



MINISTRY OF  
FOREIGN AFFAIRS  
OF DENMARK  
*Danida*

# Mango Value Chain Manual



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**Disclaimer**

This manual is for advisory use only. Users should verify details that relate to their agro-climatic zones from their area agricultural extension officers. It is also advised that this manual should be used in conjunction with the respective value chain trainers' guide and other relevant resource materials.

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## **FOREWORD**

The Micro Enterprises Support Programme Trust (MESPT) is a local development organization founded in 2002 through a partnership between the Government of Kenya (GoK), the European Union (EU), and later, the Royal Danish Government. MESPT's main goal is to eradicate poverty by supporting the growth of micro-enterprises, including agricultural production, agribusiness, and afro-processing. This support aims to foster social, economic, and environmentally sustainable growth by increasing access to financial and business development services, creating jobs, and promoting sustainable micro-enterprises. Our vision is to build a more prosperous society, and our mission is to provide sustainable business development and financial services to smallholder farmers and agri-MSMEs in Kenya.

For over two decades, our team of professionals has been at the forefront of developing cost-effective and scalable solutions that promote financial inclusion and support the growth of sustainable agribusinesses. We accomplish this by providing tailored financial solutions that meet the specific needs of various agricultural value chains, delivered through a wholesale lending model to financial service providers such as SACCOs, MFIs, and Farmer Cooperatives. These providers, in turn, extend loans to smallholder farmers and micro agricultural enterprises.

Our approach emphasizes delivering integrated financial and business development services to smallholder farmers and MSMEs in Kenya, helping them access finance, boost agricultural productivity, improve afro-processing and connect to markets. Over the years, we have worked closely with county governments, development agencies, donors, and investors to strengthen business development capacities in the agricultural sector, using a unique tripartite model that connects farmers, SMEs, and financial institutions.

Mango is among key value chains that have been supported by MESPT over the years through various interventions in order to enhance commercialization. MESPT appreciates the importance of documenting best practices for the value chain in facilitating effective delivery of training for farmers and Agripreneurs. Therefore, MESPT has facilitated the development of this manual alongside the value chain trainers' guide and other resource materials through Green Employment in Agriculture Programme (GEAP) with support from DANIDA.

This manual is expected to enhance effectiveness in delivery of trainings on Good Agricultural Practices and commercialization of the value chain. I am optimistic that this manual will be helpful to partners in the the value chain including county governments. I am grateful to DANIDA for the continued support to MESPT programmes. I am also thankful to the value chain experts who spearheaded compilation of this manual.

**Rebecca Amukhoye,  
Chief Executive Officer, Micro-Enterprises Support Programme Trust**

## PREFACE

The Green Employment in Agriculture Programme (GEAP) is 5 years' programme (2021 to 2025) funded by DANIDA and implemented by Micro-Enterprises Support Programme Trust

(MESPT). GEAP seeks to contribute directly to Kenya's Vision 2030 and to one of Denmark-Kenya Strategic Framework on accelerated decent employment creation in MSMEs and improved competitiveness of targeted value chains in agriculture which will contribute to transforming the economy towards a greener and more inclusive growth.

GEAP programme targets 40,000 smallholder farmers and has been implemented in 12 counties namely, Kilifi, Kwale, Nakuru, Nyandarua, Siaya, Kisii, Kakamega, Bungoma, Trans Nzoia, Uasin Gishu, Makueni and Machakos. The programme facilitates increased commercialization, decent employment, and green transformation through targeted interventions in seven selected agricultural value chains that include, Dairy, Export Vegetables, Indigenous Poultry, Cassava, Moringa, Pineapple, Mango, Banana, Avocado, Coconut and Aquaculture.

MESPT through GEAP has worked with the 12 County Governments Agriculture and Livestock technical staff, Kenya Agricultural and Livestock Research Organization (KALRO), MESPT technical staff and Private sector players to constitute a multidisciplinary team that developed resource materials tailored for extension service providers and smallholder farmers. The Mango value chain Manual and Training Guide are among the materials that were developed. The materials are to be used as an instructional guide for training on the implementation of good agricultural practices, value addition and marketing for the Mango value chain. Other cross cutting topics in the materials are Climate adaptation practices and technologies, Food safety and Gender and Social inclusion aspects. Relevance of the content is based on needs identified among value chain players, actors and aligned to GEAP project objectives. The training content is drawn from the Mango value chain manual and other relevant resource materials.

MESPT is grateful to the value chain experts and subject matter specialists who spearheaded the development and production of this Mango manual. It is our hope as MESPT that counties and other users will adopt and optimally use this resource for the Mango value chain development so as to increase productivity and profitability while ensuring focus on climate adaptation and sustainability.

**Doreen Kinoti,  
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## **ACKNOWLEDGEMENTS**

The Green Employment in Agriculture Programme (GEAP) participating counties (Kilifi, Kwale, Nakuru, Nyandarua, Siaya, Kisii, Kakamega, Bungoma, Trans Nzoia, Uasin Gishu, Makueni and Machakos) are acknowledged for providing resource persons in compilation of the document. The technical support and expertise provided by Kenya Agricultural and Livestock Research Organisation in development of the document is appreciated. Thanks to the Royal Danish Government's Danish International Development Agency (DANIDA) for facilitating the development of this resource material. Micro Enterprises Support Programme Trust (MESPT) is appreciated for co-ordinating the process of development and production of this document.

