



## Full Length Research Paper

### Village based promotion of improved banana technologies for food and income enhancement of smallholder farmers in western Amhara region of Ethiopia

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#### Article Info

##### Article History

Received 10 Feb. 2021;  
Accepted 25 May 2021;  
Published 11 June 2021

##### Keywords:

Banana, employment, farmers, income, nutrition, village.

#### Abstract

Village based promotion of banana varieties that gave fruit yield of 64 to 75 ton per ha per year was done at Dera, Gonji-Kolela and Bahirdar-Zuria woredas of Amhara Region, Ethiopia. The woredas were selected purposely. Hence, this activity was carried out to create wider demand and linkage among actors, to enhance banana technology multiplication and food security and income of farmers. Participatory village based promotion was followed in implementing the activity. About 10,384 banana suckers were delivered and planted on 7.114 hectares of farmers' fields making 463 farmers direct beneficiaries. The benefits of banana villages established include economic, social and environmental. Farmers able to get 160 to 180 fingers of banana per bunch, 22 to 34 kg of banana fruit yield per tree and 35.2 to 54.4 ton per ha. Farmers are fetching good prices in which they got an average of 3,010.17 Ethiopian Birr (ETB) from banana fruit and 569.44 ETB from banana suckers sale that sum ups 3,579.61 ETB from both produces per annum. The banana villages also create employment opportunities for rural youths and benefiting the women being as source of household income and nutrition.

#### Introduction

Banana (Dessert banana and plantain (*Musa sp.*)) is a major fruit crop grown in many developed and developing countries (Molla, 2017) and globally, it is the fourth most important crop of the food market next to rice, wheat and maize ((Zenebe *et al.*, 2015).

East Africa (including Burundi, Kenya, Rwanda, Tanzania, and Uganda) is the largest banana producing and consuming region in Africa and Uganda is the world's second largest producer after India, with a total of about  $10.5 \times 10^9$  Kilogram per year (Wachira *et al.* 2013).

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Banana is used as food security and income generating crop and the leaves are also used as animal feed and mulching purposes. Dessert banana is the major fruit crop that is most widely grown and consumed in Ethiopia and it is cultivated in several parts where the growing conditions are favorable, especially in the south and southwestern parts of the country with great contribution in food security, income generation and job creation (Zenebe *et al*, 2015).

The time banana was introduced to Ethiopia is before 1980s (Natnael 2016) and reports indicate that local cultivars of banana were under cultivation in Ethiopia since mid-18 century, around Ankober (McCann, 1995; Kahsay *et al*, 2008). A traveler to Eritrea also reported the existence of several Italian owned fruit farms, including banana, as early as the 1920s (Maydon, 1924). Dwarf Cavendish (*Musa acuminata*) was however introduced from Somalia to Eritrea in 1939 and then introduced from Eritrea farms to Ethiopia during the late 1950s or early 1960s (Taye, 1975) by Italians who had started banana farming in Ethiopia (Kahsay *et al*, 2008).

In Ethiopia, banana covers about 59.64% (53,956.16 hectares) of the total fruit area, about 68.00% (478,251.04 tones) of the total fruits produced, and about 38.30%(2,574,035) of the total fruit producing farmers and from this, 68.72% (37,076.85 hectares) hectares of land covered by banana, about 77.53% (370,784.17 tones) of the banana produced and 22.38% (1,504,207) of the banana producers in Ethiopia are found in the Southern Nations Nationalities and Peoples' National Regional State- SNNPRS of which Gamo-Gofa, Bench-Maji, and Sheka zones are the major banana producing ones in this region (CSA, 2015). Arba Minch zuria district alone covers over 80% of the domestic market share in Ethiopia

(LIVES, 2014). In Ethiopia, banana production contributes 47.83% for producers own consumption, 49.19% for income generation, 0.47% for animal feed, and 2.52% for other purposes (CSA, 2015).

