



A Farmer-based fruit seedling supply system in Dale Pilot Learning Woreda (PLW): Experiences from IPMS.

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This paper documents interventions, results and lessons learned for fruit commodity development in Dale 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 farmers, staff of the Dale OoARD, Melkasa Agricultural Research Centre, Upper Awash Agro industry and private sector input suppliers and traders.

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Abstract

Dale Woreda is well known for its avocado (*Persia americana*) and to a lesser extent mango (*Mangifera indica*) production. These fruit trees are planted along with coffee (*Coffea arabica*), enset (*Enset ventricosum*) and other crops. They are important sources of income and food, playing a considerable role in the livelihood of thousands of smallholder farmers of Dale. However, the varieties found in the area have large canopies that reduce land availability for other crops. They are also tall (10-15 m) thus harvesting becomes a challenge, particularly for women. Market prices for these varieties are low and during collection, there is considerable fruit loss when they fall, causing cracks and bruises and hence their rejection. The trees also take 7- 10 years to bear fruit and farmers mention that the land can be used more productively and therefore want to replace fruit trees with other more profitable crops.

The diagnostic survey carried out by Improving Productivity and Marketing Success (IPMS) of Ethiopian farmers' project identified some of the above production constraints as the major area of intervention. Further study was conducted by the International Centre for Research on Agro Forestry (ICRAF) which confirmed the above problems and suggested introduction of improved variety through grafting as one of the best solution to improve the quality of seed, reduce size and height as well as improve productivity and marketability of these varieties.

Taking the experience of Dale for coffee seedling production where farmer's nurseries have taken over 95% of seedling production, the Dale partners decided to use farmers' nurseries as the base to start production of grafted seedlings.

Using participatory extension methods with the help of various partners, the number of private nursery operators increased from the initial six (3 females) to 20 (7 female) in 2009. The number of seedlings produced has now reached 12,000 annually and this can be easily expanded since scions can now be obtained from mother trees established earlier in each of the nursery sites. Currently, seedlings are sold at around Birr 15/seedling to neighboring farmers, some on credit provided by the nursery operators. Linkages with the Productive Safety Net program are made to facilitate the scaling out of the sale of seedlings to emerging commercial farmers.

Nursery operators earned between Birr 4,000–7,000 per year from these operations. Further skills development can still be made to improve survival rates of grafted seedlings. Attention will also need to be paid to the marketing of these improved varieties as well as the development of a responsive support system providing fresh knowledge, building capacity and new technologies.

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 smallholder farmers from a predominantly subsistence oriented agriculture to a more market (commercial) oriented 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 establishing improved fruit seedling supply system in Dale Woreda with the objectives of documenting diagnostic results and value chain interventions, and providing proof of concept, challenges and lessons learned to be considered for scaling out.

Following the introductory section, the remaining sections are structured as follows. 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 irrigated vegetable 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/labour use, organizational and institutional aspects, while sections six and seven deal with challenges and lessons learned, respectively.

2. Methods and approaches

To start the development of a commodity, IPMS used a Woreda 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, and (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 Woreda, 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 (www.ipms-ethiopia.org) and the annual Monitoring and Evaluation (M&E) reports.

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 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 irrigated area coverage and the number of households involved in irrigated agriculture. This information was used to compile Woreda level information on irrigated 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, a commodity stakeholder workshop and a household level survey. The stakeholder meeting was organized to establish the evolution of the roles and linkages of the value chain actors.

In Dale, the 10 PAs (Dehub Kege, Soyama, Dehub Mesekela, Wara, Weynenata, Gjamo, Manche, Gane, Ajewa and Halile) targeted by IPMS for market development were included in the formal household survey conducted in 2009. The survey data consists of relevant production and marketing information on vegetables including area allocation, production costs and inputs use, level of production, and marketed surplus. In selecting the sample households, with the aim of getting some idea about the effect of the different interventions, a distinction was made between households

who had adopted/benefited from the various interventions and households who did not. In both sample groups, both wealth and gender criteria were considered to get a representative distribution of sample households.

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 experts at the IPMS Head Quarter.

3. Background to avocado and mango development

3.1. The Project Learning Woreda Description

Dale Woreda is located some 320 km South of Addis Ababa, in the Southern Nations, Nationalities and People's Regional State (SNNPRS). It is located at 6° 39' 20.47" to 6° 50' 28.83" North and 38° 18' 12.73" to 38° 31' 30.6078" East (Fig. 1). According to the recent population count, Dale has a total household (hh) population of 222,000. Of these, 185,000 are men and 37,000 women headed hhs with an average household size of 6–10 people (OoARD, 2007). More than 85% of these hhs are agrarian. The Woreda has an altitudinal range of 1626-2423 meter above sea level.