## **LIST OF ABBREVIATIONS**

AEZ	Agro-ecological zone
AFA	Agricultural Food Authority
APVC	Agriculture Product Value Chain
ASAL	Arid and Semi-Arid Land
CA	Conservation Agriculture
CIG	Common Interest Group
CSA	Climate Smart Agriculture
CTT	Core Team of Trainers
DANIDA	Danish International Development Agency
GAP	Good Agricultural Practices
GEAP	Green Employment in Agriculture Programme
ha	Hectare
HCD	Horticulture Crops Directorate
IDM	Integrated Disease Management
INRM	Integrated Natural Resource Management
IPM	Integrated Pest Management
ISFM	Integrated Soil Fertility Management
IWM	Integrated Weed Management
KALRO	Kenya Agricultural and Livestock Research Organization
kg	Kilogram
LF	Lead Farmer
MESPT	Micro-Enterprises Support Programme Trust
SSPs	Spray Service providers
VMG	Vulnerable and Marginalized Group

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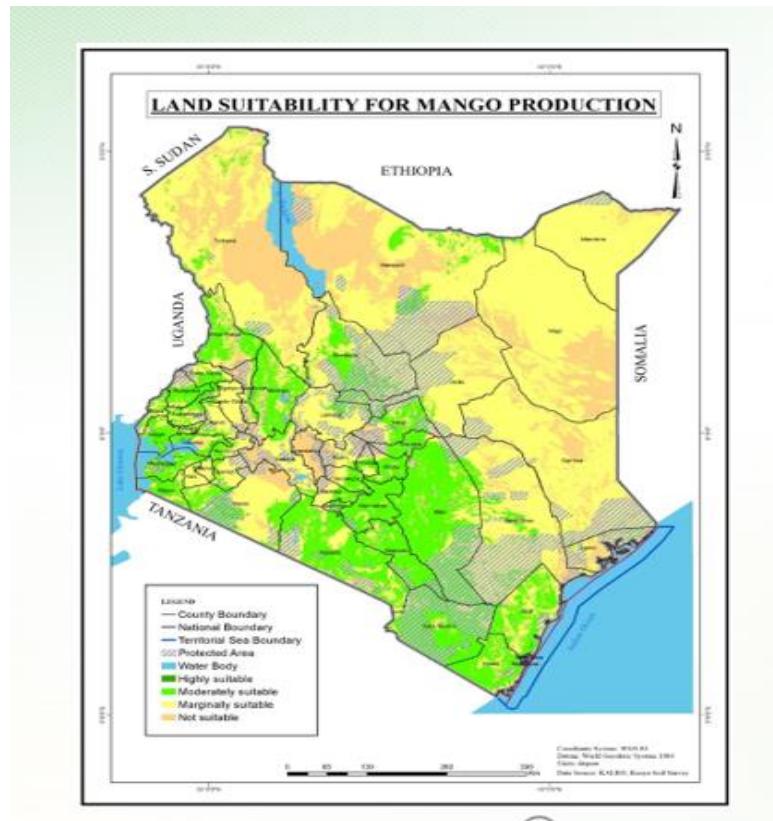
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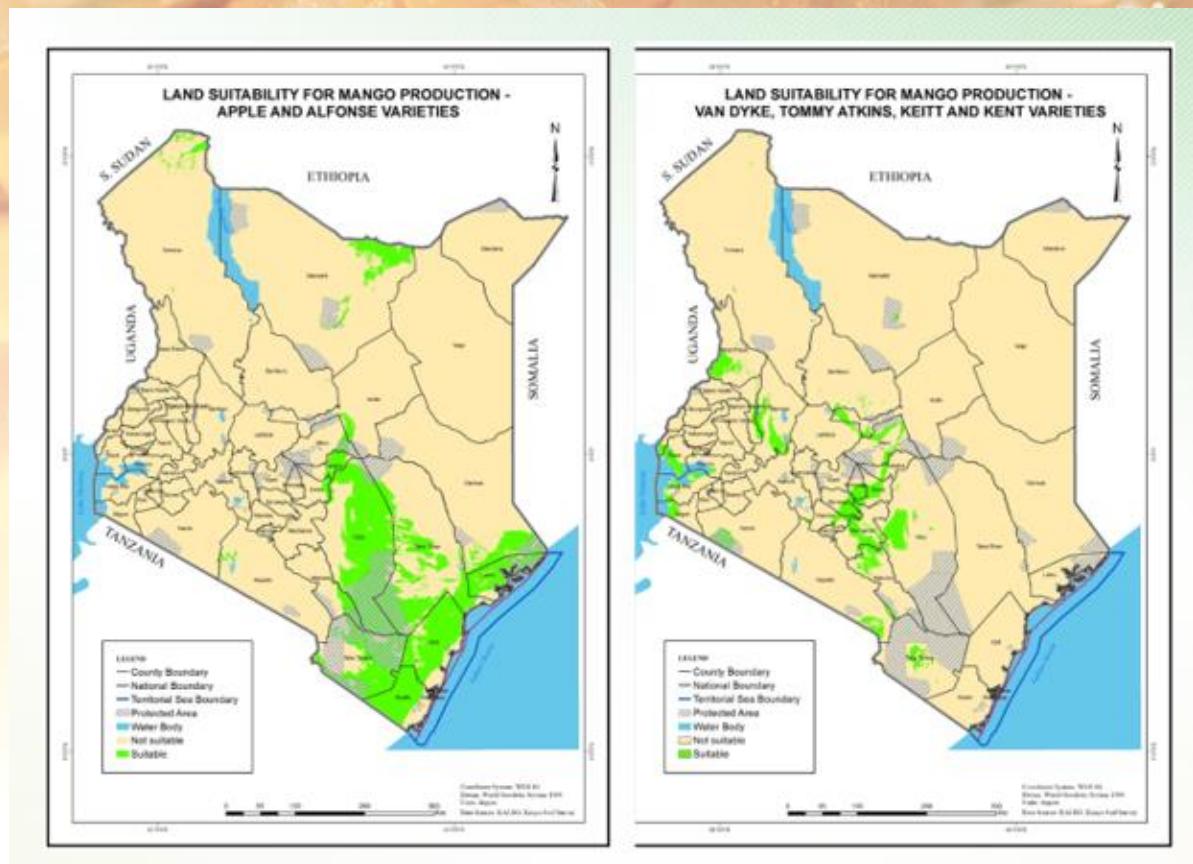
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## CHAPTER 10: INTRODUCTION

