

Innovation in banana value chain development in Metema district, North-western Ethiopia: IPMS experiences

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Abstract

Ethiopia has a diverse agro-ecology and sufficient surface and ground water resources, suitable for growing various temperate and tropical fruits. Although various tropical and temperate fruits are grown in the lowland/midland and highland agro-ecologies, the area coverage is very limited. For example, banana export increased from less than 5,000 t in 1961 to 60,000 t in 1972, but in 2003 declined to about 1,300 t worth less than USD 350,000. The limited development of fruit sector in the country could be attributed to input supply constraints, limited skilled manpower and extension approaches and, focus of agricultural development efforts on grain production amongst others. The current government's policy and development strategy prioritizes intensive production and commercialization of agriculture, including fruit production. In an effort to support this change, the International Livestock Research Institute (ILRI) and the Ministry of Agriculture and Rural Development (MoARD) initiated a five year project with financial assistance from Canada, called Improving productivity and Market success (IPMS) of Ethiopian farmers. IPMS follows participatory value chain and Innovation Systems perspectives and focuses on knowledge-based development of identified agricultural commodities with market potential in 10 pilot learning weredas (districts) in four Regional States. One of the weredas is Metema where the project introduced banana production. The objective of this paper is to share IPMS experiences in promoting innovation in banana value chain development in Metema wereda. The paper provides a brief history of banana introduction in Ethiopia, describes the value chain in banana production, input supply and marketing and the various innovations that have been introduced to develop the chain, with a focus on actors and action learning processes. The future outlooks of banana value chain and the reasons for the successful adoption of the innovation and the options to sustain it so that the value chain can respond to changing conditions are highlighted.

Key words: Action learning, Adoption, Banana, Ethiopia, Fruit production, Market linkages, Metema, Innovation, IPMS, Value chain

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Introduction

Banana is grown in many developing countries and is mainly distributed between 30⁰ North and South latitude (Taye, 1975). It is the fourth most important food crop in terms of gross value of production. Total value of international banana trade ranged between USD 4.5 and 5 billion per year, of which 80% of the export comes from Latin America with African countries having a share of only 4% during 1998-2000. The majority of the global banana production (47%) comes from Cavendish sub-group (FAO, 2003).

Ethiopia with a geographical area of 1.13 million km² and a total human population of over 77 million (CSA, 2007), is agro-ecologically diverse and can support production of temperate, sub-tropical and tropical fruits. It has areas with altitudes ranging from 116 m below to 4620 m above sea level. Twelve major river basins in Ethiopia have an annual flow of 123 000 million m³ of water with a groundwater potential of about 2.56 million m³. This gives the country a potential irrigable area of 3.5 million ha with net irrigation area of about 1.61 million ha, of which currently only 4.6 % is utilized (Amer, 2002). In addition to these major river basins, there are many smaller perennial rivers and many areas with sufficient annual rainfall which could support fruit production..

Despite this potential, the area under fruit crops in Ethiopia is very limited. About 450,932 ha of land was estimated to be under vegetable, root and fruit crops in 2004, of which about 40,600 ha (9%) is mainly under smallholder fruit crop production (MoARD, *personal communication*). Total fruit production in Ethiopia was estimated at about 320,000 tonnes (FAO, 2002). Banana export from Ethiopia (including Eritrea) started at less than 5,000 tonnes in 1961 but jumped to 60,000 tonnes in 1972 and was exported to many countries in Europe, Asia and Africa (Taye, 1975). In 2003, Ethiopia exported only about 5,366 tonnes of various fruits (including banana), and earned only about Birr² 13.3 million (equivalent to about USD 1.5 million) in foreign currency. Of this only about 1,300 tonnes worth Birr 2.8 million (USD 325,000) was from banana exported mainly to Djibouti (CSA, 2004). Global share of Ethiopia in banana export was only about 0.01% (FAO, 2003).

Some reasons for the limited development of fruit production in Ethiopia include:

- Planting materials of improved fruit varieties are produced only in very few state farms and research centres, with very limited efficiency and capacity. As a result of which there has been limited production and expansion of fruit crops. For example, Upper Awash Agro-Industry annually raises about 700,000 mango and avocado seedlings for sale to Regional Bureaus of Agriculture and Rural Development and NGOs.
- Trained manpower in the area of horticulture is also very small, compared to other areas of specialization. For example, Jimma University's Department of Horticulture, one of the main education institutes for horticulture in Ethiopia, graduates about 300 students at BSc and MSc level annually (<http://www.wi.wur.nl/NR/rdonlyres/2438A68B-E1BA-467F-8FF0-AD3517F7244F/40002/SummaryReportVisitEthiopiamaarch2007.doc>). As a result, there are no horticulturists working in many weredas (districts) despite the efforts of expanding fruit development in Ethiopia. Instead, there are many plant science graduates who only took a course or two in horticulture production.
- Production of fruits may have also been limited due to lack of post-harvest and marketing infrastructure like packaging, pre cooling, warehousing, cold storage, pre-package &

² 1 USD was equivalent to Eth. Birr 8.5997 in 2003
(<http://unstats.un.org/unsd/snaama/resultsCountry.asp?Country=231&Year=0&SLevel=99&Disp=Million>)

distribution, chemical treatment and washing facilities both on farm and at port (Seifu, 2003).

- Hitherto, the government focused mainly on improvement of grain crop production due to the objectives of attaining food security. Hence, all these might have discouraged entrepreneurs to enter into fruit development.

Historically, development needs of horticultural production were not sufficiently addressed by the government, but currently efforts have been stepped up to improve and support this sector. The policy and development strategy prioritises intensive production and commercialisation of agriculture, and horticulture has been identified as one such sector for attention. In the government economic development policy and strategy document, the need to accelerate the transformation of the agricultural sector from subsistence to a more business and market-oriented agriculture is also stressed. Many higher learning institutions (Jimma, Mekele, Haramaya and Hawassa universities) are also increasingly involved in training young people in horticulture. In addition, the government has established a modern cooling facility at the airport in Addis Ababa to support the development of the horticulture industry of the country.

