Smallholder fruit development in Bure District, Ethiopia: Experiences from IPMS

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Acknowledgements

This paper documents interventions, results and lessons learned for fruit commodity development in Bure Woreda, based on a participatory market oriented value chain approach. The approach was introduced by the IPMS project/staff, who not only facilitated the introduction of the approach (technically and financially), but also played an important role as partner in the development process. The credit for the development results obtained go, however, to all the partners involved in this endeavor especially the nursery operator farmers, staff of the Bure OoARD (Office of Agriculture and Rural development), Mr. Tafere Fentahun of SIM Injibara, Mr. Melkie Nibrat of Adet Agricultural Research Center (AARC), Melkassa Agricultural Research Center (MARC) and private input suppliers.

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Abstract

Bure district has a diverse ago-ecology, different soil types, a relatively long rainy season and a number of rivers and streams for irrigation. Therefore, it has suitable tract of land to grow temperate, subtropical and tropical fruit crops.

In 2007, fruits were identified as a potential marketable commodity by the stakeholders participating in the IPMS project. They diagnosed that farmers had limited orchard management knowledge and skill and were growing locally available less productive and low quality fruit varieties. In addition, the linkage among fruit production stakeholders was very weak. Moreover, fruit seedlings from local seeds were only multiplied and distributed from the government fruit nursery and the supply was inadequate. Therefore, the quantity and quality of fruit produced in the district was still very low. The stakeholders also identified possible interventions along the value chain and subsequently intervened in capacity building (orchard management and propagation techniques), improved varieties introduction, input supply (established private nurseries, introduced grafting in government nurseries), stakeholders linkage and marketing of outputs.

Thirteen (13) private fruit nurseries were established in four Peasant Associations (PAs) and in Bure town, which produced 68% of the seedlings in the district in 2008. Poor women and landless youth were also able to participate. The skill and knowledge of farmers, Development Agents (DAs) and experts improved through training and study tours which created linkages with new knowledge and capacity development actors. However, shortage of scion to multiply grafted fruit planting materials hampered mango and avocado expansion. i.e. only 3% of the mango and avocado seedlings in 2008 were grafted. Project partners are however addressing the issue by identifying alternative scion supply for avocado. Presently, 35% and 93% of the avocado seedlings raised for July 2010 planting, in the government and private nurseries, respectively, are grafted.

Key words: fruit production, grafting, private fruit nurseries, sustainability, value chain
1. Introduction

The IPMS project, funded by the Canadian International Development Agency, was established to assist the Ministry of Agriculture and Rural Development in the transformation of small holder farmers from a predominantly subsistence oriented agriculture to a more market oriented (commercial) agriculture.

The project adopted a “participatory market oriented commodity value chain development” approach which is based on the concepts of innovation systems and value chains. Crucial elements in the approach are the focus on all the value chain components instead of only a production technology focus; the linking and capacitating of value chain partners and the assessment, and synthesis and sharing of knowledge among the partners.

The project introduced this approach in 10 Pilot Learning Woredas (PLW) in Ethiopia with the objective of testing/adopting the approach so that it can be promoted nation wide. An integral part of the approach is the identification of marketable commodities and the value chain constraints and interventions. This was accomplished through a participatory process in all PLWs.

This case study focuses on the development of fruits in Bure District with the objective of i) documenting diagnostic results and value chain interventions, ii) providing proof of results (proof of concept), challenges and lessons learned to be considered for scaling out.

Following the introductory section, the following sections are included. Section two deals with methods and approaches used in the study, while section three presents background information, including description of the PLW and the history and diagnosis of fruit development. In section four value chain interventions - extension, production, input supply, marketing and credit issues are presented. Section five dwells on results and discussion on production/income, input supply/marketing, gender/environment/labor use, organizational and institutional aspects, while sections six and seven deal with challenges and lessons learned, respectively.

2. Materials and Methods

To start the development of a commodity, IPMS used a district level participatory market oriented value chain planning approach, aimed at identifying i) main farming systems, ii) potential marketable crop and livestock commodities at farming system level, iii) constraints, potentials and interventions for each value chain component iv) value chain stakeholder assessment with potential (new) roles and linkages. Different value chain stakeholders were involved and consulted in this planning exercise. Secondary biophysical and socio economic data were collected, followed by open ended interviews with focus groups and
key stakeholders. The results were presented in a stakeholder workshop in which priority marketable commodities were decided upon together with key intervention areas and partners.

This initial rapid assessment was followed by some more detailed studies on selected commodities. Such studies were conducted by partner institutions and/or students and or IPMS staff using formal surveys, interviews and observations.