### 1.0 The Mango Tree (*Mangifera indica*).

The mango compares favorably in food value with both temperate and tropical fruits. Mango is a member of the *Anacardiaceae* family which includes plants such as Cashew, Pistachio Nut Mango is one of the most important fruit crops in the tropical and subtropical lowlands. It is native to India, Bangladesh, Myanmar and Malaysia, but can be found growing in more than 60 other countries throughout the world. The tree is evergreen often reaching 15–18 metres (50–60 feet) in height and attaining great age. The leaves are simple lanceolate, up to 30 cm (12 inches) long, with—small, flowers which are pinkish, and fragrant—are borne in large terminal panicles (loose clusters). Some have both stamens and pistil, while others have stamens only. The fruit varies greatly in size and character. Its form is oval, round, heart-shaped, kidney-shaped, or long and slender. The smallest mangoes are no larger than plums, while others may weigh up to 400gm. Some varieties are vividly coloured with shades of red and yellow, while others are dull green. The single large seed is flattened, and the flesh that surrounds it is yellow to orange in colour, juicy, and of distinctive sweet-spicy flavour.



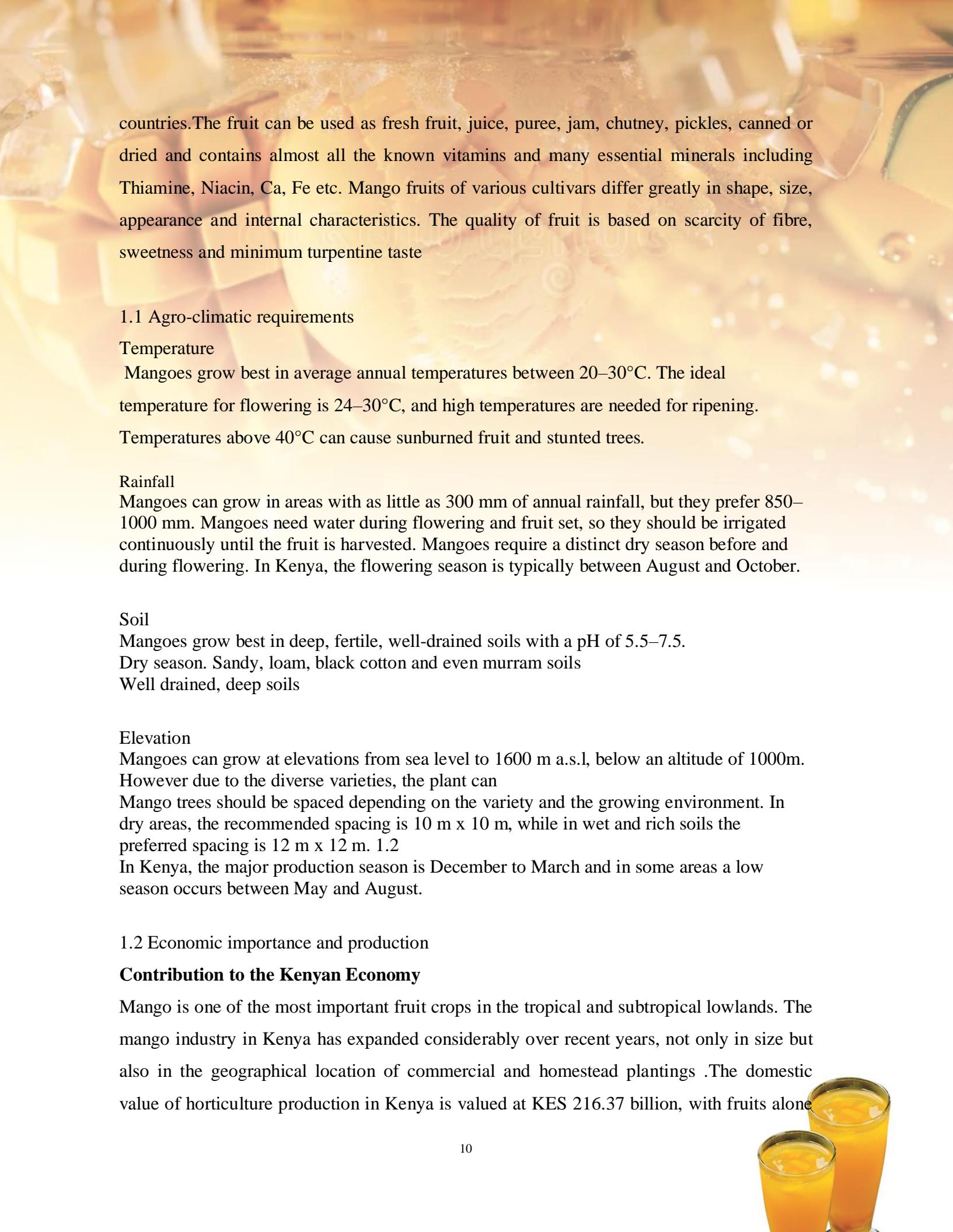


### *Land suitability map for mango in Kenya*

The mango industry in Kenya has expanded considerably over recent years, not only in size but also in the geographical location of commercial and homestead plantings. No longer is commercial mango cultivation restricted to the Coast region, as significant plantings of improved cultivars now also exist in the Country. Some of the leading counties in Mango production include Makueni, Lamu, Kilifi, Meru Murang'a, Taita Taveta, Tana River, Tharaka Nithi, Kitui County, Embu County, Machakos County, among other regions.

The mango is used as food because of its attractive appearance and the very pleasant taste of selected cultivars is claimed to be the most important fruit of the tropics. Given the multiple products, it is therefore a potential source of foreign exchange for a developing country; it is also a source of employment for a considerable seasonal labour force. In addition to income opportunities, the mango is noted for combating nutritional disorders. It is best adapted to a warm tropical climate with a dry season (>3 months) followed by rains

Most important considerations for Mango production are a dry period at flowering and sufficient heat during ripening. Fruits in Kenya are available from November to April (and sometimes to July). The main export markets for Kenyan mangoes is the Middle East