The International Livestock Research Institute (ILRI) and the Ministry of Agriculture and Rural Development (MoARD) initiated a five year project in June 2004 with financial assistance from the Canadian International Development Agency (CIDA). The project entitled: “Improving Productivity and Market Success” (IPMS) of Ethiopian farmers, aims at developing approaches to support government efforts to promote market oriented smallholder agricultural development, to contribute to poverty reduction. The project following participatory value chain and Innovation Systems approaches is focusing on knowledge-based development of selected agricultural commodities with market potential in 10 pilot learning weredas, of which Metema, the focus of this paper, is one.

The objective of this paper is to share the IPMS experiences in supporting innovation processes in banana value chain development in Metema wereda, using innovation system and value chain as analytical constructs. The paper after describing the study area and methodology employed, provides a brief history of banana introduction in Ethiopia, describes the value chain of banana and the various innovations³ that have been introduced to develop the chain, with a focus on actors and action learning processes employed. Finally, the future outlooks of banana value chain and the reasons for the successful adoption of the innovation and the options to sustain it so that the value chain can respond to changing conditions are also outlined.

Study Area and Methodology

The study was conducted in Metema wereda, located about 900 km north-west of Addis Ababa and about 160 and 340 km west of Gondar and Bahir Dar towns (the nearest big towns), respectively (Figure 1). The total population of the wereda was 78,328 (CSA, 2005) and is one of the west most weredas bordering the Sudan. The total area of Metema is about 4,400 sq. km and altitude ranges between 550 and 1608 m asl while minimum annual

³ We define innovation here as a new idea, practice, or product that is successfully introduced into economic and social processes, which positively affects the competence, productivity, competitiveness, and livelihood of agents in the value chain. They could be technological, organizational, institutional and policy innovations.

temperature ranges between 22 and 28°C. Daily temperature becomes very high during the months of March to May and reaches as high as 43°C. Nearly all the land in the woreda is located in the lowlands except some mountain tops. Sesame, cotton and sorghum are extensively grown in this woreda. Cattle, goats and sheep are the main livestock raised in the woreda.

Ninety percent of the woreda receives mean annual rainfall between 850 to 1100 mm (IPMS, 2005), with a unimodal rainfall extending from June until September. The soils in the area are predominantly black and some are soils with vertic properties (IPMS, 2005). The soils in the area are believed to be fertile and consequently, farmers do not apply fertiliser (IPMS, 2005).

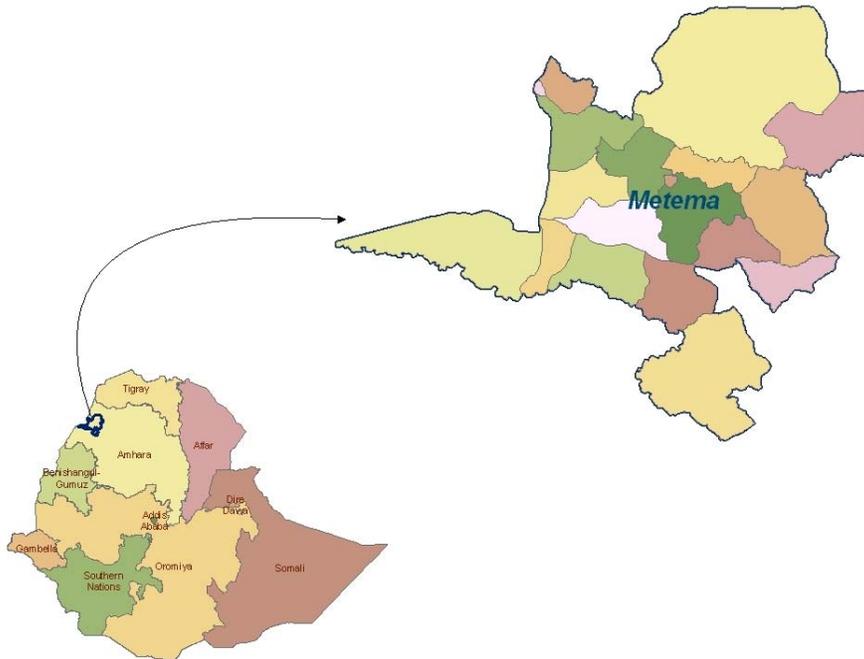


Figure 1: Location of the study area

Average land holding is about 5 ha (IPMS, 2005) which is very high compared to the highlands. There are some large farms with a holding of about 600-700 ha. In addition, Metema is a cash crop area (sesame and cotton) and hence income of farmers is relatively better than farmers in the highlands of Ethiopia. A number of refugees returned from abroad to Metema after the fall of the Military regime in 1991.

Literature review and personal experiences of the senior author formed the basis for the documentation of the history of banana development in Ethiopia. Primary and secondary data collected from the Office of Agriculture in Metema, banana producers in Metema and, key informant interviews were used to collect primary and secondary data regarding banana production and innovations thereof. The documentation of action learning processes by the IPMS project staff in Metema and their reports complemented the data set. Tools like Actor Time Line and Actor linkage maps were employed to map the changes in value chain over time, trace the chronological development of innovations along the banana value chain in Metema, involvement of new actors and roles they played in this process, development of actor linkages and knowledge flows over time that facilitated the innovations.

History of Cavendish banana in Ethiopia

Reports indicate that local cultivars of banana were under cultivation in Ethiopia. For example, reports indicate that banana was cultivated since mid 18 century, around Ankober (McCann, 1995). A traveller to Eritrea also reported the existence of several Italian owned fruit farms, including banana, as early as the 1920s (Maydon, 1924) which could possibly be from Gros Michel varieties. Dwarf Cavendish (*Musa acuminata*) was however introduced from Somalia to Eritrea in 1939 (Taye, 1975). In Ethiopia, it is believed to have been introduced from farms in Eritrea (Figure 2) during the late 1950s or early 1960s (Taye, 1975) by Italians who had started banana farming in Ethiopia (Kidane⁴, *personal communication*). Almost all big banana farms were owned by Europeans and were mainly concentrated in the Upper and Middle Awash basin. There was also a banana plantation of about 62 ha⁵ in Arba Minch state farm in 1984 in the southern Rift Valley. In the mid 1970s, however, all the farms (including those in Eritrea) were nationalised by the then military government. After this time, productivity of many of the farms declined (Seifu, 2003) and some were also converted to other land uses. However, some farms such as the state owned farm, Melka Sedi, in Middle Awash have recently stopped producing banana due to increasing salinity (Michael and Sileshi, 2007).

