COMMERCIAL FRUIT
PRODUCTION IN ETHIOPIA

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INTRODUCTION

Fruit production is relatively new to the Ethiopian agriculture system. The indigenous fruits are in most cases are wild. Very few of them are domesticated. Most of the important fruits that are produced in gardens and commercial farms are exhaustive and are recently introduced into the country. Hence their management is new to producers, merchants and consumers. Fruit production and utilization have numerous problems that must be identified and tackled accordingly.

The bulk of the fruit in Ethiopia is produced in gardens and small-scale commercial farms. The purpose of production is mainly for home consumption. In areas where it is suitable for fruit production some farmers produce fruits for local markets.

In the highlands of Ethiopia, where the majority live, fruit production is almost nil. The common fruits produced in this area are peach and plums. Their supply is far from satisfactory. Children collect and consume indigenous fruits such as ‘agam’, ‘Kegaa’, ‘shola’, ‘koshim’ etc.

Thirty years ago in the capital fruits were sold only at the gates of hospitals. They were meant for sick people and children. Their consumption even in the capital and big cities was very low. In the last three decades tremendous changes were observed in the production, marketing and consumption of fruits in the country. At present fruit shops and juice houses increased dramatically particularly in big cities.
Commercial fruit production in Ethiopia is a young industry and is started in the last six decades. There are very few commercial fruit orchards in the country and most of them are run by the state sectors.

Prior to land nationalization individuals established many orchards. These orchards were given to farmers and state farms. Most orchards declined and then uprooted due to poor management. Only few farms survived and even improved under the then Horticulture Development Enterprise the present Upper Awash Agro Industry Enterprise and Horticulture Development Department.

The industry has numerous problems in regard to technical, economical, social etc. These problems need to be identified and appropriate solutions must be found in order to make the industry viable and sustainable. This needs the effort of producers, processors, merchants and researchers.

An attempt was made to present the status of the existing commercial fruit farms in the country. Interview of the concerned individuals is employed as the major means to get the needed information. Almost all interviewed personals gave the information unreservedly. Beside they provided the author the necessary documents for the study. In the document historical background of the farms, hectarage, crops produced, cultural practices followed, constrains observed, measures taken etc. are presented.

UPPER AWASH AGRO-INDUSTRY ENTERPRISE

The Upper Awash Agro-Industry Enterprise (UAAIE) is operating in Oromya and Afar national regional states. Its total land holding is 7417 hectares of which 6903 is arable. It
has four farms and a processing plant. Fruit is produced in all four farms and processed in the processing plant.

Table 1:  Farms under Upper Awash Agro-Industry Enterprise and their locations

<table>
<thead>
<tr>
<th>Farms</th>
<th>Region</th>
<th>Zone</th>
<th>Woreda</th>
<th>Distance in Km from AA.</th>
<th>Nearest big city (Km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awara Melka</td>
<td>A.N.R.S</td>
<td>Awash Fen.</td>
<td>Awash Fentale</td>
<td>235</td>
<td>Metehara</td>
</tr>
<tr>
<td>Nura Era</td>
<td>O.N.R.S.</td>
<td>E. Shoa</td>
<td>Boset (Wolenchiti)</td>
<td>188</td>
<td>Metehara</td>
</tr>
<tr>
<td>Merti</td>
<td>O.N.R.S.</td>
<td>Arsi</td>
<td>Merti/Jeju</td>
<td>177</td>
<td>Metehara</td>
</tr>
<tr>
<td>Tibila</td>
<td>O.N.R.S.</td>
<td>Arsi/E.Shoa</td>
<td>Jeju/Boset/Arboye</td>
<td>146</td>
<td>Nazret</td>
</tr>
<tr>
<td>Degaga</td>
<td>O.N.R.S.</td>
<td>E. Shoa</td>
<td>Boset (Wolenchiti)</td>
<td>123</td>
<td>Nazret</td>
</tr>
</tbody>
</table>

A.N.R.S.  Afar National Regional State
O.N.R.S.  Oromya National Regional State

There are meteorological stations at Merti and Nura Era. The Merti meteorological station belongs to the enterprise. For some years compiled data are available for Merti and Nura Era. Simple meteorological stations need to be established on each farm.

Table 2:  Climatic information on Upper Awash Agro-Industry Enterprise farms

<table>
<thead>
<tr>
<th>Farms</th>
<th>Altitude (masl)</th>
<th>Annual rainfall (mm)</th>
<th>Temperature °C</th>
<th>Agro-ecological Zones</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Maximum</td>
<td>Minimum</td>
</tr>
<tr>
<td>Aware Melka</td>
<td>750</td>
<td>250-300</td>
<td>39.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Nura Era</td>
<td>1100-1205</td>
<td>316</td>
<td>37.5</td>
<td>10.4</td>
</tr>
<tr>
<td>Merti Jeju</td>
<td>1100</td>
<td>383</td>
<td>34.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Tibila</td>
<td>1240-1260</td>
<td>707</td>
<td>36.2</td>
<td>16.9</td>
</tr>
</tbody>
</table>

A 1  Hot to warm arid lowland plains
SM 2  Tepid to cool sub moist mid highland

Table 3:  Total Hectarage * of Fruits in Upper Awash Agro-Industry Enterprise

<table>
<thead>
<tr>
<th>Crops</th>
<th>Farms</th>
<th>Awara Melka</th>
<th>Merti Jeju</th>
<th>Nura Era</th>
<th>Tibila</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avocado</td>
<td></td>
<td>3.49</td>
<td>3.49</td>
<td></td>
<td></td>
<td>6.96</td>
</tr>
<tr>
<td>Banana</td>
<td></td>
<td>250.00</td>
<td></td>
<td></td>
<td></td>
<td>250.00</td>
</tr>
<tr>
<td>Citrus</td>
<td>122.32</td>
<td>118.40</td>
<td>953.00</td>
<td>114.63</td>
<td>1308.35</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>Grapefruit</td>
<td>24.00</td>
<td></td>
<td></td>
<td>1.17</td>
<td>25.17</td>
<td></td>
</tr>
<tr>
<td>Lemon</td>
<td>17.00</td>
<td></td>
<td></td>
<td></td>
<td>17.00</td>
<td></td>
</tr>
<tr>
<td>Lime</td>
<td>49.00</td>
<td></td>
<td></td>
<td></td>
<td>49.00</td>
<td></td>
</tr>
<tr>
<td>Mandarin</td>
<td>6.32</td>
<td>24.00</td>
<td>181.00</td>
<td>0.75</td>
<td>212.07</td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td>26.00</td>
<td>94.40</td>
<td>772.00</td>
<td>112.71</td>
<td>1005.11</td>
<td></td>
</tr>
<tr>
<td>Grapevine</td>
<td>20.56</td>
<td>17.86</td>
<td></td>
<td></td>
<td>38.42</td>
<td></td>
</tr>
<tr>
<td>Guava</td>
<td></td>
<td></td>
<td>55.00</td>
<td></td>
<td>55.00</td>
<td></td>
</tr>
<tr>
<td>Mango</td>
<td>19.00</td>
<td>17.16</td>
<td>62.95</td>
<td></td>
<td>99.11</td>
<td></td>
</tr>
<tr>
<td>Papaya</td>
<td>7.38</td>
<td></td>
<td></td>
<td></td>
<td>18.64</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>391.32</td>
<td>163.50</td>
<td>1088.81</td>
<td>136.76</td>
<td>1780.39</td>
<td></td>
</tr>
</tbody>
</table>

* Figures in this table are number of trees divided by expected number of trees per hectare. Expected number of trees per hectare vary depending on the spacing used. Actual area and this area have significant difference particularly for old orchard at Tibila and Awara Melka.

**DURATION OF HARVEST**

**Citrus**
In the past there was clear harvesting season for citrus species and varieties. In the last two years this was messed up by change in climate. Unexpected rain and extreme change of temperature is experienced. All varieties are harvested together.

Table 4: Duration of harvest for citrus at Nura Era

<table>
<thead>
<tr>
<th>Maturity</th>
<th>Varieties</th>
<th>Duration of harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early varieties</td>
<td>Parent Washington Naval, Hamlin, Algerian Tangerin, Dancy, Fairchild, Ponkan and Nova.</td>
<td>Late April to late June</td>
</tr>
<tr>
<td>Intermediate var.</td>
<td>Pinapple, Orlando, Temple.</td>
<td>June- Early October</td>
</tr>
<tr>
<td>Late varieties</td>
<td>Mineola, Cambell and O. Valencia</td>
<td>Late October to April.</td>
</tr>
</tbody>
</table>

A program is set up to produce citrus throughout the year. Unless interrupted by unexpected rain the plan will be launched soon.

**Other Fruits**
Harvesting of mango is generally from April to June. In 2000 due to low temperature at flowering (around November) harvesting was delayed by one month. Grapevine is harvested twice a year in November and July. Harvesting season for guava is from July-September.
Table 5: Productivity in quintals per hectare * in Upper Awash Agro-Industry Enterprise farms

<table>
<thead>
<tr>
<th>Crops</th>
<th>Aware Melka</th>
<th>Merti Jeju</th>
<th>Nura Era</th>
<th>Tibila</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avocado</td>
<td></td>
<td></td>
<td></td>
<td>160</td>
</tr>
<tr>
<td>Banana</td>
<td>125</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citrus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grapefruit</td>
<td>265</td>
<td></td>
<td></td>
<td>350</td>
</tr>
<tr>
<td>Lemon</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lime</td>
<td>250</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mandarin</td>
<td>76</td>
<td>500</td>
<td>250</td>
<td>300</td>
</tr>
<tr>
<td>Orange</td>
<td>375</td>
<td>50-430</td>
<td>200-420</td>
<td>120-420</td>
</tr>
<tr>
<td>Grapevine</td>
<td></td>
<td>50-190</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Guava</td>
<td></td>
<td></td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Mango</td>
<td>100-150</td>
<td>80</td>
<td>50-180</td>
<td></td>
</tr>
<tr>
<td>Papaya</td>
<td>450</td>
<td></td>
<td></td>
<td>450</td>
</tr>
</tbody>
</table>

* Yield in most state farms is what is sold. This yield does not include fruits harvested but not sold or fruits that are not harvested for managerial problems such as labor shortage, lack of transport or market, etc.). As a result it is lower than the actual yield of the orchards.

Facilities
Radio communication is possible among farms, head office and logistic office in Addis Abeba. Electricity is available in all state farms. Intercom is available at headquarter. Telephone system is established between Merti and other places in the country.
AWARA MELKA

GENERAL

The state farm is located in Sabure on 876 hectares of land. According to Ato Taddese Tekle Mariam, farm manager of Awara Melka, Sabure was a French man who established the first farm around 1906. It is believed that Sabure was working in the construction of the railway line from Djibouti to Addis. He started a small-scale farm and produced groundnut, watermelon, banana and others. He used to market his produces and charcoal in Awash.

After his death his children continued the business. During the Italian war, patriots including Ras Abebe Aregay were around the farm. After the war the Emperor gave the farm to Ras Abebe Aregay. Then, Abebe Aregay gave the farm to Segnore Montrare (an Italian) on contract basis in 1950. It was around 1954 that mango and citrus were established. Segnore Montrare had a plan to bring water from Awash for irrigation. After land nationalization in 1967 the farm became part of the state farm under the then Horticulture Development Corporation (HDC). After the disintegration of HDC the farm become under UAAIE.

The farm is 45 km from Metehara the nearest town. There is 34 km all weather road from Awash main road to the farm. The farm has radio system to communicate with head office and other farms. Generator produces electricity.

CITRUS

Irrigation is applied every 10 days whenever possible. There is water shortage during dry season (April-June). Water stress is the major problem and hastens other problems. Fertilizers at the rate of 1.3 quintals DAP and 5.4 quintals urea are applied per hectare and per year. Urea is applied three times, DAP once at the beginning of the season (July).

Roundup is sprayed at the rate of 3 l/ha to control grass weeds for about six months. Spraying Ultracide 6 l/ha, and Diazinon or Diazol 6 l/ha controlled red scale and leaf miner. False codling moth is a serious problem. There is no control measure against this pest except harvesting at early stage, harvesting all fruits at the end of the season, collecting and burring fruits attacked by the pest.

Orange and Mandarin
The old citrus orchard (26 ha orange and 9.48 ha mandarin) was established in 1952 by Montrare. It became part of Aware Melka state farm after nationalization of land. Irregular spacing is used and all sorts of problems (diseases, insect pests, nutritional imbalance etc.) are observed in the orchard. Many plants died due to various reasons. Among insect pests leaf minor, thrips and aphids were observed. There is acute shortage of irrigation water particularly in dry season from February to June.

No body knows the actual scion and rootstocks used to establish the orange orchard. Though the problem is not as serious as that of mandarin Phytophthora problem is observed in orange orchard. Acceptance by consumers is very high despite its green color at harvest. It may be possible to produce the desired color but keeping the fruits longer on tree to change their color will expose them to Mediterranean fruit fly damage.

The fruits of mandarin are deteriorating fast and trees are dying. There are many missing trees in the orchard. One of the two varieties occupies relatively larger hectares of land. The variety is unknown and it gives poor yield. Its acceptance is very low due to its puffiness and sour taste. The other variety is claimed to be Algerian Tangerine, which has no marketing problem. Phytophthora attacks both varieties, and trees are dying. This is expected if the stock, which is unkown, is susceptibile to Phytophthora. There is a plan to study the situation and replace with known materials.

Lime and Lemon

Lime and lemon were established in 1976 by the enterprise. Scion varieties are Bears and Mexican for lime and Lisbon for lemon. The rootstock used for both species was Macrophylla. Local demand is relatively low for lemon and lime. Duration of harvest is from July to September. There is export potential to neighboring Arab countries and local factories to replace citric acid.

Though the rootstock is claimed to be resistant to Phytophthora, gummosis symptom is observed. Another problem observed recently is splitting/cracking of branches particularly on lemon. Actual reason is not understood. The enterprise has a plan to expand but reason for splitting must be investigated and appropriate rootstocks resistant to Phytophthora need to be identified. A disease that cause spots on lime fruits was observed and Kocide was sprayed to control it.

Grapefruit

Twenty-four hectares of grapefruit orchard was established by HDC in 1976. Scion varieties used were Shamber and Red Blush. The rootstock was Rough Lemon, which is susceptible to Phytophthora and many plants died due to this disease. Gummosis and die back are very common on Red Blush plot.
Despite application of fertilizers, leaves become yellowish. The fruit manifest continuos decrease in size. Since the demand was low in local market proper cultural practices were not practiced. This was believed to be the main cause of the decline. To alleviate the marketing problem investigation on processing was started and encouraging result was obtained. Attempt was also made by top management to prepare a sound program in order to improve the cultural practices. For proper implementation of the plan, people directly involved in the production system need to be aware of the problem and convinced. This can be done by open discussion and upgrading of the workers’ practical experience through in-service training.

The spacings used were 8 m by 4 m. The spacing allotted between plants in the row (4 m) was not adequate. Trees intermingled within rows. Wider spacing is essential. Shamber is vigorous and seems relatively tolerant to *Phytophthora* compared with Red Blush.

Red Blush produced more fruits. Actual hectarage in the old and new citrus orchards is meaningless since quite a lot of trees are dead due to various reasons. Grapefruit is not as popular as other citrus fruits in the country. However, there is an opinion that grapefruit consumption cures blood pressure which need to be investigated.

**BANANA**

Banana was doing well at Aware Melka but recently nematode becomes a serious problem. Dwarf Cavendish variety, which is susceptible to nematodes, is predominately grown in the farm. Cigar-end rot is also observed but easily controlled by spraying chemicals (Bavistin 50 DF 3kg/ha). According to Karamura, banana expert in Uganda, the disorder might be caused by low temperature, which affects fruit development. Irrigation is not adequate during dry season. Besides cultural practice recommendations such as sucker management and fertilization are not practiced. As a result of these and other reasons fruit size is usually smaller and the enterprise cannot compete with Arba Minch produce.

Fruits are not harvested at the right time. Sometimes immature fruits are harvested which will not ripe properly. Post-harvest handling of banana in general is very rough. This has negatively affected the shelf life and quality of fruits.

The three trials started by the Melkasa group at Aware Melka on banana namely fertilizer, clump/sucker management and variety observation trials are terminated. They were poorly managed and appropriate data were not taken. Both the enterprise staff and the researchers are interested to reinitiate these trials again. It is very important that a competent individual from the farm need to be assigned and trained to take care of the trials and record relevant data at the right time.
Variety Observation Trial

The variety currently produced on the farm is Dwarf Cavendish. It is repeatedly reported that this variety is susceptible to nematode, cold, cigar-end rot and damage by wild pig. Two hectares of Poyo variety were established for observational purpose. Poyo gives high yield and quality fruits and has minimum wild pig damage as opposed to Dwarf Cavendish. Furthermore, it is more tolerant to nematode and cigar-end rot diseases. However, it is highly susceptible to wind damage. It is possible to grow the variety with effective windbreak.

The farm cannot compete with other farms using Dwarf Cavendish. Alternative varieties must be identified if the farm decides to remain as banana producer. There are many promising varieties at Melkasa Agricultural Research Center (MARC). The Center will provide planting materials of promising commercial dessert type cultivars to be observed at Aware Melka, Nura Era and Merti farms.

Sucker Management

One of the major reasons for low yield and poor quality of banana in the country is lack of sucker management. In most cases hills are left uncontrolled. Many equal sized suckers from the same hill are allowed to produce bunches at the same time. Due to high competition for moisture, nutrient and light, none of them produce desirable size of bunches and fruits.

Sucker management trial was initiated and started at the farm. Though initial performance was promising the trial was discontinued for various reasons. It is agreed to reinitiate sucker management trial to determine the optimum number of suckers for high yield and quality fruits at Awara Melka condition. This can be superimposed on the existing young banana plantation.

Fertilizer Trial

Currently 4 quintals of DAP and 6 quintals of urea are applied per hectare on banana plantation. Potassium, which is very essential for banana production, is not applied normally. The type and amount of fertilizers are simple blanket recommendations not supported by tissue and soil analysis and/or fertilizer trials. Hence, determination of the right type and amount of fertilizers is essential. The fertilizer trials conducted at Melka Sedi and Awara Melka clearly indicated that there is a need of potassium for high yield and quality fruit.

At present potassium fertilizer is not available in local market. Sugar estates are importing potassium for sugar cane production. The enterprise is discussing with sugar estates to get potassium fertilizer for the trial and its banana production. As soon as this is materialized a fertilizer trial on banana will be restarted at Aware Melka.
Currently, the enterprise is running a fertilizer trial in cooperation with Hydro Company. Complete fertilizer is applied every month at the rate of 260 grams per hill. On the control plot DAP and urea at the rate of 4 q/ha and 6 q/ha are applied respectively. DAP is applied once in July and urea is applied three times at interval of four months. Cultivation is practiced before fertilizer application. Complete fertilizer plots are cultivated 12 times while the check plot is cultivated only three times. This brings another factor in favor of complete fertilizer plots. Cost of fertilizers, amount of active ingredient of major nutrients, cost of application and practicality must be considered before reaching conclusion from this observational trial.

MANGO

Out of the nineteen hectares of mango five hectares were established in 1954 and were on their own rootstocks (seedlings). The trees are very tall and are difficult to harvest. The remaining 14 hectares were established in 1985. In the past no serious problems were observed on the mango field. Recently sorghum chaffer started to attack at flowering. Spraying of trees with Diazinon 2 l/ha was found effective. The pest must be controlled at the source. Thrip problem is also observed as in citrus. No control measure is known to date. Powdery mildew is a major disease and is controlled by spraying Bylaton 25% WP at the rate of 0.5 kg/ha. Anthracnose is also observed both on leaves and fruits. When it is observed on leaves, Mancozeb 80% WP at the rate of 3 kg/ha and Kocide 101 at the rate of 2.5 kg/ha are sprayed. Spraying will continue as long as the disease is observed. Splitting of branches is common. The reason is not known.

The production increased gradually and harvesting concentrates in one or two months. Storage is a problem particularly for perishable varieties.

PAPAYA

Marketing of papaya is a serious problem due to its very high perishable nature. After few seasons trees got too tall and become difficult to harvest. Hence plantation must be reestablished after three years of planting. For powdery mildew Bylaton is used at the rate of 0.5 kg/ha. Die back is common. As soon as symptom is observed all diseased plants must be removed and burried. Anthracnose is not a serious problem in the field and is easily controlled by spraying Mancozeb 80% WP and Ridomil 63.5 MZ at the rate of 3 kg /ha. A minimum of 12 sprays of both chemicals is needed.
MERTI JEJU FARM

GENERAL

There are two units in the farm namely Merti and Jeju. These are found in Merti and Jeju woredas respectively. Total area of the farm is 1638.

An Italian named Seignior Tiliota Santo started Merti Farm. Seignior Tiliota and his children brought irrigation water from Awash River to the farm in 1961/1962. A group of officials were also operating private farms at Merti managed by Ato Bekele Lemma. At present the latter becomes residential area.

Jeju Farm was started by a group of higher officials that included Ato Abebe Reta, Ato Addis Alemayehu, Ato Eshete Gizaw and Ato Kassa Diro and named ABADESHKA. Initially the farm was managed by Ato Bekele Lemma and used to produce cotton and haricot bean. Ato Bisrat Gebre Kal become farm manager of ABADESHKA, after Ato Bekele Lemma. Captain Kene used to produce cotton in the same area.

After nationalization of land both farms were merged and become Merti Jeju and managed by Ato Bisrat Gebre Kal. They continued producing cotton. It was in 1975 that horticultural crops were introduced in the farm. The farm became under HDC. Merti and Jeju are unit farms in the present Merti Jeju Farm under UAAIE.

CITRUS

The first orange orchards were established at Merti and Jeju (Olinda Valencia and Hamlin respectively) in 1976/77. At the same time mandarin was established at Jeju. In 1984/85 another orange orchard was established at Jeju. The same spacing were used as at Nura Era. The spacing caused serious problems particularly on Temple and Hamlin. A clear decline in yield was observed in the last five years.