countries. The fruit can be used as fresh fruit, juice, puree, jam, chutney, pickles, canned or dried and contains almost all the known vitamins and many essential minerals including Thiamine, Niacin, Ca, Fe etc. Mango fruits of various cultivars differ greatly in shape, size, appearance and internal characteristics. The quality of fruit is based on scarcity of fibre, sweetness and minimum turpentine taste

### 1.1 Agro-climatic requirements

#### Temperature

Mangoes grow best in average annual temperatures between 20–30°C. The ideal temperature for flowering is 24–30°C, and high temperatures are needed for ripening. Temperatures above 40°C can cause sunburned fruit and stunted trees.

#### Rainfall

Mangoes can grow in areas with as little as 300 mm of annual rainfall, but they prefer 850–1000 mm. Mangoes need water during flowering and fruit set, so they should be irrigated continuously until the fruit is harvested. Mangoes require a distinct dry season before and during flowering. In Kenya, the flowering season is typically between August and October.

#### Soil

Mangoes grow best in deep, fertile, well-drained soils with a pH of 5.5–7.5.

Dry season. Sandy, loam, black cotton and even murram soils

Well drained, deep soils

#### Elevation

Mangoes can grow at elevations from sea level to 1600 m a.s.l, below an altitude of 1000m. However due to the diverse varieties, the plant can

Mango trees should be spaced depending on the variety and the growing environment. In dry areas, the recommended spacing is 10 m x 10 m, while in wet and rich soils the preferred spacing is 12 m x 12 m. 1.2

In Kenya, the major production season is December to March and in some areas a low season occurs between May and August.

### 1.2 Economic importance and production

#### **Contribution to the Kenyan Economy**

Mango is one of the most important fruit crops in the tropical and subtropical lowlands. The mango industry in Kenya has expanded considerably over recent years, not only in size but also in the geographical location of commercial and homestead plantings .The domestic value of horticulture production in Kenya is valued at KES 216.37 billion, with fruits alone



contributing KES 57.5 billion (26.5%). Of the total value, Mango (*Mangifera indica L.*) is the second most important crop after banana in Kenya. The Mango fruit is grown on 49,098 hectares producing 779,147 MT of mangoes valued at KES 11.9 billion. This is about 21% of the total value of fruits produced in Kenya.

### **1.2.1 Uses and food value**

The mango—because of its attractive appearance and the very pleasant taste of selected cultivars—is claimed to be the most important fruit of the tropics. It has been touted as 'king of all fruits' but has also been described as a 'ball of tow soaked in turpentine and molasses' by critics! It is one of the most delicious fruits there is, although it has undesirable features including coarse fibrous strands through the flesh and the pungent and turpentine flavors of some cultivars.