To implement the program at district, Peasant Association (PA) and community levels, the project facilitated different knowledge management and capacity development approaches and methods to stimulate the introduction of the value chain interventions by the actors concerned. The various value chain interventions are documented by the project staff in the six monthly progress reports and the annual M&E reports.

Furthermore, in order to quantify the results from individual and/or combination of interventions, the project established a baseline and measured/documentated changes. Several data sources were used to establish the baseline and to document changes and results.

2.1. Baseline information

To establish a baseline, data from a formal baseline study and data from some special diagnostic studies were used. The initial PRA study conducted in 2007, also contributed to the quantitative and qualitative baseline information.

Amongst others, the formal baseline study used PA level interviews and records. To collect information on fruit area coverage and the number of households involved in fruit crops production. This information was used to compile district level information on fruit crops acreage (by crop) and households.

2.2. Documenting change processes and results

Several sources were used for regular documentation of change processes and results, including six monthly progress reports, annual M&E reports, MSc thesis research, records kept by the OoARD, personal observations and diaries. In some PLWs, staff also monitored changes in production/productivity for a few selected farmers on a regular basis.

In 2009, the project also developed a set of guidelines for the PLW staff to systematically collect relevant information for the case studies including history, changes in extension services, value chain interventions (production, input supply, marketing and credit), results, challenges and lessons learned. Part of the information was obtained from the previously mentioned baseline and other sources and specially arranged key informant interviews and a commodity
stakeholder workshop. The stakeholder meeting was organized to establish the evolution of the roles and linkages of the value chain actors.

Following the collection of all relevant information, a write shop was organized to present information in a systematic manner. Drafts of the PLW specific commodity case studies were then reviewed by Headquarter experts.

3. Background to fruit development in Bure

3.1. Description of the district

Bure is found 400 km Northwest of Addis Ababa (Fig. 1). It is one of the consistently surplus grain producer districts in Amhara National Regional State (ANRS). Human population of the district is 169,609 of which 143,854 (85%) live in rural areas (IPMS, 2007). The number of agricultural households, 21,793, is about eight times higher than the households in the urban areas. The total area of the district is 72,739 ha of which 46.6% is cultivated and average household land holding is about 1.6 ha. At present the district is divided into 22 PAs and two town associations (IPMS, 2007).

Agro-ecologically Bure is classified into moist and wet lowland (10%), wet Woina-Dega (82%) and wet Dega (8%). Altitude of the district ranges from 713 to 2832 metres above sea level (masl). The altitude drops from 2832 to 713 masl as one travels from North to South part (Nile gorge) of the district, while the opposite holds true for temperature. Long term annual mean temperature of Bure ranges from 13 °C to 24 °C, while it receives relatively high amount of rainfall with a balanced distribution ranging from 1103 to 1336 mm. It has mono-modal rainfall distribution extending from May to September. Shortage of rainfall is not a constraint for crop and livestock production. Farmers practice irrigation to grow crops in the district. The soils in the area are Humic Nitosols (63%), Eutric Cambisols (20%) and Eutric Vertisols (17%) (IPMS, 2007). Most of the district is flat but some areas exhibit soil erosion problems because of undulating topography and repeated cultivation of crop lands. In addition, soil acidity and water logging are crop production problems in some parts of the district.
3.2. History of fruit production in Bure

About 92% of the total area of the district is agro-ecologically suitable to grow tropical and sub-tropical fruits while the remaining 8% is also suitable to grow temperate fruit crops (IPMS, 2007). According to Kahsay et al (2009), there are 52,840 and 23,800 ha of land suitable for apple and avocado production in the district, respectively. There are also 16 diverted rivers that are essential for the expansion of fruit production in the district (IPMS, 2007). Despite this potential, fruit crops covered only 1.6% from the total irrigated cropland in the district (IPMS, 2007). This could be ascribed to a number of fruit production constraints.

As Bure has suitable conditions for different types of fruit production, the Amhara National Regional State (ANRS) Bureau of Agriculture and Rural Development (BoARD) established fruit seedling multiplication nursery in 1993. This nursery was the only source of fruit planting materials in the district until 2007 (Table 1). It multiplied and distributed fruit seedlings raised from seeds collected in different
juice shops. This practice is not technically advisable since it is difficult to predict the quality and productivity of fruit trees propagated through seed. This is especially true for cross-pollinated fruit crops such as mango, avocado, papaya, guava, etc. Therefore, farmers were planting unknown varieties of the above mentioned fruit crops. Consequently, some avocado trees failed to set fruits and will take many years to bear fruits.