Amhara region has diverse agro-ecology which ranges from 500-4620 m.a.s.l and have huge surface water, different soil types and conducive environment to grow both tropical and temperate fruits. However, according to CSA (2014), fruit crops account only 0.09% of the total cultivated land in the region. To tap into this unexploited potential, introduction, demonstrating and scaling up of the technologies is recommended in the areas of fruit crops including banana. Banana fruit was selected since Amhara Region has favorable condition for the fruit and the fruit is more advantageous to enhance farmers' income and food diversity as well as has its own share to moderate the microenvironment. Moreover, banana is easy in cultivation for farmers compared to other fruits such as mango, apple and oranges and it would yield fruit within one year period. Based on this, Adet agricultural research center has conducted participatory banana variety adaptation trial incorporating about 11 varieties that gave fruit yield of 64 to 75 ton per ha per year, on average, at Woramit trial site (around Bahir Dar town). Among the tested banana varieties, Butazu, Grand Naine, Williams-I and Poyo that gave per year fruit yield of 75.095 ton/ha, 72.24 ton/ha, 71.6qton/ha and 67.836 ton/ha respectively were selected for wider demonstration and scaling up (AARC, 2012). All those commercial banana varieties tested were previously tested and released (registered) by Melkasa Agricultural Research Center of Ethiopia in 2006 before they were brought here for adaptation trial.

Hence, this activity was designed to promote the recommended banana varieties based on village based approach for wider dissemination and production

with the objectives: to create wider demand on the improved banana technologies for its multiple functions and services for farming communities; to enhance farmers income and food diversity status; to enhance multiplication and dissemination of banana technologies; and to create and strengthen linkage among various actors involving in banana production and marketing.

### Materials and Methods

Banana village establishment was started in 2013/14 after lessons learnt from previous promotion and need of improving the approach which was non-systematic (random) distribution of suckers for farmers and offices of agriculture mostly by done breeders in 2012 to 2013 cropping season. “Banana village approach” was used for easy follow up and monitoring routine activities as well as facilitating communication; for mobilizing farmers for group work just for capacity building, resource utilization (land, labor and irrigation water) and marketing; to make the activity sustainable so that it would be model to be transferred and used as learning place and seedling/sucker source for other potential banana growing areas. The village formation activities were conducted at selected kebeles of Dera (Qorata kebele), Gonji-Kolela (Zema kebele), and Bahir dar Zuria (Yigodi kebele) woredas. The woredas were selected purposely because of their suitability for Banana production potential. Low to mid-land areas with temperature that ranges from 20 to 28 °C and rainfall amount of 1200mm is ideal to produce banana. The description of the intervention woredas is briefly given below.

**Dera woredais** located in south Gonder zone of Amhara region with 46% arable or cultivable land, 6% pasture, 1% forest or shrub land, 25% water bodies and the rest 25.9 used as different purposes. According to the 2007 national census, the total population

of the *woreda* was reported to be 248,464 of which 126,961 were men and 121,503 were females, out of which only 6.75% were urban inhabitants with population density of 162.90. The *woreda* is estimated to have a total area of 158,948 ha of which 35% is plain, 20% is mountainous, 18% is gorges and 27% is undulating and the latitude ranges from 1,500 to 2,600 masl while the average annual rainfall is 1,250mm. Tef, maize, finger millet, sorghum, coffee, chat and cotton are important crops grown in the *woreda* (Molla *et al*, 2014).

**Bahirdar Zuria woreda** is found in Bahir Dar liyou zone, Amhara Region, surrounding Bahir Dar town, the capital of the region. Total area of the *woreda* is approximately 128,360 ha with 32 administrative kebeles. The *woreda* is bordered in the east by south Gondar Zone, in the west by Mecha and Achefer *woredas*, in the south by Yilmana-Densa and in the north by Lake Tana. A topographic feature of the *woreda* is 48%undulating, % hilly, 13 % mountainous, and 7 % valleys. The altitude in meters above sea level ranges from 1,750 to 2,300 and all of the *woreda* area can be classified as midland (*Woina-dega*) climatic zone ((MoWR, 2009).

**Gonji-Kolela woredais** one of the West Gojjam zone woredas of Amhara Region, Ethiopia with an elevation that varies 1372 - 2998 meters above sea level and total population of 121,447(60,314 female). The *woreda* town, Addis Alem is located 72 Km far from Bahir Dar – the Region’s capital. The *woreda* is located 11005’ to 11020’N (Latitude), 37020’ to 37053’E (Longitude) and bordered by Dega-Damot in the south, Mirab-Estie in north east, Huleteju-Enesie in the east, Quarit in the south west, and Yilmana-Densa in the north. The total area of the *woreda* is about 662,236 hectares (ha) of which 34,336 ha is arable land; 29,846 ha is grazing land; and 677 his cov-

ered by forest. The rainfall of the woreda varies between 1700-2000 mm while the mean annual temperature ranges from 20- 30°C. Agriculture is the mainstay of economy and about 92% of the area is predominantly used for crop production with crop-live-stock mixing farming activities (Tibebu, 2014).