Fruits from the scattered mango production areas are mainly consumed locally. During the last 20—30 years, commercial mango production was developed based on locally adapted and newly imported cultivars. This has seen the area under mango cultivation in Kenya rise from 500 ha in 1970 to approximately 15,000 ha in 2000 (source: Annual Report, Ministry of Agriculture, Nairobi). There is a great diversity of mango fruit types which permits considerable manipulation for various purposes and markets: juice, chutney, pickles, jam/jelly, fresh fruit, canned and/or dried fruit. Given the multiple products, it is therefore a potential source of foreign exchange for a developing country; it is also a source of employment for a considerable seasonal labour force.

In addition to income opportunities, the mango is noted for combating nutritional disorders. The mango compares favorably in food value with both temperate and tropical fruits. Indeed, the fruit contains almost all the known vitamins and many essential minerals. Studies have shown that one mango fruit can provide a large proportion of the daily human requirements of essential minerals, and vitamins (see Table below). The calorific value of mango is mostly derived from the sugars. It is as high as that of grapes and even higher than that of apple, pears or peaches. The protein content is generally a little higher than that of other fruits except the avocado. Mangos are also a fairly good source of thiamine and niacin and contain some calcium and iron.

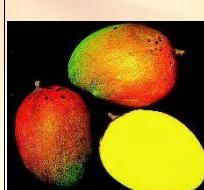
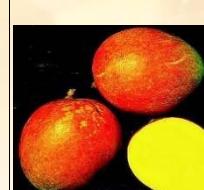
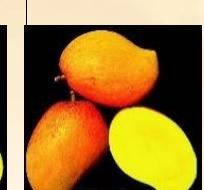
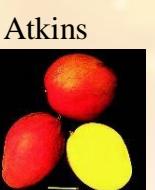


## CHAPTER 2.0: PLANTING MATERIALS AND PROPAGATION

### 2.1 Varieties

A wide range of mango varieties are grown in Kenya. The local varieties include: Apple, Ngowe, Boribo, Batawi, Dodo, Kiarabu, Kimji and Kitovu. Cultivars introduced in Kenya primarily for export include Haden, Keitt, Kent, Sensation, Tommy Atkins, Van Dyke and Sabine.

**Table 1: Attributes of the different Mango varieties**

	Apple 	Kent 	Keit 	Ngowe 	Tommy Atkins 	Van Dyke 
Origin	Kenya	Florida seedling of Brooks	Florida probably seedling of Mulgoba	Kenya	Florida	Florida
Fruit shape	Oval/ oblique	Ovate to slightly oblong	Ovate, slightly oblique and plump	Oblong	Ovate to slightly oblong	Ovate
Fruit size/ weight (average)	397 gms	372 gms	542 gms	523 gms	522 gms	280gms
Fruit colour	Yellow/ orange to red	Greenish yellow with dark red blush	Green/ yellow with pink or red blush	Deep yellow flushed with orange/red	Deep yellow with heavy red blush	Bright yellow with crimson blush

Flesh colour	Yellow	Deep yellow to orange	Yellow	Deep yellow	Yellow	Orange/yellow
Fibre	Low	None	None	None/low	Moderate	None/ low
Fruit dimension (average)	Long 9.7 cm broad 11 cm	Long 12.4 cm broad 9.7cm	Long 11.7 cm broad 9.2 cm	Long 14 cm Broad	Long 12.6 cm Broad	Long 10.5 cm Broad 7.9 cm
Seed %	9%	8.5%	7.5%	7.8%	6.6%	7.1%
Eating quality	Excellent	Excellent	Good/ Excellent	Good/ excellent	Fair/Good	Good
Maturity season **	Dec/Jan (M) End-Feb/ March (K)	March (M) Late March/ April (K)	March (M) Late March/ April (K)	Jan/mid Feb (M) Mid-Feb/ March (K)	January (M) Late Feb/ March	January (M) Late Feb/March (K)

#### Classification of mango cultivars according to maturity seasons

Cultivars	
Early cultivars (November to mid-January)	Arumanis, Apple, Carabao, Ngowe, Haden, Gesine, Dodo, Kensington, Zill
Mid-season cultivars (mid-January to late February)	Alphonso, Heart, Batawi, Boribo, Golek, Madoe, Peach, Sabre, Sabine, Tommy Arkins, Chino, Matthias, Irwin, van Dyke, Smith
Late cultivars (late February to April)	Parwin, Sensation, Kent, Zillate, Keitt

#### Remarks:

Off-season fruits are common in all regions and especially at the Coast where a distinct second cropping season occurs during the months of May to August.



The above classification is more or less valid for the early, mid-season and late mango cultivars. The months mentioned are a yardstick since—depending on location—the picking season for a certain cultivar which is listed as an early cultivar for Coast Region will definitely be in mid-season in Central Region. Still, this cultivar is an early one for the relevant Region.