Table 1. Number of fruit seedlings distributed from the OoARD fruit nursery

<table>
<thead>
<tr>
<th>Fruit crop</th>
<th>Years</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2003</td>
<td>2004</td>
</tr>
<tr>
<td>Mango</td>
<td>1276</td>
<td>1343</td>
</tr>
<tr>
<td>Avocado</td>
<td>1160</td>
<td>1415</td>
</tr>
<tr>
<td>Papaya</td>
<td>1659</td>
<td>2069</td>
</tr>
<tr>
<td>Banana</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Guava</td>
<td>828</td>
<td>38</td>
</tr>
<tr>
<td>Total</td>
<td>4923</td>
<td>4865</td>
</tr>
</tbody>
</table>

Source: OoARD annual reports, 2008 and horticulture experts

Fruit seedlings multiplied from government fruit nursery were distributed to different PAs on quota basis. Each DA shares the PA quota to a number of farmers living in his PA. Fruit seedlings are distributed only during government working hours and there was no flexibility to get seedlings during off hours and weekends, when farmers are not busy. This approach was time consuming and farmers could not access enough quantity and quality of fruit seedlings. In addition, since the government fruit nursery is located close to the town, it was less accessible to most farmers living in many remote PAs. As a result, farmers in those PAs were unable to buy and grow fruits.

Fruit crops were new to almost all farmers living in Bure district. Therefore, the source of fruit production knowledge and skill were only the OoARD staff. However, until recently there was only one higher learning institution in the country which gave training at degree or diploma level in the field of horticulture. In addition, the OoARD gave more emphasis on the planting material multiplication and distribution. As a result, farmers did not use recommended spacing, pruned their mango and avocado trees and de-suckered their banana plants. Therefore, these problems contributed to the low fruit production and productivity in the district.
Generally, the initial diagnosis, which involved different stakeholders, identified inadequate knowledge and skill on orchard management, lack of improved better marketable varieties of various fruits, lack of skill and knowledge on fruit grafting, lack of improved fruit seedling suppliers at appropriate locations in the district, lack of fruit nursery input supplies and supplier; and lack of market information as important bottlenecks for fruit development in Bure district.

4. Fruit development value chain interventions

To develop the value chain for the better marketable fruit varieties, includes inputs supply (fruit seedlings, scions, rootstocks, pesticides, fungicides, fertilizer, nursery equipments, etc), fruit production, fruit processing and marketing. The innovative approaches followed by IPMS project and the OoARD in fruit value chain development are discussed in the following sub-sections.

4.1. Extension service interventions

Fruit crops are recent introductions to Bure. The OoARD was the sole source of knowledge in fruit production. However, there was shortage of specialized experts in fruit production in the district. To improve the fruit production knowledge and skill in the district, the project in collaboration with the OoARD organized training to farmers, DAs and experts (Table 2). The training was given both theoretically and practically by nursery men from Piccolo fruit nursery (Regional fruit nursery), Adet Agricultural Research Center (AARC) and SIM project. With frequent follow-up and supply of scions from Adet and Melkassa Agricultural Research Centers (MARC), some of the trained farmers and DAs started fruit (apple, avocado and mango) propagation by grafting. In addition, some trained farmers started fruit trees de-suckering and pruning.

The project also organized study tours to farmers, DAs and extension experts to visit highland fruit (apple) orchard management at Injibara (SIM nursery site) and subtropical fruit crops (mango, avocado, banana and papaya) in Bahir Dar (Woramit horticulture research site). In addition, the project organized a number of field days to farmers, DAs and experts to share experiences on fruit tree propagation and management. Moreover, the project in collaboration with the district Office of Information, captured trainings and study tours with video camera and converted them to DVDs. These DVDs are now serving as training materials for farmers and DAs in the FTCs (Farmers Training Centre). The availability of DVD players and TVs donated by the project in selected FTCs allowed the training of farmers and DAs at village level without having to go to big towns. Both farmers and DAs appreciated training using DVD cassette since it allows visualizing the practice and seeing it repeatedly without any modification from its content. This approach was also found useful to train large number of farmers at minimum cost and especially essential to train women and illiterate farmers close to their homes. On top of these, the project also demonstrated
grafted avocados and fruit propagations by grafting at four model FTCs using water from shallow wells lifted by rope and washer device.

Table 2. Overview of capacity development interventions on fruit development at Bure

<table>
<thead>
<tr>
<th>Capacity development interventions</th>
<th>Farmers</th>
<th>Public staff</th>
<th>ATVET college students</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Trainings</td>
<td>42</td>
<td>2</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Study tours</td>
<td>20</td>
<td>2</td>
<td>27</td>
<td>2</td>
</tr>
<tr>
<td>Field days</td>
<td>297</td>
<td>8</td>
<td>358</td>
<td>54</td>
</tr>
<tr>
<td>Total</td>
<td>359</td>
<td>12</td>
<td>397</td>
<td>58</td>
</tr>
</tbody>
</table>

The project in collaboration with the OoARD provided extension service on input supply (established smallholder farmer fruit seedling supply system and linked OoARD and these nursery operators with Axum Greenline Trading Plc), post-harvest handling (demonstrated the importance of zero-energy cool chamber) and marketing (supplied weekly market price information).

