seasonal cropping to banana-based perennial fruit crop farming system.

There is increasing market demand for banana, due to well-developed infrastructures like road, telecommunication, etc., there is daily market transaction took place for banana at farm gate and traders are coming from all over the country and their number is increasing from year to year. In addition, there are weekly markets held at Lante Kebele and Kola Shelle (around 5 km away from Ganta Kanchama Kebele). Thus, most farmers sell fresh (Un-ripped) matured banana fruits at their farm gate and Kebele markets to local roadside retailers and earning money day by day. Also banana marketing in study area could be done via cooperatives and individual traders. In two Kebeles namely; Lante (Lante Tenkir farmers’ fruit and vegetable marketing cooperatives) and Genta Kanchama (Genta Sile Sira farmers’ fruit and vegetable marketing cooperatives) have fruit and vegetable marketing cooperatives. Each members of the cooperative are obliged to sell their banana to the cooperative but are assured of constant prices. Therefore, the presence of regular market and market demand could be considered as transforming (pushing) factors from seasonal crops to perennial banana based farming system in the study area.

3.5. Common banana production and marketing challenges of study area
The most common banana production and marketing-related problems are discussed below:

**Soil salinity**: small-scale irrigation is practiced and practicing in the Gamo Zone for more than 50 years. However, almost all farmers in the study areas over-irrigate their banana fields through flooding method when they get water access without being conscious of the harmful effects of over-watering on their banana fields. It believed that over irrigation leaches out nutrients present in the soil. Also some farmers use motorized irrigation and pumping water from Abaya and Chamo Lakes; thus, it deposits solutes on their banana farmland due to poor drainage system. Because of over-irrigation and use of lake water for irrigation in study area, soil salinity is an emerging challenge for the farming communities. Some banana fields in the district were abandoned due to soil salinity. The rate of salinization is still increasing due to poor water management and inadequate drainage system, which
makes additional banana farmlands out of production. Therefore, soil salinity is highly affecting banana production and productivity because banana is highly sensitive to soil and water salinity as compared to other fruit crops.

**Lack of quality planting materials:** limited availability of and access to quality planting material is one the major reasons for limited spread/expansion of banana production. Choosing the right planting materials and known variety from the trusted source is the first and most important step for crop production and productivity including banana. Most small-scale banana growers in the study area use conventional banana suckers that could potentially spread diseases. They use planting material from their own old banana farms and neighboring farmers, which may disseminate disease in the area and subsequently decrease banana yield. Generally, there is no standard quality banana planting materials supplier in the Gamo zone for the enhancement of banana production and productivity.

**Poor sucker management:** according to field observation, there is poor sucker management practice in banana field in the study area. It is common to see 8–12 banana suckers per main plant and also multiple forms of suckers with three to four banana bunches with low weight and poor finger quality hanging at the same time. This revealed that unwanted banana suckers compete for limited resources (nutrients, space, and water). Allowing unlimited number of banana suckers per mother plant can lead to not only low bunch yield and poor fruit quality; it also lengthens fruit harvesting duration. The number of banana suckers that are allowed to grow and give good bunch yield is managed through desuckering. Hence, desuckering in banana is a critical cultural practice in which unwanted suckers growing from the base of the mother plant should be removed and the number of banana suckers should be limited to 2–3 per main plant (Hidoto, 2018).

**Soil erosion and losing farmland:** farmers in Lante, Shara, and Genta Kanchama use Baso river, Hare river and Sile river, respectively, to irrigate their banana field. When rain is abundant, the rivers transport more water to the lake. This bigger flow can cause flooding and increase of the lakes catchment area, which occupy and displace banana farmers from farmland. Sometimes rivers may broke riverbanks and change its course to that of an irrigation canal, leading to a major flood. Flooding is one of the major concerns for the agricultural production in the three Kebeles. The FGD participants assured that farmers who owned banana farmland at boundaries of rivers lost minimum of half hectare banana land during three consecutive production years.

**Fruit price fluctuations:** according to FGD participants, over the past years prices of banana fruits show instability. This is very critical for banana because banana is main cash crop of the area. In addition, the case of banana, farmers bargaining power is low, traders made market price alone and farmers become price taker rather than price maker. According to participants, banana market prices are highly dependent on the prices of the market in regional towns and central market where Arba Minch banana dispatched. Thus, banana fruit marketing is vulnerable to price insecurity in the study area. As copping mechanism, most farmers are joining primary cooperatives (the case Lante and Genta Kanchama Kebeles) and members reported that being cooperative membership increased bargaining power when they supply their banana to market and there is also product grading based on banana fruit maturity and size. Cooperative members are earning premium price for their graded products and secured price. However, banana cooperatives are not strong enough to compete with private traders.

**Rainfall fluctuation:** experienced FGD participant farmers said that rainfall of study area is decreasing from year to year for the last ten years. This decrease is one of the main constraints for banana production and productivity. In addition, rainfall variability has the greatest effects on farmers that lead to low irrigation water access. As indicated in Figure 9, Arba Minch meteorological station rainfall data confirm the FGD participant farmers’ opinion.

**Lack of value addition practices and weak market integration:** most banana-growing farmers of the study area do not get value addition training like processing and packing banana fruit to
maintain fruit quality and reduce postharvest loss at farm gate and wholesalers level. In addition, smallholder banana producers lack integration that affect their bargaining power negatively, thus, traders are earning better profit than producer in banana marketing in the study area.