Based on information from Awada Research Sub-station at Yirgalem, the annual mean rainfall (1989-1998) is about 1314 mm (IPMS, 2005). There are two cropping seasons depending upon the rain. The short rains are from March–April ("Belg") while the long rains are from June–September ("Meher"). The Belg rain is mainly used to grow maize under sown with beans and transplanting of coffee seedlings, while during the main rains, coffee, "enset" (*Ensete ventricosum*) and fruit trees are planted/transplanted. Annual mean temperature ranges between 15-19 C°. In addition, the soil in Dale is mainly Nitosol with pH ranging between 5.5 and 6.5.

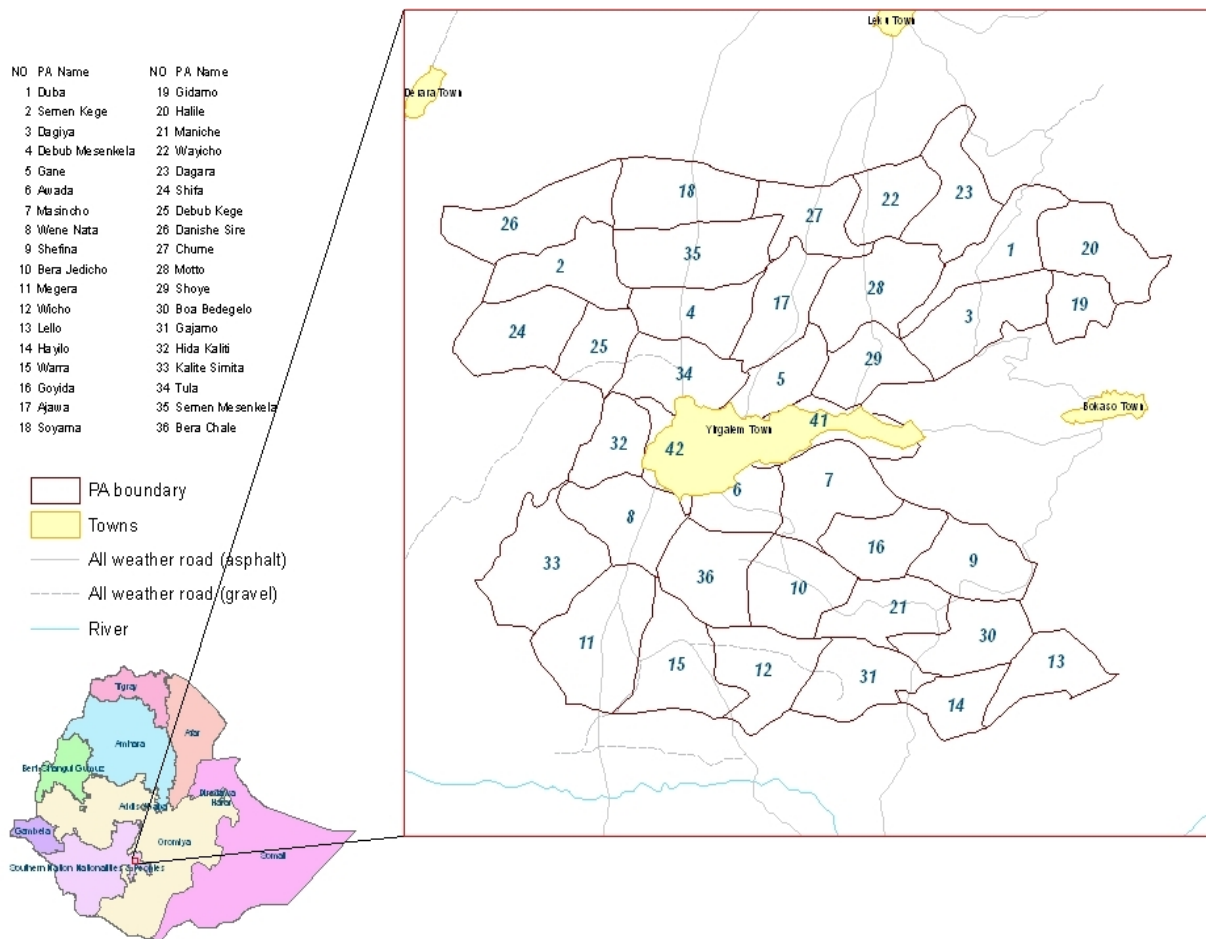


Figure 1. Map of Dale Woreda

3.2. History and diagnosis of avocado and mango production

According to the verbal history, avocado was originally introduced to Dale by Greek missionaries during the 1950s, at the Shafina PA Missionary Centre. Since then, the fruit has been integrated into the garden coffee-enset system. Avocado and mango have multiple uses, including their contribution to people's diet but the fruits also fetch good money for rural households. The number of trees per farmer varies according to the availability of land/space and preference of crop mix. According to the survey made by Anand and Justine (2006), farm households who are the lowest producers in Shafina PA on average have 2 avocado trees while medium producers have 5 trees and the best producers have up to 10 trees. Similarly, the lowest producer farmers in Halekena PA have on average 2-3 trees, a medium producer has 20 while the best producers have 30 trees. However, there are also some farmers who are reported to own up to 50 trees individually. On average, an avocado tree would yield up to 120 kg over two growing seasons (October to March and May to August) and on average fetched Birr 70-90/bag in 2007 and up to Birr 120-130/bag at the farm gate in 2008 (Personal observation). A bag of avocado weighs between 60 to 70 kg.

Farmers over the past forty years have identified various constraints that hinder them to use the full potential of the varieties grown in the Woreda. Among those, the avocados and mangoes in the area grow to the height of 10-15 m and have large canopy (personal observation). This has at least three disadvantages in that i) the height is unmanageable for fruit collection, especially for women, ii) the canopy crowds out other crops such as coffee¹ and maize and iii) many farmers claim that a considerable amount of fruit is lost due to cracking caused by falling from the big height. Furthermore, according to farmers, these trees take 7-10 years to bear fruit. This discourages farmers who have limited land to have these large fruit trees, while at the same time the opportunity value of using the land for other crops seems more viable. These factors have led some farmers to decide to remove the trees from their land.