Table 6: Hectarage and productivity by crops at Merti Jeju Farm

<table>
<thead>
<tr>
<th>Farm</th>
<th>Crop</th>
<th>Varieties</th>
<th>Rootstock</th>
<th>Hectarage</th>
<th>Productivity in q/ha *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merti</td>
<td>Grapevine</td>
<td>Chenin Blanc</td>
<td>Old</td>
<td>20.59</td>
<td>6.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>New</td>
<td>14.09</td>
<td>88/89</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>88/89</td>
<td>5.53</td>
<td>89/90</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>91/92</td>
<td>3.56</td>
<td>5.00</td>
</tr>
<tr>
<td>Orange</td>
<td>Olinda Valencia</td>
<td>Troyer Citrange</td>
<td>64.00</td>
<td>365</td>
<td></td>
</tr>
</tbody>
</table>
• Mean of the last five years except mango, which is the mean of the last two years

Table 7: Trend of citrus productivity (quintal/ha) from 1988-1992 at Merti Jeju Farm

<table>
<thead>
<tr>
<th>Farm</th>
<th>Crop</th>
<th>Variety</th>
<th>Y</th>
<th>E</th>
<th>A</th>
<th>R</th>
<th>S</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merti</td>
<td>Orange</td>
<td>Olinda Valencia</td>
<td>390</td>
<td>478</td>
<td>311</td>
<td>322</td>
<td>323</td>
<td>365</td>
</tr>
<tr>
<td>Jeju</td>
<td>Orange</td>
<td>Hamlin</td>
<td>511</td>
<td>439</td>
<td>339</td>
<td>490</td>
<td>217</td>
<td>399</td>
</tr>
<tr>
<td>Jeju</td>
<td>Mandarin</td>
<td>Temple</td>
<td>760</td>
<td>780</td>
<td>582</td>
<td>560</td>
<td>490</td>
<td>634</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>1661</td>
<td>1697</td>
<td>1232</td>
<td>1372</td>
<td>1030</td>
<td></td>
</tr>
</tbody>
</table>

Insect pest problems and their control measures are similar with that at Nura Era. Fruit split and hardening of fruits were observed on Orlando and Hamlin. There is speculation that it is caused by Terestza virus. If this speculation is true change of rootstock may be required. Nematode, minor element deficiencies and toxicity are other problems. Proper investigation of the disorder(s) by experts is unprecedented.

Trees are dying in areas where there is drainage problem. Site selection before establishment is essential for perennials. Use of resistant/tolerant rootstock against phytopthera is recommended.

**Citrus Foundation Blocks**

The foundation block was established in 1974, 1975 and 1976. The citrus scion and rootstock foundation blocks played important role in fruit development of the country. Governmental and non-governmental organizations from all regions are getting materials from Merti and Melkasa Agricultural Research Center foundation blocks. It is very important to maintain these materials properly for further citrus development in the country.

In the scion foundation block 4 grapefruit, 3 lemon, 3 lime, 11 mandarin and 11 orange scions are established. The number of trees per variety vary from 8-59. In the rootstock foundation block seven varieties are included. It is not clear whether the above
rootstocks are on their root own system (seedlings) or not. Grafting is recommended to have relatively short trees and get seed yields in short possible time (avoiding juvenility).

Many plants from the scion and rootstock foundation blocks are dying. Besides no yield and vegetative data were taken to get some idea about their performance. Scions are only on one rootstock. If that particular rootstock is not adaptable to the scion there is a possibility of loosing the scion. To avoid such risk, it is strongly suggested to reestablish the two blocks at least on three selected rootstocks. Vegetative and yield data can be taken to generate information that would help decision-making in the future.

The spacings used for the existing blocks were 8 m x 4 m for orange and 7 m x 3.5 m for mandarin, are not ideal. This can be corrected based on the experience obtained so far.

**Citrus Propagation**

The Enterprise propagates citrus budded trees for sale. In year 2000 there were 26000 seedlings and grafted trees in the nursery. Olinda Valencia is the major scion grafted on Troyer Citrange, Rough Lemon and Sour Orange. Algerian Tangerine failed to take off. This is expected because of weak scion materials. Citrus grafting need to be encouraged to fill the gap made due to absence of private or government nurseries.

**MANGO**

There is 17.16 ha of mango established starting 1983. The three improved varieties namely Kent, Kiett and Tomyatkin and local materials were established together. The demand for improved cultivars is high. This is particularly true for Tomyatkin for its color, taste, long shelf life etc. Kit has large fruits.

In one of the mango field it became difficult to establish mango. According to Ato Tesfaye the farm manager the area has drainage problem. It is planned to abandon this plot as a mango orchard. Breaking of branch at fruiting by wind is a common problem. Windbreak may be helpful. Disease problems and their control measure are similar with that of Awara Melka. The local materials are relatively tolerant to diseases.

**Mango Nursery**

In the nursery Kent, Kiett and Tomyatkin were established. Many of the trees in the nursery have died and this could be attributed to soil salinity. Reestablishment of the nursery by changing site may help to maintain these important materials.

**Mango Propagation**
The major problem in mango production is failure in propagation. The Enterprise is not successful in its attempt to propagate mango in the last few years. After grafting plants died in the nursery or in the field. Plastic pots and media made of 2/3-forest soil and 1/3 sand were used. The possible causes of failure are expected to be source of seed, method of grafting, irrigation water, pot size etc. Similar attempt failed at Melkasa Agricultural Research Center (MARC).

Prof. Dr. Ravishanka from Alemaya University visited Melkasa and Merti and demonstrated two methods of propagation. Further investigation is needed to propagate the promising mango varieties effectively.

GRAPEVINE

Merti Jeju is expanding its vineyard. At present a vineyard of about 19 ha is established in the farm. The Enterprise is making its own concrete poles, which is very important for trellising grapevines. The vineyard is predominately of Chenin Blanc a premium white wine grape variety. It is productive and easy to manage. It is not the best table grape. Though it is high yielder its demand for wine is limited since red wine has more demand than the white wine. Hence further expansion of the variety may not be encouraged.

Many plants died and need to be gapped. Gapping is difficult in old vineyard. Two harvests are made every year. The attempt made to study the effect of multiple harvests on yield, quality and life of the trees at Nura Era was not successful for various reasons. This need to be reinitiated.

Due to cost of trellising material Ziwai Farm abandoned 70 ha of grapevine. Head training is suitable for wine types to reduce cost of production by eliminating cost for poles and wires. To this effect MARC researchers initiated a trial at Merti. From the previous trials it is observed that the standard training systems are superior to head training. Proper attention was not given to the trial with regard to data collection and care. An observation trial comparing head training at 100 and 150 cm with central bilateral cordon is suggested.

Grape vine nursery

The nursery is reestablished on new area. Ninety-two cultivars are included in the nursery. Spacing used between rows was 2.5 m and 1.5 m was used between plants in the row. One row (35 plants) was allotted per entry. Characterization and grouping of cultivars by color and use will be done at later stage. Samples will be sent to winery to test for their suitability to wine making. Yield and quality will be assessed.

Cultivars not available in the nursery can be obtained from research centers. Previously collected data need to be analyzed to get basic information on the performance of the
available cultivars. All cultural practices such as irrigation, cultivation, fertilization, pruning and training will be applied as needed. Cuttings are also planted for grapevine variety trial.

AVOCADO

Avocado Nursery

The nursery is totally destroyed mostly by soil problem (salinity). The dry growing condition is expected to contribute its share for the deterioration. The nursery should be reestablished in areas where growing conditions are optimum for avocado development.

NURA ERA

GENERAL

Seignior Montrare established the farm in early 1950. Initially, cotton was the major crop of the farm. Few mango trees were established from seedlings. The trees were tall for proper harvest and were removed at. After nationalization (1967), the National Resource Development office transferred it to Horticulture Development Corporation (HDC) as Nura Era Enterprise. Nura Era Enterprise comprised of the farms that are under the present Upper Awash Agro-Industry Enterprise (UAAIE). After nationalization, the farms gradually changed to sole horticultural crop production.

Total area under current Nura Era Farm is 3277 ha. About 33 percent of this (1087 ha) is under fruits. The major fruits produced on the farm are orange, mandarin, mango, grapevine and guava (Table 3). In the early years the demand for fruits was low. Quite a lot of fruits were dumped. Through development of market and advertisement the demand for fruits has increased and there is no problem of marketing fruits at the present time.

CITRUS
The largest citrus orchard (about 1000 ha) in the country is found at Nura Era. This orchard was established starting 1975 up to 1982. All materials were propagated and planted by the Enterprise.

Acceptance of Ponkan is almost nil. It is puffy and has dry vesicles compared with others. Temple is used as pollinator for Orlando and Minneola. The demand is low except in seasons where orange and mandarin are scarce.

Washington Naval produces very large fruit, which has low acceptance by consumers. Removing all fruits and withholding irrigation water for some times can create a close season. This forces the trees to produce flowers at the same time and produce relatively smaller fruits. Relatively higher altitude is recommended for Parent Washington Naval.

Table 8: Total area and productivity of citrus varieties at Nura Era farm

<table>
<thead>
<tr>
<th>Species and scion varieties</th>
<th>Rootstocks</th>
<th>Hectare</th>
<th>Productivity in quintal/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Orange</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washington Naval</td>
<td>RL, SO, TC</td>
<td>65.15</td>
<td>214</td>
</tr>
<tr>
<td>Hamlin</td>
<td>RL, SO, TC</td>
<td>163.68</td>
<td>340</td>
</tr>
<tr>
<td>Olinda Valencia</td>
<td>RL, SO, TC</td>
<td>151.86</td>
<td>308</td>
</tr>
<tr>
<td>Campbell Valencia</td>
<td>RL, SO, TC</td>
<td>203.23</td>
<td>339</td>
</tr>
<tr>
<td>Pineapple</td>
<td>RL, SO, TC</td>
<td>186.75</td>
<td>422</td>
</tr>
<tr>
<td>Ruby Blood</td>
<td>RL</td>
<td>0.53</td>
<td></td>
</tr>
<tr>
<td>Jaffa</td>
<td>SO</td>
<td>2.30</td>
<td></td>
</tr>
<tr>
<td><strong>Mandarin</strong></td>
<td></td>
<td>181.00</td>
<td>206</td>
</tr>
<tr>
<td>Temple</td>
<td>CL, TC</td>
<td>55.64</td>
<td>167</td>
</tr>
<tr>
<td>Mineola</td>
<td>CL, TC</td>
<td>77.49</td>
<td>185</td>
</tr>
<tr>
<td>Nova</td>
<td>CL</td>
<td>0.37</td>
<td>195</td>
</tr>
<tr>
<td>Dancy</td>
<td>RL, SO</td>
<td>0.68</td>
<td>48</td>
</tr>
<tr>
<td>Ponkan</td>
<td>CL, SO</td>
<td>3.78</td>
<td></td>
</tr>
<tr>
<td>Fairchild</td>
<td>RL, SO</td>
<td>11.12</td>
<td>306</td>
</tr>
<tr>
<td>Orlando</td>
<td>CL, TC</td>
<td>12.18</td>
<td>446</td>
</tr>
<tr>
<td>Algerian Tangerin</td>
<td>RL, SO, CL</td>
<td>19.74</td>
<td>237</td>
</tr>
</tbody>
</table>

CM Cleopatra Mandarin        RL Rough Lemon
SO Sour Orange               TC Troyer Citrange
Olinda Valencia also produces large fruits that are not suitable for fresh market. Oversized fruits of this variety are used for processing as opposed to Parent Washington Naval. Fruit size may be controlled by the use of appropriate rootstocks. Pineapple and Valencia are good for fresh market and processing. Hamlin is fleshy which is good for fresh market but not for processing.

MARC and UAAIE initiated a joint preliminary observational trial on some of the combinations. Preliminary information productivity and constraints were identified. It is important to include all combinations to get information for future expansion.

Spacing

The spacings used were 8 m x 4 m and 7 m x 3.5 m for orange and mandarin respectively. This was done with two assumptions.
- To hedge the rows with mechanical hedger - this was not materialized because mechanical hedgers could not be purchased.
- To uproot every other plant within a row after a certain period. This too was not materialized due to fast turnover of management staff. Those who were present at initial stage of development left before the trees produce fruits.

The spacing used between plants in the row is too narrow for all species and varieties. Minneola, Orlando and Hamlin are vigorous and are seriously affected by the narrow spacing in the row. Plants in the row are intermingled for the other orange and mandarin varieties. The management at Nura Era is taking out every other plant as planned on two hectares of land. The result of this exercise will assist decision-makers by providing data that shows the effect of spacing on yield and quality. For further expansion depending on varieties wider spacing between plants in the row and narrower spacing between rows is recommended.

Insect Pests

Fruit fly incidence on citrus has become very important. Effective chemical control requires aerial application. Sanitation is very important to reduce the incidence. As the fruit ripens it becomes susceptible to fruit fly damage. Harvesting all fruits at the end of harvesting season and collecting dropped fruits and burying them will reduce the infestation level. Fruits should not be allowed to over mature on trees.

Pheromone trap is recommended in other citrus growing countries. It is impractical in our case due to its cost and unavailability in local markets. Trap crop is also recommended to attract the pest.

Scale insect incidence was very serious problem in the past. After spraying the recommended chemicals, the incidence lowered significantly. Tractor mounted sprayers are needed to be effective. Ultracide 6 l/ha and Diazinon or Diazol 6 l/ha were sprayed.
alternatively when the scrolers are observed. Once the scrolers are in the scale chemicals are not effective. Medapoz spray oil at the rate of 8 l/ha acts as a sticker is effective. White oil was recommended in the past. But it is not available in local market.

Due to routine use of chemicals and change of weather, those considered minor pests previously have become a threat in fruit production. Thrips and leaf miner can be sited as examples. Leaf miner had become a very serious problem recently. It destroys the new shoot, which caused a reduction in photosynthesis. Thrips cause flower defoliation, fruit drop and reduces quality of fruit considerably. Effective control measures are required. Sorghum chaffer is a serious problem at flowering. This is particularly true on early citrus.

Diseases

No significant disease problems were observed at Nura Era. Phytophthora, which was a serious problem in old orchards in many farms and even in new orchards at Awarae Melka, is not considered as a problem at Nura Era. Proper irrigation system (double rings) must be used to limit its spread.

Many trees in Block C72 died and others are dying while the trees in neighboring rows are healthy and productive. Hardpan underneath and/or use of susceptible rootstock could be some of the possible reasons. There are symptoms that resemble greening but not confirmed. Such symptoms can be caused by hardpans that in turn could be caused by carbon deposit. At first the leaf color changes to yellow and then defoliate. There is no symptom on stem.

An Italian firm studied the soil of the farms of the enterprise. There is a document to this effect, which needs to be studied.

One problem in the farm is that all fruits are not harvested as scheduled. Flowering, fruiting and harvesting are observed on the same tree. This has impact on yield and quality. The weather change creates this problem. Close season is not practiced. Right after harvest irrigation is reduced and then irrigated to initiate flowering. This practice will concentrate production and reduce disease and insect incidence by depriving breeding ground.

GRAPEVINE

Grapevine was established at Nura Era by the enterprise starting 1976. The first harvest was made in 1981/82. Area covered was 40.3 and yield was 16 q/ha. The yield increased to 18.9, 20.0, 27, 44.8 q/ha in consecutive years. In 1986/87 yield declined considerably to 1.5 q/ha. Some improvement was made in 1987/88 and 21.8 q/ha was obtained. In 1988/89 all plants were stumped and sound framework was established. In 1989/90 11.8
q/ha yield was obtained. In 1987/88 the total area of the plantation was 37.5 hectares. There were missing plants. When the actual number of plants divided by expected number of plants only 16 ha was remained. After stumping some plants failed to survive and the actual hectarage declined to 9.43 ha. The 1990/91 yield was 16.9 q/ha.

As indicated above the yield was not satisfactory. Advice was thought from experts. High level nitrogen was a suspect and an observational trial was initiated. Full fertilizer dose for grapevine in the area was 2 q/ha of each DAP and urea. Four levels of nitrogen (0, 0.5, 1 and 2 q of urea) were tested. No significant difference was obtained. This was repeated for the second time. But the result was the same. Cane maturity was suspected to be the cause of the decline. Ordinarily one-month dormancy was allowed. Some canes were left unpruned for one year and there was no significant difference among treatments. Another suspect was phosphorus placement problem. As suggested phosphorus was placed near the root system. Again no change was observed.

After trying all these the enterprise is planning to remove the local cultivars and replace them with improved cultivar Chenin Blanc. Chenin Blanc a white wine cultivar gave about 180 q/ha in two harvests per year. The local cultivar ‘Tikur Weyen’ is good for making red wine. As alternative some cultivars were identified from the collection block. Samples were supposed to be tested by the Awash Winery factory but has not materialized so far for various reasons.

**Intensity of harvest**

Grapevine is harvested two times a year. The effect of two harvests per year on yield, quality, cost of production and exhaustion on plants is not clearly understood. Trial was initiated in the past but was not completed for various reasons.

**MANGO**

Harvesting season for mango is from early March to early July. Varieties vary in their maturity and are harvested at different times. Grouping of these materials according to their maturity and establish them in different plots makes harvesting easy, extend harvesting season and reduce cost of production. Identifying the potential lines among the existing cultivars (relatively large fruits, small seeded, fiberless, good flavor and color) is important to upgrade quality. Collection and characterization of mango materials is initiated at Melkasa Agriculture Research Center. This study includes mango materials from UAAIE.

Some promising varieties are large in size (500 – 1000 g/fruit). As a result their local demand is low. On the other hand the local types are small in size, fibrous, large seeded and do not store on trees. But these materials can serve as rootstocks for the improved materials.
GUAVA

Unknown variety is established on a 55 ha of land. Materials are grafted but the rootstock is not known. The demand for the produce is low. A very small portion is processed. The bulk of the fruits fall on the ground before harvest. This is due to false codling moth damage which is aggravated by low demand of the produce.

In general guava materials on the farm vary considerably in size, color and shape. Due to low demand of the produce less attention is given in regard to irrigation, fertilization, pest control etc.

TIBILA FARM

GENERAL

The Tibila farm has three units. The farm was established by Haile Selassie First Prise Trust, Leul Ras Astrat Kasa, other imperial family and higher officials. It was nationalized in 1967. Proper studies were not made in its establishment. Varieties were not selected, land was not leveled and drainage system was not established. Furrow irrigation is used which aggravated the gully formation.

Table 9: Irrigated, rainfed land and land allotted for other purposes at Tibila Farm

<table>
<thead>
<tr>
<th>Farms</th>
<th>H</th>
<th>E</th>
<th>C</th>
<th>T</th>
<th>E</th>
<th>R</th>
<th>A</th>
<th>G</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degaga</td>
<td>197</td>
<td>33</td>
<td></td>
<td></td>
<td>49</td>
<td></td>
<td></td>
<td></td>
<td>279</td>
</tr>
<tr>
<td>Membere Hiwot</td>
<td>189</td>
<td>95</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>295</td>
</tr>
<tr>
<td>Tifshete Genet</td>
<td>475</td>
<td>172</td>
<td>113</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>760</td>
</tr>
<tr>
<td>Total</td>
<td>861</td>
<td>300</td>
<td>173</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1334</td>
</tr>
</tbody>
</table>

The major fruits produced on the farm are citrus, banana, papaya and avocado.
Table 10: Areas allotted for different fruits at Tibila Farm

<table>
<thead>
<tr>
<th>Crops and species</th>
<th>F</th>
<th>A</th>
<th>R</th>
<th>M</th>
<th>S</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tifshte Genet</td>
<td>Degaga</td>
<td>Menbere Hiwot</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avocado</td>
<td>4.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.00</td>
</tr>
<tr>
<td>Banana</td>
<td>15.44</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15.44</td>
</tr>
<tr>
<td>Citrus</td>
<td>96.80</td>
<td>21.66</td>
<td>2.15</td>
<td></td>
<td></td>
<td>120.61</td>
</tr>
<tr>
<td>Grapefruit</td>
<td>3.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.50</td>
</tr>
<tr>
<td>Mandarin</td>
<td>6.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.00</td>
</tr>
<tr>
<td>Old</td>
<td>6.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.00</td>
</tr>
<tr>
<td>Orange</td>
<td>87.30</td>
<td>21.66</td>
<td>2.15</td>
<td></td>
<td></td>
<td>111.11</td>
</tr>
<tr>
<td>Old</td>
<td>70.40</td>
<td>3.66</td>
<td>2.15</td>
<td></td>
<td></td>
<td>76.21</td>
</tr>
<tr>
<td>New</td>
<td>16.19</td>
<td>18.00</td>
<td></td>
<td></td>
<td></td>
<td>34.90</td>
</tr>
<tr>
<td>Papaya</td>
<td>1.57</td>
<td>9.89</td>
<td>0.85</td>
<td></td>
<td></td>
<td>12.31</td>
</tr>
<tr>
<td>Total</td>
<td>117.81</td>
<td>31.55</td>
<td>3.00</td>
<td></td>
<td></td>
<td>152.36</td>
</tr>
</tbody>
</table>

DEGAGA UNIT

A person named Ato Seid Kasaye started Degaga farm on 53.5 ha in 1949. In Degaga water is pumped from Awash River to higher ground and irrigate the field by gravity. Here the major problem is recurrent flood from Awash River.

Citrus

The orchard is about 40 years old. Productivity of citrus declined through time. Only 45% of what was planned used to be harvested. In the old orchard there is no outlet for water during the rainy season. Drainage problem aggravated the Phytophthora incidence. Due to drainage problem, disease build up and old age many of the plants are dead and more plants are dying. There are a lot of gaps in the orchard. The attempt made so far to gap the dead plants was not successful due to problem of getting the needed material, attack by Phytophthora and irrigation problem of newly established plants that are scattered through out the orchard.

The new orchard was established in 1978 with spacings of 8 m by 4 m and the scion is expected to be Valencia. Fruit drop and leaf miner are the two major problems in the
Nematodes are suspected. Nutrient deficiency particularly minor element is expected to be one of the causes for of the decline. Different confusing symptoms are observed and are difficult to relate them with the different disorders. A team of researchers from EARO is investigating the causes of the problems.

At Degaga the variety for mandarin is reported to be Minneola. But it is completely different from Minneola at Nura Era in size and taste. As in orange many plants are dead due to disease (*Phytophthora*) and other reasons.

**Banana**

At Degaga banana was established on 15.44 ha, but it is destroyed by nematode infestation. Cold (frost) is another problem in some years. The variety used was Dwarf Cavendish which is susceptible to nematode and cold. A variety observation trial is suggested at Degaga.

**Papaya**

Papaya was established on 12.31 ha of land out of which 6.5 ha is going to be out of production at the end of 2000. Average yield is 450 q/ha per year. In some spots up to 1000 q/ha is obtained. If not harvested at the right time due to high supply from other places (Wonji, Meki, Ziway, Arba Minch, Koka, Alemtena) it is seriously attacked by birds (Glyci Sterling and birds with long tail).

According to the farm manager Degaga papaya is superior in taste and flesh color. Unavailability of true to type planting material is the number one problem. The three types namely solo, local and Cuba are now mixed due to cross-pollination. As a result fruits vary in shape, size, color, taste etc. EARO researchers from MARC by themselves and in cooperation with the state farms need to develop varieties. Since maintenance of varieties is difficult at producer’s level, researchers must maintain them.

Seedlings are raised on very small pots by placing 2-3 seeds in a pot. Two to three pots are planted per hill. Five to six seeds should be sown on larger pots to avoid complication at time of transplanting.

Generally 2.0 meters by 2.5 meters spacings are used. Sometimes 2.5 by 2.5 m are used to reduce unnecessary competition. But in some hills two female plants are allowed to grow that increases the population. On hills where two or more plants allowed growing there is a tendency for the plants to grow outward. Beside encouraging logging the practice results in small fruits due to competition.

To control *Anthracnose*, in the farm, Ridomil MZ and Mancozeb sprayed at the rate of 2.5 and 3 kg/ha respectively. Frequency depends on the intensity of the diseases and annual spray ranges from 2-6 times. Practical control measures against Anthracnose
including use of resistant/tolerant variety, sanitation, fertilization, and chemical need to be developed. MARC and state owned enterprises already have started work in this line. Nematode is another problem that requires attention of researchers.