## **2.2 TREE NURSERY MANAGEMENT**

### **2.2.1 Tree Nursery Techniques**

#### **a) Introduction**

Mango is established through grafted seedlings of desired variety. To raise rootstock for grafting, mango seeds are extracted from fully ripe fruits of local mango varieties. In Kenya mango varieties used for rootstock includes Kimji, Kisikio puna, Kitovu, Dodo, Peach and Sabre. Mango seeds remain viable for only a short time (3 to 5 weeks). Germination rate and vigor of seedlings is best when seeds are obtained from fully ripe fruits. Before planting, the hard woody endocarp (shell) is removed to examine the seed for disease or any damage caused by the mango weevil. The de-husked seeds (kernels) are treated with fungicide and immediately planted. They are sown at a spacing of 15 x 30cm, 5 cm deep. Seeds planted with the convex side up germinate in 2 to 4 weeks. Seedlings are ready for transplanting 5 to 6 weeks later when they are about 10cm in height. They are transplanted into a nursery bed at spacing of 40 x100cm or in poly-bags. The seedlings should be watered regularly and fertilizer applied regularly (every 6 weeks). Seedlings are ready for grafting when they have reached pencil thickness at about 20cm above the ground



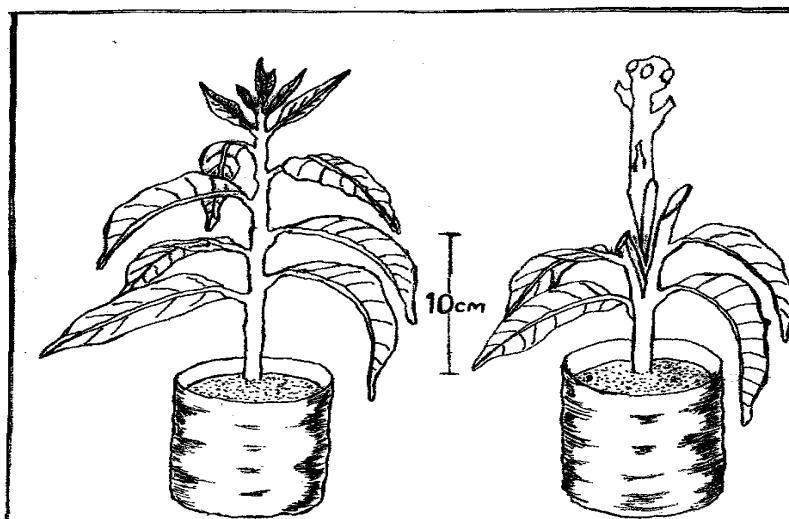
## Grafted Mango Seedling

### Source:

Mango seedlings are grafted using top-wedge grafting method. Other methods such as side-graft, whip-graft or splice graft can be used. However, only wedge grafting is described in this manual.

While grafting mango seedlings through top-wedge grafting the following steps are followed:

- Obtain scions from new wood (current season flushes).
- Scion wood should be pencil-size with 3-4 nodes. Few leaves below the graft union enhance success.
- Make a wedge-like slanting cut at the base of the scion with a sharp grafting knife.
- Make a vertical union at the top of the rootstock.



- Place newly grafted

plants under 50% shades. They should not be over-watered as the roots have a reduced leaf area to support and are easily damaged by over watering.

- After 2-3 weeks loosen the grafting tape on the scion which is progressively removed within 6 weeks depending on the scion growth.

- Any shoots developing below the union must be removed, as they will affect scion growth



### **Grafted seedlings ready for planting**

#### **Source:**

Trees are indispensable for our daily life. To grow them much more tree seedlings are required. To produce vigorous mango seedlings, the people involved in the nursery operation need to have mastered the nursery techniques on nursery operation

#### **b) Establishment of a small-scale tree nursery**

The main obstacle in orchard establishments in rural areas has been availability of certified seedlings which is caused by lack of registered nurseries closer to the farmers. To raise Mango seedlings is not a difficult job, it only needs a small piece of land, tools and materials and care from the farmer/owner of the nursery. Nurseries can be owned and managed by individual farmers, group, schools, churches, cooperatives and other institutions. Benefits from nurseries include:

- Possibility to produce suitable number and species.
- Income generating from selling of seedlings.
- Flexibility of planting time since the seedlings are always with you.
- Used as a teaching material.

#### **c. Location (Nursery siting)**

Several factors must be put into consideration which include the following for ASAL areas

- Water availability throughout the year (near a river, near your kitchen to utilize wasted water)
- Accessibility for transporting, soils and seedlings if the nursery is comparatively large.
- Availability of good soils preferable forest soil.
- Fencing around the nursery.
- Protected from a strong wind.
- Sunny condition.
- Gentle slope of water drainage.
- Near the supervisor's house for daily management.

#### **d. Scale**

The size of a nursery depends on the number of seedlings to be raised. Examples, 500 seedlings require a space of 3m x 3m, 2000 seedlings require 6m x 6m. In addition to the above you need space for collected soil, sand and manure and some space for mixing them.

#### **e. Facilities required**

- **Storage:** Storage for keeping the nursery tools safely and in good condition, but not necessarily in the nursery.
- **Fence:** Fencing around the nursery for keeping livestock out. For permanent use a live fence is recommended.
- **Water storage:** if there is no near-by water source like a river, pond, a water tank or drum is required.