Despite the long experience, performance of fruit development in Dale is also poor because of an inefficiently organized system for the supply of improved fruit tree varieties/cultivars/type. The sources of improved fruit seedlings in Ethiopia are few, with the major one being the state farms in The Upper Awash Agro-industry. With demand coming from all over the country, Upper Awash could not but supply very limited numbers for customers. Melkassa Agricultural Research Centre (MARC) which is the centre of excellence in tropical fruit research is also the only source of scion supply so far.

To improve the performance of the fruit value chain in Dale, emphasis was put on the introduction of grafted fruit varieties which have a good market potential according to the PRA conducted by the project (IPMS, 2005), confirmed by a marketing study conducted by Anand and Justine, 2006.

Furthermore, grafted avocado and mangoes with some pruning and training at later stage of growth will limit the growth of trees to manageable height. In addition, grafted avocado will start to bear fruit after 3-5 years and 3-4 years in case of mangoes (Rice *et al* 1987).

Focusing on this strategy of introducing grafted better marketable varieties, the project partners decided on the development of village level smallholder farmer fruit nursery system. This was partly based on the experience gained from coffee seedling production and supply by smallholders, where more than 85% of the seedlings in Dale Woreda was supplied by small scale nursery operators in 2005 (IPMS, 2005) and increasing to more than 95% in 2008/9 (Dale OoARD 2009).

Such a private, village based nursery system will also contribute to a) reduce transport distance between seedling suppliers and users and hence cost, b) reduce mortality of the scion or seedling during transportation, c) create employment and income for nursery operators and d) introduce new skill and knowledge in grafting

¹ These are coffee types which were brought from the Southwestern part of the country in the 70s because of coffee berry disease (CBD) attack which are normally planted in open fields. Local coffee types are however planted under shed.

techniques and management and improved fruit management in general (Kahsay *et al.*, 2009).

4. The value chain development approach

4.1. Extension interventions

Following the decision to adopt this strategy, 10 couples (husband and wife) were selected and consulted to start the fruit seedling nursery business. Among other criteria, consideration was given for availability of land, access to perennial water source, willingness to engage in the venture by allocating labor and other resources including compost by farmers themselves to establishing a nursery. Some of these farmers have actually previous experience in fruit production (having their own trees) as well as managing their own coffee nurseries.