Powdery mildew is observed first and followed by downy mildew where the relative humidity is high and the temperature in the morning is low. Bylaton at the rate of 0.25 kg/ha is sprayed to control powdery mildew. For downy mildew Ridomyl MZ at the rate of 2.5 kg/ha is sprayed. The rate increases depending on the intensity.

Plant die back is observed in the field. The cause is not identified. It starts from terminal end, top part changes its color to yellow and rot.

Dodder, a parasitic weed is observed in the field. It kills the young plant by choking. First it was observed in the nursery and then moved to the field with the planting materials. Physical control measures were taken so far. Immediate action must be taken to destroy the parasitic weed before it spread throughout the field.

Size and number of fruits, height of plant at bearing are the criteria for selecting fruits for seed production. More emphasis should be given to the disease status of selected trees. Fields and plants that are free from diseases are selected and then healthy and desirable fruits are picked for seed extraction.

Another problem commonly observed in papaya fields is too many male (unproductive) plants. Male plants are needed only for pollination and the proportion ranges 1:15 – 1:25. Obtaining optimum proportion of male to female plants is a problem. Searching for hermaphrodite is the best solution. For dioecious type it is recommended to saw 4-5 seeds per pot or 5-10 per hill. Once the sex of the plant is known unnecessary male plants and weak females must be removed. Only one plant per hill is allowed to grow.

Plants start to bear fruits after about 10 months and are harvested for three consecutive years. After three years yield declines and plantation becomes out of production.

MENBERE HIWOT UNIT

Membere Hiwot farm is the farm around the main office and was established by Leul Ras Asrat Kasa. Leul Ras Asrat Kasa developed the area by establishing a radio, telephone, electric line, constructing road etc. In addition to fruit production the farm involved in dairy, vegetable and cereal production.

Awash River is the source of irrigation water source for Membere Hiwot Farm. Due to position of the river pumping the water requires additional cost. On the farm, once the water is pumped it cannot reach all places in earth cannel due to ragged nature of the farm (topography). This forced the management to use pipes. Repair and maintenance of pipes, leakage and pumping are good portions of the production cost. During the rainy
season it is practically impossible to pump water from Awash River. As a result Menber Heiwet Farm gets its irrigation water from Hiskelo and Worenso Rivers by gravity. This water is needed to supplement the rainfed maize and fruit production. If it is possible to get adequate water from these two rivers (by damming) there is no need to pump water from Awash for this farm. Both units Membere Hiwot and Tifsihete Genet can be expanded very easily.

**Citrus**

Orange Varieties and rootstocks used are not known. Two varieties of orange are claimed to be Shamute and Valencia and are established together. Shamute has good juice content and is easily peelable. It is good both for fresh market and processing. Valencia has long shelf life, thick rind and is good for long distance transport.

**TIFSIHETE GENET UNIT**

According to Ato Sahle Yirga (former unit manager of the farm) Tifsihete Genet farm was managed by Haile Selassie First Prize Thrust Board from 1956 to 1969. The crops produced at that time were fruits (orange, mandarin and grapefruit), haricot bean, maize, tef, etc. The area was about 2420 ha. All this land was not under crop. Some part was forest and contract farmers used others. During nationalization a good portion of the land was given to farmers.

There were no trained personnel at that time and the productivity was very low. At the beginning products were cheap due to low demand of the fruit. Transportation was not convenient. Problems were not properly identified and appropriate measures were not taken. A good portion of the fruits was not marketable due to various reasons (diseases, insect pests, transport problem etc.). This situation was improved after the farm transferred to Horticulture Development Corporation under the then Ministry of State Farm and Development (MSFD). Productivity increased considerably. This is due to use of agricultural inputs such as fertilizer, effective disease and pest control measures, improved handling of fruits and marketing.

At early stage planting materials were imported directly from abroad most probably from United States. The varieties were Shamute, Parent Washington Naval, Campbell Valencia etc. The other cultivars were few trees in number and were not well adapted. Through time they disappeared. The rootstocks used were not known. Later on about 80 ha Valencia and Shamute grafted on rough lemon were planted. The mandarin was also grafted on rough lemon. But after establishment it failed due to *Phytophthora, Psorosis* and gummosis. Sources of rootstock and scion materials were from the same farm.
Water is the number one limiting factor for the production of fruits in the farm. Water sources are Werenso and Biskelo rivers. There is very limited water in the rivers during the dry season. Even this limited water is taken by individual farmers to irrigate their fields and some sunken in the soil. Consequently expansion of perennials and semi-perennials are reduced some existing orchards such as avocado are threatened.

**Citrus**

**Orange**
Due to age, disease and other problems the area of the old orange is reduced from 165 to 118 ha. This was calculated by counting existing total number trees and divided it by expected number of trees per hectare. Dead plants are not replaced and this has caused an increase production cost for certain operations such as weeding, irrigation, harvesting etc. The situation requires decision either to fill the gap or establish a new orchard. Neither the scions nor the rootstocks are known for the old orchards. All sorts of varieties are found in the orchard (Valencia, Parent Washington Naval, Hamlin etc.).

Olinda Valencia is the scion for the new orchard and the rootstock is not known. It just gave its first yield this year. Some trees are dying due to water logging. This strongly suggests that site selection is important for perennial crops. Once the orchards are established it is practically impossible to change the site or modify it. Poorly drained soils, areas prone to flooding must be avoided.

**Mandarin**
The variety is Algerian Tangerine. The rootstock used is not known. The mandarin plants are planted in orange orchards. Since the variety is early most fruit drop before harvest, which is a loss to the farm. As in orange many mandarin plants died due to disease (*Phytophthora*) and other reasons.

**Grapefruit**
The actual area now is equivalent to 1.17 ha. Both scion and rootstocks are not known. It is the white type and has low demand in the market (40 cents/kg in Addis Abeba). Less attention is given in terms of irrigation and fertilization. As in orange and mandarin, quite a lot of trees died due to *Phytophthora* and other factors.

**Avocado**
Four hectares of land is covered by avocado but the actual equivalent hectarage is 3.49 ha. This was established in 1975/76. The varieties were one local, Hass, Pink, Fuerte,
Etinger, Naval and Becon. Water stress in dry season is the major problem. Avocado has high demand by consumers, no marketing problem. According to farms officials the shelf life of Tifshete Genets’ avocado is longer compared with that of Wondo Genet and Arba Minch.

Minor scale insect (black) problem is observed and is controlled by spraying Ultracide and Suprathion at the rate of 3 and 3.5 l./ha. respectively.

MERTI PROCESSING PLANT

In 1974/75 crop season experimental productions were made. The factory became operational in 1975. Fruit crops used in the factory were citrus (orange, lime, lemon and grapefruit), guava and strawberry.

Despite use of varieties that mature at different time fruit production is seasonal. The purpose of processing is to increase the shelf life. Fruits are processed when they are cheap (pick harvesting season) and the products are sold when fruits are out of season. Practically, there is no export of the processed products. It is practically impossible to compete with sophisticated processing plants abroad. The processing machinery is not updated to the modern processing needs. Sometimes it is difficult to get spare parts from abroad. However, there is possibility to export fruit juice concentrate that is reconstituted in the importer countries. This calls expansion of the fruit production and establishment of better processing plant.

THE MAJOR PRODUCTS OF THE FACTORY

Orange – marmalade, squash

Shamuti and Valencias are preferred varieties for processing. Pectin is imported and is used for jellification of jam and marmalade. In other parts of the world the byproducts are dried and milled to be used as component of animal feed. At present the byproduct is not sold but given to workers free of charge. This helped the laborers to increase production of livestock and survive the dry season.

Lime and lemon – Citric acid
Citric acid is needed in the factory for the production of citrus based products. At present lemon/lime juice replaced citric acid in the manufacturing of orange marmalade. An attempt is being made to replace citric acid by lemon and lime juice in other products too. However, it is not completed yet.

**Grapefruit – Squash and juice**

It is possible to produce both grapefruit juice and squash. Grapefruit squash has great demand but oxidizes easily and changes its color in transparent containers. Proper containers are needed.

**Guava - Nectar**

At present guava nectar is produced and marketed by the factory.

**Strawberry - Jams**

It is tested and found to be promising. The problem is lack of raw materials due to high cost of production, disease, lack of appropriate technologies regarding varieties and agronomical practices.

**Mango - Mango nectar**

Experimental work had been done and encouraging result was obtained. However, mango pure extraction requires special machinery which is not available in Merti Processing Plant.

The variation in input and output from one year to the other is due to variation in quality of raw materials submitted to the processing plant. Total soluble solid and acid sugar ratio of the raw materials have effect on input and output ratio. From poor lot relatively high percentage of fruits are discarded. During the process some raw materials may not be used effectively. Problem of recording weight, loss of commuted orange due to storage management or power failure also contributes to the difference.

Table 11: Raw materials used and processed products in quintals of major products at Merti Processing Plant

<table>
<thead>
<tr>
<th>YEAR</th>
<th>C</th>
<th>R</th>
<th>O</th>
<th>P</th>
<th>S</th>
<th>T O T A L</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O</td>
<td>R</td>
<td>A</td>
<td>N</td>
<td>G</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td>SQ</td>
<td>U</td>
<td>A</td>
<td>S</td>
<td>H</td>
<td>Marmalade</td>
</tr>
<tr>
<td>Raw</td>
<td>Processed</td>
<td>Raw</td>
<td>Material</td>
<td>Processed</td>
<td>Raw Material</td>
<td>Processed</td>
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<tr>
<td>Raw</td>
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<td>Processed</td>
<td>Raw</td>
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<td>Raw</td>
</tr>
<tr>
<td>Year</td>
<td>Product</td>
<td>Orange</td>
<td>Lime/lemon</td>
<td>Product</td>
<td>1</td>
<td>Product</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>--------</td>
<td>------------</td>
<td>---------</td>
<td>---</td>
<td>---------</td>
</tr>
<tr>
<td>1987/88</td>
<td>-</td>
<td>-</td>
<td>5779</td>
<td>935</td>
<td>8432</td>
<td>-</td>
</tr>
<tr>
<td>1988/89</td>
<td>184</td>
<td>179</td>
<td>9228</td>
<td>1834</td>
<td>10651</td>
<td>-</td>
</tr>
<tr>
<td>1989/90</td>
<td>187</td>
<td>201</td>
<td>5455</td>
<td>1391</td>
<td>6560</td>
<td>42</td>
</tr>
<tr>
<td>1990/91</td>
<td>79</td>
<td>68</td>
<td>23845</td>
<td>6611</td>
<td>28672</td>
<td>-</td>
</tr>
<tr>
<td>1991/92</td>
<td>51</td>
<td>55</td>
<td>22227</td>
<td>6715</td>
<td>25649</td>
<td>127</td>
</tr>
<tr>
<td>1992/93</td>
<td>129</td>
<td>141</td>
<td>15280</td>
<td>4344</td>
<td>18454</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>630</td>
<td>644</td>
<td>81814</td>
<td>21830</td>
<td>98418</td>
<td>169</td>
</tr>
</tbody>
</table>

**MAJOR PROBLEMS**

**Raw Materials**

There is no serious problem in getting citrus fruits both in quantity and quality. For guava the raw material is not properly ripened when it reaches the factory. This is to avoid pest attack in the field. As a result the color and taste of the product is not desirable. At a time when guava is in pick season, the factory may be busy with other products and when the factory is in need of guava it may not be available.

**Packing Materials**

Lack of quality packing materials and high cost are the major problems of the factory. The natural juices are not produced because of lack of appropriate containers. There are no glass and plastic factories in the country that produce appropriate and attractive containers at reasonable price. Most packing materials are imported and the price is increasing continuously in the last few years due to devaluation of Birr. The cost of packing material accounts 30-40 percent of the cost of production. Currently, tins and glasses are used as packing materials. Attempt was not made to produce these packing materials locally. Other packing materials (plastic bottle, aluminum foil) are not used.

Orange peel oil is a byproduct used in the production of orange liquor, soap production, flavor in pastries and pharmaceutical productions. There is no problem of raw materials. It is not promoted due to lack of appropriate containers.

**Capacity**

Theoretical capacity of the factory is 47900 q/year while attainable is 43500 q/year. The factory uses 52 % and 48 % of its capacity to produce tomato and fruit products respectively. This proportion varies greatly depending on the demand of the products (e.g. military activity).
The factory is not updated and most spare parts are modified locally. It is not continuously working. Sometimes there is failure of electricity. The available generator is not capable to run main processing lines like tomato and marmalade evaporators. If electricity fails while it is processing every thing in the line will be lost.

There is only one pasteurizer cooler. All processed products should pass through it. Obtaining an additional pasteurizer cooler can increase the capacity greatly. Also there is only one raw material washing and sorting table. Hence, it is not possible to wash, sort and crush different raw materials simultaneously.

Marketing

There is lack of information in marketing of processed products. Proper local demand assessment, what is imported and what is needed are essential. Due to low demand or high cost, sometimes products are piled. The orange squash or tomato products locally produced are comparable or even better than some imported materials. But acceptance of local products by consumer is not encouraging. This can be changed through time by properly synthesizing consumers, using attractive containers and strong publicity. The amount produced currently does not justify its promotion cost.

Currently, the factory mainly supplies to the military. Ninety percent of tomato fruits produced by the enterprise are processed. Tomato is mainly produced for the factory. Very small portion of orange and guava are processed (about 5%). Orange squash produced by the factory has high demand but its supply in the market is very much limited in the last few years.

FUTURE OF PROCESSING PLANT

Processing technology is highly advanced. Ethiopia is way behind compared with some developing countries. In Ethiopia there is one small processing plant. It has serious shortage of spare parts. There is great potential to produce fresh fruits and processed products for export to different countries. This field is untouched in Ethiopia and simply talking about potential cannot benefit the nation unless it is fully exploited.

Expansion of fruit production is the prerequisite for expansion of processing and export of processed products. Fruits need to be available for local and export fresh markets. It is only the excess that is processed.

SUGGESTIONS

The factory has research unit. There are research areas that UAAIE and EARO could work together to develop different products, to tackle the existing production and processing problems by adapting relevant technologies available elsewhere.
HORTICULTURE DEVELOPMENT ENTERPRISE

Horticulture Development Enterprise (HDE) was established as Small Farms Coordination Office under Horticulture Development Corporation (HDC) in 1968. The farms were partly nationalized from individuals.

Table 12: Farms under Horticulture Development Enterprise and their locations

<table>
<thead>
<tr>
<th>Farms</th>
<th>Region</th>
<th>Zone</th>
<th>Wereda</th>
<th>Distance in km from Addis Abeba</th>
<th>Nearest big city</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error Gota</td>
<td>SNRS</td>
<td>Shinele</td>
<td>Error</td>
<td>400 E (Train) 560 E Road</td>
<td>Dire Dawa</td>
</tr>
<tr>
<td>Ellen</td>
<td>ONRS</td>
<td>East Shoa</td>
<td>Bora</td>
<td>108 SE Road</td>
<td>Mojo</td>
</tr>
<tr>
<td>Gibe</td>
<td>ONRS</td>
<td>Jimma Gurage</td>
<td>Socoru Goro</td>
<td>185 S Road</td>
<td>Wolkite Addis Abeba</td>
</tr>
<tr>
<td>Tsedey</td>
<td>ONRS</td>
<td>W. Shoa</td>
<td>Welmera</td>
<td>40 W Road</td>
<td>Addis Abeba</td>
</tr>
<tr>
<td>Ziwai</td>
<td>ONRS</td>
<td>E. Shoa</td>
<td>Adami Tulu</td>
<td>165 SE Road</td>
<td>Ziwai</td>
</tr>
</tbody>
</table>

ONRS: Oromia National Regional State
SNNPRG: South Nation Nationalities Peoples Regional Government
SNRS: Somalia National Regional State

Table 13: Climatic data on Horticulture Development Enterprise farms

<table>
<thead>
<tr>
<th>Farms</th>
<th>Altitude</th>
<th>Rainfall in mm</th>
<th>Temp. in °Centigrade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Maximum</td>
</tr>
<tr>
<td>Dukem</td>
<td>1900</td>
<td>866</td>
<td>27</td>
</tr>
<tr>
<td>Error Gota</td>
<td>1115</td>
<td>517</td>
<td>38</td>
</tr>
<tr>
<td>Ellen</td>
<td>1550</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gibe</td>
<td>1095</td>
<td>814</td>
<td>35</td>
</tr>
<tr>
<td>Tsedey</td>
<td>2300</td>
<td>1010</td>
<td>24</td>
</tr>
<tr>
<td>Ziwai</td>
<td>1650</td>
<td>543</td>
<td>28</td>
</tr>
</tbody>
</table>

All dates are in Ethiopian calendar unless mentioned specifically.
Table 14: Total Area in Hectares of Fruits in Horticulture Development Enterprise Farms

<table>
<thead>
<tr>
<th>Crops</th>
<th>Farms</th>
<th>Ellen</th>
<th>Error Gota</th>
<th>Gibe</th>
<th>Tsedey</th>
<th>Ziwai</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avocado</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Banana</td>
<td>-</td>
<td>21</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Citrus</td>
<td>7</td>
<td>140</td>
<td>53</td>
<td>-</td>
<td>53</td>
<td>255</td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td>6</td>
<td>121</td>
<td>44</td>
<td>-</td>
<td>53</td>
<td>224</td>
<td></td>
</tr>
<tr>
<td>Mandarin</td>
<td>1</td>
<td>13</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Grapefruit</td>
<td>6</td>
<td>9</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Grapevine</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Mango</td>
<td>3</td>
<td>31</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Papaya</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Pome/apple</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>16</td>
<td>-</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>171</td>
<td>53</td>
<td>16</td>
<td>122</td>
<td>395</td>
<td></td>
</tr>
</tbody>
</table>

Table 15: Productivity in Quintal per Hectare in Horticulture Development Enterprise Farms

<table>
<thead>
<tr>
<th>Crops</th>
<th>Farms</th>
<th>Error Gota</th>
<th>Elon</th>
<th>Gibe</th>
<th>Tsedey</th>
<th>Ziwai</th>
<th>Average Price Birr/kg</th>
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</thead>
<tbody>
<tr>
<td>Avocado</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>98</td>
<td>1.00</td>
</tr>
<tr>
<td>Banana</td>
<td>200</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.50-0.70</td>
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<tr>
<td>Orange</td>
<td>140</td>
<td>156</td>
<td>154</td>
<td>-</td>
<td>-</td>
<td>45</td>
<td>0.40-1.10</td>
</tr>
<tr>
<td>Mandarin</td>
<td>140</td>
<td>48</td>
<td>453</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.40-1.10</td>
</tr>
<tr>
<td>Grapefruit</td>
<td>140</td>
<td>-</td>
<td>117</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.20-0.50</td>
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<tr>
<td>Grapevine</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>40</td>
<td>3.00</td>
</tr>
<tr>
<td>Papaya</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
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<td>0.50-1.25</td>
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<td>Mango</td>
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<td>80</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
</tr>
<tr>
<td>Pome</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>11</td>
<td>-</td>
<td>5.00-10.00</td>
</tr>
</tbody>
</table>

Yield in the Enterprise is what is sold but not what is produced. Fruits that are not sold due to problem of market, transport, quality (undersized, taste) or other reasons are not considered yield. Hence, productivity figures should be taken with precaution.

The enterprise has not well equipped meteorological stations in the farms. Some farms have thermometers and rain gauges. Except Ziwai, which has a telephone system, all others are communicated with radio.
ERROR GOTA

A foreigner initially established the farm. The land was under the control of the palace. Later on it was given to the Haile Silassie First Prize Thrust (HSIPT) and was run by the Thrust for years. In 1945 the first citrus trees were planted. The farm was expanded and more trees were planted. After nationalization it became under East ‘Fetan’ Development Farms. In 1969 the farm was transferred to Horticulture Development Corporation under Small Farms Coordination Office. Out of the 450 ha of land 179 ha. is covered with fruits.

CITRUS

The orange varieties include Valencias, Pineapple, Hamlin and Navels. The rootstock used for the old orchards is expected to be Sour Orange. For recently established orchards the rootstock is Troyer Citrange. Varieties and species are planted in mix. This is particularly true for the old orchard at Error and Fatule. The new orchards were established in 1974/75 at Gota farm. The scions used for the new orchards are Campbell Valencia, Ruby blood, Olinda Valencia.

Table 16:  Fruit Orchards in Hectares at Eror Gota Farm

<table>
<thead>
<tr>
<th>Crops</th>
<th>F</th>
<th>A</th>
<th>R</th>
<th>M</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Eror</td>
<td>Gota</td>
<td>Fetule</td>
<td>Fetule</td>
<td>Total</td>
</tr>
<tr>
<td>Banana</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30</td>
</tr>
<tr>
<td>Citrus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mandarin</td>
<td>3.50</td>
<td>6.96</td>
<td>3.50</td>
<td></td>
<td>13.96</td>
</tr>
<tr>
<td>Grapefruit</td>
<td>-</td>
<td>6.00</td>
<td>-</td>
<td>-</td>
<td>6.00</td>
</tr>
<tr>
<td>Orange</td>
<td>25.00</td>
<td>22.04</td>
<td>80.16</td>
<td></td>
<td>127.20</td>
</tr>
<tr>
<td>Mango</td>
<td>*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>*</td>
</tr>
<tr>
<td>Total</td>
<td>28.50</td>
<td>35.00</td>
<td>83.66</td>
<td></td>
<td>274.36</td>
</tr>
</tbody>
</table>

* Negligible

Seven hectares of Mandarin was established before nationalization mixed with orange at Error and Gota. Both scion and rootstocks are unknown. People in the area called the scion ‘Ferencay’. The scions used for the new orchard is Dancy, Algerian Tangerin, Fairchild and the rootstock is Troyer Citrange. For grapefruit, the scion varieties used are Red Blush and Ruby. Troyer Citrange is the rootstock.
The source of planting materials for the new orchard was Melka Sedi. The farm had started propagating its own materials. The major source of rootstock was Upper Awash. The farm has also propagated and distributed planting materials to farmers in the region. Now the propagation program has stopped since expansion has ceased on the farm.

The spacings for the old orchard vary considerably. For the new orchard 8 m by 4 m for orange, 7 m by 3.5 m for mandarin and 7 m by 7 m for grapefruit were used. The reason is the same as UAAIE.

Fertilizer

Urea and DAP at the rate of 1 kg and 0.5 kg respectively are applied per tree twice a year for old trees. Fertilizers are broadcasted in the basin and incorporated with the soil. There is no good base for the recommended rate. Even though signs of minor element deficiencies are observed no control measures have been taken so far.

Irrigation

The source of irrigation water is Error and Gota rivers. Furrow irrigation is practiced. In the dry season the volume decrease and farmers are using the rivers for the production of chat, fruits and vegetables. These days there is serious water shortage and orchards are not irrigated as planned. Fields are irrigated every 15 days whenever possible. Shorter interval is recommended but not possible due to shortage of irrigation water. This is believed to be one of the major reasons for reduction of yield.