Adapted and high yielder banana varieties namely Butazu, Grand Naine, Williams-I and Poyo were used for the village-based promotion activity (Table 1). All those commercial banana varieties were previously tested and released (registered) by Melkasa Agricultural Research Center of Ethiopia in 2006 before they were brought here for adaptation trial. The varieties were tested and released for an altitude up to 1500 masl with 1300 to 3600 mm rainfall (Melkasa, Jimma, Werer and Areka areas of Ethiopia) planted on 2.5mX2.5m per plant spacing. Butazu, Grand Naine, Williams-I and Poyo gave a fruit yield of 39.1 ton/ha, 43.6 ton/ha, 55.6 ton/ha and 48.19 ton/ha per year respectively and their plant height was 3.6m, 3m, 2.9m and 3.47m in the same order while they took 350 days, 357days, 373days and 360 days to first flowering to harvesting in the same order too

(MoARD, 2006). The adaptation trial performance of those varieties in Amhara Region is given in Table 1.

Healthy banana suckers (seedlings) with height of 50-100cm, mostly prepared in the tissue culture were used for planting. The banana suckers were planted on 2.5m by 2.5m spacing (1600 trees per ha) on farmers' fields after preparing 60cm deep and 60cm wide hole a month before planting. Depending on the availability in each locality, 2 bucket manure/compost per tree before planting and 45gm UREA fertilizer per tree during planting were applied. After four months of planting, 60-gram UREA and 40gram DAP/NPS inorganic fertilizers per tree were applied. For matured banana trees, 120-gram UREA, 60 gram DAP/NPS and depending its availability in each intervention woredas, 8-10 kg manure/compost per tree per annum was applied. Irrigation water was applied with 15 days interval during dry season. Suckers were managed so that only mother, child and second child trees/suckers were allowed to be available per hill (hole) per year. Dried leaves and false (stem after harvest) were removed for aeration and minimize nutrient competition

**Table 1.** Description of performance of banana varieties used for promotion at Woramit trial site (in Bahirdar town), 2013-2014

Variety	Plant height (m)	Bunch Weight (kg)	Banana finger			Fruit pulp/flesh to peel ratio			Productivity (ton/ha)	
			Weight (gm)	Height (cm)	Thickness (cm)	Pulp	Peel	Ratio	One time harvest	Per annum
Butazu	3.05	25.48	187.5	20.43	4.28	113.61	76.21	1.52	35.49	75.09
Grand Naine	2.55	27.23	207.8	21.35	4.33	122.68	82.06	1.50	36.57	72.24
Williams I	2.61	25.86	198.2	21.83	4.34	121.30	74.66	1.62	38.52	71.68
Poyo	3.02	28.18	188.6	21.67	4.32	106.98	74.60	1.43	38.74	67.84
Giant Cavandish	3.19	24.61	194.7	22.09	4.30	117.80	78.31	1.49	34.12	49.24
<b>Mean</b>	<b>2.88</b>	<b>26.27</b>	<b>195.36</b>	<b>21.47</b>	<b>4.31</b>	<b>116.47</b>	<b>77.17</b>	<b>1.51</b>	<b>36.69</b>	<b>67.22</b>

Source: ARARI, 2016

The sharing of roles and responsibilities of each activities were done with woreda level to decide, who dose what, when, where, why, and how through Memorandum of Understanding (MoU). The roles and responsibilities of Adet Agricultural Research center were: delivering the seedling/suckers, arrange and provide training, monitoring and evaluate activities, etc. while the role of woreda agricultural offices were mobilizing and selecting as well as clustering farmers, arrange trainings and filed days and facilitate wider disseminations efforts through continuous monitoring and evaluation. On the other hand, the roles and responsibilities of farmers were providing their land for planting banana, conduct all crop management activities from land preparation to harvesting, monitoring and evaluation of activities and give feed backs as well as technology multiplication and dissemination.