Training was developed after consultation with farmers who clearly identified areas where they needed more information or skill to improve their nursery and also orchards management. The training followed a new approach that involved mainly the trainees in identifying the issues/topics to be addressed (rather than prescribed training module and training perceived necessary by the trainers), farmers, mainly women, were given the upper hand to decide the number of days, venue and time of the training. This had taken women's daily routines and family responsibility into consideration which usually is more than those of men in general. Such considerations in general recognize productive and reproductive roles of women and open up opportunities for women to participate in trainings and other capacity building endeavors.

The project identified resource persons to conduct the training in nursery management and grafting. The trainers included a lecturer in fruit production from Awassa College of Agriculture along with the Woreda subject matter specialists who provided the first theoretical background and some practical demonstration in 2005.

The first training (27-30 December 2005) was delivered in open space under a tree and farmers went around the village looking at cases of avocado and mango, exchanging knowledge, asking practical questions at the same time and receiving qualified experts' advises on the matters raised. They also visited and conducted practical training in nursery establishment at the nearby government nursery. The training was organized to enhance the capacity and knowledge of farmers in nursery establishment and fruit tree management so that the short term training arms them with sufficient knowledge and skills in fruit tree management from nursery to establishing their own commercial private farms.

The second training took place between 2 and 6 of March 2006. This training was mainly focused on grafting in which three seasoned technicians from Melkassa Agricultural Research Centre (MARC) (with 15-20 years of experience in grafting) provided training for the same 20 farmers who were trained previously and 5 DAs and 3 Woreda SMSs. The training again was practical skill hands on training where farmers immediately went in to practicing what they had learned in grafting

technique. For this training, MARC provided scions/bud sticks for grafting while OoARD availed its nursery at Gidabo with 2300 seedlings for practical training.

As part of the capacity building effort in 2006, a Woreda staff was sent for a six weeks training on temperate fruits management including nursery management and grafting techniques, to Chenchu where Kale Hiwot Church has made great way in this area, including apple production.

In addition to the training, OoARD SMS and desk heads and DAs took part on a field tour to MARC and Upper Awash agro industry farms where nursery and fruit tree management including grafting was demonstrated and also introduced to new varieties in the country. The OoARD also became an active participant in the scaling out of the nursery technology and sale of seedlings in and outside the Woreda using various approaches and tools, which are summarized below:

Most fruit seedlings are sold through the OoARD, which organizes buyers in every PA and eventually facilitate the sales. The project also developed posters that show what the grafted fruit tree look like at full bloom and fruiting. The promotional material was distributed throughout the 36 PAs in the Woreda by DAs and SMSs who have conducted scaling out planning in June 2009.

In addition to the above, the local Sidama FM and the regional FM 100.9 radio stations and the Southern region television visited the nurseries and aired programs regarding grafted seedling production in the Woreda, in both 2007 and 2008. In these programs, Woreda SMS and nursery owners were interviewed to explain the nature of the new activity and relative advantage in improvement of avocado and mango production. The impact of these efforts will be observed at a latter stage through increased sale of seedlings by the nursery operators or increased number of farmers engaged in this business and hence increased fruit production in the Woreda.

In 2009, a scaling out planning meeting was held for more than 300 lead farmers, some 126 DAs and Woreda SMSs as well as the Woreda council The IPMS RDO and Woreda fruit expert and some of the nursery owners took the opportunity to present the success story achieved in the Woreda that created a huge interest by farmers. Later on, follow up planning meetings were held in each PA where DAs, farmer leaders and SMSs spread the message to more farmers (see result section).

Another strategy used in promoting the new system was through inter-PA visits. Many farmers from the 36 PAs of the Woreda were encouraged to visit the Farmers' nurseries and discuss and learn from their fellow farmer nursery operators. In addition farmers' representatives from all over the Woreda visited some of the nurseries during farmers' field days. In 2008, Dale Woreda OoARD was chosen to show the experiences of the fruit nursery operators for farmers and development workers from all over Ethiopia who took part in the annual national farmers' festival in Awasa. Some 360 farmers from all over Ethiopia visited nurseries in Dajia. OoARD staff from various Woredas in Sidama zone and farmers and development workers from as far as Tigray in the North and South Omo in the South visited the nurseries of the operators to share their experiences. Following that, farmers from Bale in

Oromia region came to buy seedlings from Dale. As a consequence, demand for the seedlings came as far as Tigray and Gondar. This therefore became part of the scaling out activity.