Crop Protection

No serious pathological problems were observed on citrus at Error Gota. Some trees died due to *Phytophthora* incidence. No control measures have been taken so far. Some trees are drying due to unknown reasons (greening, gummosis, etc.). Red scale is the major insect pest that attack fruits, leaves and branches. It reduces yield and fruit quality. Highly infected fruits are not marketable. It also affects fruit bearing age of trees. Ultracide 40% EC at the rate of 200 – 250 cc/100 liters of water, Medapoz spray oil at the rate of 500 – 750 cc/100 liters of water, Diazinon 60% EC at the rate of 250 – 300 cc/100 liters of water are sprayed alternatively. The total spray per year should not exceed four. Medapoz oil sprayed with Diazinon or Ultracide.

In the last two to three years leaf miner and thrips incidence became very important. Thrips reduce the appearance of fruits (quality). This is expected to be caused by routine spray of insecticides to control other insects. Routine spray of insecticide expected to kill insect predators and parasites, which naturally control the pests. The effect of leaf miner and thrips on yield and quality was not studied. No control measure has been taken so far to control the pests.
Many symptoms of minor element deficiency and/or toxicity are commonly observed in the farms. Fertilon Combi used to be sprayed in the past. Since no significant change was obtained spraying of the chemical has been suspended. Appropriate recommendations must be available through tissue and soil analysis to control the disorders.

Cultivating around the trees and chopping between the rows controls weed. For cultivation men laborers are needed. Sometimes there is shortage of labor when it coincided with other operations.

Harvesting, grading, packing and marketing

Climbing trees and dropping fruits are the common harvesting methods. Fruits are graded by size. Fruits that are rotten, undersized and mechanically damaged are discarded. The merchants receive the produce on the farm. They use wooden boxes and plastic crates. They transport to cities using open trucks and train trailers. Due to rough handling during loading, transportation and unloading, mechanical damage is common. Since demand is higher than the supply any thing produced is either exported to Djibuti or sold at Dire Dawa, Harar and Jijiga. There is no contract between the enterprise and ETFRUIT. ETFRUIT buys produces as any other merchants. Error produce juicy, sweet fruits and citrus production on the farm is profitable.

BANANA

The materials were obtained from the area and the variety believed to be Dwarf Cavendish. Acceptance by consumers is good. The spacings used are 2.5 m between rows and 2 m between plants in the row. Two to four suckers are left per hill.
Banana production was abandoned in the past and recently reinitiated. Its water requirement is high compared with citrus. This creates a serious problem in the dry season.

Fertilizer

Fertilizers are not applied as recommended due to high cost. The recommended rates are 6 quintal of urea splitted four times and 4 quintals of DAP splitted two times. Actual application is 4 quintals of urea and 2 quintals of DAP per hectare per year (splited 4 and
2 respectively). Method of application is broadcasting and incorporating of the fertilizer with the soil. Potassium is not applied.

Irrigation

Basin type irrigation is practiced. Fields are irrigated at an interval of 7 – 10 days. Longer interval is practiced in the dry season when there is acute shortage of water.

Crop Protection

Apart from some problems in production management such as irrigation, fertilization and sucker management etc. there are no serious disease or insect pest problems observed in the farm. Weed is controlled as that citrus orchard.

Harvesting and Ripening

Bunch is harvested and sold to merchants on the farm. Merchants cut hands and transport them in wooden and plastic boxes. Ripening takes place in the major cities where fruits are marketed.

MANGO

Mango plants are scattered in banana plantation. There are no specific cultural practices for mango. It is treated with banana. Marketing is the same as citrus.

ELEN FARM

Elen farm was nationalized from individuals. An individual of Greek nationality established it. The total cultivable area is 55.9 hectares out of which 12 hectares are allocated for fruit production.

CITRUS

The old orchard was established in 1963 before nationalization. The Ministry of Agriculture had established five hectares of citrus orchard in 1978. The spacings used for the new orchard were 7 m between rows and 3.5 m between plants. Three hectares were abandoned due to hard pan. The varieties used were Valencias for orange, Clementine for mandarin. The rootstocks are not known even though Sour Orange and Troyer
Citrange are expected to be the rootstocks used for the old and new orchards respectively. The new orchard gives about 200 q/ha while it is about 50 q/ha in the old orchard.

Four quintals urea and 1 quintal DAP are applied per hectare every year. Irrigation is applied at 10 days interval if the pump function well. Weed control is the same as in Error. Minor incidence of red scale and leaf miner were observed on the farm but not serious. As in Error Gota regular sprays are made to control red scale.

Those trees that are on hard pan are dying. Fruits ripe before they get mature. About 50% of the produce is damped because of quality. The soil above the pan is too shallow and is pumas which can not retain moisture. Application of manure has improved the situation but not much. The farm has planned to expand the citrus orchard at least by 5 hectares.

MANGO

Mango trees are established on five hectares of land. One hectare of the orchard is old while the other four hectares are relatively young which were established after land nationalization. Varieties are unknown, mixed and they are seedlings. But the fruits have good acceptance. Since narrower spacing was used for the old orchard and plants are crowded. Eight meters between rows and seven meter between plants in the row were used for the young orchard.

The orchard is not regularly fertilized. Urea and DAP at the rate of 2 quintals each per hectare are applied every year. Source of irrigation water is Lake Elen. Water is pumped to higher elevation and furrow irrigation is practiced. Except when there is pump failure trees are irrigated regularly at an interval of 10 days.

Problem of hard pan is not very serious on mango plantation. There is serious powdery mildew problem at flowering stage. It caused flower abortion and produces spots on fruits. Smoking is practiced to warm up the surrounding area, and Bylaton at the rate of 0.4 – 0.5 kg/ha is sprayed one or two times to control the disease. Seedling trees are inconvenient for spraying. Special sprayer (tractor mounted sprayer) is required to effectively spray tall trees.

BANANA

The farm has planned to establish 5 hectares of banana plantation. The orginal source was Arba Minch. The farm is advised to use Poyo and Gant Cavendish instead of Dwarf Cavendish which is susceptible to nematode.

GIBE FARM
There are two units one is in SNNPG and the other is in ONRS. Ato Getachew Wolde Amanuel established Gibe one (in Gurage Zone) in 1951. Ato Mohammed Osman, Ato Yesuf Mohammed and Ato Muse Yami established Gibe two (in Jima Zone) in 1954.

Initially the farm was producing maize and cotton. Fruit production was started in 1958. The first fruit produced was orange. The scion was Campbell Valencia but the rootstock was unknown. It is assumed to be Sour Orange since it was the most common rootstock used at that time. After land nationalization in 1967, The National Resource Development expanded the existing orange orchards and added mandarin and grapefruit in 1967.

Citrus is the major group of fruits produced on Gibe farm. The orange varieties were Olinda Valencia, Campbell Valencia, Hamlin and Parent Washington Navel. According to Ato Feleke Feltamo an expert in HDE, the rootstock used was Troyer Citrange. Areas in table 3 is the number of existing trees per number of trees expected per hectare. There is gap in all orchards. The actual area covered by fruits is much greater than what is presented in this report. According to the officials on the farm this is due to Phytophthora (citrus aids) disease.

The previous orchards were spaced 6 m by 6 m, 7 m by 7 m. The young orchards were established using 7 m between rows and 3.5 m between plants in the row. This was done with the assumption that every other plant in the row will be uprooted use hedger. None of these were practical for various reasons. Suckers grown from rootstock, water sprouts that grow internally and dead branches are removed.

SOIL

The soil was not studied for its suitability for citrus production. Eighty percent of the soil is Vertisole (black cottony) which is not suitable for fruit production. Hard pan is expected underneath. Flood is another reason for the decline in yield. About 16 hectares of citrus trees were uprooted after 10 years of establishment. However, there are spots of land that are suitable for citrus production.

Traditionally DAP and urea are applied every year. The rates are 4 quintals urea and 1 quintal DAP per hectare. This is below the recommended rate. Urea is applied twice a year (end of August and end of January).

IRRIGATION

The Gibe River is the source of irrigation water for the farm. Water is pumped to higher elevation and gravitational irrigation system is practiced. As in other farms basin irrigation is used for citrus. The field is irrigated at an interval of 1-2 weeks depending
CROP PROTECTION

Leaf and fruit spot disease appeared in the last five years. It significantly reduced yield and quality (appearance, juice content, flavor etc.) of fruits. It does not necessarily cause death of plants. Low temperature and humid conditions favors the disease. This is from September to November at Gibe. There after trees start to revive but the fruits are already damaged. The disease contributed to shift in the production period of the orchards. The weak trees need sometime to produce fruits for next season. Grapefruit is most susceptible to leaf and fruit spot diseases.

In the past the incidence was restricted to south and southwestern part of the country. Recently it is observed in northern Ethiopia. At present it is not observed in Upper Awash and other major citrus producing regions. Kocide 101 at the rate of 4 – 5 kg/ha and Daconil at the rate of 4 kg/ha are used to control the disease. They are found to be ineffective. Now the Enterprise and EARO initiated a comprehensive research activity to control the disease. This includes variety screening, chemical screening, sanitation, etc.

Phytophthora is another disease observed on the farm. No chemical control measure has been applied. Double rings are constructed around trees to limit the spread of the disease during irrigation.

Scale insects (black and red) were serious problems in the past. The incidence declined after Medapoz and Ultracide at the rate of 3 – 5 liters/hectare sprayed. But due to lack of tractor mounted sprayers there are misses which act as source of infection for next season.

Leaf miner was a minor pest in Ethiopia but became very important in the last four years. This is expected to be due to routine spray of insecticides to control scale insects. The pest generally affects young leaves of young shoots. It commonly appears throughout the year but the incidence is low in dry and hot season (March to may). It seriously affect the leaves, the site for photosynthesis. It delays fruiting and reduces yield and quality significantly. Trial is on progress in cooperation with EARO researchers to control leaf miner incidence.

MARKETING

The enterprise is selling its produce to merchants, consumers and ETFRUIT. It uses auction and sell it openly to merchants. There is no market problem. The business is not profitable at present. According to the farm manager the farms never made profit after nationalization. The extent of loss increased in the last few years. The loss is contributed
by overhead cost, previous interest, unnecessary permanent laborers and expensive irrigation system.

In the past the farm used to produce citrus when there was scarcity in the market (February to June). Grapefruit quality is exceptionally good. These days its productions coincided with that of Upper Awash, the major citrus producer in the country. This has negative effect on the Gibe farm. The major reasons for this shift and low production and productivity are expected to be due to change in climate (Illino), leaf and fruit spot incidence, inadequate irrigation at the time of flowering, failure to apply fertilizer as recommended (mainly due to shortage of irrigation water), age, lack of close season and harsh weather.

Banana was tried on two hectares of land. The temperature reaches up to 42 °C from March to May. According to Ato Kasaye the farm manager, banana could not tolerate high temperature of the area. Fruit burn is observed starting from the tip.

MANGO

The area has great potential mango production. According to the farm manager mango production may not be profitable since there are many farmers producing mango. Supply of mango is seasonal and the demand never met by the supply. Use of quality mango varieties coupled with proper management can make mango production profitable both for local and export markets.

FUTURE PLAN

Expansion of citrus orchard has been halted due to the problems of leaf and fruit spot disease and leaf miner. Once solutions are obtained for the problems the farm would far better of by producing fruits than other crops such as cereals, oil crops, pulses, fiber crops, vegetables. Unless appropriate measures are taken now it is most likely that Ethiopia in general the farm in particular will lose its potential of producing citrus. All concerned organizations producers and researchers should work together in finding solutions. HDE and EARO already have started research work on the two problems; bit the effort should be strengthened.
Ras Mesfin Seleshi used to own the farm. Then he transferred it to his adviser Jusepe Jakom, an Italian. The hectarage of the farm was not greater than 58 hectares. They tried to produce grapes. They were not successful due to high rainfall, cold, storm and drainage problems. They planted Eucalyptus trees around the farm and in areas where drainage was a problem.

After nationalization the farm become under HDC. At present the farm has 154 hectares of cultivable land. Potato and other vegetables such as cole crops, beet, carrot, spinach, chill peppers were produced. In 1975 the farm started to produce temperate fruits. It imported peach, apple, plum, pears, quince, apricot for observational purposes. These materials were imported from Spain, Israel, Zimbabwe and California.

Out of the total imported materials Anna and Enshimer (a pollinator) on Malus 09 found to be promising. These materials were imported from Israel. The spacings used between rows and between plants was 2 meters. Three meters spacing is used between rows every four rows. Anna’s chilling requirement is reported to be 325 hours. Enshimer (pollinator) on the other hand require 400 hours. The base for chilling temperature is not indicated. There is lack of synchronization in flowering time between the major variety Anna and the pollinator Enshimer. This is another problem that contributed for low yield. Chemicals are not applied to initiate flowering.

Next to Anna, Winter Banana is the best fruit producer on the farm. It is relatively resistant or tolerant to agro-bacterium. But the fruit quality is relatively poor and has low demand. The 0.2 hectares field had been totally neglected. Agro-bacterium attacks the root system. Use of resistant rootstock is the best means to control the disease. The fact that the Winter Banana trees are resistant/tolerant to agro-bacterium indicates that either the rootstock or the scion or both are resistant / tolerant to the pathogen. If by chance the rootstock has this character it can be used for Anna and Enshimer.

Initially mixture of Anna and Enshimer were established on 14 ha in 1980. After two years 2 hectares were added. After seeing the good performance of Anna and Enshimer the farm imported many varieties from Spain. They were established on 60 hectares of land. These were not successful and were uprooted after four years. The reason why they failed was not clearly understood. Peach varieties were established on 12 ha. The early development and flowering were good but failed to fruit. After eight years these too were uprooted.

IRRIGATION

There are 250 ha of land on the farm and about 200 ha is irrigable. Out of the irrigable land 30 ha is irrigated by pump and the remaining can be irrigated by gravity. The source
of irrigation water is Holleta River which dependable. Irrigation is applied at an interval of 10 days in the dry season. The interval is reduced to 2 days at flowering and fruiting. Furrow irrigation method is practiced in the farm.

PROPAGATION

Rootstock plants are harvested from the production field. These plants are planted in the nursery. When they reach pencil size they are grafted with desirable scions. The farm used to propagate and distribute budded apple trees to users. This program is halted after the researchers from Ambo reported that young plants from the farm nursery are infected with agrobacterium.

FERTILIZERS

DAP and urea are applied at the rate of 2 and 3 quintals per hectare, respectively. Urea is applied in two splits in a year and applied early August with DAP and late September.

WEEDS

Weeds are controlled around the tree by cultivation manually. Sometimes roundup is applied once in July. Weeds between rows are slashed as necessary. Labor is preferred to control weeds whenever available.

CROP PROTECTION

Apple scab, powdery mildew, *Phythophthora* root rot, bacterial wilt and *Fusarium* wilt are observed in the orchard. The 16 ha apple orchard (Anna and Enshimer) used to give up to 80 q/ha/year. This yield declined gradually and reached 10 q/ha/year. The quality of the fruits has declined as well. This is due to complex problems such as diseases, insect pests, physiological, high chilling requirement, nutritional inbalance, management etc.

Fruit trees are pulled out in great number. The major reason for the death of trees is *Agro-bacterium tumafecies* (bacterial wilt) which causes crown gall. Almost all trees are infected with the disease. The disease is suspected to be imported with the planting materials, but there is no hard evidence to accept the claim. There is no control measure against bacterial wilt.

*Phythophthora* is another major disease. In the last ten years Redomil 5 G was applied at the rate of 8-10 kg/ha to control *Phythophthora*. This treatment reduced the incidence to some extent. International Livestock Research Institute (ILRI) reported *Fusarium* wilt after studding the orchard.
Apple scab reduces the quality of fruits by forming spots on them. Baycor 300 EC a protective and curative chemical is effective to control the disease. Since it is not registered it is not available in local market. The rate used was 1.35 l/ha in 400-500 liters of water. Kocide 101, Mancozeb and Anthracol are protective chemicals against apple scab. These chemicals are not effective in the rainy season. As a result apple scab has become a serious problem this year. Extended rainfall favored the development of the disease.

Powdery mildew is another disease which attacks young leaves and flowers. This too reduces yield. Control measure against powdery mildew is Bylaton 25 WP 0.4-0.5 kg/ha in 400-500 liters of water.

Woolly aphids are the major insect pest observed around root zone and in areas where pruning takes place. Insecticides such as Dimecron 100 ACW, Ultracide and Cymbush are used to control the pest. Some unidentified leaf eater insect pests are observed but not serious.

HARVEST/MARKET

Harvesting apples is from January and February. Smoothness, shininess and size are used as harvesting index. Fruits that are mechanically damaged are discarded. Since the demand is high and supply is low any fruit is easily sold. Market is not a problem. The price ranged from 5 – 10 Birr per kg.

TO PRODUCE APPLE IN THE COUNTRY

- Rootstocks resistant to the diseases and pests must be identified
- Low chill requiring scions materials should be imported
- Compatibility of scion and rootstock should be studied
- Materials imported should be free from disease
- Training personal on temperate fruits management both in research and development sectors is essential
- Study application of defoliator chemicals and physical defoliation of leaves on yield and quality of fruits
- Study soil nutrition requirement of the crops

Highlands are good to satisfy the chilling requirement but are poor for fruit ripening and development of desirable color. As alternative to provide fruits for highlanders, peach and plums that are grown in many highlands can be tried. The local varieties can be used as rootstock and improved peach and plum varieties from research centers can be used as scions. In the mean time varieties that are adaptable to the growing conditions can be developed.
ZIWAI

The farm was nationalized from three individuals Dejazmach Berhane Meskel Aba Erie, Ato Chanyalew Tesema and Ato Solomon Mahteme Selassie. For expansion land was taken from peasant associations. Before nationalization the land was used for cattle raising, vegetable and cereal production. The farm has 900 hectares of cultivable land.

CITRUS

The orange varieties are Valencias and the rootstocks are unknown. The farm does not propagate its own planting materials. Grafted trees were received from Merti and planted in 1977/78. The yield 50 quintals per hectare is considerably low for its age. There are a lot of gaps in the orchard. This could be due to the use of unadaptable rootstock. Soils in Ziwai area are highly alkaline. Rootstocks such as Troyer and Carrizo Citranges are sensitive to alkaline soil. Other problems such as nematodes, soil nutrient imbalance, raised ground water during rainy season, high evapotranspiration etc. are possible reasons for its poor performance. The trees are very weak and are prone to diseases and insect pests. Spacings 7 m between rows and 6 m between plants in the row were used in the orchard establishment.

A variety observation trial comprising of species and varieties is recommended. Sour orange and Volkamriana are suggested as rootstocks. Melkasa Agriculture Center can provide these materials.

DAP and urea 1.5 and 6 quintals respectively per hectare are applied per year. Urea is applied during blooming and after fruit set. Fertilizers are broadcasted between the rings and incorporated with the soil. Though minor element deficiencies are observed no control measures are taken.

Irrigation is applied during dry season at an interval of 15 days. The source of irrigation water is Bulbula River, which is reliable. Water is pumped to higher level and then applied using gravity force. It is believed that irrigation water has high salt content. Frequent irrigation is expected to raise the soil’s salt content. Appropriate measures to cope up with the problem must be found. Weed control is done in the same manner as in Error Gota

According to Ato Million the Enterprise crop protection expert, the disease and insect problems are not clearly identified. Red scale and leaf miner are observed but not serious to cause the decline. In general the trees are in poor condition.
The trees are short and fruits are harvested by hand picking. Fruits have good color but it is a little bit soury. Production season is from May to July. Grading and marketing are the same as that at Eror Gota. Due to low yield the citrus production is not profitable.

**PAPAYA**

There is no field with pure variety. All types can be found in a field. The area is good for papaya production. Solo types gave up to 500 q/ha/yr in the past. At present yield is very poor. This is because of degeneration of varieties, disease incidence particularly *Anthracnose*. Nematodes are also suspected.

Seed source is a problem. The farm produces its own seed. It extracts seeds from selected, well ripen fruits. In the seed production program attention is not given to select healthy plants and healthy fruits. As a result there is a build up of diseases particularly Anthropose. Besides, yield and quality declined through cross pollination.

Spacings of 2.5 and 2 m were used between rows and between plants in the rows respectively. Four and 3 quintals of DAP and urea respectively are applied per hectare per year. Urea is split three times. Irrigation is applied at an interval of 14 days. Partly ripe fruits are harvested and marketed on farm site.

Anthracnose is a serious problem. A joint research program with EARO in the control of the disease is in progress. Red spider mite is observed on leaf stalks. This is expected to reduce yield. Mitac 20% EC/ULV at the rate of 2 –3 l/ha is sprayed to control the pest.

**BANANA**

Banana is recently established. The planting materials were obtained originally from Arba Minch. The variety is expected to be Dwarf Cavendish. Except the leaves which are shredded by wind, there is no significant problem observed so far. Dwarf Cavendish is susceptible to burrowing nematode incidence. Variety observational trials should be considered in order to identify alternative varieties. MARC can supply materials.

Spacings used, fertilizers applied and weed control measures are the same as in Eror Gota. The area is dry and soil is sandy. Irrigation water is applied almost throughout the year at an interval of 10 days. Sucker management is not practiced. Two or more equal sized suckers are allowed to grow from the same hill. This will definitely have negative effect on bunch and fruit size.

**GRAPEVINE**
The 40 hectares vineyard was established from 1971 to 1974. Other 70 hectares were established in 1980. The latter was abundant due to shortage of support poles in 1982. The vineyard is somewhat neglected in favor of export crops and maize. Irrigation is not applied as needed. Since fertilizer is applied with irrigation it is not applied timely. As a result yield is relatively low.

Mixed varieties were planted using spacings of 2.5 m between rows and 2 m between plants. Fertilizers are applied at the rate of 2 and 1 quintals of DAP and urea per hectare per season respectively. Irrigation is applied at 10 days interval if possible. At fruit maturity it is irrigated at longer interval (15 days).

Downy and powdery mildews are very common diseases in vineyard. Redomil MZ 63.5 at the rate of 2.5 kg/ha is applied during rainy season (downy). Kocide 101 at the rate of 2.5 kg/ha and Mancozeb 80% 3kg/ha are sprayed to control downy mildew where infestation is high. Three to four sprayings are made per season depending on the weather condition. To control powdery mildew Bylaton 25% WP is applied 3 – 4 times at the rate of 0.4 – 0.5 kg per hectare.

No entomological problems were reported. But a certain leaf eater beetles are observed at the beginning of the small rainy season (March – April). The influence of single and two harvests per year need to be studied for yield, quality, duration etc.

It is harvested twice in a year. Pruning is done in August and January. Grapes are sold to the winery on the farm and the winery is responsible for packing, transporting and storage. The farm is not happy with the demand for high bricks by winery.

Both the management and the farm workers agreed to expand the perennial crops. To this effect the farm has plan to expand the vineyard by five hectares. Planting material of Tikur Weyen is being propagated in the nursery. Planting materials are also propagated for grapevine variety trial.

**AVOCADO**

There are five varieties. These are Naval, Hass, Backon, Fuerte and Pinkerton. These were received from California and some from Upper Awash. Trees are grafted and suppliers did grafting. Navel has vigorous trees and produce large fruits. Hass and Fuerte have short trees and produce small fruits with acceptable taste.