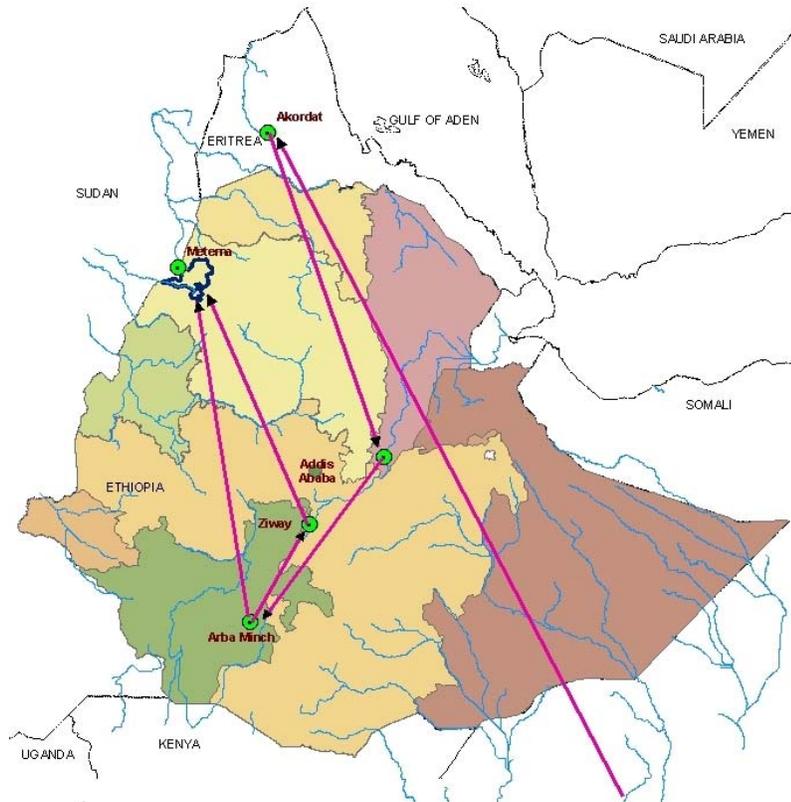


Figure 2. Route of Cavendish banana introduction to Ethiopia and the study area.

⁴ Mr. Kidane is one of the first Ethiopians who has worked in one of the biggest Italian banana farms in Eritrea for more than 30 years.

⁵ The senior author of this paper was a regional agronomist in Arba Minch from November 1980 to March 1985 and knows the farm.

Dwarf Cavendish was introduced to smallholder farms around Arba Minch from the nearby state farm in 1984. The senior author of this paper while working as a regional agronomist for the then Gamo Gofa region (now Gamo Gofa zone) agricultural office introduced 5,000 suckers on 4.2 ha at the then Lante Farmers' Producers' Cooperative farm. Production on this cooperative farm continued, but expansion was very limited until the change of government in 1991 (Abren and Daniel, 2006). Smallholder banana farmers in Lante and surrounding Farmers Associations (FA) have since increased the hectarage from none in 1984 to over 970 ha in 2005 (Abren and Daniel, 2006), mainly producing for the market. A study indicated that more than 75% of the banana sold in the Addis Ababa fruit market comes from this area but and they are also almost the only source of planting material for the entire country (Aithal and Wangila, 2006). About 80 to 100 trucks (50 qt⁶ capacity) transport banana daily from this area (Melese Mada, *personal communication*) to the market in Addis and elsewhere. Once it comes to the Addis market, the green mature banana receives air tight heat treatment using kerosene burners in a ripening house, locally called “*Chela house*” in order to initiate the ripening process. It is then distributed to supermarkets and shops in Addis but also to other towns throughout the country.

Innovations in banana value chain development in Metema

This section describes the identification of constraints and opportunities and the various innovations that have transformed the various elements in the banana value chain in Metema, followed by a chronological summary of these presented in the form of an Actor Time line.

Identification of constraints and opportunities in banana value chain

A multi-stakeholder meeting (farmers, Office of Agriculture and Rural Development (OoARD) staff, researchers, traders, farmers' association (FA), administrators, etc.) conducted in 2005, preceded by a participatory rural appraisal (PRA) identified improved banana production as one of the potential marketable commodities in Metema district. The opportunities and constraints in the banana value chain were identified during this process (Figure 3). This helped planning of activities to address some of these and the potential actors to partner with.

Even though the district is agro-ecologically suitable for the production of the improved banana variety, no Cavendish dwarf bananas were grown in the wereda. Some farmers were growing a very tall (locally known as “*Kenya*”) variety. The seedling supply system for this variety too was not sufficiently developed with a government nursery producing only very limited numbers. Hence, adoption of this variety was also very low. Other reasons for the limited spread of this variety were the low yield, difficulty in harvesting, low market preference due to its poor taste and, general lack of farmers’ knowledge and skills to manage banana. There was demand for the Cavendish varieties in the market and these were being imported from Arba minch, 1400 km away. Gondar (zonal capital) and Bahir Dar (regional capital) are two big cities close to Metema. The population of these towns is estimated at 213,673 and 183,489, respectively (CSA, 2007). The banana market in these towns is also served by production from Arba Minch *via* the central market in Addis Ababa. Their weekly import capacity is around 1000 qt of banana (Worku Teka⁷, *personal communication*). This is then redistributed to these cities and many neighbouring towns for retailing. These two cities were identified as potential market outlets for Metema banana during the PRA. All

⁶ 1 qt is equivalent to 100 kg.

⁷ Research and Development Officer, IPMS, Metema.

stakeholders, particularly farmers with access to irrigation, were enthused when this opportunity was identified.