In May 2009, there was a national fruits festival in Arba Minch town where one leading nursery operator from Dale demonstrated and sold grafted avocado and mango seedlings. This was made possible by the support of IPMS and Woreda OoARD facilitation.

4.2. Production intervention

The production intervention includes introduction of improved commercial cultivars that have been tested and now promoted by the national research centre at Melkassa and Upper Awash Agro Industry. The introduced avocado varieties include “Ettinger”, “Fuerte”, “Hass” and “Bacon” which are known for bearing uniform and good quality fruits. Among the mango varieties, Apple mango was the only variety available at the time of research for distribution. Apple mango is popular for its good fruit characteristics with average fruit size of 400mg, high flesh (pulp fruit weight) 316 mg/fruit and fibreless nature as well as high juice concentration (Edosa, 2006).

In addition to capacity development, the new varieties required linkage with research for new technology, knowledge and skill transfer. MARC provided the scions, grafting technicians and also shared knowledge by participating and presenting seminars (that highlighted the prospects and opportunities of fruit production in Ethiopia) and practical advises to farmers as well as Woreda SMS during their field visits. Besides training on nursery related topics, farmers who received grafted seedlings were also trained in modern fruit management.

4.3. Input supply provision

The project identified some 20 farmers of whom 13 were male and 7 female (6 out of these were couples and one widow) in 10 PAs (Ajawa, Awada, Dagia, Halekena, Huletegnna Ferro, Gane, Gejaba, Shafina, Shoye and Manche) to be trained in establishing fruit nurseries to grow grafted seedlings. In order to materialize, the project facilitated the acquisition and delivery of the scions from the MARC to farmers’ nurseries. Scions were provided free of charge from MARC, however, this could not continue and at one time in 2008 the research had indicated their intention to charge Birr 0.75 per scion. To create a more sustainable supply of grafting materials, all the nursery operators have established their own mother trees of about 13 to 15 each for sourcing scions in the future.

Nursery operators were new to the new varieties introduced. In addition to capacity building through training and study tour, photos of the fruits by variety were displayed so that farmers who will be buying the seedlings will chose the fruit type or will understand what type of fruit their seedling will be bearing later on. This was also used as a means of identifying the names of the seedlings. At this time, all of the nursery operators know the names and the growing characteristics of the various varieties introduced.

Nursery operators are assisted in the sale of their seedlings by the OoARD (see extension interventions – also see result section.)

4.4. Marketing

Since the introduced improved varieties have only started producing fruits recently, no specific fruit marketing interventions were so far introduced by the project. ICRAF did however conduct a study on the existing market channels from Dale and other Woredas. Findings from the study can be used to design a marketing strategy for improved fruits. Findings of the study include that:

1. There is growing demand for fruit in Addis Ababa, the main market
2. Ethiopia is not able to meet the local demand for fruit
3. Demand for exotic fruit varieties is higher than demand for indigenous fruits/varieties

An informal fruit market assessment was carried out in March-April 2009 in Addis Ababa, identified prices for the improved varieties of avocado at Birr 11-12/kg and Birr 10 for the apple mango. It is obvious that farmers who are planting these seedlings will eventually benefit from the new market. However, this will require a few more years, when the number of trees increase in and around the Woreda, raising production level and thus also improve the quality of fruits.

5. Results

5.1. Production, productivity and coverage

The baseline survey conducted in 2005 showed that fruits were wide spread (around 30 PAs). No reliable data could be obtained on the number of households growing fruits, however some household level data on the marketing of fruits provided information on the importance of local fruits in the Woreda, as shown in Table 1.

Table 1. Households involved in local fruit production in Dale in 2007

Fruit	No of sample HH producing/selling fruits	Av volume sold kg/HH**	Av Mean income Birr/HH**	Average Price (Birr)
Avocado	46/43	182	102 (44)	0.56
Mango	45/43	95	72 (43)	0.76
All fruits	65		131.8	

IPMS baseline survey 2005

* In brackets the number of PAs, ** only household selling

In 2008/09, the household survey conducted on fruits provided another overview of the importance of local fruits

Table 2. Household survey data local fruit system in Dale in 2008

No	Fruit type	For all growers			For sellers				Percentage of selling households
		Obs	Average volume sold (kg/HH)	Average value sold (Birr/HH)	Obs	Average volume sold (Kg/HH)	Mean value (Birr/HH)	Average selling price (Birr/kg)	
1	Avocado	40	417.4	448.19	38	439.3	471.8	0.95	95.0
2	Banana	72	369.8	433.94	64	416.0	488.2	1.92	88.9
3	Mango	7	126.4	158.57	7	126.4	158.57	1.10	100.0
4	All fruits	83		615.59	77		663.56		92.8

A comparison between the sets of survey data suggest that household income derived from the existing fruit production system increased considerably i.e. from Birr 132 to 663/household from 2004/5 to 2008/9, as a result of increased volumes sold and increased prices.