Farmers, DAs and extension experts were given training on the production of banana and organizing farmers group and clustering activities were done by each woredas DAs. Proper monitoring and evaluation were done by each respective researcher and field days were organized to enhance the production of banana by the majority of farmers. Extension materials like banners, posters, brochures, leaflets were used during the banana village establishment process. Moreover, mass media events were organized and broadcasted for wider use and dissemination. Primary data were collected from sample farmers using a semi-structured questionnaire. Before the implementation of the activity, agreement was reached on the implementation process of the activities after discussion, awareness creation and capacity building events.

**Types and methods of Data collection:** Both quantitative data such as yield and yield related and financial/income data and qualitative data such as farmers and experts perception/opinions were collected. Yield data was collected per tree per farmer basis preparing checklist and by assigning Development Agents in close supervision of researches. Farmers' preference and overall performance of the technology was collected by check list on host famers who implemented the village based banana promotion activity. Total number of farmers participated in training, field visits and field days were collected by disaggregated in sex categories. Farmer-to-farmers sucker exchange and area expansion was recorded. Social data like role of farmers and other stakeholders in technology promotion market and sucker (seedling) linkage created and farmers' and experts' opinion/perception/feedbacks on the technology promoted were collected during monitoring and evaluation (M and E), experience sharing, field day events and joint planning meetings. Direct field observation; individual host farmers' interview using checklists; Focused Group Discussion (FGD) and Key Informants Interview (KII) were also some of the methods of data collection in this village based banana promotion activity.

#### **Method of data analysis**

Data was analyzed using simple descriptive statistics such as mean, maximum, minimum and percentages. Social data (farmers' and experts opinion/feedbacks) was simply qualitatively described and classified by themes and contents.

#### **Results and Discussion**

##### ***Established banana villages***

In 2014, banana villages were established at Gonj-Kollela (Zema kebele) and Dera (Korata kebele) woredas based on clustering approach delivering Grand Naine, Poyo, Butazu and Williams-I banana

varieties. Moreover, in 2015 to 2016, additional banana villages were established at Bahirdar Zuria (Yegodi kebele) Mecha (Biraqat and Kudmi kebeles) and Yilmanadensa (Angar kebele) woredas. However, sampling was done and data was collected on banana villages established at Dera, Bahirdar Zuria

and GonjiKolela woredas. More than 10,384 banana suckers of 4 improved banana varieties were delivered and planted on 7.114 hectares of farmers' fields at intervention woredas benefiting directly more than 463 farmers (Table 2).

**Table2.** Banana village establishment in 2013/14 to 2017/18

Village locations (Districts and kebeles)		Area, suckers and participants		
Distirtcs	Kebeles	Area (ha)	Suckers (no)	Participant farmers
Bahir dar zuriya	Yegodi	0.813	1300	13 (all youths)
Mecha	Birakat	1.113	781	15
	Kudmi	0.625	1000	15
Dera	Qorata	3.438	5500	200
Gonji-Kolela	Zema	0.750	1200	200
Yilmana-Densa	Angar	0.375	600	20
<b>Total</b>		<b>7.114</b>	<b>10,381</b>	<b>463</b>

**Training arranged and field days organized**

**Trainings:** Training was given for farmers and extension workers on contents like banana production agronomy, sucker management, postharvest handling, ripening techniques and marketing. More than

4 training sessions were arranged and given for about 147 farmers and 65 agricultural experts ((Development Agents-DAs) that sum up to 212 persons (Table 3).

**Table 3.** Training given, type and number of participants in 2015/16 to 2016/17

Location	Participants	Years and number of training participants disaggregated by gender			
		Sex	2015/16	2016/17	Total
Gonji Kollala,	Farmers	Male	81	55	136
		Female	6	5	11
Dera, Bahirdar Zuria and Mecha	Sub total		87	60	147
	Experts	Male	7	48	55
		Female	2	8	10
	Sub total		9	56	65
	<b>Grand total</b>		<b>96</b>	<b>116</b>	<b>212</b>

**Field days:** Two large field days were organized at Gonjikoleta woreda, Zema kebele and Bahirdar Zuria woreda, Yigodi kebele for awareness creation and wider dissemination of banana technologies so that officials, leaders, experts, researchers, traders and farmers were participants and more than 300 farmers (50 females) and 280 officials, experts and researchers were participants of the field day event. During the field day and training events, more than 176 banana production leaflets were distributed, Moreover,

banner that explains field day event in short was prepared. The field day event was broadcasted through television and radio programs of the Amhara Region and the country level broadcasting agency.