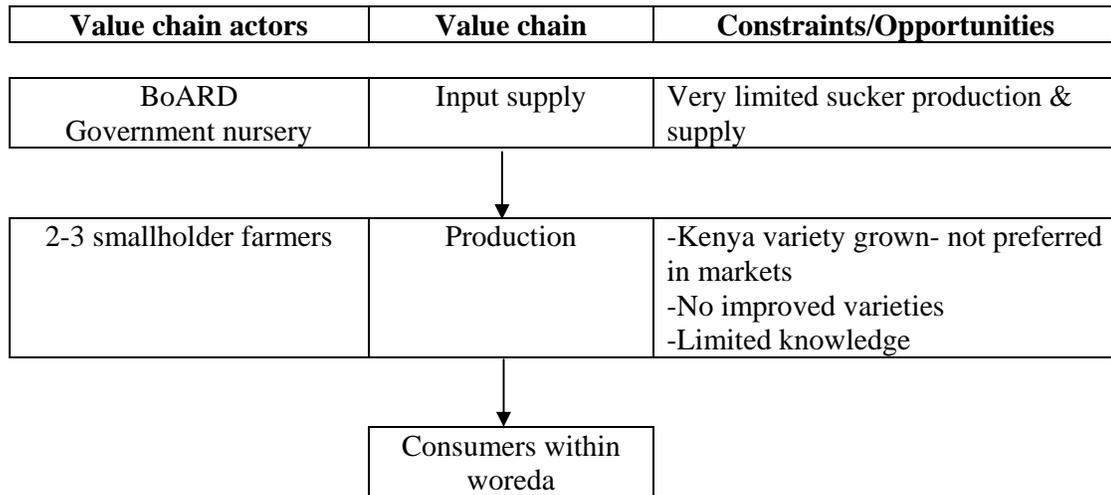


Figure 3: Banana value chain in Metema –Early 2005.

Development of farmer based sucker supply system

Limited availability of and access to planting material of canvendish variety was identified as one of the major reasons for limited spread of banana production. In order to overcome the limitations and to take the production of planting material beyond government farms to make it more sustainable and accessible, a strategy was designed to develop a farmer based sucker production and distribution system. In March 2005, the first 35 suckers of Cavendish dwarf banana were brought from Zwai private farm located 160 Km south of Addis Ababa. These suckers were planted in one farmer’s plot and the wereda OoARD nursery. The idea behind planting some of the suckers in the government nursery was for multiplication and easy distribution of the suckers to farmers. Once they became aware of this, many farmers with access to irrigation contributed money to buy suckers from Zwai and Arba Minch. The wereda OoARD and IPMS provided transport, while IPMS also provided information on where, what price and how to get suckers. In June 2005 and 2006, the wereda OoARD and IPMS facilitated the procurement of 600 and 750 banana suckers, respectively for the farmers who paid for the suckers. The initial adopter farmers were located around three rivers (*Genda Wuha, Guang and Shinfa*). Once these plants were successfully established, the district OoARD and farmers were linked to the major planting material source area, to facilitate additional supply of planting materials. In addition, it was also necessary to create linkages with chemical suppliers to be able to respond to possible pests and diseases attacks. Over 400 suckers have also been recently sold by a Metema farmer to a Sudanese businessman, expanding the market area for inputs.

Previously input supply, especially for smallholder farmers, was completely in the domain of the wereda OoARD. However, for banana now it is completely farmer based. The role of the wereda OoARD in the banana value chain has been mainly focusing on providing technical knowledge, linking farmers and facilitating transport of suckers.

Infusion of new management practices for new varieties through capacity building

Both the farmers and development agents (to develop accessible technical backstopping services as and when required) were trained in the production and management of banana. In

nine months time, most of the plants yielded bunches weighing about 18 kg each. Currently, there are about 100 farmers growing Cavendish banana in the wereda on area ranging from 0.1 to 2 ha each. Some of the farmers involved in banana production are returnee refugees from the Sudan and ex-soldiers, but few are also native people. Some are farmers who are town dwellers, who can afford capital investments in water pumps for irrigation.

Currently, it is estimated that a total of about 15 ha is under banana with an estimated annual production of 660 tonnes⁸. This must have required exchange of about 30,000 suckers on a farmer to farmer basis but also suckers used for expanding own plantations, except for the initial suckers supplied from external sources. Weight of individual bunches increased to more than 25 kg the following year because of better management. Some giant Cavendish plants introduced on some farmers' plots yielded about 40 kg weighing bunches. Around Arba Minch, giant Cavendish yields up to 95 kg per bunch (Bizuneh, *personal communication*). Based on the above calculations and assuming that 50% of the total irrigable land (Table 1) will be under banana, it is estimated that about 21,000 tonnes of banana could potentially be produced in the near future in Metema annually. The enthusiasm to grow banana by many farmers and support by development workers and many other government officials now made us estimate that at least 50% of the total irrigable land will be under banana soon in Metema. Other reasons are also listed under the "*future outlooks....*" section of this document.

Table 1. Farmers growing banana and other horticultural crops with developed and potential irrigable land by Farmers' Associations, Metema

No	FA	Number of farmers			Irrigable area		
		Male	Female	Total	Developed	Additional potential	Total area
1	Awasa	13	0	13	0.50	4	4.5
2	Kokit	7	0	7	3.5	45	48.5
3	Kumer	6	2	8	5.25	201	206.25
4	Meka	6	0	6	2.1	27	29.1
5	Gendawoha	2	1	3	1.5	33.75	35.25
6	Zebach bahir	6	1	7	2.2	135.1	137.3
7	Metema yohanes	13	1	14	14.7	38	52.7
8	Gubi Jejebit	2	0	2	2.6	70	72.6
9	Kemechela	2	1	3	2.3	7	9.3
10	Mender 6,7,8	40	1	41	14.4	84	98.4
11	Shashiga	7	0	7	0.25	21.75	22
12	Shinfa	8	0	8	4.4	20.2	24.6
13	Lencha	2	0	2	0.75	47	47.75
14	Tumet	94	85	179	35.7	87.2	122.9
15	Genda Wuha town	11	0	11	15.1	11.44	26.54
16	Awlala	2		2	1.7	10.1	11.8
	Total	219	92	313	106.95	842.54	949.49

Source: Metema OoARD Extension Team (2008)

Although woreda experts had little knowledge on banana production to begin with, they were involved in capacity building and knowledge management, through field days, video shows, posters and paper presentations which helped scale up and out banana production within and

⁸ Calculations are based on 1100 plants/ha and 20 kg/bunch. This estimation also considers that about 2 harvests at any one time will be possible from these fruiting plants annually.

outside the wereda. The wereda advisory and learning committee (WALC)⁹ established by IPMS project, has also played a major role in this regard.