The development of a fruit value chain, based on more marketable, grafted varieties started more or less from zero based on seedlings distributed by the OoARD and seedlings produced by the private nursery operators. A total of 1,565 grafted seedlings were distributed in 2007 (Table 3), and another 1,120 in 2008 (Table 4) and 2,619 in 2009. About 10 to 12,000 are expected to be sold in the coming year (2010). The mother fruit trees planted at the beginning of this program have just started producing fruits.

5.2. Input supply and marketing

In 2006, some 20 farmers (13 males and 7 females) from 10 fruit producing PAs (Ajawa, Awada, Dagia, Halekena, Huleteгна Ferro, Gane, Gejaba, Shafina, Shoye and Manche) were trained initially in nursery management and later on in grafting techniques. In addition 5 DAs and 3 Woreda staff took part in the same training.

During the first grafting training, the average success of grafting for avocado was 78.6% and 55.5% for mango. The grafted seedlings were distributed to the 20 farmers that were trained in grafting and potential private fruit nursery operators. They received 13-15 seedlings from both fruits each to start the fruit nursery operation in their backyards. These seedlings were intended to serve as the future mother trees for producing scions. Another 124 farmers were selected by OoARD and received 11 seedlings each to start their own orchards. These seedlings are tagged and registered by Woreda OoARD fruit experts.

Table 3. Number of avocado and mango seedlings grafted and success rate during the first training in 2006

Type of fruit	Grafted	Successfully grafted	Success rate in (%)
Avocado cultivar			
Fuerte	222	177	79.7
Bacon	146	116	79.5
Ettinger	664	530	79.8
Average for avocado	1032	823	79.7
Mango			
Apple mango	1341	745	55.5
Total	2373	1568	66.1

Source: OoARD report 2007

Table 4. Grafted seedlings and success rate during the second time, 2008

Fruit type	Grafted	Successfully grafted	Re-grafted seedlings ²
Avocado	1407	973 (69.2%)	100
Mango (apple)	213	147 (69%)	100
Total	1620	1120 (69.1%)	

Source: OoARD 2008

In 2007, out of the 20 selected and trained hhs, three started fruit nursery business – the number was limited mainly due to shortage of supply of planting material for grafting (only 2,000 scions were obtained from MARC). Moreover, some of the promising farmers were unable to participate due to the new Woreda delineation which placed them in a new Woreda. The three farmers together produced 1620 seedling out of which 1120 seedlings were successfully grafted in 2008.

In 2009, three more farm households joined as nursery operators to raise grafted seedlings. Out of 4,312 rootstocks, 2,619 seedlings (60.7%) were successfully grafted and reported sold.

As a result of the planning workshop in 2009, some 26 farmers joined the private nursery business and the number of nursery operators increased to 32 spreading across 8 PAs – see scaling out interventions. Now, these 32 nursery operators have sown over 20,500 seeds of mango and avocado for raising root stock seedlings, as counted in October 2009.

Currently farmers have started to use scions from their own orchard for grafting. Seedlings that were planted in the last three years have started to bear fruit as well as provide planting material. However, with the increment of the number of farmers that went into raising grafting seedlings business, their requirement can only be satisfied with some more external supply.

² Seedlings which were grafted earlier but failed were re-grafted with new scions

Table 5. Number of root stock growers and seeds for rootstock raised by farmers in Dale, 2009

	Name of PA	Nursery owners	Mango	Sown Avocado seeds
1	Showe	6	1075	1081
2	Dagia	10	2380	8480
3	Moto	3	511	1196
4	Ajawa	2	600	Not reported
5	Bera Tedicho	3	770	500
6	Wara	3	437	1694
7	Wicho	3	237	579
8	South kege	2	530	510
	Total	32	6540	14040
	All seeds planted			20580
	Expected successfully raised seedlings for grafting (based on Table 4)	12607	5068 (at 77.5% success rate)	7539 (at 53.7% success rate)

Source: OoARD, 2009

The estimated cost of production is Birr 5/seedling and the average sales price was 13.5, resulting in a profit of about Birr 8/seedling – see Table 6 – based on a nursery producing 1200 grafted seedlings.