4. Conclusion and recommendation

4.1. Conclusion
Cropping systems of Arba Minch Zuria district have been changed a lot during the last years, going from annual crop farming to perennial fruit crop-based farming. Early farming practice in Lante, Shara, and Genta Kanchama Kebeles was cultivating of annual crops like maize, teff, sweet potato, and cotton. Later on, farmers have shifted to perennial cash crops like banana and mango. During 2019 production period, banana share the highest percentage in land coverage and total production as compared to other fruit crops grown in the country and SNNP regional state. More specifically, 0.39, 0.77, and 1.24 ha are an average area allocated for banana per household from Genta Kanchama, Shara, and Lante Kebeles, respectively. During establishment of banana farmland, farmers’ inter-crop vegetable crops like tomato and then, they inter-crop maize and cotton together on single banana farmland to use the available free space. When banana develop three to four suckers per hill and full canopy, farmers make their banana farm monoculture. Moreover, the study results show that almost all farmers in the study area use cow dung, poultry droppings, house cleans, cutting, and chopping of banana pseudostem and other crop residues as source of fertilizer on their banana field and they call it “organic fertilizer”. Banana fruit supply is year round, while farmers harvest banana three to four times per year. After harvesting green matured banana bunches, banana producers sell to traders who decide and fix prices for banana without bargaining with producers. Those traders dispatch banana fruit to different regional towns and central market, but banana producer farmers’ role is limited to production only.

Most banana-growing farmers have access to irrigation water from year round flowing rivers in the selected Kebeles like Boso, Hare, and Sile River. Access to irrigation water, minimum input requirement nature of banana production, market demand and existence of regular market demand were considered as pulling factors to shift farming system from seasonal cropping to banana-based perennial crops farming. Whereas soil salinity, lack of quality planting materials, poor sucker management, banana fruit market fluctuation, rainfall fluctuation, lack of value addition practices and weak market integration were considered as common pushing factors of banana production and marketing in the study area.

4.2. Recommendation
Based on the findings of this study the following points were recommended for further improvement of smallholder banana production and earning appropriate income from banana production.
• Sufficient amount of organic fertilizer shall be applied to improve soil fertility status of banana field with appropriate other agronomic practices.

• Banana growers of the study area shall limit the number of banana suckers per main plant to reduce resource competitions among suckers, to increase bunch yield and fruit quality in addition to shorten harvesting duration.

• Banana producer farmers shall be trained about water scheduling because water scheduling of study area is poor, but for maximizing banana productivity in the study areas, water scheduling is highly advisable to give water to the crop at the right time and in the right amount and appropriate drainage system shall be practiced.

• Well-organized marketing information delivery system shall be developed and farmers shall access market information in right time with accuracy and clarity.

• Known banana-based value chain shall be developed and producers margin sharing shall be monitored by concerned government bodies.

• Capacity building training and facilities shall be delivered for fruit-based primary cooperatives of the study area.

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References
Agaje, T., Tadele, M., Tolesa, A., Abera, G., Wudineh, G., & Takele, M. (2018). The dynamics of the central Ethiopian farming systems. Research Report No 120. ISBN: 9789994466603. Ethiopian Institute of Agricultural Research.

Alemu, M. M. (2017). Banana as a cash crop and its food security and socioeconomic contribution: The case of Southern Ethiopia, Arba Minch. Journal of Environmental Protection, 8(3), 319–329. https://doi.org/10.4236/jep.2017.83024.

Ambisa, Z., Tesf, B., Olini, T., & Abdeta, D. (2019). Review on the production and marketing of banana in Ethiopia. World Journal of Agriculture & Soil Science, 2(1), 1. https://doi.org/10.33552/WJASS.2019.02.000529.

Aregay, W. (1999, October). Exploratory study of two regions in Ethiopia to identify target areas and partners for intervention. Report No. 6. Dry lands Coordination Group (DCG) and Noragric, Agricultural University of Norway.

Chamberlin, J., & Schmidt, E. (2011). Ethiopian agriculture: A dynamic geographic perspective. Development Strategy and Governance Division, International Food Policy Research Institute-Ethiopia Strategy Support Program II. Working Paper No. 017.

CSA. (2019). Report on area and production of major crops in Ethiopia (Private peasant holdings, ‘Meher’ season). Agricultural sample survey 2018/19. Volume-I, Statistical bulletin 589. Central Statistical Agency (CSA) of Ethiopia, Addis Ababa, Ethiopia.

Dawit, A., & Asmare, D. (2008). Banana markets in Ethiopia. Research report 76, Ethiopian Institute of Agricultural Research (EIAR).

Dixon, J., Gulliver, A., & Gibbon, D. (2001). Farming systems and poverty: Improving farmers’ livelihoods in a changing world (English). Food and Agriculture Organization and World Bank Group. www.fao.org/farmingsystems/.

Fanos, M. (2014). The history and future of banana in Arba Minch, Ethiopia. Livestock and Irrigation Value Chains for Ethiopian Smallholders (LIVES). Retrieved September 10, 2020, from https://livesethiopia.org/2014/02/25/banana-history.

Gebre, G. G., & Rik, E. (2016). Sustainability assessment of a banana value chain: The case of Arba Minch, Ethiopia. Journal of Agribusiness, 34(2), 181–193.

Hidoto, L. (2018). Growth and fruit yield response of banana (Musa spp.) to sucker management. Journal of Natural Sciences Research, 8(3), 6-9.

Ruthenberg, H. (1971). Farming systems in the tropics. Clarendon Press.

Woldu, Z., Mohammed, A., Belew, D., Shumeta, Z., & Bekele, A. (2015). Assessment of banana production and marketing in Ethiopia. International Journal of Sciences: Basic and Applied Research, 24(3), 283-307.

Yadda, T. A. (2007). Effect of fruit based land use systems on soil physicochemical properties: The case of smallholders farming systems in Gamo Gofa, Southern Ethiopia [MSc Thesis]. Hawassa University, p. 115.