Action learning employing available indigenous and external knowledge on post harvest management

During the first harvest, due to lack of ripening experience, farmers were cutting and keeping the fruits in wooden crates without any cover. As Metema has a high annual average temperature, the fruit turned black and put off consumers. This offered a temporary setback to marketing banana. A banana farmer, based on information he got from one of his friends who previously worked in a farm (*Akordat farm*¹⁰) in Eritrea, attempted a simple and innovative method of ripening *in situ*. This involves digging a hole in the ground and placing hands of banana (Figure 3) in it. Between layers of the hands, dry grass was placed to hasten ripening and also serve as a cushion between the hands. Once filled, it was covered with banana leaves and other green materials at ground level (Figure 4). The fruit was kept for about 5 days, before the banana was ripe but the colour of the fruit did not become yellow. Using this system, the first harvest, which was small in quantity, was sold.



Figure 4. Underground banana ripening in Metema **Figure 5** Banana covered with green material
Photo: Dirk Hoekstra

Some farmers also attempted another way of ripening, by keeping the fruit above ground in sacks, crates and simply under shade but covering with hay and thick banana leaves and sometimes plastic sheeting for 5-6 days. This method proved to be better in attaining the desired colour, but the fruit remained hard, hence better shelf life (Figure 6 and 7). This method is suitable for farms which are located close to towns and are on routes to commercial farms, where commuting daily labourers buy fruit from these farms. Banana ripened in this manner had fewer bruises but is difficult to transport and market in far away places.

⁹ WALC is a team comprised of key stakeholders in weredas where IPMS is involved.

¹⁰ This is believed to be one of the first banana farms in Eritrea and the source of initial planting material for Ethiopia. That is probably why banana in Arba Minch is known as “*Asmara muz*” (Banana from Asmara, Eritrea’s capital).



Figure 6. Banana ripened above ground **Figure 7.** Banana ripened above ground in crates
Photo: Kahsay Berhe

The wholesalers in Gondar with whom market linkages were created were not able to ripen the bananas and the fruit became black, now due to low temperature in Gondar. These wholesalers were therefore unwilling to buy the banana from Metema.

It was observed that wholesalers in “*Atkilt tera*” (vegetable market) in Addis Ababa allow green mature bananas to ripen in an airtight room heated using properly placed kerosene burners (Figures 8 & 9), which induces early ripening. The size of the room is usually around 3 x 4 m with a capacity of about 100-110 quintals. In “*Atkilt tera*”, these rooms are locally called as “*Chela*” houses. The number of kerosene burners or hours heated depends on how soon the fruit is needed or how high or low the surrounding air temperature is. If it is needed very soon, then up to 6 burners are used overnight, but if not, about 3-4 burners are placed for about 1½ days. However, only two burners are used for the same quantity of banana for 24 hours in Hawasa, which has a warmer climate compared to Addis Ababa. Special arrangement of bunches and burners is made to give uniform heat to the fruit. In order to ensure air tightness, all outlets are sealed with newspapers using the fresh banana fruits as glue. Ceilings of these rooms are usually made of wood. Experienced people take up this activity in Addis. Once ripening is initiated, the fruit is sold to wholesalers from different parts of the country. These wholesalers distribute it to retailers who further ripen them by wrapping with newspapers and keeping them in warm places before selling them to consumers.



Figure 8. Trainer arranging banana for ripening
Photo: Worku Tekla



Figure 9. Kerosene burners in use

Having acquired knowledge of this method, IPMS facilitated a ripening training by an experienced ripening technician¹¹ from “*Atkilt tera*” in Addis Ababa for two major fruit wholesalers in Gondar and six banana farmers from Metema.

Creation of market linkages

As the production increased gradually, the producers had to explore markets outside the wereda. IPMS facilitated linkages with the Gondar market. Sample bunches were delivered to big fruit wholesalers to introduce the produce from Metema. A visit was organised for the wholesalers to the various smallholder banana farms in Metema on more than one occasion. Fruit marketing groups were organised to facilitate collective marketing in two FAs.

Samples of banana were distributed to wholesalers in Bahir Dar, while video on banana development in Metema was shown during a National Farmers Festival. This opened new avenues for expanding the markets. There is demand from these traders now for banana from Metema. Traders in Gondar obtain banana from Arba Minch (1250 km away) *via* Addis Ababa (750 km away), while Metema is only 160 km away. This would substantially reduce the transportation cost, post harvest losses for the traders, and make it relatively cheaper for the consumers.

An entrepreneur and large fruit distributor from a neighbouring region, Tigray, was contacted and inspired to open ripening house in Gondar. A market promotion event was organised in Gondar OoARD for furthering market linkages.

Figure 10 represents the current banana value chain in Metema and the innovations introduced to upgrade the value chain. The value chain now has a significantly higher number of links, actors and linkages.

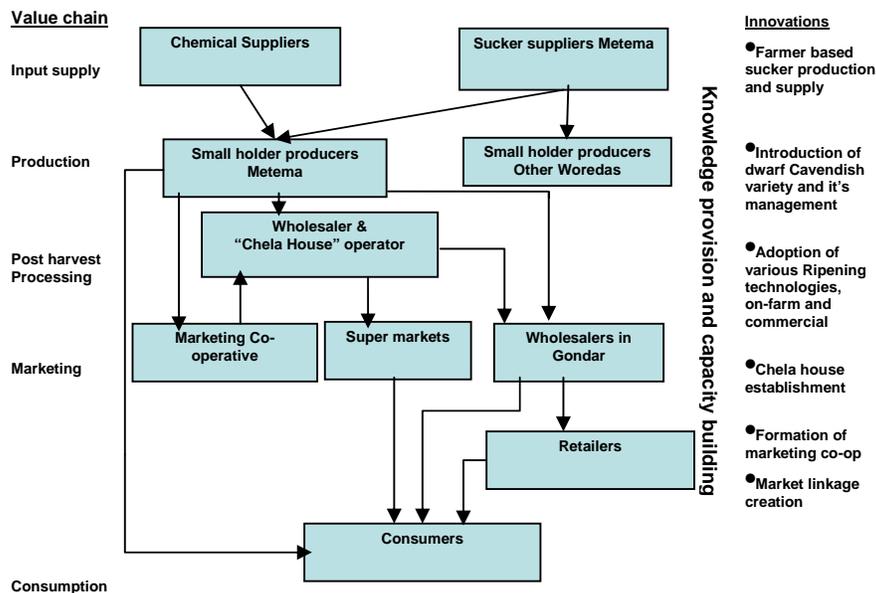


Figure 10. Current Banana value chain in Metema and innovations along the chain

¹¹ This trainer happens to be the first in the country who started using kerosene burners for ripening. Before he came back from Eritrea in 1991, heat generating diesel engines and electricity was used for ripening, which made the operation very expensive. Placement of the burners, according to him, is very critical for facilitating faster and uniform ripening.