4.2. Input supply interventions

4.2.1. Improved fruit seedling supply

To solve the problems of inaccessibility and unavailability of quality improved fruit seedlings at a required quantity, the project selected motivated farmers and facilitated training on fruit propagation techniques together with DAs and experts. In addition, the project in collaboration with AARC and SIM project introduced and planted different cultivars/varieties of banana (Poyo, Butazo and William II), avocado (Hass and Fuerte), apple (Anna, Crispin, BR & MM 106) and papaya (Solo) in the government and smallholder farmer nurseries to serve as mother trees for propagation. On top of this, the project transported over 1000 scions of improved varieties of avocado from MARC and AARC for grafting in the smallholder farmer and government nurseries in 2008. The smallholder farmer nurseries were established at four PAs (Arbisi, Wadera, Wangedam and Wundegi) and Bure town (Table 3). Hence, a limited number of improved fruit crops planting materials are now available in the market from both the government and private fruit nurseries (see result section). The government nursery has started selling grafted seedlings since 2008. These fruits are of high quality and will serve both for domestic and export markets.

1 It is noted that the bulk of the seedlings from the government nursery are still not grafted– see result section
Table 3. Distribution of private fruit nurseries in Bure district

<table>
<thead>
<tr>
<th>No</th>
<th>PA/Town</th>
<th>Number private fruit nursery operators</th>
<th>Fruit crops propagated in the nurseries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Arbisi</td>
<td>4</td>
<td>Avocado, Banana and Papaya</td>
</tr>
<tr>
<td>2</td>
<td>Bure town</td>
<td>1</td>
<td>Apple</td>
</tr>
<tr>
<td>3</td>
<td>Wadera</td>
<td>3</td>
<td>Banana and Papaya</td>
</tr>
<tr>
<td>4</td>
<td>Wangedam</td>
<td>4</td>
<td>Apple, Avocado and Papaya</td>
</tr>
<tr>
<td>5</td>
<td>Wundegi</td>
<td>1</td>
<td>Apple</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

In addition to the linkages between Axum Greenline Trading Plc the nursery operators for nursery equipments, IPMS also purchased and provided fruit grafting knives and pruning sheers as demonstration materials to the OoARD. Moreover, the project also purchased and provided four rope-up water pumps, to lift water from shallow wells, for four model FTCs in support of irrigated agricultural development, including fruits. As a result of these demonstrations, the OoARD purchased six pruning sheers, two grafting knives and one pruning saw for the government nursery. Similarly, a large number of farmers purchased rope-up water pump to grow fruit crops using under-ground water.

4.3. Fruit production interventions

Farmers did not prune and de-sucker fruit trees since they were not aware of the importance. They were also planting tropical fruits in the highlands and irrigating their fruit trees using flood irrigation methods. Consequently, the productivity of fruit crops was low. To solve these problems IPMS project in collaboration with AARC, SIM project and Picolo fruit nursery staff trained farmers, DAs and experts on fruit management, selection of adaptable fruit crops for different agro-ecologies, multistory fruit crops production system, frequency and application rate of fertilizer and different irrigation methods. As a result, fruit growers started growing apple in the highlands while avocado, mango, banana and papaya in the mid to low altitude areas. They also started pruning and de-suckering their fruit trees. Moreover, some farmers adopted ring (basin) method of irrigation.

Farmers grew less productive local fruit varieties but the project introduced improved varieties of apple (Anna, BR and Crispin), avocado (Hass and Fruete), banana (Butazo, Poyo and William II) and papaya (Solo) in eight PAs to demonstrate the performance of these varieties to farmers, DAs and experts. Introduced varieties of banana and papaya started bearing fruits and are now
expanding in the district through farmer to farmer planting material exchange system.

**4.4. Fruit marketing interventions**

Fruits are highly perishable products and hence market information is very important for producers and traders. The project in collaboration with the OoARD and BoARD provided weekly market price information from the district and region, respectively. In addition, IPMS in collaboration with OoARD is demonstrating zero-energy cool chamber to farmers and experts to increase the shelf-life of fruits (Fig. 2). Its cooling system works with water and extends the shelf-life of fruits for a considerable number of days. Therefore, it assists farmers to sell their produce with competitive price by extending the shelf-life. Zero-Energy Cool Chamber can be constructed locally from locally available materials such as bricks, sand, stone, grass and wood.