Table 6. Production cost of seedling raising and price in Dale

No	Production activities/Items	Cost type	Amount	Unit	Unit cost (Birr)	Total cost (Birr)
1	Preparing forest soil (4m ³)	Labour	14	Man-Day	10	140.00
2	Purchase of sand	Material	2	m ³	40	80.00
3	Compost 3 bags	Material	3	bags	40	120.00
4	Polyethylene bag	Material	7	kg	50	350.00
5	Seed bed preparation and placing poly bags	Labour	4	Man-Day	10	40.00
6	Filling 2200 bags with mixed soil	Labour	22	Man-Day	10	220.00
7	Seed purchase cost	Material	2200 ^a	Pieces	0.75	1650.00
8	Grass for cover	Material				200.00
9	Planting the seeds and covering with grass	Labour		Man-Day	10	20.00
10	Watering for the first six weeks	Labour	24	Man-Day	10	240.00
11	Seed bed shade material	Material				130.00
12	Shade construction	Labour	2	Man-Day	10	20.00
13	Care for the seedlings (for four months including watering and weeding)	Labour	30	Man-Day	10	300.00
14	Scions purchase including transport	Material	1540 ^b	scion	1	1540.00
15	Grafting by technician (200 seedlings per day)	Labour	7.7	Man-Day	70	539.00
16	Care for the seedlings (five months)	Labour	20	Man-Day	10	200.00
17	Total cost					5789.00
18	Unit production cost (Birr/Seedling)					4.82
19	Selling price (Birr/seedling)					13.50
20	Income from seedling production (Birr)					16200.00
21	Profit per seedling (Birr/seedling)					8.68
22	Total profit (Birr)					10411.00

Note: ^a To get 1540 seedlings at 70% seed germination rate.

^b To get 1200 grafted seedlings at about 80% success rate in grafting.

Source: personal data

The estimated gross income by the different nursery operators in 2008 is shown in Table 7.

Table 7. Gross income of nursery operators, 2008/9

Name of farmer	Avocado	Mango	Total	Actual sale (2007-2008)
Limassa Rikiba	288	110	398	5,174
Getachew Gebre	450	110	560	7,280
Kinawo Kieto	267	97	364	4,732
Limeno Rikiba	361	62	423	5,499
Tonkosha Ebro	152	197	349	4,537
Wude Guye	165	360	525	6,825
Reported sold	1683	936	2619	34,047
% successfully grafted seedlings up to sale	53.7	77.5		

Source: Nursery operators themselves

5.3 Organizational arrangement

At the start of the project, the OoARD was involved in the production of subsidized seedlings, and all costs were born by the government. Apart from the operational cost of managing nurseries, Woreda SMSs and DAs spend their time in seedling distribution which consumes a considerable amount of their working/productive time (Berhanu *et al.*, 2006). The shift to get out of subsidized service provision to that of market oriented development model has taken the burden of the input supplying duty from the shoulder of OoARD who can now concentrate on provision of training and advisory services to farmers on nursery management and quality seedling production as well as fruit trees management.

The introduction of the new intervention has brought about new partnership and linkage among the major actors. The following table portrays roles and responsibilities of actors:

Table 8. Main actors and roles in farmers based fruit seedling supply system

<p>OoARD mainly: Assigned its SMSs and DAs in the fruit nursery owners to work closely with nursery owners SMSs and DAs identified farmers and recruited farmers that fit in the selection criterion Organize and participate in capacity building trainings Follow up day today progress in the field Jointly assess and monitor progress Assist in record keeping/ also keep and avail records Through its safety net program bought seedlings from nursery operators Assist in marketing seedlings Presented reports and findings Scale out best practices</p>	<p>Farmers:</p> <ul style="list-style-type: none"> ➤ Invest their time and resource in the new business ➤ Start and maintaining their nurseries ➤ Maintain their farm records ➤ Promote their products ➤ Sale grafted avocado and mango to other farmers. ➤ Maintain orchards as mother plants for future source of scions
<p>MARC:</p> <ul style="list-style-type: none"> ➤ Provided scions (bud-sticks) of improved avocados and Apple mango varieties for grafting. ➤ Provided grafting technicians hand on grafting skill to farmers and OoARD workers ➤ Research scientists visit farmers' nurseries and provide technical advise ➤ Participate in knowledge sharing events such as presenting seminars to woreda staff during their visits 	<p>Awassa College of Agriculture:</p> <ul style="list-style-type: none"> ➤ Provided trainings at the beginning of the intervention
<p>IPMS: Linking research with OoARD and farmers Guide the over all activity. Played a role in organizing knowledge sharing events, Documentation Jointly access best practices and popularize for scaling up Transported scions Organised study tours to MARC, Addis fruit market and Upper Awash Agro industry fruit farms Organised studies on fruit in Dale and others</p>	