**Monitoring and Evaluation (M and E):** There was strong field M and E event on banana villages' establishment process and comments, suggestions and correction methods were forwarded and feedbacks from farmers and experts were collected and analyzed to draw lessons and challenges. Moreover, farmers' practice of banana field management was seriously

monitored and farmers were advised about banana plant and suckers management, fertilizer and/or manure application, water management, ripening and

marketing issues during M and E events. Joint M and E events were carried out at least four times per year.



**Figure 1.** Banana village field day event and participants, Bahir Dar Zuria woreda, Ethiopia.

***Farmers’ benefits from the established banana villages***

Farmers are benefited from the established banana villages in terms of economic, social and environmental aspects. The benefit derived from each is described briefly below.

**Economic advantages of banana villages**

It was confirmed that, from the primary data collected through structured questionnaire on some farmers among users and experts as well as field observation and monitoring and evaluation events, farmers are fetching good prices from banana fruit and sucker marketing. Farmers reported that, they got about 160 to 180 fingers of banana per bunch and 22 to 34 kg of banana fruit yield per tree (35.2 to 54.4ton/ha based on 1,600 trees per ha basis). From the established banana villages, farmers got an average of 3,010.17 (500 to 12,000) Ethiopian Birr (ETB) from banana fruit and 569.44 ETB from banana suckers sale with

sum of 3,579.61 ETB from both fruit and suckers per annum (Table 4).

Farmers expanded the number of banana suckers (plants) from the initial number what was delivered to them (10 to 400 suckers with mean of 112) to more than doubled (24 to 5000 with mean of 703 suckers) by planting on their nearby fields. This is a good achievement that indicates diffusion of banana plantlets within the beneficiary farmers themselves. From the field observation and monitoring events, it was confirmed that, the neighboring farmers do also plant new banana fields taking suckers from the initial beneficiary farmers. Farmers tried to apply techniques of banana production (sucker management, agronomic practices, watering, etc.,) that they obtained during training and monitoring and evaluation. And about 54.55% of farmers do apply compost/cow-dung on their banana fields.

**Table 4.** Farmers’ benefits from the established banana village, 2015/16 to 2016/17

Sampled Farmers	Number of suckers (banana plants)		Difference (expansion of banana suckers plantation)		Income from sale of suckers		Income from sale of fruits	
	Initially delivered (2014)	Current in 2017	In number	%age	2016	2017	2016	2017
1	45	50	5	11.11	500			1,300
2	50	250	200	400.00	500		1,600	6,200
3	10	40	30	300.00				1,200
4	300	500	200	66.67	1500		2,500	3,800
5	400	600	200	50.00	800		1,300	1,400
6	24	24	0	0.00				500
7	50	100	50	100.00	300		1,200	1,500
8	120	5,000	4,880	4,066.67	500	200	1,2000	8,000
9	130	1000	870	669.23	500		3,500	1,280
10	50	70	20	40.00	350	600	1,350	2,500
11	60	100	40	66.67	500	800	2,400	3,000
Mean	112.64	703.09	590.45	524.21	605.56	533.33	3,231.3	2,789.1
Minimum	10	24	0	0	300	200	1,200	500
Maximum	400	5,000	4,880	4,066.67	1,500	800	12,000	8,000
Mean income from sale of suckers and fruits in 2016-2017					569.44		3010.17	
Mean income from both suckers and fruits sale over the two years					3579.61			



**Figure 2.** Established banana field, banana bunch, ripen banana fruit and banana suckers ready for sell by farmers.

**Employment opportunities:** It is obvious that, rural youths are the future of the agricultural sector in developing countries like Ethiopia. Rapidly growing population, land size decrement per household and decreasing agricultural productivity are threatening rural Ethiopian youths making them landless and that means jobless. In our banana village establishment process, more than 100 jobless rural youths become beneficiaries from the activity. Rural youths in Bahirdar zuria woreda of Yigodi kebele were brought in groups (in 4 groups) in collaboration with the woreda office of agriculture experts and administrative bodies and they were able to take the community land which was almost idle and plant it with banana. They

are benefiting from the plantation and become seed/sucker sources for the surrounding farmers, even out of the woreda. During monitoring and evaluation events, we found farmers buying and loading the suckers from the youths’ banana village coming more than 50 km distance and they were transporting the suckers by mule cart. Moreover, the area is known by chat production which should be banded and replaced by fruit production like banana which are important for human than chat. As it is already known and the practical experience in some parts of the country, although chat is benefiting the producer farmers in generating high income from its production and sale, it is hurting the segment of the society



who consumes it in economic, social and health terms.