#### **f. Tools**

The main basic nursery tools are: rakes, Jembes, Slashes, watering cans, wheel barrows, pruning knives, sharpening files, soil sieves, shovels, pangas, and jerry cans.

#### **g. Time to start the nursery**

Timing is very necessary; the time to start the nursery depends on the time to plant the seedlings. There must be enough time for seedlings to grow up to growable size. Secondly availability of labour must be considered since initial labour input for bed construction, soil collection, fencing; procurement of tools and materials is a lot more than the daily operation activities. Hence the busy farming season (cultivation, sowing and harvesting) should not be

selected. In this region trees are planted in November, December or January. Seeds can be sown by February, pricking out can be done by March and then short rains in April/May helps the young seedlings be ready for the long dry spell.

## 2.2. Soil mixing and preparation of sowing

### a) Soil mixing

Forest soil, manure and sand are usually mixed and used for sowing. A soil collection site should be identified under the forest. The soil must be rich in nutrients. At the forest site the soil is dug up to about 10cm deep using Jembes after scrapping off the vegetation. It is recommended to collect soil 3 months prior to the potting so that organic matter can decay and the seeds of the weeds germinate and can be removed easily. The soils must be sieved before mixing to remove stones, branches, roots, and other unnecessary matter. The soil is mixed with fermented cow manure in the ratio of Four to One. If the soils are clayey, sand should be added to allow the air and the water to infiltrate

### b) Potting

The pots (normally 4"x 7") is used as planting pots. Also locally available materials like small or big tins, tetra packs, milk packets, boxes can be used. When potting ensure 0.75 of the lower part of the pot should be made firm with fingers while the upper quarter should not be. The soil used for filling should contain some moisture but never wet.

### c) Bed arrangements for pots

- 1: Bed on flat ground.
- 2: Sunken bed- This kind of bed is used in very dry area to retain moisture; the depth is usually 5 inches. It is recommended to make 100pots (10 x 10) a unit to ease the work and counting.

### d) Seed bed construction

The necessary materials are sieved sand, sieved forest soil, big and small stones.

Procedure:

- 1: Sieve the sand and forest soil separately
- 2: and then mix them in a ratio of 1:1

NB: if the seed bed had been in use, remove the soil/sand mix and refill the bed with new soil/sand mixture. The recommended width of the bed is one meter

## 2.3 Sowing

### a) Direct sowing in pots:

For big seeds like *tamarindus indica*, *croton megalocarpus*, *cassia spp* e.t.c. it is more economic to sow them directly into the pots

#### Procedure

- 1: Water the pots properly one day prior to the sowing
- 2: use a stick or dibble to make two holes in each pot, if the germination rate is comparatively low, make three holes. The depth of the holes depends on the size of the seeds (usually 5mm or 1cm). Sowing too deep will render the seeds to decay
- 3: put a seed in each hole and gentle cover with soil
- 4: Water the pots
- 5: Make the shade cover the pots with small poles and grasses
- 6: water twice a day, early in the morning before 9.00am and in the evening after 4.00pm.  
Do not water during the hot days' time.
- 7: If two or more seeds germinate in one pot, wait until the sprouts reach to about two inches, and then remove the small ones remaining the healthiest one

### b) Sowing in the seed bed

Fine seeds and also large seeds with low germination rates are sown in the seed bed

#### Procedure:

- 1: Use the flat piece of timber to make the soil/sand mixture surface evenly flat
- 2: Broadcast the seeds evenly on the bed. The seeds should not be overcrowded lest fungal attack will be encouraged after germination. For very fine seeds like Eucalyptus spp. mix the seeds with sand before sowing. This method helps to broadcast the seeds evenly.
- 3: Cover the seeds lightly with the soil/sand mixture
- 4: Cover the bed with dry grasses lightly to protect from the water drops and to keep the moisture
- 5: Water the bed gently. Use of a watering can with fine holes is recommended.
- 6: Make light shade using small poles and dry grasses
- 7: Water twice a day.

## **2.4 Pricking out**

Pricking out is the process of transplanting the seedlings from the seed beds to the pots. This is usually done about two weeks after sowing but depends on the species, but mostly when the seedlings in the seed beds attain between one to two inches in height

Procedure of pricking process

- 1: Prepare an empty can (Kasuku, Kimbo, Cowboy) and fill  $\frac{3}{4}$  with water
- 2: Water the bed
- 3: Hold the leaves of the seedlings gently and insert a dibble underneath the root system of the seedlings to loosen the soil
- 4: Pull out the seedlings gently and immediately put them in the can which contains water. If the roots of the seedlings are kept under sunshine they lose the viability quickly
- 5: Water the pots
- 6: Make a hole with a dibble at the center of the pots
- 7: Hold the leaves of the seedling and insert the whole of but only its root system in the hole
- 8: Hold the dibble in a tilting position; insert it in the soil about half inch away from the seedling to the same depth as the hole
- 9: Push the soil towards the seedling to hold it tightly. This ensure that all air pockets around the roots are close
- 10: Cover the hole you made
- 11: The seedlings pricked out from the same batch of the seed bed should be arranged in the same place
- 12: Water the pots properly
- 13: Make the shade

## **2.5. Watering**

Watering can or an empty can with holes at the bottom (if watering can is not available) should be used for watering.