Farmers' involvement in chain management

Small-scale farmers participate in value chains in many different ways. The types of participation can be summarized in two broad dimensions – (a) the types of activities that farmers undertake in chain and (b) the involvement of farmers in the management of the chain. When farmers engage only in production and have no influence over the management of the chain, they are called chain actors. They become chain activity integrators when they move from farming into other activities in the chain, yet without exerting any influence on the management of the chain. Chain activity integrators may be organised into groups (such as marketing co-operatives) to buy inputs, process or market produce, but have no managerial control over the chain because they are not involved in quality management, consumer targeting or proactive innovation. They become chain partners when they start exerting influence over the management of the chain. They may develop a long-term chain partnership with traders, processors or retailers. They may be organized for technological innovation and institutional dialogue in the chain (KIT *et al.*, 2006). In the case of the banana value chain in Metema, the following chain movements took place.

From chain actors to chain activity integrators for ensuring sustainability

During the first year, three trips were made to Zwai and Arba Minch in order to bring enough planting materials until suckers from the established plants in the wereda could support its own expansion. Some entrepreneurial farmers, who saw the opportunity, started selling suckers to fellow farmers in the wereda while at the same time expanding their own farms. Banana production was popularised by farmers, IPMS, development workers and government officials in the wereda. A number of field days, video shows, posters and paper presentation were organised in Metema involving farmers and experts from within and outside of the wereda. Farmers and development workers from the neighbouring weredas (eg. Quara) made regular visits and shared experiences and planting materials. In addition, distant weredas also bought suckers from Metema at Birr 10/sucker equivalent to 1 USD (*personal observation*). Gradually, a well developed and efficient farmer to farmer banana sucker supply system, triggered by the high and stable demand, has developed in the wereda.

In order to support marketing, a fruits marketing group was created to link the smallholder farmers and the wholesalers in big towns. The process should now aim at developing the capacities of the smallholder farmers to become chain partners, so that they develop sustainable linkages with various other actors in the chain and organize for pro-active innovation and dialogue. Table 2 presents the Actor Time line of various activities associated with promoting innovation in banana value chain in Metema, since 2005.

Table 2 Actor time line of banana value chain development in Metema

Date	Event	Actors involved
February 05	Identification of market potential, constraints and opportunities for banana production in Metema	IPMS, OoARD, BoARD, Farming communities
March- May 05	35 suckers imported from Zewai farm and planted in one farmer's plot and Woreda OoARD nursery for adaptation trial and multiplication, followed by farmers visit and training	IPMS, OoARD, farmers, Zewai private farm
June 05	600 banana suckers from Zewai procured by 11 farmers, after providing practical training	OoARD, Farmers, IPMS, Zewai private farm
October 05	The Woreda cabinet takes up a banana production popularization campaign by facilitating farmer's field visit event.	Woreda cabinet, OoARD, Farmers
December 05	After the popularisation visit, farmers who were interested requested for irrigable land to plant bananas and two FAs administrators (Metema Yohanes and Mender 6,7,8) gave land to the farmers. Four farmers who received the land purchased water pumps and generators to start operation.	Farmers, PA administrators, OoARD, IPMS
Dec 05 and May 06	A massive popularization program organised with farmers from Metema and 4 neighbouring woredas. Posters prepared and distributed to enhance the scaling out process.	IPMS, Woreda information office, OoARD, farmers
Dec 05 - June 06	Pioneer farmers started to expand their banana plantation. More than 260 suckers were detached and planted by two farmers in Tumet (200 suckers) and Metema Yohanes (63 suckers) FAs for expanding their own farms.	Farmers, IPMS, OoARD
February 06	Cigar tip rot disease identified in 2 farmers' field, leading to consultation with crop protection experts and chemical suppliers. Disease controlled immediately through chemical use.	IPMS, Chemical suppliers, farmers
March 06	First batch of bananas harvested and sold in Metema Yohanes	Farmers
May -June 06	Many farmers in the woreda expressed interest in taking up Cavendish banana cultivation. 750 suckers procured from around Arba Minch and distributed to 13 fruit growers, including some previous farmers.	OoARD, IPMS, Arba Minch sucker supplier farmers, Metema farmers
June 2006	Trial of underground ripening system (Metema Yohanes FA)	Farmer
September 06	Farmer to farmer sucker supply initiated. 67 seedlings sold to other farmers from Metema Yohanes farm at 8 birr/sucker.	Farmers
January 07	Trial of above ground ripening method (Tumet PA)	Farmer
March 07	Field visit organised for Ethiopian Fruit Marketing (Etfuit) manager in Gondar and a trader in Chilega to link them with the banana producers in Metema.	IPMS, Private trader, Etfuit
April 07	Samples of banana delivered to fruit wholesalers and super markets in Gondar to link banana producers and demonstrate the quality and test the ripening process under Gondar environment.	IPMS, Wholesalers, Super market owners
May 07	Fruit marketing groups organized in Tumet and Mander 6,7,8 FAs	IPMS, OoARD, Farmers
September 07	Field visit organised to Metema banana farms for 2 major fruit wholesalers in Gondar.	IPMS
November, 07	Modern ripening training for wholesalers and farmers in Gondar. Market visit program organised for these farmers in Gondar. Banana samples ripened in Gondar distributed to fruit traders in Bahir Dar and regional Bureau of Agriculture and Rural Development staff in Bahir Dar.	IPMS, Farmers, Traders
November, 07	A popular banana wholesaler and sole distributor for Tigray region contacted to create awareness about expanding banana	IPMS

	production in Metema and to involve him in banana ripening and sale	
November 30, 07	Field visit involving decision makers from the region, zone, neighbouring weredas (Quara, Tach Armacho, Adi Arkay) and more than 500 farmers from other FAs of Metema organised to scale out the banana innovation. This fora was also used to fulfil demand for irrigated land by some farmers who wanted to enter into banana farming. A private banana distributor from Tigray, neighbouring region, participated in this visit.	Farmers, IPMS, OoARD, Trader
December 1-2, 07	Panel discussion organised for regional, zonal and woreda level decision makers to discuss issues of market and road infrastructure.	IPMS, OoARD
December 07	Opening of a private ripening house in Gondar by the Tigray fruit distributor	Trader
December 07	Market promotion event facilitated in the premises of Gondar zone OoARD to link private banana distributors in Gondar with some consumers. More than 300 kg banana was sold.	IPMS, Zone OoARD
January 08	Regional higher officials including head of Regional BoARD head, food security head, Trade and industry bureau heads visited some of the banana farms in Tumet and Marterad areas and awarded the banana farmers' cooperative in Mertrad with a water pump. A DA working there was awarded with a motorbike in appreciation of the developments.	OoARD, Traders
March 08	Cigar rot symptoms observed in 3 farmers plot located along the <i>Guange</i> river side and managed to control the disease by spraying fungicides	IPMS, OoARD, Farmers, Chemical supplier
March 08	More than 500 suckers sold to farmers outside Metema.	