**Gender and nutrition aspects:** It is believed that, women often face different and more basic economic constraints than men, linked to a lack of access to and control over resources in Ethiopia. During follow up and monitoring events as well as data collection, we found women selling the banana fruits out of the village on roadside markets in Gonji-kollela woreda of Zema kebele (banana village). We asked them why

they sell banana and they replied that, we are selling the banana fruits instead of annual cereal produces and buy some important household items like fuel, oil, sugar and spices that demand money. They also added that, we feed our children bananas especially the market left-over and the over ripened ones and the family also enjoy in consuming it during coffee ceremonies. This has an implication in diversifying household food nutrition which is cereal dominant in the areas.



**Figure 3.** Youth in their banana fields collecting banana fruits and suckers for market and women with ripen banana for road side market

**Farming system diversification aspects**

Land is limited in Ethiopian agriculture including in those areas where our banana villages are established and bananas have also become an important component of mixed production systems. Farmers are trying banana leaves as fodder for animals, which in turn

provide manure for the farm. Apart from mixed farming, farmers inter-cropped (under sow) with both perennial (mango, avocado, papaya and citrus) and annual cash crops such as green pepper, onions and cabbages for market and home consumption too.



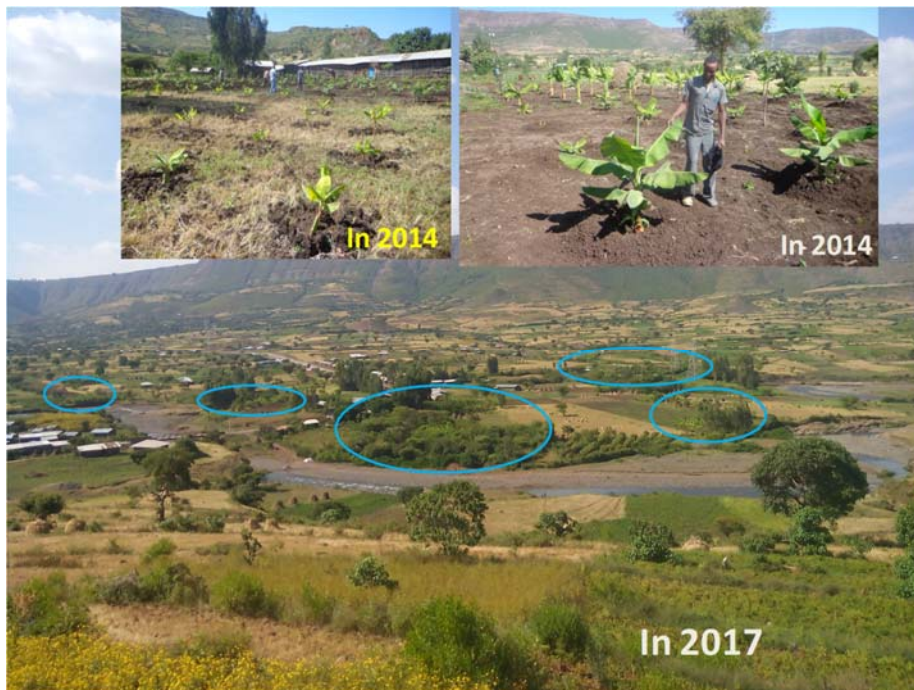
**Figure 4.** Banana village expansion by farmers themselves and banana-onion intercropping field.