Trees are spaced seven meters both between rows and between plants in the row. DAP and urea at the rate of 1.5 and 6.0 quintals, respectively are applied per hectare per year. Urea is applied in two splits. The first one is applied before flowering and the second one after fruit set. Irrigation is applied at an interval of 20 days. No serious entomological and pathological problems were observed so far on Avocado. Continuous flowering and fruiting are increasing cost of production.
It is harvested when it produces the right size, for the variety and when fruits become shiny. Ripening is the responsibility of the consumers. For ripening fruits are placed in warm condition. Avocado has high acceptance by consumers. Production is low and cannot satisfy the demand.

ABA SAMUEL

Aba Samuel grapevine orchard was established by Madam Filicha a Greek national in early 1930s. The size of the farm was three hectares. The Small Farms Coordination Office handed this farm to farmers’ association in 1974. Different varieties were established and were used as table grapes. The farm was poorly managed and the yield was very poor.

DUKEM

Muse Dimitri Boleras a Greek national leased the land in 1957. In 1958 he established 19 ha orchard. At a later date the Horticulture Development Corporation established additional 5 ha. The vineyard was totally rain-fed and produces once in a year. Planting materials were prepared from cuttings. Mixture of varieties was established together.

Some of them were:
- Red wine - Tikur Weyn
- Nech Wine - Atere
- Table - Key Dube, Nech Dube (Muscat), Nech Shul

The purpose of production was both for fresh table grapes and wine making. The demand was high that what had been produced was sold without problem. According to Aro Wodemmu Gebre kidan who worked on the orchard since its establishment there was high level of management before land nationalization. As a result productivity was high. The produces were supplied to Saris Weyen Tej, Altavila and Mekanisa wineries.

Right after nationalization, production declined due to poor management. This was improved gradually through training personnel, providing farm inputs and implements, etc. Yield and quality increased significantly. Average yield was about 50 quintals per hectare. There is an opportunity to get yield up to 90 q/h. Horticulture Development Department played important role in the rehabilitation program of the farm.

Total land holding of the farm was 60 ha. During the transitional period in 1983 the orchard was totally destroyed by neighboring farmers. Now only 25 hectares of land without grapevine is under Horticulture Development Enterprise.
Pruning

In rainy season the incidence of downy mildew is high. To avoid this problem pruning was conducted in late August. Following pruning cultivation is made with three pronged hoe. Tractor mounted rotivator was used to brake and loosen the soil. After cultivation, DAP and urea at the rate of 2 and 1 quintals per hectare respectively were applied and incorporated with the soil. The vegetative buds brake after about 20 days. Young shoots were trained and unwanted once removed. Sometimes the vegetative development was continuos. Some shoots used to be topped so that the nutrients could be used for berry development.

Powdery and downy mildew were problems in the production of grapevine. Downy is a problem during rainy season and when relative humidity is high (90%). Protective chemicals such as Kocide 101 at the rate 2.5-3.0 kg/ha, Mancozeb 80% 3kg, Dithane M45 3 kg and Redomil MZ 63.5 2.5 kg/ha was applied alternatively. Powdery mildew is a dry season problem especially on white cultivars. To control powdery mildew, Bylaton 25% WP 0.4-0.5 kg/ha and Afugan 30 EC at the rate of 0.7 kg/ha are sprayed alternatively.

Harvesting was done manually, produce were sold directly to winery or sold to individuals in road side shop near the vineyard.

FRUIT AND VEGETABLE MARKETING ENTERPRISE

The Ethiopian Fruit and Vegetable Marketing Enterprise (ETFRUIT) was established in 1972 as state owned marketing organization. It was responsible for marketing of horticultural crops produced by the state horticulture state farms. Its has the objectives mentioned:

- To supply horticulture products both for local and export market by using appropriate facilities and transport means
- To supply suitable packing materials to promote fruits and vegetables
- To provide efficient uplifting exportable horticultural crops using refrigerated trucks
- Import and distribute selected vegetable seeds for producers

The enterprise started its work in the nationalized stores, ripening rooms and offices. Lideta Branch is the major distribution center. The previous owner was Segnore Kapele. Abune Petros and Afencho-Ber branches are the second and third distribution centers nationalized from Segnore Montrare. People that were working in the distribution centers were also transferred to the enterprise. Its major responsibility was to market products of horticultural crops produced by the horticultural state farms on a commission basis. Later on it included products of other farms that produce horticultural crops. The list includes Melka Sedi Farm, Federal Prison Farms (Ziway & Shewa Robit) etc. Over
the years of its establishment ETFRUIT established its distribution centers and branches in the capital and other major towns of the country.

1. **Addis Abeba**
   - Three main distributions centers
   - Twenty-one permanent container retail shops
   - Thirty temporary tents (mobile) retail shops

2. **Debre Zeit Branch** 45 km. east of Addis Abeba
3. **Nazret Branch** 100 km. east of Addis Abeba
4. **Metehara Branch** 200 km east of Addis Abeba
5. **Asela Branch** 175 km south east of Addis Abeba
6. **Shashemenie Branch** 250 km south of Addis Abeba
7. **Dire Dawa Branch** 515 km east of Addis Abeba
8. **Harer Branch** 535 km east of Addis Abeba
9. **Bahir Dar Branch** 580 km north west of Addis Abeba
10. **Mekele Branch** 783 km north of Addis Abeba
11. **Awassa Branch** 275 km south of Addis Abeba (Recent)

The Enterprise is equipped with refrigerated and non-refrigerated trucks to transport products. The refrigerated trucks are used only for export commodities such as flowers, green beans, okra, melon and passion fruits. Fruits for local markets are transported by non-refrigerated trucks, which is less expensive.

**QUALITY CONTROL SERVICE**

The purpose of the Service is to maintain the quality of the produces that the Enterprise handles. The Service has quality standards for citrus and banana. Inspectors evaluate the incoming produces, prepare samples for different grades and check if the grading is done accordingly. Random checking is conducted in the distribution centers. Number of checks depends on the quality. Sometimes the inspectors visit the farms and assess how the grading is done there, too.

Marketing stations generate information on the type of fruits demanded by consumers (size, shape, price etc.). Consumers generally prefer medium sized fruits. Varieties such as Parent Washington Navel are not preferred due to their large size.

The Quality Control Service evaluates the physical appearance fruits. It has no laboratory to evaluate internal quality (chemical composition).

At present producers are not paid by the quality of fruits they produced. Consumer can not get quality fruits even if they are willing to pay. This has negative effect on the fruit industry. Concerned organizations such as ETFRUIT, Ethiopian Standard Organization (ESO), Ethiopian Nutritional Institute (ENI) and Ethiopian Agricultural Research Organization (EARO) and fruit producing farms should work together to change the situation. Concerted effort should be made to study the existing situation and device means to improve the quality standard. This unequivocally will enable the country in general and growers in particular to increase production of fruits for local consumption.
and export of fresh and processed fruit products. Quality is important particularly for export markets where competition is very keen.

CITRUS

SPECIES AND VARIETIES

The Upper Awash Agro Industry Enterprise (UAAIE) is the major supplier of citrus. The group includes orange, mandarin, grapefruit, lemon, lime. Tangor and tangelo are considered as mandarin.

The well known varieties of orange are Campbell and Olinda Valencia. Hamlin, Pineapple and Parent Washington Navel are also marketed. The Valencias have high acceptance by consumers. They have longer-shelf-life, good appearance and taste. Hamlin on the other hand, has short-shelf-life. Parent Washington Navel fruit is oversized and sometimes they are watery. Next to Valencias, Pineapple is transported to long distance markets due to its better indurance to handling. But it has small fruits.

The main mandarin varieties include Mineola, Orlando, Fairchild, and Algerian Tangerin. In Southern Ethiopia mandarins have preference compared with orange. Mineola and Orlando have high market acceptance. Fairchild is preferred for its taste but not available as needed. Algerian Tangerin is green even after ripening which reduces its acceptance.

The demand for grapefruit is gradually increasing recently. Red Blush has high demand compared with the white. Awara Melka is the major supplier to ETFRUIT. Mexican lime has high demand in Arabian markets. Poor package is the major problem for export. The spot developed on fruits makes it unexportable. Egypt is the major supplier to Arabian markets.

Citrus fruits sometimes are not harvested at the right time. Some are over matured and can not be hold for longer time. Immature fruits will not develop the right color and acceptance is low. Sometimes undersized fruits are received. These have very low demand by consumers. The quality of the fruit is affected because of insect damage mainly by thrips.

Due to uneven irrigation system sometimes, fruits have low juice content. This lowers the demand. Mechanical damage are commonly observed on fruits. This is mainly due to rough handling before and after harvest.

GRADING
The farms are grading and discarding unworthy fruits on the farm. This includes deformed fruits, fruits with rough skin, fruits damaged by Mediterranean fruit fly and false codling moth.

In the main distribution center (Lideta) there are two sections for grading and distribution of fruits. In the First Distribution Section citrus fruits are graded and packed in 20 kg plastic boxes. This is mainly for whole sale. The clients includes merchants, hotels, hospitals, higher learning institutions, military police etc. Repackaging is practiced whenever fruits stay more than 48 hours in the center. In Container Distribution Section, citrus fruits are sorted, graded and packed to be sold in containers and tents in Addis Abeba.

The fruit received from the farm are mixed in size, maturity, ripening, variety etc. Preliminary grading is practiced by all distributing centers. Fruits that are damaged by Mediterranean fruit flies and false codling moth, diseases or cracked and physically damaged fruits are discarded.

The second grade includes undersized, very small fruits for the variety, fruits damaged by scale insects, oversized and deformed fruits. Those fruits are sold to retailers by auction and marketed in small markets called ‘Gulete’. The price is 25% less than the first grade. Over mature fruits are separated and disposed as soon as possible. Washing, waxing and degreening are not practiced.

Grading is manual. Fruit handling during unloading, grading, packing and loading is very rough. Sometimes fruits are treated like stones. Mechanical grading is possible. Grading machine was obtained from GTZ. It was not in use for years (15 years). This includes washing, grading and probably waxing.

According to the Foreign Trade Division Head Ato Sisay grading is important both for the Enterprise and consumers. This will help to develop quality awareness among producers and consumers. There are complaints that fruits purchased from retailers are relatively good compared with those purchased from the containers. According to the officials the fruits for retailers and whole sellers are taken from the same lot. As far as the Enterprise is concerned special treatment is not given to merchants. Relatively large fruits are not sold in containers due to low demand.

Price varies depending on species, varieties and grade (0.85 – 1.40 Birr/kg). The merchants purchase the best variety at higher price. They are re-grading, cleaning and washing the fruits and their display method is attractive and of high standard. They charge high price for such products.

PACKING

Fruits are received from the farms in plastic boxes. After grading, the fruits are put in plastic boxes (20 kg). In pick season 2 kg fruits are packed in plastic bags. These are sold
to consumers either in container or tents. The plastic bags are not perforated for air circulation and affect fruits negatively. Using perforated bags or making some holes in the bags can reduce the damage. Merchants are using wooden boxes for local and Djibouti markets.

STORAGE AND SHELF LIFE

Fruits are highly perishable. They are not stored under normal conditions. Sometimes market problem, cost, pick production season force growers or traders to store fruits. Stores are simple (no refrigeration, natural ventilation, no humidity control measures). Normally fruits stay in the distribution centers for 48 – 72 hours. At pick season, fruits may stay up to five days.

Weight loss due to storage and evaporation is common. This is not properly established. This created problem between the farms and enterprise, enterprise and merchants. This is a very sensitive issue and need to be studied. The amount of weight loss is affected by time of harvest, transportation and storage conditions. The enterprise allows a 25 gm compensation for 2 kg of produce in 24 hours.

Pineapple and Valencias have good shelf life and transported to long distance. Only first class is sent to distant distribution centers. The centers receive their fruits directly from farms.

Fruit stores in Ledeta branch are equipped with ventilators but ventilators are not functional since their establishment. The Enterprise installed the cooling system in fruit stores with Russian assistance. The officials in the store reported that electric consumption of the system is high and the Enterprise requested the removal of the electric meter. To reduce the heat generated by the products in the store many holes are made on the walls.

MARKETING

The Marketing Enterprise is selling fruits on commission basis. The Enterprise charges commission of certain percentage of the cost. The fruit marketing system is not well developed. The Enterprise established a marketing research and customer service. This is to strengthen the existing marketing system both local and abroad, market promotion, to introduce new horticultural crops into the system, to encourage private producers, etc. Transportation is the main problem for export markets. Transport is also a problem for transporting fruits to distributing centers. The main and feeder roads are not in good condition.

SOURCE
The main source for citrus fruits is the UAAIE. Fruits are also received from Metehara, Shoa Robit, HDE (Error Gota), Hurso Military Training Center. The Marketing Enterprise is profitable. Citrus is the major commodity handled by the Enterprise 75 % of the total).

EXPORT

Very small amount of citrus is exported to Middle East. Sometimes lime, mandarin and grapefruit are exported to Djibouti. There is no problem of marketing lime in the Middle East. Air freight makes the price unacceptable. Sea and land freight of fresh fruits and processed products can make the business more profitable. This requires to use the appropriate facilities.

PROCESSED PRODUCTS

Processed fruit products are sold through the Enterprise. The UAAIE is also selling such products to various government and non-government organizations. The processing plant the only one in the country should be updated to accommodate different products and maintain the quality standard. Improvement in packaging material, cost and quality should be to expand the local and export markets.

BANANA

The major sources of banana for the enterprise are Awara Melka, North Omo Agricultural Development Enterprise and farmers around Arba Minch.

Fruits from Awara Melka are small in size. This is expected to be due to lack of sucker management, nematode and cigar end rot incidences. Farmers around Arba Minch produce excellent banana that has high acceptance by consumers. The road is relatively good for transport. The Enterprise has plan to receive produce directly from farmers. At present some merchants in Addis Abeba have their own ripening rooms.

PRE AND POST HARVEST PROBLEMS

Immature fruits, which will not ripe properly, are harvested and transported to ripening centers. Use of maturity index to harvest at optimum stage is expected to reduce the problem. Failure to practice what is recommended (fertilization, irrigation, sucker and bunch management) resulted in small fruits.
Except from UAAIE all fruits are transported in bulk. Bunches are loaded loosely in truck (non-refrigeration truck) and covered with banana leaves. This may cause damage, which is revealed after ripening. Transporting hands in boxes is recommended.

GRADING

As opposed to other fruits, banana is available throughout the year. The two distribution centers in Addis Abeba have banana-ripening rooms. The Enterprise has a plan to open ripening center at Debre Zeit and Nazret. The centers receive green mature banana from state farms and individuals. Before putting fruits into ripening rooms defected (broken, rotten, immature) fruits are discarded. Banana hands are packed in plastic boxes and are piled in ripening rooms. Kerosene stove is burnt and doors are closed for some time to enhance ripening.

Though the ripening rooms at the main center are equipped with the necessary equipment non-of them are functional. There is no washing, chemical treatment and packaging. There is no grading after ripening. Fruits are sold to merchants and consumers. Fruits are disposed as soon as possible. But at times when the demand is low fruits can stay in the store for few more days after ripening. Loss after ripening is not experienced. If it was not for the supply the demand is always there.

Export demand is high particularly from the Middle East. This was not exploited because of poor quality of the produce, lack of appropriate packing materials and transporting facilities. At present, high quality banana for export market is not produced in the country. If improvements can be made on production and handling after harvest (trimming, washing, fruit treatment with chemical, use of land and sea freight, proper packaging materials) market can easily be developed in the Middle East and Europe.

MANGO

Availability of mango is seasonal and the Enterprise receives mango from UAAIE and Welega. Mango from UAAIE is marketed both locally and abroad. Some of the internationally known varieties such as Tommy Atkins, Kent and Kiett have high quality. It is exported to Middle East mainly to Saudi Arabia. Mango from Welega is not of high standard and is used only for local market. The fruits are small, fibrous and the seeds are large. Mango has good market at present. There is potential to produce mango in many parts of the country. Production of mango in Ethiopia in general is poor due to lack of improved varieties and management practices.

PASSION FRUIT
Passion fruit is produced mainly by the UAAIE and is entirely for export purpose. Though the volume is small the yellow type is exported to European markets. It is not popular in the local market.

Fruits for export can not compete with other exporters in quality. There is no adequate infrastructure for grading, treating, storage and transport. Air transport is very expensive to make the business profitable. The packaging materials that are produced locally are not strong and attractive. It is expected that improvement can be made in the future as private investors show interest in the field. There is however a long way to go to expand the sector properly. Producers, exporters, transporting companies (airlines, sea, and land) should work together to promote fruit export.

FRUIT SELL

Considering fruit sell by the Enterprise (1988 – 1992) citrus dominates both in quantity and Value (over 90%). Orange ranks top in quantity (78.8 %) and value (80.6 %) followed by mandarin (13.4 % and 10.5 %) and ( 6.9 % and 7.8 %) banana. ETFRUIT is the major supplier of orange and mandarin in big cities. Outside citrus banana is the most important crop handled by the enterprise. Mostly merchants handle banana produced in peasant sector. Others fruit contribution is less than 1 percent each both in quantity and value.
Table 17: Fruit sell from 1988 to 1992 by ETFRUIT (Quantity in quintals per hectare and value in Birr)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>Quantity</td>
<td>Value</td>
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<td>215.2</td>
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<td>3447329</td>
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<td>3671735</td>
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<td>Banana</td>
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<td>3652638</td>
<td>29675.9</td>
<td>4006995</td>
<td>26685</td>
<td>3447329</td>
</tr>
<tr>
<td>Citrus</td>
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<td>43734438</td>
<td>415327</td>
<td>47198027</td>
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<td>42537563</td>
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<td>252195</td>
<td>1461</td>
<td>66565</td>
<td>502</td>
<td>29314</td>
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<td>Lemon</td>
<td>875</td>
<td>81233</td>
<td>19188</td>
<td>10045</td>
<td>49</td>
<td>6140</td>
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<tr>
<td>Mand.</td>
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<td>5810596</td>
<td>61440</td>
<td>5678567</td>
<td>56906</td>
<td>5221754</td>
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<td>Orange</td>
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<td>37590414</td>
<td>35272</td>
<td>41333707</td>
<td>308928</td>
<td>37276450</td>
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<td>Guava</td>
<td>696.9</td>
<td>127456</td>
<td>477.6</td>
<td>122231</td>
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<td>184085</td>
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<td>2522</td>
<td>1045.5</td>
<td>777.5</td>
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<td>1803.3</td>
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<td>726799</td>
<td>194066</td>
<td>777.5</td>
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<tr>
<td>Passion F</td>
<td>625.8</td>
<td>70495</td>
<td>195.1</td>
<td>19028</td>
<td>22.1</td>
<td>2768</td>
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<td>457520</td>
<td>47943852</td>
<td>447129.3</td>
<td>52075621</td>
<td>395242</td>
<td>46386895</td>
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</table>

Source: Ethiopian Fruit and Vegetable Marketing Enterprise
Table 18: Quantity (q) of fruits sold and values (Birr) and their respective value of each crop in percent from 1988 to 1992 of Fruit and Vegetables Marketing Enterprise

<table>
<thead>
<tr>
<th>Crops</th>
<th>Total Sell</th>
<th>Quantity in quintal</th>
<th>Value in Birr</th>
<th>Percent of the total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banana</td>
<td>142922.5</td>
<td>19027379</td>
<td>6.93</td>
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<tr>
<td>Citrus</td>
<td>1907917.2</td>
<td>223791359</td>
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<td>Grapefruit</td>
<td>7506.0</td>
<td>388535</td>
<td>0.36</td>
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</tr>
<tr>
<td>Lemon</td>
<td>1414.0</td>
<td>117811</td>
<td>0.07</td>
<td>0.05</td>
</tr>
<tr>
<td>Mandarin</td>
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<td>25762976</td>
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<tr>
<td>Orange</td>
<td>1622931.0</td>
<td>197522037</td>
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<tr>
<td>Grapevine</td>
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<td>434492</td>
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<td>Guava</td>
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<td><strong>Total</strong></td>
<td><strong>2060974.5</strong></td>
<td><strong>244960049</strong></td>
<td><strong>100.00</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

Source: Ethiopian Fruit and Vegetable Marketing Enterprise

**AVERAGE FRUIT PRICE**

Apple is the most expensive fruit in Ethiopia. This could be attributed to low quantity and limited locations of production of the crop. Grapes and mango are relatively expensive. Grapefruit, guava and passion fruit have least price. Banana and orange are slightly higher than average and they are the most popular fruits in the country. Most other fruits requires popularization and different utilization methods must be studied.
Table 19. Average fruit price (Birr per quintal) from 1988 to 1992 of Fruit and Vegetables Marketing Enterprise

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Apple</td>
<td>904</td>
<td>1889</td>
<td>1990</td>
<td>1991</td>
<td>1992</td>
<td>904</td>
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<td>Avocado</td>
<td>160</td>
<td>98</td>
<td>150</td>
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<tr>
<td>Banana</td>
<td>115</td>
<td>135</td>
<td>129</td>
<td>142</td>
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<tr>
<td>Citrus</td>
<td>104</td>
<td>114</td>
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<td>G. Ft.</td>
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<td>46</td>
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<td>Lemon</td>
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<td>Mand.</td>
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<td>92</td>
<td>92</td>
<td>96</td>
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<tr>
<td>Orange</td>
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<td>118</td>
<td>121</td>
<td>128</td>
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<tr>
<td>Grapevine</td>
<td>183</td>
<td>256</td>
<td>216</td>
<td>171</td>
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<tr>
<td>Guava</td>
<td>51</td>
<td>50</td>
<td></td>
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<tr>
<td>Mango</td>
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<td>189</td>
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<td>98</td>
<td>125</td>
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<tr>
<td>Passion F</td>
<td>63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>63</td>
</tr>
<tr>
<td>Mean</td>
<td>220</td>
<td>196</td>
<td>146</td>
<td>163</td>
<td>122</td>
<td>209</td>
</tr>
</tbody>
</table>

Source: Ethiopian Fruit and Vegetable Marketing Enterprise

UNMARKETABLE FRUITS

Percent unmarketable fruits of the total product received for the major fruits from 1988 – 1992 is presented in Table 4. This is obtained from the amount delivered to the Enterprise minus the amount sold by the same. The major reasons for unmarketability are:

- Weight (water) loss during transport and storage
- Discrepancy in weighing and recording
- Mechanical damage due to mishandling in the field, transit, packinghouse etc.
- Damage by diseases and insects.
Table 20: Percent unmarketable of various fruit crops from 1988 to 1992 of Fruit and Vegetables Marketing Enterprise

<table>
<thead>
<tr>
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<tr>
<td>Banana</td>
<td>10.9</td>
<td>12.2</td>
<td>20.1</td>
<td>16.9</td>
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<td>Citrus</td>
<td>6.1</td>
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<td>8.2</td>
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<td>G. Ft.</td>
<td>7.1</td>
<td>4.5</td>
<td>5.8</td>
<td>5.9</td>
<td>0.5</td>
<td>4.8</td>
</tr>
<tr>
<td>Lemon</td>
<td>3.0</td>
<td>11.1</td>
<td>9.5</td>
<td>*</td>
<td>*</td>
<td>4.7</td>
</tr>
<tr>
<td>Mand.</td>
<td>7.1</td>
<td>9.9</td>
<td>10.4</td>
<td>11.2</td>
<td>6.7</td>
<td>9.1</td>
</tr>
<tr>
<td>Orange</td>
<td>4.0</td>
<td>8.0</td>
<td>6.9</td>
<td>7.6</td>
<td>6.0</td>
<td>6.5</td>
</tr>
<tr>
<td>Guava</td>
<td>4.6</td>
<td>4.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4.5</td>
</tr>
<tr>
<td>Mango</td>
<td>7.6</td>
<td>16.3</td>
<td>15.4</td>
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<tr>
<td>Papaya</td>
<td>5.3</td>
<td>2.4</td>
<td>*</td>
<td>-</td>
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</tr>
<tr>
<td>Mean</td>
<td>6.9</td>
<td>8.5</td>
<td>10.8</td>
<td>11.9</td>
<td>9.1</td>
<td>8.1</td>
</tr>
</tbody>
</table>

Source: Ethiopian Fruit and Vegetable Marketing Enterprise

* The amount of produce delivered is negligible and/or sold without any problem.
- Produce was not delivered to the Enterprise

AWASH WINERY

Prior 1963 home made wines were produced. It was in 1963 factories started to produce industrial wine for commercial purpose. The pioneer in this field was Saris Wine Factory
(the present Lideta Wine Factory). Their products were diversified. Sometimes the same wine was given different names.