![Figure 2. Zero energy cool chamber](image)

**5. Results**

**5.1. Fruit tree expansion, production and income**

Fruits are a relatively new commodity in Bure and hence coverage and impact at this time are still small. According to the baseline survey conducted in 2007 the main fruits introduced in the district were banana, avocado, papaya and mango – see Table 4.
Table 4. Number of households/PAs involved in fruit production in Bure

<table>
<thead>
<tr>
<th>Fruits</th>
<th>No of households</th>
<th>PAs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banana</td>
<td>357</td>
<td>13</td>
</tr>
<tr>
<td>Avocado</td>
<td>1151</td>
<td>15</td>
</tr>
<tr>
<td>Papaya</td>
<td>504</td>
<td>11</td>
</tr>
<tr>
<td>Mango</td>
<td>900</td>
<td>14</td>
</tr>
</tbody>
</table>

IPMS baseline survey, 2007

According to the records of the OoARD, a total of almost 30,000 fruit seedling had been distributed to the farmers from 2003 to 2007, including about 5,500 local mango and about 9,000 local avocado seedlings (Table 1). The distribution continued in 2008 and 2009 as shown in Table 5, which includes the grafted mango and avocado varieties produced by the government and private nurseries.

Table 5. Number of fruit planting materials multiplied and distributed in Bure district

<table>
<thead>
<tr>
<th>Fruit crop</th>
<th>2008</th>
<th>2009</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mango*</td>
<td>5292</td>
<td>5327</td>
<td>10619</td>
</tr>
<tr>
<td>Avocado*</td>
<td>3534</td>
<td>3992</td>
<td>7526</td>
</tr>
<tr>
<td>Papaya</td>
<td>5518</td>
<td>987</td>
<td>6505</td>
</tr>
<tr>
<td>Banana</td>
<td>1882</td>
<td>319</td>
<td>2201</td>
</tr>
<tr>
<td>Guava</td>
<td>1334</td>
<td>660</td>
<td>1994</td>
</tr>
<tr>
<td>Total</td>
<td>17560</td>
<td>11285</td>
<td>28845</td>
</tr>
</tbody>
</table>

Source: OoARD annual reports/* including grafted seedlings

About 49.3% of the area covered by fruit crops was planted in 2008 and 2009 as a result of IPMS/OoARD knowledge management, capacity building and input supply interventions.

Following the training, some farmers started de-suckering banana and pruning mango, apple and avocado trees, mulching of fruit trees during the dry season.
and irrigating fruit trees using ring method. These practices contributed to increase fruit production, reduce disease and insect pest incidence and produce high quality fruits.

The banana and papaya varieties introduced have already started bearing fruits. The introduced banana varieties have bigger finger size, large number of fruits per bunch (160 fruits) and longer shelf-life compared to the local available banana cultivar. Therefore, such desirable characters of these banana cultivars contributed to increase banana production and productivity in the district. Better quality fruits will soon be available both for the local and distant markets. Similarly, the papaya variety introduced by the project is hermaphrodite and the fruit has long shelf-life unlike the locally growing papaya variety. It has large number of fruits, about 45 fruits per tree, which are big in size (2.0 to 2.5 kg/fruit) and higher fruit dry matter content compared to the locally available variety. After observing the performance of these banana and papaya varieties, farmers started purchasing papaya fruit for seed extraction and to raise their own seedlings. Similarly, farmers purchased banana suckers from model farmers for multiplication. This practice is new in the district.

Improved varieties of avocado (Hass and Fuerte) were introduced in Arbisi, Wangedam, Wadera, Zalema and Zeyewshewen PAs, while improved apple varieties (Anna, Crispin and BR) in Wangedam, Wundegi, Agnifereda and Shaqua PAs and Bure town. These improved varieties have established well. These are internationally known varieties for their productivity and fruit quality. Therefore, improved orchard management coupled with introduction of high yielding improved varieties are expected to contribute to higher fruit production in the district. In addition, introduction of different fruit crops will contribute to reduce risk of disease outbreak and market glut.

Moreover, the project purchased 150 grafted apple seedlings and demonstrated in three PAs and Bure town for the first time. Following that, the OoARD purchased and distributed 233 grafted apple seedlings to farmers in 2008 and 2009. Similarly, two farmers from Shaqua PA purchased 42 grafted apple seedlings at Birr 28 per seedling from apple propagating farmers in the neighboring district.

The general household survey conducted in 2009, had insufficient observation on individual fruits and household fruit sale to draw conclusion on household level impact of the various interventions. Both district and household level impact studies will be conducted in the coming year.