**Environmental benefits of banana villages**

Trees are like the lungs of the planet and they alter the environment in which we live by moderating climate, improving air quality, cooling local air temperatures, sequestering carbon, absorbing ozone, carbon monoxide and sulfur dioxide and releasing oxygen, reducing storm water runoff and harboring wildlife (FAO, 2016; ISA, 2011; Nowak, 2008). It is fact that,

forests are destructed for different purposes (clearance for farm land, fuel wood, construction, etc.) in Ethiopia and their coverage is minimal so that the above mentioned environmental benefits of trees is low in Ethiopia. Hence, banana as a tree is believed to contribute its own natural gift for the environment in addition to its economic and social benefits in the banana village areas and Gonji-Kollela woreda of

Zema kebele banana village is a case in point that, the area turned green after the introduction of banana.



**Figure 5.** Banana village at early stage of establishment and final stages that show the change of microenvironment at Gonji Kollala woreda

### Market linkages created

Market linkage between banana producer farmers and traders was created by inviting banana traders who do business by bringing green banana and ripen here in Bahirdar town during field day events. During discussion, traders promised for producers that, they can purchase raw banana from producers if supply is large (atleast a full of lorry car of capacity of 3 to 5 ton) with priory information with traders. Producers are also advised to sell their banana in group than individually for large supply, market information and price negotiation. The research centre and office of agriculture are also being facilitating the fruit as well as the sucker market sources and methods of selling it.

### Farmers' and Experts' opinions, feedbacks and suggestions

Farmers, experts and officials were able to forward their comments, suggestions and feedbacks during monitoring and evaluation as well as field day events and it is described below:

#### Farmers' feedbacks:

- Farmers said that, we are trying to cultivate bananas as recommended but we need some crops that are suitable for the integration of banana production. The land is idle especially at initial stages of banana and we need some cash crops to be integrated with banana for addition income sources.
- Farmers also forwarded their comments on the link for markets.....they said that we have little knowledge and even capacity for banana ripening and marketing facilities. We tried to ripen banana here and sell on road sides in addition to main market. Hence, we need sustainable market outlet for our products.

**Expert and officials feedbacks:**

- These banana villages established by research centers and office of agriculture are very interesting and could be a model for other potential areas. However, it should be integrated with livestock production so that each could benefit from the process. They added that, we know that, shortage of feed is a major problem for livestock production in Ethiopia especially in dry seasons and this is a good opportunity to integrate banana village with livestock production so that banana leaves, pseudo-stems, peels and damaged banana fruits can be feed to animals alone or in supplement with other feed sources for dairy and fattening purposes and in turn manure can be source of fertilizer for banana. Moreover, unused (boarder) and/or furrow irrigation areas can be planted with fodder/feed plants area or even possible to integrate (intercrop) them with banana plantation.
- It is also suggested that, it is possible to integrate apiculture in banana villages to maximize yield since year round flowering of banana and rejected fruits of banana could be major sources of bee forage.
- Experts suggested that, farmers could also prepare compost from banana leaves, pseudo-stems, peels and damaged banana so that compost could be source of organic fertilizer for producers.
- Tissue culture (TC) laboratories like Amhara Regional Agricultural Research Institute (ARARI) TC has great role in supplying clean and disease free banana suckers and it should be linked to banana villages in sucker supply.
- The youths' banana village should be expanded more to benefit producers in allocating more communal land and facilitating credit supply for them as well as strengthening them in material supply like water pump and irrigation equipment.

- Linkage among stakeholders (research, office of agriculture, quarantine office, universities, NGOs, etc.) should be strengthened more for the sustainability of banana villages established.

**Lessons learned**

- The improved banana varieties were excellent in performance on farmers' fields with farmers own management,
- Feedback assessment from Monitoring and Evaluation (M and E), frequent field visit and field days showed that demand was created about the improved banana technologies,
- Knowledge transfer methods like training, field days and technology evaluation played key roles in technology demand creation and dissemination activity,
- Follow up, monitoring and evaluation were very vital for banana village establishment process,
- Sharing of roles, responsibilities and accountability were very essential for coordination of the scaling up process in banana village establishment,
- Village based pre-scaling up of banana technologies can be used as a model for other horticultural crops and tree promotion activities and this achievement should be scaled up to other banana and fruits potential areas of Amhara Region.

**Challenges encountered**

- Some production, marketing and consumption constraints were encountered: Shortage of water for irrigation during dry seasons, lack of market linkage both for fruits and suckers of banana for producers who are far away from the main market, Bahir Dar, lack of improved skill on banana ripening and handling as well as transporting skills including researchers and experts, etc.