Awash Winery comprises of three wine factories, namely Lideta, Mekenisa and Addis Ketema. Lideta branch, which was the biggest winery was established by an Italian and Greek national, Mr. Alexanderakis (Muse Saris) in 1937. Mr. Jacomo Marini established Addis Ketema branch in 1947 while Mekenisa branch was established in 1952. Initially Mekenisa used to produce hard liquor until converted to winery in 1971. All were nationalized in 1967 and became under Awash Winery. In 1988 the Addis Ketema Branch merged with Mekenisa.

After nationalization the factories were gradually expanded, renewed with fully or partially automated machinery. They have capacity of 10.9 million litters per year. From 1967 – 1982 production increased and attained the highest capacity 9.8 million litters per year. Thereafter, the production declined. Though Lideta and Mekanisa factories have 8.0 million liters capacity per year they produce only 3.5 – 4.0 million litters per year.

There is high demand for Ethiopian wine both locally and abroad. But the high cost discouraged local consumers. The price of wines produced by the enterprise increased by three to four folds. This is mainly because of increased cost for raw materials (rising exchange rate for imported raw materials and sugar, etc.). Consequently consumers shifted to other traditional drinks.

In the establishment of the factories it was assumed to establish agro-industry in order to produce the major raw material (grapes) locally. At early stage, raw materials was provided by many farms. Later on the farms failed to supply and the factories were forced to import raw materials from abroad. From 1986 to 1988 the factories imported materials worth of 5.3 million Birr. Of this 40% was raisin. The rests were chemicals, corks etc.

Bottles used to be imported from Italy, Israel and Kenya. They are now produced locally for local market but their cost is gradually increasing which increased cost of production. The factory still is importing bottles from Kenya and Israel for the export markets.

Fresh grapes are used to produce quality wine. The quality of wine depends on the variety used, the area it is grown and the treatments it receives in the field. Grapes produced in Ethiopia have high quality. There is high demand for the wine both locally
Table 21: Imported materials for Awash Winery 1986 - 1992

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Raisin</td>
<td>2000</td>
<td>2101924</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2000</td>
<td>2101924</td>
</tr>
<tr>
<td>Citric acid</td>
<td>-</td>
<td>-</td>
<td>180</td>
<td>286630</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>180</td>
<td>286630</td>
</tr>
<tr>
<td>Enochenina powder</td>
<td>30</td>
<td>692409</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>480142</td>
<td>40</td>
<td>1172551</td>
</tr>
<tr>
<td>Grape Juice</td>
<td>50</td>
<td>226605</td>
<td>150</td>
<td>604892</td>
<td>590</td>
<td>330005</td>
<td>103</td>
<td>295094</td>
<td>893</td>
<td>1456596</td>
</tr>
<tr>
<td>Wine Essence</td>
<td>16</td>
<td>241324</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>16</td>
<td>241324</td>
</tr>
<tr>
<td>Total</td>
<td>2096</td>
<td>3262262</td>
<td>330</td>
<td>891522</td>
<td>590</td>
<td>330005</td>
<td>113</td>
<td>775236</td>
<td>3129</td>
<td>5259025</td>
</tr>
</tbody>
</table>

Quantity in quintals (100 kg)
Value in Birr

SOURCE – Awash Winery
and abroad. Improving technologies for grape and wine will enhance wide expansion of the local and external markets.

The amount of fresh grape obtained from local vineyards declined in the last one and half decades. The attempt made by the factory to encourage local producers has not not been fully successful. In 1991 and 1992 crop seasons about 1850 and 2000 quintals, respectively were obtained. Currently the winery receives fresh grapes from Guder, Nura Era, Merti and Ziwei vineyards. Using high yielding cultivars, improving cultural practices, continuous supervision and offering attractive price are means to obtain quality wine grapes.

The country has great potential to produce grapevine for different purposes. Suitable land, water for irrigation and labor are available. Farmers can easily produce grapes if they get appropriate instruction and incentive. Hence involvement of the factory in the production of wine grape is essential and timely.

In the absence of quality fresh grapes, raisin, sugar, tartaric and citric acids, pigments as coloring materials, tanins, anochenina, aromas and flavors are needed to upgrade the quality of wine. About 17000 kg of raisin is used per year. Enochenina coloring material currently imported with hard currency. It can easily be produced from red wine skin. It can even be exported to earn foreign currency. Though concentrates (grape juice) are imported they can not meet the factory's standard due to their poor quality.

Currently the winery produces 15 products. In 1988, out of these products the market share of Saris White Wine was 92%. While those produced from fresh grapes and others was 8%. Since 1988 the demand for Saris White Wine reduced to 67% while those produced from fresh grapes rose to 33%. This is due to intensive advertisement by the factory. As a result the demand by local consumers is shifted to the wine made from fresh grapes. Since there is no adequate supply of fresh grapes, further expansion of quality wine has not been possible.

First class red wine includes Export Guder, Dukem and Axumite and has 6% share of the total produce. Cristal, Kemila, Champegne are first class white wine and cover 2%. Guder local and Especial red wines are considered second class red wines and have 21% share. The other products include Saris White Wine, vermut, ‘Kelkel’, vinegar and ginger comprise the remaining.

In order to satisfy the existing local and export demands, the available machinery need to be improved. This includes

- Improving fermentation tanks/cellars, automatic temperature regulator (coated on double walls), preferably stainless steel cellars.
- Automatic built in washer to reduce inconvenience of manual cleaning.
Table 22: Wine Sale From 1988 to 1992 at Awash Winery

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Qu.</td>
<td>Sale</td>
<td>Qu.</td>
<td>Sale</td>
<td>Qu.</td>
<td>Sale</td>
</tr>
<tr>
<td>Domestic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Class Red Wine</td>
<td>94</td>
<td>1230</td>
<td>73</td>
<td>1269</td>
<td>90</td>
<td>1793</td>
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<tr>
<td>First Class White Wine</td>
<td>63</td>
<td>955</td>
<td>55</td>
<td>923</td>
<td>47</td>
<td>1017</td>
</tr>
<tr>
<td>Second Class Red Wine</td>
<td>313</td>
<td>2050</td>
<td>306</td>
<td>2465</td>
<td>376</td>
<td>3464</td>
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<tr>
<td>Second Class White Wine</td>
<td>1</td>
<td>10</td>
<td>1</td>
<td>14</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Saris or Awash White wine</td>
<td>5284</td>
<td>25242</td>
<td>3037</td>
<td>15298</td>
<td>2083</td>
<td>11463</td>
</tr>
<tr>
<td>‘Vermute’ and ‘Kelekel’</td>
<td>26</td>
<td>201</td>
<td>38</td>
<td>358</td>
<td>33</td>
<td>327</td>
</tr>
<tr>
<td>Giger</td>
<td>3</td>
<td>49</td>
<td>4</td>
<td>45</td>
<td>3</td>
<td>32</td>
</tr>
<tr>
<td>Vinegar</td>
<td>15</td>
<td>68</td>
<td>16</td>
<td>46</td>
<td>15</td>
<td>66</td>
</tr>
<tr>
<td>Sub Total</td>
<td>5799</td>
<td>29805</td>
<td>3530</td>
<td>20418</td>
<td>2647</td>
<td>18162</td>
</tr>
<tr>
<td>Export</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>First Class Red Wine</td>
<td>14</td>
<td>140</td>
<td>5</td>
<td>71</td>
<td>15</td>
<td>125</td>
</tr>
<tr>
<td>First Class White Wine</td>
<td>2</td>
<td>32</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>24</td>
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<tr>
<td>Sub Total</td>
<td>16</td>
<td>172</td>
<td>5</td>
<td>71</td>
<td>18</td>
<td>149</td>
</tr>
<tr>
<td>Grand Total</td>
<td>5815</td>
<td>29977</td>
<td>3535</td>
<td>20489</td>
<td>2665</td>
<td>18311</td>
</tr>
</tbody>
</table>

SOURCE – Awash Winery

Qua. – Quantity in 1000 liters
Sale – Sale in 1000 Birr

First Class Red Wine – Guder Export, Dukem and Aksumite
First Class White Wine – Kamila, Cristal, Champaign, Grapa and Escanesa
Second Class Red Wine – Local Guder and Especial Red Wine
Second Class White Wine - Muscatelo
Bottle washers, feelers, corksers, labelers and capsular needed to be improved. Upgrading the existing facilities to introduce new products such as grape juice.

Moreover investment in training experts and technicians to upgrade their knowledge and experience deserves attention.

**GRAPE WINE PRODUCTION**

Grapevine is not new to the majority of Ethiopian comminutes. Raisins were imported for church services for long time. Grapevines were imported by Europeans missionaries and planted in their gardens. Areas with mid altitudes that are suitable for human beings, animals and crops are referred as ‘woyna dega’. Woyna is probably derived from ‘woyen’ which means grape.

The limiting factor in producing quality wines with reasonable price is inadequate supply of fresh grapes. Quite a lot of export demand is unanswered because of this problem. The problem of raw material must be solved prior to others. The industry should not be dependable if it is wanted to be sustainable. Traditional wine production will have acceptance for the coming many years.

Currently there are very few vineyards in the country. Many of the previous ones became out of production. People working in the vineyards are not experienced. Mixture of varieties, low total soluble solid (TSS) and small yield are the common features of grapes produced at the present time. With this situation it is practically impossible for the factory to be sustainable.

To be profitable and sustainable the winery’s best alternative will be is to have its own vineyards. These vineyards will serve as nuclei to encourage farmers around the vineyards to produce grapes for the factory. It is essential to have trained agronomists for its vineyards. Farmers can receive technical advice from factory’s experts.

In the country there are many potential areas to produce quality grapes for different purposes including winemaking. Areas with light soil, mid altitude (1500-2000 masl) are preferred. High fertility is not necessary for grapevine. Grapes produced at Guder and Dukem were superior in quality.

Vineyards, preferably should have access to all weather road and should be close to factory to facilitate transportation and easy to manage. Potential grapevine areas for wine grape production are the highlands such as Guder and its surroundings.

Dryer areas in the lowland (Zewai, Merti, Nyra Era, etc.) are good for production of table and raisin grapes. Improving management practices (fertilization, irrigation, pruning, etc) may help to produce quality wine grapes. Selecting varieties that are suitable for wine
making is important. Most of the world known wine grape cultivars are available in the country. But these materials are not evaluated under all potential grapevine-producing areas. EARO researchers to evaluate potential wine cultivars in major grapevine producing areas initiated a wine variety trial. Cooperation of producers and wine factories is highly needed.

Grapevine production is new to Ethiopian agriculture system. It requires love and devotion to be successful in the business. Training individuals in different disciplines both in research and development is necessary. Research work on agronomical practice to improve yield and quality such as pruning and training, fertilization, irrigation, single versus double harvest per year etc. should be reinitiated.

The production of fresh grapes locally will enable the winery to save earn substantial amount of foreign currency through export of quality wine, and create employment for many Ethiopians.

GUDER FARM

The Guder farm, which is comprised of small farms, used to be owned by different individuals, namely Ras Mesfin Seleshi, his brother Ato Bezabeh Seleshi, Ato Kabtyimer and Ras Emeru Haile Silassie. All were nationalized and become under the then Horticulture Development Corporation (HDC). Total area was 187 hectares. Out of this 34 ha was used for grapevine production. Eleven hectares were developed by HDC. The average yield was about 35 quintals per hectare. There are many gaps in the orchard. Some trees are old. In 1979 the farm was transferred to the then Tatek Engineering the present Hormat Engineering Complex Project (HECP). Due to poor management the farm declined has since then.

The bulk of the grapes produced was wine type and is referred as Black (‘Tikur’). This was the predominant cultivar grown in the Guder area. Guder used to to be the only major supplier of grapes for the wineries. The popular Guder wine was named after the area of production.

Spacings of 2.5 m between rows and 2 m between plants in the row were used. Pruning, type and amount of fertilizer, disease control measures, weed control and harvesting were the same as that of the old Dukem vineyard. It is irrigated from Guder River, which is a tributary of Endis and Chole rivers. The annual irrigation requirement is only once or twice.

Negotiation has been underway between Awash Winery and HECP to transfer the management of the vineyard to the winery. S a result 20 hectares is given to be given to
Awash Winery on temporary basis. The seven hectares can easily be rehabilitated. The remaining 13 hectares require extensive rehabilitation program including reestablishment. Thirteen hectares of the vineyard has been cleared, pruned and cultivated in 1993 crop season.

The vineyard was totally neglected for the last five years. Vine development was poor and disease infection up was high. It may take some time to rehabilitate the orchard properly. Once it is rehabilitated and maintained properly the routine management will be easy.

Downy and powdery mildews are very common in grapevine production. This is particularly true for grapevines, which has been neglected for years. Both protective and curative chemicals need to be applied to control the disease. Protective chemicals Mancozeb and Kocide 101 were sprayed 3-4 times at the rate of 2.5 kg in 200 liters of water. The chemicals found to be ineffective. This could be due to time of application. Such chemicals need to be sprayed before the onset of the disease and routinely applied thereafter.

It was difficult to get Ridomyl (curative) in the market. Protective chemicals were not routinely applied to prevent the incidence. The unexpected rain and humid conditions favored the development of downy mildew, which devastated the vineyard. This is unpleasant situation for the winery to face such problem in its first year of management experience. Much should not be expected this year. Effort should be made to protect the canes for next year crop. All parts that are infected should be removed, collected and disposed by burning or burying to reduce the source of inoculum. This is very common in the agriculture sector. The important lesson is to prepare oneself to cope up with such problems by purchasing the needed chemicals ahead of time.

There is quite a lot of gap in the vineyard. As the rehabilitation program proceeds gapping need to be considered. In areas where about half of the plants missed, reestablishing is recommended. For new vineyard only known, uniform and productive materials from reliable source must be used.

Nine varieties obtained from Melkasa Agricultural Research Center were established in 1986. Another lot from Debre Zeit Agricultural Research Center was established later. The latter is relatively small for its age. The plots were totally neglected and it is only recently (mid September 1993) that the rehabilitation program was started.

**COFFEE PLANTATION DEVELOPMENT ENTERPRISE**

The three Coffee Plantation Development Enterprise farms namely Bebeka, Gogeb and Tepi are also producing fruits. Coffee being the major crop of the Enterprise, full attention has not been given to fruits production. Bebeka and Tepi farms are similar in
most respects and fruits produced on these two farms are the same. The list includes banana, avocado, mango, citrus and jackfruit.

Table 24: Altitude, rainfall, temperature and soil pH data of Bebeka and Tepi farms

<table>
<thead>
<tr>
<th>Farms</th>
<th>Altitude</th>
<th>Rainfall in mm/annum</th>
<th>Temperature in °C</th>
<th>Soil pH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Maximum</td>
<td>Minimum</td>
</tr>
<tr>
<td>Bebeka</td>
<td>900-1200</td>
<td>1750</td>
<td>30</td>
<td>15</td>
</tr>
<tr>
<td>Tepi</td>
<td>1200</td>
<td>1400-1800</td>
<td>25-36</td>
<td>13-18</td>
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</tbody>
</table>

Table 25: Hectares under fruit in Coffee Plantation Development Enterprise farms

<table>
<thead>
<tr>
<th>Crop</th>
<th>F</th>
<th>A</th>
<th>R</th>
<th>M</th>
<th>S</th>
<th>Total</th>
</tr>
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<tr>
<td>Gojeb</td>
<td>Bebeka</td>
<td>Tepi</td>
<td></td>
<td></td>
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<tr>
<td>Avocado</td>
<td>0.1</td>
<td>44.6</td>
<td></td>
<td></td>
<td></td>
<td>44.7</td>
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<tr>
<td>Banana</td>
<td>278.0</td>
<td>200.0</td>
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<td>478.0</td>
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<td>70.0</td>
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<td>Sole</td>
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<td>130.0</td>
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<td>Citrus</td>
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<td>2.6</td>
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<td>11.4</td>
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<td>Jack fruit</td>
<td>0.1</td>
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<td>0.8</td>
<td></td>
<td></td>
<td>0.9</td>
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<tr>
<td>Pineapple</td>
<td>50</td>
<td>6.1</td>
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<td></td>
<td></td>
<td>56.1</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>293.1</td>
<td>248.0</td>
<td></td>
<td></td>
<td>591.0</td>
</tr>
</tbody>
</table>

**BEBEKA FARM**

Bebeka coffee development project was initiated to expand coffee production of the country. Out of the total area of 9113 hectares over 70% (6500) was allocated for coffee production. The productivity was not as expected due to lack of specific research results for the area. The farm is working in collaboration with Jima Agriculture Research Center in identifying varieties and cultural practices.

There were citrus, pineapple, banana, mango, and avocado orchards on the farms before nationalization. Pineapple used to be transported to Addis Abeba by plane. Other fruits were produced in individual gardens. The pineapple orchard was abandoned and replaced by coffee. Latter on some fruits were considered and planted for diversification purpose. Adaptation trial on spices and fruits were started.

**BANANA**
Banana is produced on two hundred seventy eight hectares as a sole crop in marshy areas, which is not suitable for coffee production. The variety used was what is available on the farm. Most probably it could be Dwarf Cavendish.

If it was not for marketing problem tremendous amount of banana could be produced in the area. Until recently there was no serious production problems on banana was reported. Recently, productivity and quality are reduced considerably. This is expected to be due to the occurrence of long dry season and disease incidence. The major symptom observed was drying of leaves. Banana is a good source of mulching material for coffee.

The yield reported by the farm does not include what is not harvested on the field, fruits harvested by laborers and wild animals, what is harvested but not marketed etc. There is no well-established marketing system that enables the farm to expand the banana production. As a result no serious attention is given to banana plantation concerning proper management such as slashing off weeds, mulching, fertilization etc. seem to have been neglected.

**PINEAPPLE**

There is great potential to produce pineapple in the area. At present there is 6.12 hectares of pineapple plantation. Despite its potential the plantation is not expanded rather it declined. The main consumers are the farming community. There is no serious production constraint.

**CITRUS**

The farm established the citrus (orange and mandarin) orchard at different time. Orange is the dominant one. There are some hybrids. Materials were obtained from Nura Era some 10 – 12 years ago. Varieties are not known.

The spacings used for citrus were 6 m between rows and 3 m between plants in the row. These spacings were adapted from Nura Era. In the orchard there are many big trees which shaded the fruit trees. These trees are potential threat to the fruit trees as they may damage them in case they fall down. The area has great potential to establish irrigation system.

Banana was inter-cropped between the orange rows. As banana is not compatible with citrus, it was not successful. Management is generally poor. There is no basin construction and mulching is not practiced. It was reported that fertilizer is applied every year. This can be washed down because of heavy rain. Split application particularly for nitrogen is recommended.

Leaf and fruit spot disease has affected the orchards seriously. Bebeka was one of the trial sites in studding the disease by Jima Agriculture Research Center. The disease
reduces the appearance, taste and yield of the fruit and kills branches. Sanitation and fertilization are practiced to reduce the incidence.

Cooperative work in screening varieties for adaptation and tolerant/resistant against the disease is highly recommended. Participation to work on other aspects of the disease could probably help to control the disease on the farm.

**AVOCADO AND MANGO**

Seedling trees are planted both in the fields and gardens. The cultivars are not known. Fruits are sold in the farm. The farm in cooperation with research organizations must initiate screening of varieties and developing appropriate agronomical practices.

**JACK FRUIT**

The flesh part that covers the seed is eaten. Juice is also prepared from this part. Since it is too sweet it is mixed with other fruit juice. Its utilization aspects should be studied. Though yield is very high fruit rot is experienced which require researchers’ attention.

The staff on the farm is highly specialized on coffee production. They are not knowledgeable in the management of fruits. It is advisable and highly recommended to send those people who are directly involved to research centers for practical training. This will help to improve the management of fruit production on the farm. Productivity and quality of fruits can be improved greatly by applying existing technologies from elsewhere.

**GOJEB**

Ato Teka Agyane established Gojeb farm. The farm used to produce pineapple, maize, hot pepper and spices. After nationalization it became under state farm. Quite a lot of attempts were made to expand the pineapple orchards and even to establish a processing plant to produce canned pineapple products.

Gojeb is the biggest pineapple-producing farm in Ethiopia. At present the farm has about 50 hectare, of land under pineapple. Smooth Cayenne is the only variety produced in this and other farms.

Due to extremely fast turn over of the management staff, assignment of inexperienced persons and shortage of planting materials the expansion schemes were not materialized. Melko Agricultural Research Center was using Gojeb as major site for researches on pineapple. Researchers from the Center and from Melkasa Agriculture Research Center have been conducting various researches in selecting type of materials, spacing, fertilizer etc.
After conducting research for years, researchers recommended spacings of 90 cm between rows including the furrow, 60 cm between rows on the bed and 30 cm between plants in the row. Slips were found as the best planting materials. Type, amount and rate of fertilizers were also recommended. However, none of these recommendations were applied now due to various reasons. As a result production and productivity of the farm continued declining.

According to Ato Dessalegne it is possible to get up to 1000 q/ha if the crop is handled properly. At time of harvest there was acute shortage of moisture due to change of climate. As a result productivity of the crop reduced considerably. Since the crop is semi-perennial it needs supplementary irrigation when amount and distribution of rainfall is not optimum. Gojeb River is dependable source of water in the area. The initial cost to develop irrigation facility is high. But it is possible develop profitable pineapple orchard in the long run.

The author visited the farm and observed that the fields were totally neglected. The management complained about shortage of labor. Pineapple fetches high price in Jima and Addis Ababa markets.

TEPI FARM

The plantation has 6265 hectares of land on which it produces coffee and some types of fruits such as banana and citrus.