6. Challenges and recommendations

6.1. Production of grafted seedlings

- Shortage of scions/planting has been a limiting factor to scale out this new business. Currently some of the trees planted three years ago have started to produce fruits and farmers have started grafting using their own scions. In case of severe shortage of external source of scions, researchers from MARC also **suggest as an option** to use scions from locally available superior trees with the desirable quality of flesh recovery (flesh to seed ratio), flavor & test, fruit shelf life and above all market desire. Generally, grafting will help farmers to grow fruit trees that bear fruit in 3-4 years time after planting.
- Lack of essential nursery materials (like hand pruners or secateurs and grafting knives) in the market remain a challenge for the success rate of grafting. Though some of nursery owner are willing to buy from their own fund others might need a short tem loan to own these equipments.
- Lack of quality seed for root stock and low germination and viability has been a problem for nursery owners. Seeds have been collected from juice producers in Awassa and Yirgalem towns. However, for better successes in germination one has to collect seed from the trees with healthy flesh and use it with in days (Rice *et al* 1987). Therefore, for better results farmers should be advised or supported to acquire seeds either from local known trees or from other known sources.
- Grafting success of avocado (57.3%) is rather low during the reported season. Edossa (2006) discusses the seasonality effect; i.e. success rate of up to 80% against 42% with avocado if cleft grafting is done between end of July and beginning of August. Rice (1987) mention that grafts successfully attaches in humid environment and temperature of 13-32 C⁰. The success rate for avocado seedlings in 2009 was also low because the rootstock had overgrown while the scions were smaller. This therefore created compatibility between the scions and the rootstock. This knowledge should be used to developing its grafting calendar to suit local situation in Dale
- In addition skill of the technicians could also be another factor for success (Rice 1987). Therefore, staff and farmers involved in nursery management require more skill development exercise to perfect their grafting skills.

6.2. Sale of grafted seedlings

- Selling grafted seedlings in a population that is used to subsidized inputs supply including seedlings has been a challenge. The idea of subsidy and also free distribution is embedded during long years of highly subsidized coffee seedling distribution in the Woreda. Continued dialogue with the actors involved should take place to change the mindset.
- Lack of cash during the planting seasons (June-August) hampered many farmers from buying seedlings. A credit arrangement was facilitated by DAs

where farmers who want the seedlings are registered and receive the seedlings on credit -from the nursery operators - to be paid usually during the coffee harvesting season of September-November when farmers earn money. So far, the first attempt has worked and there is no reason why this arrangement would not work in the future.

- Others have shown reluctance to purchase the new seedlings due to risk avoidance. Farmers who are risk avoiders need to see how the fruits trees perform before they invest on a new variety. The project organized group visits to nursery and orchard owners where the new trees have born fruits. Nursery owners also report that farmers from different PAs come and see the new fruit trees in their back yard and learn from each other.
- Linkages with the Productive Safety net program for scaling out the sale of seedlings should be strengthened, including the use of short term credit (see above). Another option to be explored would be to supply the seedlings as payment for what ever productive food security payment is made or encourage farmers themselves to buy during their payment.

6.3. Marketing of improved fruits

A future challenge will be the development of a market channel for the improved fruits

7. Lessons learned

- Using a participatory market oriented value chain approach, led to the identification of a key intervention for the development of improved fruits which are expected to fetch good prices in the market i.e. village based private nurseries for the production of improved grafted fruit seedlings
- These private nurseries can be established by developing the technical skills of the extension staff and nursery operators in learning by doing approach, taking into account the failures and successes.
- Various marketing arrangements for the seedlings can be used including cash sales to better resourced farmers, informal credit arrangements through the nursery operators and formal credit arrangements through government/donor funded programs.

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