5.2. Input supply

Both smallholder and government fruit nurseries multiplied and sold planting materials of avocado, mango, guava, banana and papaya (Table 5). In 2008, about 68.6% of the total fruit seedlings supplied in the district were multiplied by
private fruit nursery operators (Table 6). This indicates that the smallholder nurseries are becoming more efficient compared to the government fruit nursery in multiplying and distributing fruit seedlings to farmers. Supply of fruit planting materials from smallholder nurseries, which are established close to farmers villages will help improve survival rate of seedlings planted by farmers and reduce cost of transport, time and bureaucratic processes. In addition, private fruit nurseries contribute for the sustainable supply of fruit planting materials to fruit growers and to supply fruit planting materials in remote or inaccessible areas easily.

However, most of the avocado and mango seedlings are not grafted (only 3% of the avocados and mangoes were grafted in 2008), mainly because of lack of scions. Currently, however, the OoARD is discouraging sale of non grafted mango and avocado seedlings from its nursery. Some of the planted avocado mother trees have started yielding scions and a source of improved avocado scions was identified in the District. As a result, for the 2010 planting season, more than 1500 avocado seedlings (35%) are now grafted in the government nursery. Data from 5 private nursery operators even show that 93% of the avocado seedlings raised for the July 2010 planting seedlings are grafted (personal communication). Furthermore, non grafted mango seedlings raised in the government nursery will be grafted later.

Table 6. Number of fruit seedlings multiplied by government and private nurseries in 2008

<table>
<thead>
<tr>
<th>Fruit crop</th>
<th>Nursery operators</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Government</td>
<td>Private</td>
</tr>
<tr>
<td>Mango*</td>
<td>2621</td>
<td>2671</td>
</tr>
<tr>
<td>Avocado*</td>
<td>1363</td>
<td>2171</td>
</tr>
<tr>
<td>Papaya</td>
<td>1170</td>
<td>4348</td>
</tr>
<tr>
<td>Banana</td>
<td>43</td>
<td>1839</td>
</tr>
<tr>
<td>Guava</td>
<td>317</td>
<td>1017</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5514</strong></td>
<td><strong>12046</strong></td>
</tr>
</tbody>
</table>

* Data includes both grafted and non grafted seedlings.
5.3. Marketing

In 2008 and 2009 about 185 and 933 grafted mango and avocado seedlings, respectively, were sold to small scale farmers and an investor (Table 7). The price of a grafted fruit seedling was 7.00 birr in the government nursery and 20.00 birr in the private fruit nurseries, while ungrafted seedlings sold at Birr 2 each. Despite the fact that the price of grafted fruit seedling is 10 times higher than non-grafted fruit seedlings, farmers preferred to buy grafted fruit seedlings and the supply was by far lower than farmers demand. Therefore, fruit planting material multiplication and marketing became lucrative business for some landless youth and female headed households (Table 8).

Table 7. Number of grafted fruit seedlings multiplied from private and government fruit nurseries in Bure district.

<table>
<thead>
<tr>
<th>Nurseries</th>
<th>2008</th>
<th>2009</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Avocado</td>
<td>Mango</td>
<td>Avocado</td>
</tr>
<tr>
<td>Government</td>
<td>54</td>
<td>77</td>
<td>390</td>
</tr>
<tr>
<td>Private</td>
<td>110</td>
<td>0</td>
<td>379</td>
</tr>
<tr>
<td>Total</td>
<td>164</td>
<td>77</td>
<td>769</td>
</tr>
</tbody>
</table>

Source: horticulture expert and IPMS staff

Table 8. Number of grafted fruit seedlings sold by some private nursery operators (2008 and 2009)

<table>
<thead>
<tr>
<th>PA</th>
<th>Farmer’s name</th>
<th>Gender</th>
<th>No. of seedlings sold</th>
<th>Price/seedling</th>
<th>Gross income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arbisi</td>
<td>Shetie Megbaru</td>
<td>Male</td>
<td>32</td>
<td>20</td>
<td>640</td>
</tr>
<tr>
<td>Arbisi</td>
<td>Yehuala Abate</td>
<td>Male</td>
<td>38</td>
<td>20</td>
<td>760</td>
</tr>
<tr>
<td>Arbisi</td>
<td>Getaneh Hunegn</td>
<td>Male</td>
<td>30</td>
<td>20</td>
<td>600</td>
</tr>
<tr>
<td>Wangedam</td>
<td>Addis Bekalu</td>
<td>Male</td>
<td>90</td>
<td>20</td>
<td>1800</td>
</tr>
<tr>
<td>Wangedam</td>
<td>Asheber Alemu</td>
<td>Male</td>
<td>268</td>
<td>20</td>
<td>5360</td>
</tr>
<tr>
<td>Wangedam</td>
<td>Kassu Afework</td>
<td>Female</td>
<td>31</td>
<td>20</td>
<td>620</td>
</tr>
<tr>
<td>Total</td>
<td>489</td>
<td></td>
<td></td>
<td></td>
<td>9780</td>
</tr>
</tbody>
</table>

Source: Nursery operators
The gross income derived from the grafted seedlings varied from Birr 640 to 5360 as can be seen from Table 8.