BANANA

At present banana is produced as a sole crop on 30 ha of land. Another 70 ha of banana is also planted around the coffee trees to protect damages that may be caused by wild animals. The banana pseudostem is used as mulch in coffee plantation. Shade is constructed from banana leaves for young trees. The bunch size of banana that is produced in Tepi is greater than that of Bebeka. Different varieties that vary in plant height and bunch size are found in the banana plantation. Bunches that weigh from 35 – 45 kg per bunch are common. The average finger length is about 20 cm.

The farm as well as the local people gives priority to coffee, which is an important cash crop. The attention given to banana is minimum. Banana plantations usually are not
fertilized, cultivated etc. to improve yield and quality. In the area with minimum care banana is produced at least for consumption.

Productivity reported by the farm is what is sold. Banana fruits that are consumed on the field, harvested but not marketed due to problem of market, fruits eaten by wild animals and bunches that are not harvested to reduce cost of production are not considered in estimating yield. The farm gives fruits free of charge to laborers that come to work in coffee plantation. As a result productivity given by the farm (45 q/ha) is far less than the actual.

Market is the major problem for banana production in the area particularly at picks harvest season. This is mainly due to the fact that the farm is located far away from big cities where transport facilities are poor. As a result the farm sells its produce on the farm. At pick season the price is as low as 15 cents per kg.

The diseases that are observed on the farm are likely to be sigatoka and cigar end rot. Some of the symptoms commonly were – drooping of leaves, changing of color of the leaves to yellow, shredding of leaves, etc. These symptoms appear in the dry season and disappear in the rainy season.

The main rainy season is from March to November. The dry season is from December to February. There is no irrigation system established on the farm. There is however potential to develop the system but it requires high initial cost. Many of the rivers are located in gorges which makes their use too difficult. There is no sign to expand the banana plantation due to poor marketing system. But the farm is distributing planting materials to other organizations.

Banana is easily produced in the area. The natives in the area are nomads and are practicing shifting agriculture to produce maize. They are not interested to produce perennial and semi perennial crops. The new comers are producing banana in their gardens both for consumption and cash. Management is very poor. As source of income in some rural schools students have started banana production. This has positive effect on students to produce banana in their home gardens as well.

**AVOCADO**

There is 44.56 hectares of avocado in the farm. Expansion was done in the last three years. Locally available material produce small sized fruits and is preferred by consumers. The bulk of the material is from Melko. All trees are started from seedlings.

Recently a new disorder is observed. The tree start drying from the top of the tree. This is serious in the dry season. In the rainy season, the drying trees, start reviving. This disorder is serious on young trees. Watering and mulching reduce the problem. This however requires further investigation.
Fertilization is not practiced. Slashing off weeds and mulching with vetivar, banana trash, coffee husk and removing of dead parts are practiced. Basin construction (double ring system) reduces the spread of diseases. Some fruits start to rot after harvest. Pre and post harvest handling needs to be improved.

**MANGO**

There is no mango plantation on the farm. However mango is a common shade tree in Tepi town and its surrounding.

**CITRUS**

Citrus at Tepi was established in 1979. The source of planting material for citrus is most probably Nura Era. Orange dominates the orchard though mandarin and grapefruit are also established.

Disease problem particularly leaf and fruit spot is serious. Joint work with state farm in chemical screening, sanitation measures and variety evaluation is essential to control the disease.

**MIZAN TEFERI AGRICULTURAL OFFICE**

Ato Gebrie Atomsa the Mizane Teferi Agriculture Office head indicated that zone is very popular in spice. According to him, out of the five ‘weredas’, three have great potential in terms of rainfall, soil and temperature to produce horticultural crops.

**BANANA**

In the zone banana is produced both for local and distant market. There are two types of banana in the area. The local type has large plants and small fruits. The other type is commonly referred as Kenya or ‘Ferengy’ has short plant and large fruits. The latter is the most commonly produced type for distant market (Addis Abeba). It is most probably Giant Cavendish and is recently introduced by foreigners working in Bebeka development project. The local type is produced mainly for local consumption and local market. The quality is relatively poor for distant market. It takes long time to produce its fruits (2 years). Once it established it stay long time. In the dry season vegetative part of banana is used as feed. The leaf is used as shade and mulch.

In the past there were individuals who produce banana and marketed it in Addis. It is believed that Mizan banana was exported in large quantity. After nationalization production dropped. Recently due to its high productivity and acceptance by consumers
its production increased significantly. Now Mizan banana is marketed in Jimma and Addis Abeba.

Despite its potential the industry is not growing as expected because of unreliable market. Farmers increase and decrease production based on the demand. Mizan banana is relatively smaller in size and its acceptance is low. There are no serious constraints that limit its production.

Market development need to be considered the number one problem. Farmers sell a bunch 1 – 3 Birr, which is discouraging. Government organizations should work together to create workable marketing system.

Production packages are introduced in the last few years. The introduced technologies need to be adapted for the region. Taro, coffee, spices and banana should have package. Investors are invited to the region.

**CITRUS**

Due to disease hectrage is reduced significantly. The recommended chemical is not practical for farmers who have 2 – 3 trees. Copper fungicide 50 Birr per kg. Not known materials. The farmers are desperate to get solution for this crucial problem.

**MANGO**

Mango becomes very popular fruit in the recent years. Its productivity is very high. It is expanded very rapidly in the zone. Juice is produced locally. It is relatively free from diseases and insects. But fruits are not high quality.

**PAPAYA**

There is potential to produce the crop. It is perishable. This too is transported and marketed in Jimma. Management is very poor (it is totally neglected). Most of the time birds harvest it.

**AVOCADO**

Trees are not large as in other place. Yield is not comparable. Its color is not dark blue when it is ripe. Handling and utilization have some problems. It is a very recent introduction. The demand is very high.

There are indigenous fruits that are harvested from the natural forest. These fruits contributed in improving the diet of the people.
The Federal Prison Administration has two farms. Shoa Rabit is found in Amhara National Regional State in North Shoa Zone. It is located 220 km from Addis Abeba on Dessie road. The other farm is found in Oromya National Regional State and is located at Ziway 160 km from Addis Abeba on Awassa road. The purpose of these farms is to provide skill training to inmates in helping them to find jobs or start their own after their release from prisons.

Table 26: General Information on Federal Prison Farms

<table>
<thead>
<tr>
<th>Farms</th>
<th>Altitude in masl</th>
<th>Temperature in °C Max.</th>
<th>Temperature in °C Min.</th>
<th>Rainfall in mm</th>
<th>Productivity in q/ha Orange</th>
<th>Banana</th>
<th>Mango</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoa Robit</td>
<td>1220</td>
<td>39</td>
<td>12</td>
<td>425</td>
<td>80-120</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>Ziway</td>
<td>1650</td>
<td></td>
<td></td>
<td>600-1000</td>
<td>70</td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>

SHOA ROBIT FARM

National Army was established under Ras Abebe Aregay in 1946 at the present Shoa Robit Farm. Most of the buildings were constructed at that time. The Emperor dismantled the army and the land was given to the prison administration in 1952. Some members of the army joined the prison administration. Prisoners and jobless individuals
from Addis provided labor for the farm. At that time the landholding was 1600 hectares. Out of this 400 hectares was under cultivation. In 1967 about 1000 hectares were given to peasants. The farm remained with 600 hectares. In 1983, 125 hectares were given to the Afar settlers. According to the officials 57 percent of the land can be irrigated and simple gravity system is used. The important fruit crops cultivated at the farm are banana, orange and mango.

**BANANA**

Dwarf Cavendish was brought from Keren (Eritrea) in 1954. Since then this variety was produced in the farm. At early stage banana was used as windbreak. Later on it was established as a sole crop on 20 hectares. Now it is reduced to 10 hectares. Because of poor management and built up of diseases (cigar end rot and nematode), productivity has declined. No control measures were taken against the diseases.

The soil at Shoa Robit is black cottony with heavy infestation of soil born diseases. The soil is very fertile and does not require fertilizers at initial stage. Gradually it is loosing its fertility and may require fertilization to maintain fertility. Except in the dry season there is ample irrigation water from Robit River and irrigation is applied every 15 days.

Spacing used was 2.2 m between rows and between plants in the row for crop plant. Ratoon crops can not be maintained at this spacing due to lack of proper sucker management. Weed is not a serious problem. *Cynodon dactylon* ‘Serdo’ weed is controlled by cultivation.

Most of the fruits are ripen on plants. In some cases unripen bunches are harvested and stored to be ripen. No special treatment is given in store. Fruits are marketed in Shoa Robit. EARO is willing to provide materials to be screened at Shoa Robit. This may enable to identify varieties that are resistant or tolerant to the common diseases observed on the farm.

**CITRUS**

A Valencia variety (80%) and Parent Washington Navel are the varieties produced on the farm. These were brought from Keren in 1954 and established on 5 hectares. The rootstocks used were Rough Lemon and Sour Orange. Rough Lemon is susceptible to *phytophthora*. Scions (fruiting varieties) on Sour Orange have relatively good performance.

At present there are 25 ha of citrus, mainly oranges, on the farm. The materials for the 20 hectares were propagated on the farm and the varieties were Valencia and Parent Washington Navel.
Spacing is 2 m between rows and plants in the row for the old orchard. In young orchard wider spacing (5 m) was used. Intercropping is practiced in the new orchard. Weeds are controlled by cultivation around trees and slashing between rows.

Urea is applied in two splits, the first one at flowering (February) and the second right after harvest (October) at the rate of 3kg/tree. Pruning is practiced to remove dead, diseased and cross over branches. Nutrient deficiency symptoms were observed but no control measures were taken.

During fruiting, irrigation is applied at an interval of 7 days. Thereafter frequency is reduced to 1 month. The farm used to produce quality fruits, but now its standard has declined because of shortage of trained manpower and hence lack of good management.

*Phythophtora* (root rot) is commonly observed in the orchard. Rough lemon is susceptible to the disease. Red scales are observed and chemicals such as Cidial and Roguer are sprayed to run off at the rate of 50 ml/ 10 liters of water. There is lack of knowledge and experience as when and what to spray at what interval.

Citrus is marketed in Shoa Robit. At pick season fruits are sent to Dessie, Kombolcha, Asayta, Mekele etc. After the establishment of ETFRUIT products are sold through the marketing enterprise.

Melkasa Agriculture Research Center can provide budded trees of orange, mandarin, lime, lemon for observation purpose at the prison farm. If necessary the Center can give practical and theoretical training to the farms employees in fruit production.

**MANGO**

The different mango materials were obtained from Keren. The materials include fiberless and small seeded fruit varieties. These materials were established in 1954. The second batch was obtained in 1957 from Debre Zeit (10 ha). In 1972 the farm propagated its own material for 6 hectares. All trees are seedlings. Three different spacing were used in the establishment of the orchard (5m by 3m, 5m by 5m and 7m by 7m). Mildew is a problem and Morstan is used to control it. Anthracnose is also observed.

**ZIWAY HORTICULTURAL CROPS PRODUCTION CENTER**

The farm has a total area of 265 hectares. Out of this 200 hectares is irrigated. The farm has two small pumps for nursery, three big pumps (one diesel and two electric) for the orchards. Source of irrigation is Lake Ziway. Water is pumped to higher elevation and
then irrigates the farm by gravity. Currently it produces banana, citrus, papaya, vegetables and sugar cane.

BANANA

The banana plantation was established 10 years ago. Productivity is reasonably good despite the poor management practices it receives. Soil is piled hipped around the plants which encouraged the production suckers susceptible to lodging. Many suckers of similar size are allowed to grow from the same hill which reduces the size of bunches and fingers.

Private Gezahegne received practical training at MARC on fruit production. He started to apply what he had learned at the Center. Now the soil piled around the hills have been removed. After harvest the pseudostem are chopped and the used as mulch. Sucker management is strongly recommended.

Sometimes manure is applied. No chemical fertilizer is applied due to cost. Irrigation is applied at interval of seven days and extended to one month whenever there is irrigation problem.

The variety used is most probably Dwarf Cavendish, which is susceptible to nematode. Using the same plot for many years encourage the build up of the nematodes. The use of resistant/tolerant cultivars on the farm and practicing crop rotation are strongly suggested.

The farm has its own shop in town where the farm produces are sold. The prison community consumes the bulk of the produce.

PAPAYA

The density of the old papaya plants on the farm is extremely low. Trees are highly branched. Vegetables are produced underneath. Sole papaya production need to be practiced. For this purpose healthy trees are identified and healthy fruits are harvested. It is preferred to have hermaphrodite typebut one must be sure that fruits for such plans have acceptance by consumers. Seeds are extracted, dried in shade and seedlings are raised in pots (plastic or banana pots). The number of seeds per pot vary depending on the type (dioeceous or monoecceous) and germinability of the seed. Seeds can be directly sown on the field but it is expensive. Raising seedlings on seed bed also encounter many problems.

CITRUS

There is 18 hectares of citrus orchard in the farm. The orchard was established in 1978 and 1979. The bulk of the materials were obtained from Gibe and Awash (most probably
from Melka Sedi.). Scions and rootstocks are unknown. Parent Washington Navel, which is referred, as ‘Gorge Bush’ locally is not performing well.

The farm has established a new orchard (3.5 ha) in 1989. The source was Shoa Robit Prison Farm. The scion is most likely Valencia but the rootstock is unknown. The trees are too small for their age. They are not bearing fruits at the time of the visit. Eight meter between rows and seven meter between plants in the row spacing was used for the new orchard. The spacing appears too wide for the area.

Unless there is serious problem in the irrigation system water is applied once in a week. There are very big trenches in the field to hold water. The whole irrigation system in the orchard need to be studied to save water and related problems. The purpose of the double rings is not clearly understood. The inner rings which is supposed to protect direct contact of water with the trunk is replaced by soil heaps around the trunk including the scion. With this practice direct contact of soil with scion is enhanced.

Diammonium phosphate and urea at the rate of 1 and 0.5 kg per tree respectively is applied right after harvest (September). Again 1 kg of urea is applied at flowering. Fruit split is observed at fruiting which is expected to be due to irregular irrigation. There could also be other physiological reason for the disorder.

There are many big trees in the orchard. Their negative effects are clearly observed on fruit trees under them. They shade the trees and must be cleared.

Mandarin and Parent Washington Navel are susceptible to scale and leaf miner. In the past Ultracide was used as spray to control the pest, but now it is not possible to get the chemical in the local market. Roger and Endosulfan are sprayed to control leaf miner.

In the orchard there are spots with shallow or infertile soil. Trees on such spots have died and still are dying. Parent Washington Navel and Mandarin trees are dying in larger numbers. The performance of the existing trees (vegetative development and yield) is not satisfactory. Harvesting season for mandarin is in July and August.
ETHIO FLORA FARM

Ethio Flora is a private farm involved in fruit and other horticultural crop production. It is owned and managed by Ato Tsegaye Abebe. The farm is situated in Oromya, East Shoa Zone near Adami Tulu. It is 171 km south east of Addis Abeba. The nearest town is Ziwei. The present owner contracted the farm from producers cooperative for 15 years. Though the area is small the management strictly follows recommendation made by experts. This deserves appreciation.

The orchard was established in 1979/80 with technical assistance from GTZ for a producer cooperative. The planting materials were received from Upper Awash. According the ato Mulugeta Abebe the variety is Parent Washington Navel. The two hectares citrus orchard was in very poor condition before the change of the management.

The spacing used were 8 m. between rows and 4m.between plants in the row. For the area and the variety the spacing between rows is wide and that between plants is narrow. To use the land effectively the farm is inter cropping papaya between rows. Except the area around the fruit trees there is no need to cultivate orchards.

At present 225 quintals of marketable fruits obtained per hectare per year. In spite of regular irrigation fruit cracks is observed which makes the fruits unmarketable. Fruit drop is common. Fruit peduncle dry first and then the fruit drop. The farm is loosing about 70 quintals per hectare every year due to the above problems. Mancozeb is sprayed at time of flowering to reduce fruit drop.

The major variety used on the farm is Parent Washington Naval. Parent Washington Naval produce very large fruits of excellent quality. Acceptance by consumer is low due to its large size.

The trees produce fruits throughout the year. Attempt was made to have close season to regulate fruit size and produce fruits when there is shortage of fruit in the market. This was accomplished by dropping flowers and fruits and depriving irrigation water in May-June after the main harvest. At the onset of the rainy season uniform flowering is initiated and due to competition fruits are not too big. The farm was successful to produce reasonably smaller fruits in February when Upper Awash citrus is out of production. Harvesting is concentrated in March and April.
Thirty kilograms of manure is applied per tree every other year. DAP is applied at the rate of 275 kg per hectare every other year. Urea is applied at the rate of 150 kg per hectare per year. Less than 0.5 kg of urea is applied per tree. Raising the nitrogen level and applying it at least twice a year is suggested. Yellowing of leaves is observed on some trees. This deserves investigation. Soil and tissue analysis for macro and microelement deficiency or toxicity is essential. Correction measures for this disorder must be found including aerial spray of microelements. Fields are irrigated every 7 days.

**PAPAYA**

Solo type is produced on 1.3 hectares. The orchard is four years old and the trees are too tall for proper harvest. As in other farms maintaining papaya true to type is a problem.

**BANANA**

Banana is planted as windbreak. Currently the farm has about 0.5 ha. It has planned to expand banana as a windbreak as well as a sole crop. The variety used is Dwarf Cavendish. The farm is advised to have variety observation trial to replace nematode susceptible variety it is currently using. In order to have large bunches and fingers use of sucker management is essential.

**STRAWBERRY**

The demand of strawberry is limited and is mainly in the capital. This limited the production. The farm produce strawberry at Ziway and Addis Ababa. Strawberry is doing well in the rainy season in Ziway areas while it is doing well in the dry season around Addis Ababa.

The farm recently obtained 117 hectares of land in Amhara National Regional State. There are 16 hectares of old citrus orchards. At present horticultural crops are produced in the farm.
HURSO FARM

The Hurso Farm is located in Somalia National Regional State (SNRS), Shinele Zone and Error Gota Woreda. It is 440 km from Addis Ababa via railroad and 35 km from Dire Dawa. Hurso Military Training Center owns the farm. The farm has a total area of 100 hectares of which 50 hectares are covered by fruits. It has a store and an office in Hurso town.

Haile Selassie I Price Trust used to have 9 hectares of citrus orchard near Hurso town. The orchard is totally destroyed for unknown reasons. Before land nationalization there were many small farms that produced various fruits. The list includes orange, mango, mandarin, guava, bull-ox heart, lime, lemon, grapefruit and banana. When the area was converted to a military training center, the farms were nationalized and farmers were given compensation land near Nazret.

During the Derg regime farmers were not allowed to settle near the training center. In recent years farmers settled on both side of Hurso River. There is no opportunity to expand the farm due to acute shortage of irrigation water in the dry season. The farm was totally neglected during the transitional period. Though effort is made to rehabilitate the farm, some orchards are beyond recovery.

Orange is the dominant fruit crop followed by mandarin and mango. Guava, bull-ox heart, lime, ‘ambeshok’, lemon and grapefruit are also produced on the farm. In the past banana used to be produced but abandoned due to disease incidence. Banana production has been reinitiated recently. ‘Ambeshok’, guava and bull-ox heart are mostly harvested by monkeys, baboons and birds. Since the demand for these crops is low less attention is given by the farm with regard to irrigation, fertilization, pruning etc. Besides guava is attacked by insect pests (worms). This is particularly true for the white type.

CITRUS

The citrus orchards were established using unknown materials. Farmers normally use what is available at hand and in this case no one knows the scions and rootstocks used. The major orange scion variety used in the area is Valencia. It is claimed that the Haile Selassie I Price Trust brought this material to the area. Probably sour orange is the rootstock used.

A variety known, as ‘Enkulal’ by local people is another variety produced along Valencia. The shape of the fruit of this variety is egg-shaped and is smaller in size. It has good taste when ripen well; but it is low yielder. The tree continuously produces flowers, which makes it suitable as garden cultivar. The other minor cultivar is
‘Ferencay’, which has larger navel fruits. Though the taste is excellent its productivity is lower than Valencia.

There are two types of mandarin, namely ‘Germany’ and ‘Abesha or ‘Bale Kekela’. ‘Germany’ is delicious and has high demand both in local and external markets. It can be stored for longer time compared to ‘Abesha’. Abesha on the other hand, is relatively sour and its narrow leaves distinguish it from the others. ‘Abesha’ must ripe well to be accepted. There are 988 sour orange trees on the farm, which are unproductive. There is no need to maintain all these trees. Few trees are adequate to supply the needed rootstock seed.

The spacings used vary considerably. About 6 m spacing is used between rows and between plants in larger citrus orchards. In smaller farms all sorts of spacings (from 4 m to 8 m) are used. There are many gaps in all orchards. Spacing of 6 m by 6 m is used to calculate hectare equivalent. The actual hectare covered by citrus is far greater than hectare equivalent presented in table 2. No specific spacing is used for the other fruits. Hence it is practically impossible to determine their hectage.

Table 27: Number of trees, expected yield and hectare equivalent of Hurso Farm.

<table>
<thead>
<tr>
<th>Crops</th>
<th>No. of trees</th>
<th>Expected yield in q/ha</th>
<th>Hectare equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citrus</td>
<td>9701</td>
<td>152.43</td>
<td>34.92</td>
</tr>
<tr>
<td>Orange</td>
<td>5957</td>
<td>194.41</td>
<td>21.45</td>
</tr>
<tr>
<td>Mandarin</td>
<td>1749</td>
<td>138.89</td>
<td>6.30</td>
</tr>
<tr>
<td>‘Abesha’</td>
<td>376</td>
<td>139.26</td>
<td>1.35</td>
</tr>
<tr>
<td>‘German’</td>
<td>1373</td>
<td>139.07</td>
<td>4.94</td>
</tr>
<tr>
<td>Lemon</td>
<td>800</td>
<td>57.29</td>
<td>2.88</td>
</tr>
<tr>
<td>Lime</td>
<td>189</td>
<td>139.71</td>
<td>0.68</td>
</tr>
<tr>
<td>Grapefruit</td>
<td>18</td>
<td>300.00</td>
<td>0.06</td>
</tr>
<tr>
<td>Sour Orange</td>
<td>988</td>
<td>-</td>
<td>3.56</td>
</tr>
<tr>
<td>Mango</td>
<td>472</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Bull-ox heart</td>
<td>95</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>‘Ambeshok’</td>
<td>192</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Guava</td>
<td>310</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Banana</td>
<td>400</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11170</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CROP PROTECTION

Many plants are dying due to complex problems of disease and nutritional imbalance. *Phytophthora* is the major disease observed. Uprooting of diseased plants had been the only method used to control the diseases. Improving the irrigation system and using resistant rootstock is recommended. The farm suspected tristeza and greening. They observed that just above the graft union, tissue start drying followed by death of branches. With such poor management practices nematodes, nutritional deficiencies and toxicities problems are expected.

Scale insects particularly red scale is observed in the farm. Pruning of infected branch and spraying with malathion and ultracide are used as control measures. Leaf miner, thrips and bud mites are observed problems of concern. The latter attack fruit buds and and cause fruit drop that ultimately reduce fruit set.