Future outlooks of the banana value chain development

Banana production is expanding within and outside of Metema. Number of farmers involved and area under banana has substantially increased from 0 in 2005 to 100 farmers and 15 ha in 2008 in Metema alone. Metema traditionally has been known for its rainfed sesame and cotton production, and no interest was evident in irrigated agriculture. Since the introduction of banana, applications for access to irrigated land have overwhelmed the wereda OoARD. Irrigated vegetable production is also expanding. The trend indicates that expansion of banana production will continue as far as irrigation potential allows. It is expected that soon banana from Metema will fulfil market demands of Gondar and Bahir Dar because of the distance advantage. The road between Gondar and Metema is being upgraded to concrete and this is expected to ease the transportation constraints to further encourage the marketing of banana beyond Metema.

Currently, mainly the initial volunteer farmers have benefited from the sale of both fruits and suckers, due to the front runner advantage. While most of the banana producers until recently, were male, many women farmers have now taken the lead in growing banana. For example, there are two groups of 78 native Gumuz women and 5 men organised to grow banana in one FA (Table 2). In any case, the role of women even in the male-lead banana farms is significant as they carry out most of the day to day activities related to banana production on these farms.

The smallholder farmer banana production around Arba Minch took about a quarter of a century to reach to about 970 ha (Abren and Daniel, 2006), but it is expected that it will take

much shorter time to attain an equivalent level for Metema. The high demand owing to high population, a developing road network connecting big towns and improving telephone connectivity, proximity to some major market outlets (both domestic and cross-border in Sudan), possibility of irrigation through the use of perennial rivers and the fact that banana is not grown on a larger scale in nearby areas are expected to contribute to this growth. The entrepreneurial mindset of farmers who are leading this is also a positive factor, as compared to the subsistence farmers around Arba Minch at the initial stage.

Livelihood of farmers involved in banana production is improving. For example, three farmers earned equivalent to USD 1600, 1087 and 950 in one season from the sale of suckers only (*Worku Teka, personal communication*). Many other farmers also benefited from sales of both fruits and suckers.

Future expansion efforts are therefore expected to play a significant role in the economy and also change in dietary composition of people in the area and beyond. One could also expect changes to the existing land use (natural grasslands, bushes and shrubs) around the perennial rivers.

Integration of livestock in banana farms

Shortage of feed is a major problem for livestock production in Ethiopia. In Metema, livestock are extensively managed under open grazing conditions, with very low productivity. Average milk yield is about 1 l/day. Major livestock feed in Metema is grass, mainly *hyparrhenia* spp from the bush. Transhumance cattle production system is common with many highland cattle moving to Metema during the start of the rainy season in June, and stay until October every year, competing for available feed resources. Recently about 151 farmers in 13 FAs have started fattening about 400 cattle for the market, adding to the competition for the available feed resource from natural pasture. During the dry season, *hyparrhenia* spp becomes very hard and unpalatable and its nutritive value also becomes very low (about 3-4% crude protein). Feed conservation is not practiced in Metema because of lack of knowledge, which would have facilitated meeting year round livestock feeding requirements. The low nutritive value of tropical grasses and roughages highlights the need for low-cost supplementation to improve animal productivity.

Banana farmers have started fattening cattle with supplements coming from banana leaves, pseudostems, peels and damaged banana fruits. About 7 farmers have started fattening small ruminants in association with banana. Some banana farmers have started growing feed for river bank stabilisation and selling this to other farmers during the dry season. According to Perez and Roldan (1984) cited in Babatunde (1992), cattle fed on 40% banana reject, 42% Napier grass and 18% legume forage (all on dry matter basis), gained up to 0.91 kg/day in 100 days. Banana can also be mixed with leguminous feed species such as *Leucaena*, *Sesbania*, *Gliricidia* and others which could easily be grown in association with banana for fattening cattle. Hence, by-products from banana can effectively be mixed with grasses or legumes to supplement available feed resource. The nutritive value of banana is shown on Table 3.

Table 3. Nutritive value of banana

	DM	Protein	Energy	Oil	Fibre	Calcium	Phosphorus
	% DM		(MJ/Kg)	% DM			
Banana plant	16	6.4	9.9	0.8	23.7	0.9	0.3
Ripe banana fruit	31	5.4	15.2	0.9	2.2	0.2	0.1

Source: Machin, D.H. (1992).

Many banana farmers are integrating apiculture in their farms. About 7 farmers have introduced 2 to 10 modern and traditional beehives in their farms. Farmers say that productivity is very high with an average honey production of 30 kg/modern hive annually. Two harvests are possible with round year flowering and rejected fruits as major source of bee forage.

Factors Influencing Banana Innovation

There are many factors involved in the success of banana adoption in Metema, some of which have been alluded to in the preceding sections. To summarise, some of the contributing factors are:

Adoption of a systems view: The project and its partners took a systems view in addressing this issue, which meant seeking entry points and interventions for knowledge-based development of banana for increased productivity and market access, using value chain and innovation systems perspectives. This has been a radical departure from the routine way of doing things in the context of Metema, in particular and Ethiopia, in general. The policy and public sector hitherto focused solely on technical solutions, but ignored the fact that some non-technical (organizational, institutional and managerial) interventions are necessary, to make the technical interventions effective and help embed them in socio-economic processes. Taking a systems view meant the public sector partners had to forge linkages with private sector actors, with whom they had limited interactions previously, and facilitate private sector led innovation. This led to a coordinated innovation across the whole value chain. No one innovation would have achieved the impact that is visible now without linkages through the rest of the value chain.