The zero-energy cool chamber established at the government nursery is currently used to improve shelf life of some vegetables but it is expected to be used for fruits as well. As this chamber could easily be made locally, it is expected to expand in the near future, especially in far away places where easy access to market is difficult.

5.4 Indirect benefits

5.4.1. Gender

Fruit nursery activities are mostly done by women and children since they are located in the backyards. Therefore, fruit development interventions of the project created favorable conditions for female headed households (FHH) to generate better income using their limited resource (land and capital) and labor. For example, one of the private fruit seedling suppliers at Bure is a female headed household who raised and sold 31 grafted avocado seedlings and obtained Birr 620 in 2009. In addition, four FHHs from Arbisi, Wadera and Wangedam started benefiting from the banana cultivars introduced by the project. Field crops require repetitive land preparations (ploughing), which become very difficult for women farmers because they are traditionally not allowed to plough using ox. Therefore, FHH usually rent-out their farmland for share cropping. With fruits however, this is not a problem because once holes are prepared it becomes easy to manage them. Therefore, FHH can fully benefit by growing fruit crops on their land.

5.4.2. Employment opportunity

Fruit seedling multiplication and marketing is a lucrative business. It requires small amount of capital, labor and land. Therefore, it is ideal to employ women and landless youth in rural areas. A number of landless youth from Arbisi, Wangedam, Wundegi PAs and Bure town started fruit seedling multiplication and marketing. For example, a landless youth from Wangedam PA obtained 5360 birr by grafting and selling 268 avocado seedlings (Table 8).

The expansion of fruit production in the district contributed for the establishment of six fresh fruit and four fruit juice selling shops in Bure town. In addition, local fruit traders started fruit collection from villages. Therefore, expansion of fruit production in rural areas is gradually creating employment opportunity to the town dwellers too

5.4.3. Environment

Fruit development contributes to the sustainable utilization of natural resources since it reduces soil erosion, reduces runoff, increase water infiltration and permit to fulfill the household livelihood from a small plot of land. Fruit crops are usually perennials and do not require frequent cultivation. It also protects the soil from
wind and water erosion through its roots, branches and leaves. Therefore, fruit development has vital role on soil conservation. In addition, some farmers, especially landless youth, who used to sell charcoal, are now engaged in fruit seedling business. Their enrollment in such activities will make them work for the environment because they will be away from selling charcoal which enhances deforestation. Moreover, fruit development is important for apiculture development. The flowers of fruit crops serve as honeybee forage especially during the dry season when the natural vegetation is not able to supply (Segeren, 2004).

5.5. Institutional/organizational changes

- In the previous years fruit seedlings were supplied only by government fruit nursery. However, currently private fruit seedling suppliers established in Arbisi, Wadera, Wangedam and Wundegi PAs and Bure town are as well supplying fruit seedlings. Therefore, the role of farmers changed from merely input users to both improved input suppliers and users.

- Bure district OoARD was distributing fruit seedlings free of charge to farmers even with transport service until 2006. In 2007 the OoARD terminated free of charge fruit seedling supply system.

- Expansion of fruit production in the district contributed to the establishment of a number of fresh fruit juice selling shops in Bure town. In addition, local fruit traders started fruits collection from farmers’ villages.

- In the previous years, the assistance of DAs on fruit development was mainly on distributing fruit seedlings to farmers. However, after IPMS training on fruit propagation techniques to DAs, they started to assist farmers on fruit grafting and orchard management (sharing of knowledge and skill).

- The OoARD and fruit growers established linkage with SIM project and AARC for the supply of improved varieties of various fruit crops as well as for training farmers and experts on orchard management and fruit propagation.

- The OoARD and fruit growers established linkage with Axum Greenline Trading Plc and rope-up water pump supplier to access various fruit nursery equipments and water pump.

- DAs started demonstrating fruit grafting and supplying water from shallow wells using rope-up water pump for improved avocado varieties in FTCs.

- Bure ATVET college started providing practical training to students (candidate DAs) on fruit propagation and management using private fruit planting material suppliers as resource persons.
• Individual farmers as well as OoARD of neighboring districts purchased fruit planting materials from Bure district.