IRRIGATION

Hurso River, which starts from Chelenko Mountain is the major source of irrigation water. In the area water is the major limiting factor for crop production in general and fruits in particular. Farmers on both sides of the river are using the water for irrigation and domestic use. An irrigation program is established in the area. Hurso Farm used to get 100 hours per week. It is now reduced to 42 hours per week due to an increase in the number of farmers using the river.

Gravitational irrigation system is practiced in the area. On the highland, farmers produce chat, vegetable and fruits. In the mid-altitude they produce fruits and vegetables. Irrigation is applied at an interval of 15 days. In the dry season attempt is being made to irrigate at weekly interval. This however is not possible from February to June because of acute shortage of water.

The established irrigation program is not running smoothly due to great demand for water. During the dry season the farm guards the water day and night. The farm gives priority to orange and mandarin. But vegetables are commonly produced when there is adequate water supply.

FERTILIZER

Fertilizers were not applied for the last 5 years due to their high cost. Manure obtained from goat was applied at rate of 15 kg/tree.

HARVESTING
Early fruits (‘belg mert’) are harvested in July to September. Normal harvest starts from October and extends to December. Fruits are harvested manually. Dropping fruits from trees and collecting them afterwards is the common practice. Bamboo baskets are used to collect and transport fruits to trailers. Plastic boxes are replacing bamboo boxes. The farm transport fruits in trailers. However, merchants use their own wooden boxes to transport fruits.

MARKETING

There is no serious problem in marketing fruits. Dire Dawa, Harar and Jibuti are the major markets. The farm has a store at Harar and use tents to sell its products in Harar and Dire Dawa. Fruits are sold to merchants both for local and export markets. A good portion is also sold to the military training camp.

MANGO

All mango trees are on their own root system (seedlings). Planting was not done systematically, they are scattered all over. There are no known varieties. Mixed materials were used. Fruits vary considerably in size, shape, color, taste, fiber content, seed size etc. Some fruits ripe easily while others remain unripe. One type known as ‘Coronail’ has large fruits. Alternate bearing, wind damage and flower drop (powdery mildew) are common on mango trees.

BANANA

The farm used to produce banana on 2-3 hectares. The plantation was abandoned due to age and build up of diseases. Recently, a new plantation is initiated in small scale. Half a hectares of Dwarf Cavendish was established using spacing of 3m between plants and rows. The spacing is considered wide for propagation purpose. The farm is strongly advised to consider clump management practice for fruit production.

ABADIR FRUIT FARM
According to the farm officials, the farm got its name from the name of a Harere religious leader. They claim that the religious leader blessed the area and ordered the wild animals not to attack human beings and domestic animals. Since then the wild animals (snake, hyena, lion and tiger) did not attack human beings and domestic animal.

The farm was established in 1955 by Muse Paynote a Greek National. The major crops of the farm was cotton. But banana, citrus, grapevine and mango were produced on the farm.

After muse Paynote left the farm National Resource Development Private Share Company took over. The owners of the organization were high officials including Ato Yilma Deresa, Ato Kedir Eba, Ato Zewdeneh, Ato Neguse and Ato Tilaye Kasaya. Ato Tesfaye Girma and Ato Tekle Mariam Zemichal were managing the farm including the fruit orchards. Israel’s were given the farm on contract basis for a short period. After Israel’s withdrawals all the farms became under one management. Ato Mersha Bete Mariam became the farm manager and Ato Solomon Tebebu was head the fruit orchards.

After land nationalization in 1957, farms in Upper Awash became under one management. Ato Lulseged Bekele, Ato Tadesse Yeneneh and Ato Fekadu Tadesse were general managers at different time. In 1973 the fruit orchard and cotton farm were given to Methara Sugar State.

**CITRUS**

The spacing used for citrus orchard was 7 m both between rows and between olants in the row. Citrus orchards 42.0, 84.5 and 6.5 hectares were established in 1955, 1964 and 1968 respectively. Orange, mandarin, lime, and grapefruit are produced in the farm. All varieties were planted together. Among the known varieties Valencia and Parent Washington Navel are the major once. Oval Calabrate (egged shape, seedless and very sweet) is a special variety. Red type orange variety is available. The two major mandarins are referred as ‘Abesha’ and ‘Fernenge’. The latter is seedless, sweet and is highly attacked by birds and human beings. It is claimed that Paynote got planting materials from Asmera. The newly established once were from Gibe and Merti.

At present the enterprise is propagating and gapping empty spaces. Sour orange is used as rootstock. Orange variety Valencia is preferred due to its relatively long shelf life, medium size, and desirable skin color. Parent Washington Navel is sweet but its large size, low yield, susceptibility to disease and insects makes it second choice.

Leaf minor is the major pest on citrus. Karatane is sprayed to control the pest. Ultracide was found to be effective in controlling good for scale, aphids and spider mites. But it is not effective on leaf minor and thrips.

So far no control measure is found for *Phytophthora* (gamoses). Ridomil was tried but found ineffective. As far as fertilizer is recommended only ammonium sulfate nitrate 8
kg/ tree split twice applied. Time of application is right after harvest and at fruiting. Other fertilizers are not available in the Sugar State.

Irrigation water is applied roughly at interval of 2 weeks. This depends on soil type and season. There is no shortage of irrigation water. The incidence of phytophthora is related with faulty irrigation practice.

In the past weed used to be controlled manually. It is in 1993 that round up at the rate of 5 l/ha is used to control weeds. Some trees are dying and the actual cause is not known (nematode).

Climbing trees, cutting and throwing fruits on the ground is the harvesting method practiced. If the fruit cannot be reached hooked poles ‘oko’ is used. Harvesting is done when reasonable numbers of fruits are ripe. Many harvests (ten or more) are made. Production season is from July to December for citrus. The farm discards those fruits that have major defects (cracked, damaged by insect etc). Fruits are packed in plastic boxes and sent to Addis. Actual grading is made at ETFRUIT. About 25 % are marketed on the farm for workers. Actual yield is not recorded. Citrus production is profitable considering the cost of production and sale.

Banana and grapevine are no more produced on the farm.

MANGO

Mangos trees were planted as windbreak around fields and as sole crop. Total area is expected to be 4 ha including 2.19 ha sole crop. Mango seedlings are planted using different spacing 7m to 10m. Produce is sold locally. The total production is about 1900 q/year.

Mango trees around fields are not fertilized. Sole mango is fertilized with ammonium sulfate at the rate of 8 kg/plant/year. The soil is light and mangos are irrigated at interval of 10 days. No major disease and insect are observed on mango. Except gapping there is not plan to expand fruit in the farm. Total production is about 30000 q/year. Marketing of mango is as in citrus.

TONY FARM

Tonny farm was a commercial farm nationalized in 1967 and is found in the periphery of Dire Dawa. At present Alemaya University manages it. Some researches on horticultural crops are conducted on the farm and serves as demonstration site for courses given at Alemaya. The farm has three shallow wells as source of irrigation water.
CITRUS

There are two lots of citrus orchards of about three hectares each. One of them is very old. The scions used for this lot are unknown. The rootstock used for the old orchard believed to be Sour Orange. Researchers on citrus reported that nematodes, Phytophthora and bark splitting were observed in the old orchard. The latter is expected to be due to exocotis but not confirmed. Whatever it is precaution need to be taken. Dipping of implements in ordinary bleach before they are used in a new field is essential. Greening and Psorosis were suspected in the old orchard but not confirmed.

Die back is common in the old and new orchards. This is expected to be due to anthracnose and powdery mildew. Wetable sulfur and copper fungicides recommended respectively.

Severe infestation of stem borer is observed in the old orchard. The old trees act as source of infection to the new field. Leaf minor, red scale, false codling moth and Mediterranean fruit fly have been observed in the orchards.

It is observed that amount and frequency of irrigation is not adequate. Type and amount of fertilizers and time of application are not supported by research results. 1-2 kg of DAP and urea each applied per tree twice a year. The first application is right after harvest and the second is applied at fruit set.

In the new orchard four orange, one temple and one grapefruit varieties were established (table 1). The spacing used for this orchard was 6 m between rows and 4 m between plants in the row. Spacing is generally narrow. This is particularly true for spacing between plants in the row. Parent Washington Navel as expected is not performing well under Dire Dawa growing conditions.

Table 28: Species and varieties of new citrus orchard at Tony Farm

<table>
<thead>
<tr>
<th>Scion</th>
<th>Rootstock</th>
<th>Number of Trees</th>
<th>Number of Hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet orange</td>
<td></td>
<td>1570</td>
<td>3.77</td>
</tr>
<tr>
<td>Parent W. Naval</td>
<td>Troyer Citrange</td>
<td>200</td>
<td>0.48</td>
</tr>
<tr>
<td>Pineapple</td>
<td>Troyer Citrange</td>
<td>325</td>
<td>0.78</td>
</tr>
<tr>
<td>Hamlin</td>
<td>Sour Orange</td>
<td>325</td>
<td>0.78</td>
</tr>
<tr>
<td>Valencia</td>
<td>?</td>
<td>720</td>
<td>1.75</td>
</tr>
<tr>
<td>Temple</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carizo Citrang</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>----------------</td>
<td>------</td>
<td>-----</td>
</tr>
<tr>
<td>Mineola</td>
<td></td>
<td>59</td>
<td>0.14</td>
</tr>
<tr>
<td>Grapefruit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Blush</td>
<td>Troyer Citrange</td>
<td>26</td>
<td>0.06</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1655</td>
<td>3.97</td>
</tr>
</tbody>
</table>

OTHER FRUITS

There are small areas under papaya and mango. Initially Solo type was used to be produced on the farm. Now mixture of types are grown together. The fruits vary in size, shape and color. Besides female, male and hermaphrodite types are found in the field.

Though there is great potential to produce mango around Dire Dawa it is not produced at commercial level. The Alemaya researchers are carrying out collection and characterization of mango materials in the region.

There was a very good banana plantation on the farm. Now it is destroyed mainly by nematode. Collection and evaluation of banana germplasm from hararghe region is in progress.

BILATIE MILITARY TRAINING CENTER

The farm used to be owned by Princess Tenange work Haile Selasse. A French man named Mr. Demore was responsible for the establishment of the farm. Land clearing was started in 1958. In 1959 cotton, French beans and hot pepper were produced.

CITRUS

In 1964 citrus planting materials were brought from Awash area and established on 66 hectares of land. Orange, mandarin and lemon were the major species produced. At
early stage productivity was high. Produces were transported and marketed in Addis Abeba. Transportation was difficult and expensive due to poor road.

The major insect pests observed were false codling moth and red scale. According to Ato Elias, agriculture development head chemicals were not available to control these pests. Disease that caused drying and death of plants was observed before 1986. This could be perhaps due to salinity and *Phytophthora* problems most probably caused by faulty irrigation system practiced on the farm.

The dam, which was built on Bilatit River in 1988 to facilitate irrigation, was demolished by flood. Consequently, the 66 hectares citrus orchard was destroyed due to lack of irrigation. The citrus orchard is now turned for the production of other crops.

**MANGO**

The source of the planting materials is not known. But seedlings were planted around the farm. The trees did not receive proper care such as irrigation, fertilization etc. Though the yield is low, the fact that most trees are alive at this condition indicates that mango is relatively tolerant to extreme shortage of water.
BANANA
About 8 hectares of banana plantation was established on the farm. The produces were marketed locally. Some plants died starting from the top. This could be due to poor drainage system. The whole plantation was abandoned because of shortage of irrigation water.

OTHER CROPS
Papaya and sugar cane were tried and gave encouraging results. At present these crops are not produced because of lack of irrigation water. According to the center officials the center spends 20,000 Birr per month for the laborers it received with the farm. The laborers are willing to produce at least to cover cost of labor.

It seems there is a possibility of reconstructing of the dam by NGO through the regional bureau of agriculture. A committee is formed by the center to study the possibility of resuming horticultural crop production. The Melkasa Agriculture Research Center will provide practical training for the technicians and also planting materials of citrus and banana for observational purposes.

MELKA SEDI
Denadai established Melka Sedi banana plantation in 1963/64. At pick time the plantation reached 700 ha. On average 250 quintals per hectare per year was obtained. There were facilities for grading, washing, chemical treatment, packing and storage. First class banana used to be exported to Saudi Arabia. The farm was exporting about 20 trucks per day.

After land nationalization banana plantation merged with Melka Sedi Farm which was under Ministry of State Farms and Development. The farm was not giving the needed attention to banana plantation since its concentration was on cotton production. As a
result banana plantation declined considerably. Before the plantation was closed in 1994 its size was reduced to 250 ha and the average yield per hectare was 50 quintals. The packinghouse facilities are not functional. Export was discontinued and the farm was selling its banana in bunches and ripe banana in metal containers.

After 1989 banana plantation was considered as a separate farm. This did not help much and the farm continued to decline in production and quality. The farm management claimed that it is loosing about one million Birr every year. There are internal (technical) and external reasons for the deterioration of the plantation.

The pastoralists living in the area drive their animals into the plantation. This is particularly true when there is drought in the area. Wild pigs and baboons damage the plantation when feed is scares. Theft was another serious problem that contributed for the decline.

Poyo is the major variety produced in the farm. Ducase Hybrid is commonly used as windbreak. Giant Cavendish and Dwarf Cavendish are also produced in small area.

There was acute shortage of trained and experienced staff on the farm. As a result proper cultural practices such as fertilization, irrigation sucker management, bunch management before and after harvest, etc. are not practiced.

There were plantations as old as 30 years. Due to build up of diseases and age such plantations are not productive. After a certain period say seven years the plantation should be removed and the land should be left fallow or used to produce other crops at least for two years. This practice reduces nematode population and make banana plantation profitable.

For a crop plant spacing of 2.2 is used both between rows and between plants in the row. Sucker management is not practiced. Many equal sized suckers are left per hill. Due to competition among suckers size of bunches and fruits are reduced. It is recommended that at any given time 3-4 suckers of different size should be left per hill.

Type and amount of fertilizers applied is not as recommended. At time of planting DAP is applied at the rate of 200 kg per hectare. Urea is applied twice a year at the rate 200 kg per hectare. Even this rate is not applied regularly. Uncompleted fertilizer trial on the farm indicated that potassium is important nutrient for banana growth and development. But fertilizers with potassium are not available in local market.

In the past water was pumped out from Awash River. Later on dam was constructed to irrigate gravitationally about 10000 hectares. According to the officials water is applied every 12-15 days interval. Due to improper irrigation (flooding) system used in the farm the bulk of banana plantation was abandoned due to build up of salt. Sub surface drainage canals (23 km) was built to alleviate this problem. Even after having the subsurface drainage system the problems were not over. The drainage system has its own
problem. The Drainage Construction Company left the farm before training users as to how to use the system.

Though nematode is considered as one of the major problems in banana production in the area planting materials are not treated against nematode. Trimming suckers, dipping them in nematicide solution or hot water treatments are simple methods to reduce the nematode incidence. The best method is to obtain cultivars that are resistant/tolerant to the diseases. It is suggested to have banana observation trial to identify cultivars that are resistant/tolerant, high yielders with acceptable quality and adaptable to the growing area. Melkasa Agriculture Research Center has many dessert type cultivars in its collection.

Handling of fruits on the farm was not optimum. Fruits are not harvested at the right time based on harvesting index. Inexperienced laborers are handling fruits very roughly. For ETFRUIT hands are put in to boxes. For others fruits are sold in bunch on the field. The farm ripens its banana in a metal container.

If banana is reconsidered by the farm people who have appropriate training and experience need to be assigned for the job. If such people are not around those people who have interest to learn need to be trained. The trained individuals can guide the laborers to do the right job.

<table>
<thead>
<tr>
<th>Year</th>
<th>Area in ha</th>
<th>Production in quintal</th>
<th>Productivity in q/ha</th>
<th>Income in Birr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986/87</td>
<td>340</td>
<td>2325</td>
<td>7</td>
<td>169725</td>
</tr>
<tr>
<td>1987/88</td>
<td>260</td>
<td>10580</td>
<td>41</td>
<td>293260</td>
</tr>
<tr>
<td>1988/89</td>
<td>272</td>
<td>13056</td>
<td>48</td>
<td>358272</td>
</tr>
<tr>
<td>1989/90</td>
<td>286</td>
<td>31856</td>
<td>111</td>
<td>2229920</td>
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<tr>
<td>1990/91</td>
<td>286</td>
<td>14572</td>
<td>51</td>
<td>1149000</td>
</tr>
<tr>
<td>1991/92</td>
<td>262</td>
<td>4435</td>
<td>20</td>
<td>354286</td>
</tr>
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</table>
### Table 30: Extent of damage for selected years

<table>
<thead>
<tr>
<th>Year/cause of damage *</th>
<th>Extent of damage</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quintals</td>
<td>Value</td>
</tr>
<tr>
<td>1989/90 Wind</td>
<td>37268</td>
<td>2668760</td>
</tr>
<tr>
<td>1990/91 Wind</td>
<td>27846</td>
<td>1949220</td>
</tr>
<tr>
<td>1990/91 Animals</td>
<td>7892</td>
<td>552440</td>
</tr>
<tr>
<td>1991/92 Wind</td>
<td>1277</td>
<td>89390</td>
</tr>
<tr>
<td>1991/92 Animals</td>
<td>9034</td>
<td>482380</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5842190</strong></td>
<td></td>
</tr>
</tbody>
</table>

* It is not possible to estimate fruit loss due to theft

Source: Melksedi State Farm

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**PERSONS CONTACTED**

**Upper Awash Agro Industry Enterprise**

- Ato Amsalu Bekere: UAAIE Agriculture Division Head
- Ato Taddesse Tekle Mariam: Aware Melka Farm Manager
- Ato Solomon Begashaw: Merti Processing Factory Plant Manager
- Ato Kasaye Abebe: Merti Jeju Farm Operation Coordinator
- Ato Berhane Meskel: Nura Era Farm Farm Manager
- Ato Jambo Aliye: UAAIE Plan and Program Service Head
- Ato Fisiha Ayalew: Tibila Farm Manager
- Ato Kiros Aregay: Aware Melka Fruit Farm Manager
- Ato Sahle Yirga: Tibila Former unit manager
- **Ato Tesfaye Tezera**: Merti Jegu farm manger
- Ato Kasaye: Operation coordinator
- Ato Sheferaw Terefe:
Ato Waktola Gute  Farm Manager Degaga Farm

Horticulture Development Enterprise

Ato Ayele Meseker  Operation and Follow up Division Head
Ato Fekre Botere  Horticulturist/Agromonist
Ato Feleke Feltamo  Horticulturist/Agromonist
Ato Kasaye Gebre Eyesus  Gibe Farm Manager
Ato Million Abebe  Crop Protection Expert
Ato Wodemu Gebre Kidan  Former supervisor of Dukem Farm
At Taddesse Teshome  Farm Manager
At Taddesse Teshome  Farm Manager

Fruits and Vegetable Marketing Enterprise

W/o Abeba Mekana  Store 12A Head
W/o Belaynesh Solomon  Quality Control Service Head
Ato Deriba Gemechu  Quality Inspector
Ato Gezahegne Abebe  Container Coordination Head
Ato Girma Demissie  Quality Inspector
Ato Kedir Legesse  First Distribution Center Sales Head
Ato Seifu Gebre Michael  Abune Petros Distribution Center Head
W/o Senayet Bante  Store 12B Head
Ato Sisay Kebret  Foreign Trade Division Head
Ato Tariku Yewaidemam  Planning and Statistics Service Head

Awash Winery

Ato Kassaye Zewdie  Plan and Market Research.
Ato Bogale Worku  Grapevine Agriculture Department Head  712491

Gamu Gofa Zone Agricultural Office

Ato Mulugeta Fetene  Agriculture Department Head
W/o Almaz Tekla  Horticulturist (Arba Minch Zuria Agriculture office).
Ato Abrnam Chamo  Development Agent in Wanke Wajifo Farmer Association
Ato Tameru Tekla  Agronomist in Merab Abaya Wereda
Ato Melkamu Getachew  Nursery expert in Merab Abaya Wereda

Arba Minch Agriculture Development Enterprise

Ato Mengestu Tilaye  Enterprise Manger.
Ato Solomon Bezuneh  Agriculture Division.
Ato Bazezew Gebre- Marium  Arba Minch and Sile state farm manager.

Coffee Plantation Development Enterprise

Ato Sisay Asrat  Tepi Farm Manager
Ato Teferi Wakjira  Tepi Farm - Head of Agronomy and Crop Protection Section
Ato Teferi Gedlu  Tepi Farm - Head of Agriculture Division
Ato Mulugeta Tadesse  Bebeka Farm - Administrative Division Head
Ato Yohaness Eteffa  Bebeka Farm - Agronomy and Crop Protection Head
Ato Dessalenge Bezabeh  Agronomist and Agricultural Section Head of Gojeb Farm.

Mizan Teferi Agricultural Bureau
Ato Gebrie Atomsa  Bench Maji Zone, Agricultural Department Head

Federal Prison Administration

Ato Seifu Ahmed  Rehabilitation and Development Head
<table>
<thead>
<tr>
<th>Name</th>
<th>Position/Positioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ato Solomon Haile</td>
<td>Development Coordination Section Head</td>
</tr>
<tr>
<td>Ato Birele Ayalneh</td>
<td>Development Coordination Section Senior Expert</td>
</tr>
<tr>
<td>Private Gezahegne Defabachew</td>
<td>Ziwai Horticultural Crops Production Center Supervisor</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Ato Solo</td>
<td></td>
</tr>
<tr>
<td>Ato Birele Ayaleh</td>
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<td>Private Gezahegne Defabachew</td>
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<tr>
<td>Ethio Fora Farm</td>
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<tr>
<td>Ato Mulugeta Abebe</td>
<td>Farm manager</td>
</tr>
<tr>
<td>Hurso Military Training Center</td>
<td></td>
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<tr>
<td>Captain Gebre medhin Haile</td>
<td>Farm manager</td>
</tr>
<tr>
<td>Ato Tefera Alemu</td>
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</tr>
<tr>
<td>Ato Bekele Ewnetu</td>
<td>Horticulture technical head</td>
</tr>
<tr>
<td>Private Wasycha Worku</td>
<td>Technician</td>
</tr>
<tr>
<td>Abadir Fruit Farm</td>
<td></td>
</tr>
<tr>
<td>Ato Gebre Mariam Mulugeta</td>
<td>Farm supervisor</td>
</tr>
<tr>
<td>Ato Leta Bulto</td>
<td>Senior headman</td>
</tr>
<tr>
<td>Tony Farm</td>
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<tr>
<td>Prof. H Ravashinkar</td>
<td>Professor of Horticulture – Alemaya University</td>
</tr>
<tr>
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<td>Ato Elias Anjilo</td>
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<tr>
<td>Captain Habtamu Mengesha</td>
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<td>Ato Yared Getachew BMTC</td>
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<td>Melka Sedi</td>
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<tr>
<td>Ato Eshetu Beruke</td>
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</tr>
<tr>
<td>Ato Tamrat Tsehay</td>
<td>Cultural practice and advisory research section head</td>
</tr>
<tr>
<td>Ato Brehane G/ Yohanes</td>
<td>General Manager</td>
</tr>
</tbody>
</table>