Adaptive management approach: Taking an adaptive management perspective meant that partners had to go away from their much preferred ‘one size fits all’ solutions for problems and appreciate the importance of context specific solutions, entry points and appropriate pathways based on particular characteristics of the banana value chain, based on knowledge (combined from various sources). This in turn, meant following participatory approaches and engaging in dialogue processes, so the clients had a voice and were able to determine the pathways they preferred (that conformed to their socio-cultural norms).

Boundary spanning role: To forge linkages with various actors (for example chemical suppliers, market agents etc), an actor was needed. IPMS project played that role to begin with. But recognising the importance of such a boundary spanning role for sustaining the innovation processes, the project tried to develop the capacities of the public sector to play such a role to ensure sustainability after the project and ownership by local organisations.

Short gestation and demonstration of quick benefits: The first banana plants started to bear fruit in only 5½ months and demonstrated the possibility of quick economic return. The dual

benefits from the commodity (fruits and suckers) could also have played an important role for the adoption of the fruit. This was one factor which seems to have motivated a large number of farmers to get involved in banana production. Previous experiences in banana production and management of one of the experts involved during the PRA, to realise the suitability and potential was critical in this whole process.

Variety suitability: The fact that banana easily established under the farmers management conditions and that there was ready market with fruits produced being sold right at the farm gate is another reason for rapid spread of banana production.

Resource availability: Some of the volunteer farmers were already involved in irrigated agriculture and some possessed reliable water pumps. The success of these farmers then attracted others to be involved in banana production.

Knowledge through previous exposure: Equally important is also the fact that some of the farmers were refugee-returnees who were exposed to fruit development in general when they were farm workers in the Sudan.

Development of sustainable and farmer based input supply: Sucker supply system is totally devoid of any bureaucratic hassles and suckers are easily available through farmer to farmer networking. This has led to a rapid expansion.

Trust: The provision of timely access to planting material as per commitment may have contributed to farmers developing trust in IPMS project and OoARD staff. Continuous and close interactions, coupled with dialogue processes and commitment of partners to provide support and backstopping during all stages of development through creation of appropriate linkages to address emerging problems and challenges created close relationships over time and hence contributed to the adoption.

Enabling environment: The policy of the government towards promoting irrigated agriculture and horticulture was encouraging. This has been demonstrated by regular visits and encouragement of farmers by government officials at regional, zonal and wereda levels. Farmers were supported by continuous technical knowledge delivery about the management of banana from experts (even with the limited knowledge). In addition, farmers were supported through the supply of vehicles for transporting suckers from Zwai, Arba Minch and later on within Metema. Involvement of government officials at various stages in the process and the communication strategies followed gave fillip to the scaling out of banana and a sense of ownership paving way for strategies to support this initiative, even beyond Metema.

Recommendations

Technically, farmers need to be advised to minimise mono-cropping, although it is still early, so that disease build up and fertility decline will be minimised. Recently, a new strain called 'Panama disease' (*Fusarium oxysporum*) has begun to attack Cavendish banana plants in south Asia. Even though, plant breeders and geneticists are trying to develop new resistant cultivars, the progress is slow. This is because the banana cultivars selected for human consumption are seedless and reproduce asexually which decreases genetic variation and makes breeding difficult (http://en.wikipedia.org/wiki/Fusarium_wilt). Hence, development workers need to capacitate farmers on safe propagation methods of this crop. Farmers should also be advised to apply optimum nutrients and irrigation water. In general, banana on nearly

all farmers' fields in Ethiopia is grown without fertilizer even in areas around Arba Minch where banana has been grown for about a quarter of a century (Abren and Daniel, 2006). Farmers who grow banana near to their homesteads were however, observed applying manure and ash (Daniel, 2000). Excessive application of irrigation water in Metema may also enhance salinity in the long run. Therefore, optimum irrigation practices should be made so that farm lands under banana would be used for a longer period of time.

Cavendish dwarf variety is widely grown in the country, including the study area. This variety is susceptible to nematodes and cigar tip rot disease (Seifu, 2003). On the other hand, the planting material moving from one place to another (as a planting material) is from very old clones (Taye, 1975). Therefore efforts should be made to introduce other varieties of export quality to the area for the sake of variety diversification and hence minimise losses in case of these problems. According to Taye (1975) and Seifu (2003), poyo variety is tolerant to these problems, high yielder and also has less after harvest weight loss compared to Cavendish dwarf, except that it is susceptible to wind.

Linkages among farmers, traders, the public sector and NGOs have been made but need to be strong enough to respond to emerging challenges (new diseases, salinity, changes in market dynamics, etc). This will require regular capacity building and information sharing among the stakeholders. This should enable banana farmers to source knowledge and services as and when required, and hence take banana production and marketing forward in the future. This linkage among major stakeholders should further be strengthened and should enable establish a platform so that development of the commodity is further strengthened.

On the other hand, the zonal and wereda OoARD are already involved in the scaling up and out of banana. The Regional Bureau of Agriculture and Rural Development need to also be strongly involved in this activity. The strong involvement of these bodies along with the other stakeholder is very important to support future development of banana in Metema. Creditor institutions are also expected to support the development of this commodity in the future where poor farmers, including women and the young, could also benefit from this activity.

The experience shows that, although a technology can spread from farmer to farmer, adoption at a bigger scale is greatly enhanced when well equipped extension staff actively help farmers in the diffusion process. This is because banana has proved beneficial to farmers and there would be a big loss of opportunity if the spreading of banana is not actively facilitated by the concerned bodies.

In general, Ethiopia has a relatively good export potential for banana, provided infrastructure necessary for export, including new varieties and market linkages are put in place. These facilities will be required at all levels (on farm, during transportation on land and sea; and port) at a country level. The fact that the study area is a border town, banana from Metema could easily be marketed to or through the Sudan. There is good road network to and cooling facilities at Port Sudan (Dr. W. Hancock, *personal communication*).

On the other hand, a project, supported by Common Fund for Commodities, has recently started to be operational in both Ethiopia and the Sudan in order to promote organic banana production destined for export. This project could contribute to enhancing the marketability of banana from Ethiopia by creating market linkages. IPMS will therefore need to link with this project to learn and improve on farm and post harvest management systems to support banana production and marketing.

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