**Conclusion and Recommendations**

**Conclusion**

Adet agricultural research center in collaboration with each respective woreda offices of agriculture established model banana villages especially at Gonj-Kollela (Zema kebele), Dera (Korata kebele) and Bahir Dar zuria (Yegodi kebele in 2014 to 2017 that would be a learning field as model banana production expansion in Amhara Region in particular and in Ethiopia in general. The rest banana villages which are found at Mecha (Biraqat and Kudmi kebeles) and Yilmanadensa (Angar kebele) woredas as well as the new ones which are being established starting 2017 taking lessons from the old ones at Jabitehinan and North Achefer needs more assistance for their sustainability.

Capacity building such as theoretical and practical training, continuous monitoring and evaluation and support, field days and media events and strong stakeholders' linkage and platforms played roles for the successes of banana village.

About 10,384 banana suckers of 5 improved banana varieties namely Grand Naine, Poyo, Butazu and Williams-Iwere delivered and planted on 7.114 hectares of farmers' fields at those model banana villages benefiting 463 farmers.

Participant farmers in the banana villages benefited in economic, social and environmental terms from the banana plantations. Farmers were able to get 22 to 34 kg of banana fruit yield per tree (35.2 to 54.4 ton/ha based on 1600 trees per ha basis) and earned income, on average, 3,010 Ethiopian Birr from banana fruit and 569.44 ETB from banana suckers sale with sum of 3,579.61 ETB from both fruit and suckers per annum. Expansion or diffusion of banana plantation within the beneficiaries' villages themselves and outsiders is also another great achievement. The banana villages also create employment opportunities for rural youths and benefiting the women being as source

of household income. Moreover, banana as a tree and the banana village formation as plantation forest, it could contribute its own natural gift for the goodness of the environment in addition to its economic and social benefits.

### **Recommendations: The way forward**

- For food security, income, environmental, etc. issues, these model banana villages should be maintained by agriculture offices and be used as learning fields and seedling/sucker sources for all institutions (governmental and non-governmental) interested in banana production system,
- New banana villages should be established in other banana potential areas based on the lessons learnt from these villages and this could be facilitated by office of agriculture or bureau of agriculture in collaboration with research centers since giving agricultural extension services for producers is its first mandate,
- There should be continuous monitoring and evaluation (M and E), technical and material backstopping on training, seeds/suckers, new ideas and varieties, crop integration and agronomic practices and watering; and post-harvest issues like ripening, market linkage and value addition from research centers in collaboration with office of agriculture of each respective woredas.
- Linkages among farmers, traders, the public sector and Non-Governmental Organizations (NGOs) have been made but need to be strong enough to respond to emerging challenges (production, marketing and consumption issues). This could enable banana farmers to source knowledge and services hence take banana production and marketing forward in the future. This would go as to establish stakeholders platforms to strength linkage for the development of the banana commodity.

- Banana villages sustainability in terms of market linkage, sucker management (advise farmers to have separate field for banana sucker and fruit production purposes), annual or perennial crops identification for banana-crop integration (intercropping), mono-cropping of banana for a longer period on the same field, disease and pest aspects in sucker exchange should be given emphasis. Moreover, marketing and issues that would be important for future banana large scale production should be given emphasis by researchers and agricultural experts involving in the field of banana production enhancement.
- Banana village should be integrated with livestock production system and soil fertility management issues like devise ways how to prepare feed and compost from banana leaves and other remains instead of simple removal by producer farmers. Livestock feeds would be planted on the irrigation furrows and/or intercropped/under sown with banana fields and more importantly introduction of improved

livestock breeds in banana village farmers could maintain the sustainability of the village more.

### **Conflict of Interests**

There is no conflict of interest with respect to this research

### **Acknowledgments**

Agricultural Growth Programme II (AGP II) project for funding and monitoring and evaluating the implementation process and Adet Agricultural Research Center of the Amhara Regional Agricultural Research Institute (ARARI) in implementing the activity are highly acknowledged. Although it was done for their benefits, farmers are acknowledged for being willing to take over the activity and in carrying out all the routine and tedious cultivation of banana fields. The participation of Agricultural experts and Development Agents in mobilization farmers during training and field days and in any agricultural activities and willingness of officials to participate on field days to give feedbacks and give commitment for the activity to be sustainable is also appreciable.

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