6. Challenges

• As a result of fruit propagation technique training and by observing the economic benefit of fruit seedling multiplication and marketing activity, a number of private fruit seedling suppliers were established in different PAs. However, shortage of seed for rootstock multiplication and scion for grafting is a challenge. In addition, grafting equipments and other consumables are not locally available for private fruit seedling multipliers. The project partially solved these problems by planting improved varieties in the orchards of private fruit nursery owners, to serve as future mother trees. It also linked the OoARD and private fruit nursery owners with Axum Greenline Trading Plc for nursery equipments.

• Private fruit nursery operators are now multiplying grafted fruit seedlings and marketing to farmers. However, grafted fruit seedling certification system is not yet established in the district, zonal or even regional level.

• Potted fruit planting materials multiplication for marketing resulted in depletion of top soil in private fruit nursery sites. Therefore, shortage of top soil for potted fruit seedling multiplication is becoming a challenge for private fruit nursery owners especially for landless youths. Nursery operators are however advised to have own compost pits in their compounds.

• Most fruit crops are perennials and require repeated fertilizer application per year. However, fertilizer is not locally available throughout the year and it is not supplied at smaller quantities. Moreover, the type of fertilizer available nationally contains only two elements, nitrogen and phosphorous. However, fruit trees require micro- and macro- elements to improve fruit quality, extend shelf-life and increase productivity.

• Some fruit crops mature seasonally and are highly perishable compared to field crops. Therefore, harvested fruits have to be transported immediately to the local market by producers. This situation created labor shortage on other agricultural activities. This problem can be solved through contract farming or collective marketing approaches or arrangements.

• In the future, insect pest and diseases will buildup and may cause fruit yield losses as a result of expansion of fruit production. In addition, shortage of irrigation water may also limit expansion of fruit production in the area. However, these problems could be solved by using resistant varieties, proper agronomic practices (adequate nutrient supply, mulching, pruning, etc), pesticide, fungicide and sub-surface irrigation techniques.
• The current harvesting (by directly throwing from big trees to the ground), transport (by donkey or humans) and marketing systems (on the open air) are contributing to fruit quality deterioration and higher post-harvest losses. These challenges can be solved through training and by linking with harvesting and transporting equipment suppliers.

7. Lessons learned and recommendations

• Commodity development interventions should consider all the steps in the commodity development value chain for the smooth functioning of the value chain. For example the deadlocks on improved fruit production at Bure were lack of improved varieties, lack of fruit grafting knowledge and skill and lack of fruit propagation equipment supplier which were solved by the commodity development interventions.

• The OoARD focused on fruit seedling multiplication and distribution to farmers. It was proved that, this responsibility can effectively and efficiently be handled by smallholder fruit nursery operators. In addition, it opened up employment opportunities to landless youth and poor women farmers. Therefore, the OoARD should leave seedling multiplication and distribution responsibility to smallholder nursery operators and focus more on knowledge sharing through training and linking of farmers to input suppliers and traders.

• Although fruit production is a backyard activity and usually managed by women and children, trainings and study tours were previously given only to male farmers. IPMS project provided training on fruit nursery management to men farmers, poor women farmers and landless youth. Most of the adopters of this training were landless youth and poor women farmers. Therefore, trainings and study tours on fruit production and nursery management should focus on landless youth and poor women farmers as well.

• Activities such as grafting which seemed difficult and requiring special skills were easily managed by smallholder farmers. This is because smallholder nursery operators in Bure successfully grafted avocado, mango and apple seedlings. Therefore, it is important to expand fruit grafting practices or experience through farmer to farmer training or study tours within the district in order to increase the supply of grafted fruit seedlings.

• Improved fruit seedling multiplication will be true only if private fruit nursery owners use improved varieties as scions in the grafting activity. Currently, scion is not adequately available for grafting and some private fruit nursery operators may graft using unimproved varieties as a scion. Therefore, the
OoARD should play regulatory (monitoring or certification) role to control the quality of grafted fruit seedlings by private nursery operators.

- Most of the fruit crops are perennial crops and have long juvenile period. Therefore, they require a lot of time to return the investment cost. Inappropriate irrigation, nutrition and agronomic practices will cause death or delayed production period of fruit trees. For example fertilizer is not available throughout the year and the available fertilizer lacks other essential elements for fruit production. This situation should be improved by importing and distributing fertilizer which contains other macro and micro-nutrients which are essential for fruit production.

- Fruits are highly perishable and bulky commodities. Therefore, a lot of extension effort is required on post harvest handling and marketing of fruit crops.

- Private fruit nurseries are established near to farmers’ villages, sell fruit seedlings to everybody without any precondition and provide service all the time. Therefore, private fruit nurseries removed the lengthy bureaucratic process of the government fruit nursery, reduced fruit seedling transport cost, increased the survival rate of planted fruit seedlings and created convenience to female farmers to buy and plant fruit seedlings.

8. References