This is to reduce the power of water drops which cause soil erosion and to distribute water evenly. As already mentioned, watering in principle should be done twice a day, once in the morning and once in the evening. The soil in the pots should be kept moist, however, watering too much causes some fungal disease. If it is raining, watering might not be

necessary. Dirty water e.g soapy water or chemical wastes should not be used for watering. The temperature of the water should be cool. If the surface of the soil becomes too hard for water to penetrate, use the dibbler to break.

## **2.6. Weeding**

Removing weeds from the pots reduces the competition for nutrients. Don't wait until the weeds become too big with deep roots lest they damage the roots of seedlings. In case the weeds overgrow, use a dibble to root them out.

## **2.7 Cleaning around the beds**

Weeds come up not only in the pots but also around the beds. These weeds attract crickets, caterpillars and other insects which feed on the seedlings, and also give them a place to hide. Remove all the weeds around the beds with jembes and don't leave any rubbish around.

## **2.8 Application of additional fertilizers**

If seedlings show sign of weakness, some agricultural fertilizers can be applied or animal manure. The most common ones are APK and DAP and also manure from livestock can be used. However, the weakness of the seedlings can be caused not only by insufficiency of the nutrient but also by pests and disease.

## **2.9 Root pruning**

When seedlings have reached to a certain size, their roots become longer than the depth of the pots. If the roots are left without pruning, they penetrate into the ground and develop the root system there. Once the root system develops under the ground, it is hard to move the pots and if the roots are cut the seedlings will be weakened. Hence, periodical root pruning is required before the root system reaches into the ground. The period and interval of pruning depends on different species and other conditions. Water the seedlings properly in the evening before the day of pruning. Cut the roots using a knife, a razorblade or scissors at the bottom of the pot. Water the seedlings again after pruning.

## **2.10 Hardening up**

Hardening up is to expose the seedlings to harsh conditions to make them strong so that they will be able to survive under harsh climate in the fields after planted out.

The methods for hardening are:

- (i) When the seedlings grow and reach the certain size, the shade should be removed to expose them to the heat of the sunshine.

- (ii) Before planting out, root pruning should be carried out frequently. Once the roots penetrate into the ground, the plants get extra nutrient and water from there and develop delicate and soft tissues, so these seedlings cannot survive in the field.
- (iii) Reduce the quantity or frequency of watering to expose the plant against the drought.
- (iv) Arrange the seedlings pots in one or two lines to harden their roots.

## **2.11 Damage of seedlings**

There are many factors which cause damage to the seedlings in the nursery. Among them, biotic factors like pests are mentioned.

Damages by people are not technical matters and concern to management matters.

Therefore, in this MODULE only meteorological factors are mentioned.

### **i). Drought**

Drought is a climatic disaster which cannot be anticipated. The only measure is to keep a permanent water source near the nursery or construct the nursery near a water source.

### **ii). Wind**

Strong wind encourages evaporation from the surface and the seedlings can also be damaged physically by the sand carried by the winds. To establish windbreaks is recommended and the details of this technique are presented.

### **iii). Sunburn**

The heat of the sunshine near the equator damages the leaves directly and also damages the shallow roots by heating the soil surface. These damages may occur when the tissues of the seedlings are soft or weakened by some reasons. Use of the shade is strongly recommended especially when the seedlings are young.

## **2.12. Nursery Calendar**

Establishment of a tree nursery requires a timely schedule to enable every tree species to start development at the right time. Different tree species grow at different rates whereby a specific time for sowing for each species is required for it to attain a required height of 30cm to 80cm.

Rainfall is also another factor to note. Appropriate timing should be noted for each species to be ready for planting at the onset of rains.

Nursery calendar is therefore required to guide all the operations in the nursery.

## 2.13 Nursery operations

### **Planning of nursery operations.**

The procedures of planning any nursery are as follows:

(i) Selection of the species:

The select of species to be raised in the nursery, considering the use. In case of the groups ‘nurseries, the selection and priority of the species should be discussed and agreed among the members. In case of a school nursery, local demand should be surveyed.

(ii) Operation scale:

Since the scale of operation is highly depending on the availability of materials, tools and labor, decide the number of the seedlings to be raised, considering them.

(iii) Availability of materials

List the necessary materials and tools and think about the procurement whether your budget allows to buy or not. It is recommended to use local materials (farming tools, empty cans, milk packs) since they are cheaper and easily available.

(iv) Annual operation plan:

Make an annual working schedule (sometimes called as “a nursery calendar”) considering the fruiting seasons of candidate trees (necessary for seed collection) the duration to grow up (it differs depending on species, provenance and environment) and other conditions. For example, if a species needs six months in the nursery to be of plantable size, the seeds must be sown probably seven months before planting. Consult nearby foresters and or extension staff is available.

### **Before starting the operation**

There are some important matters to be done or clarified before the nursery operation starts.

The indispensable ones are:

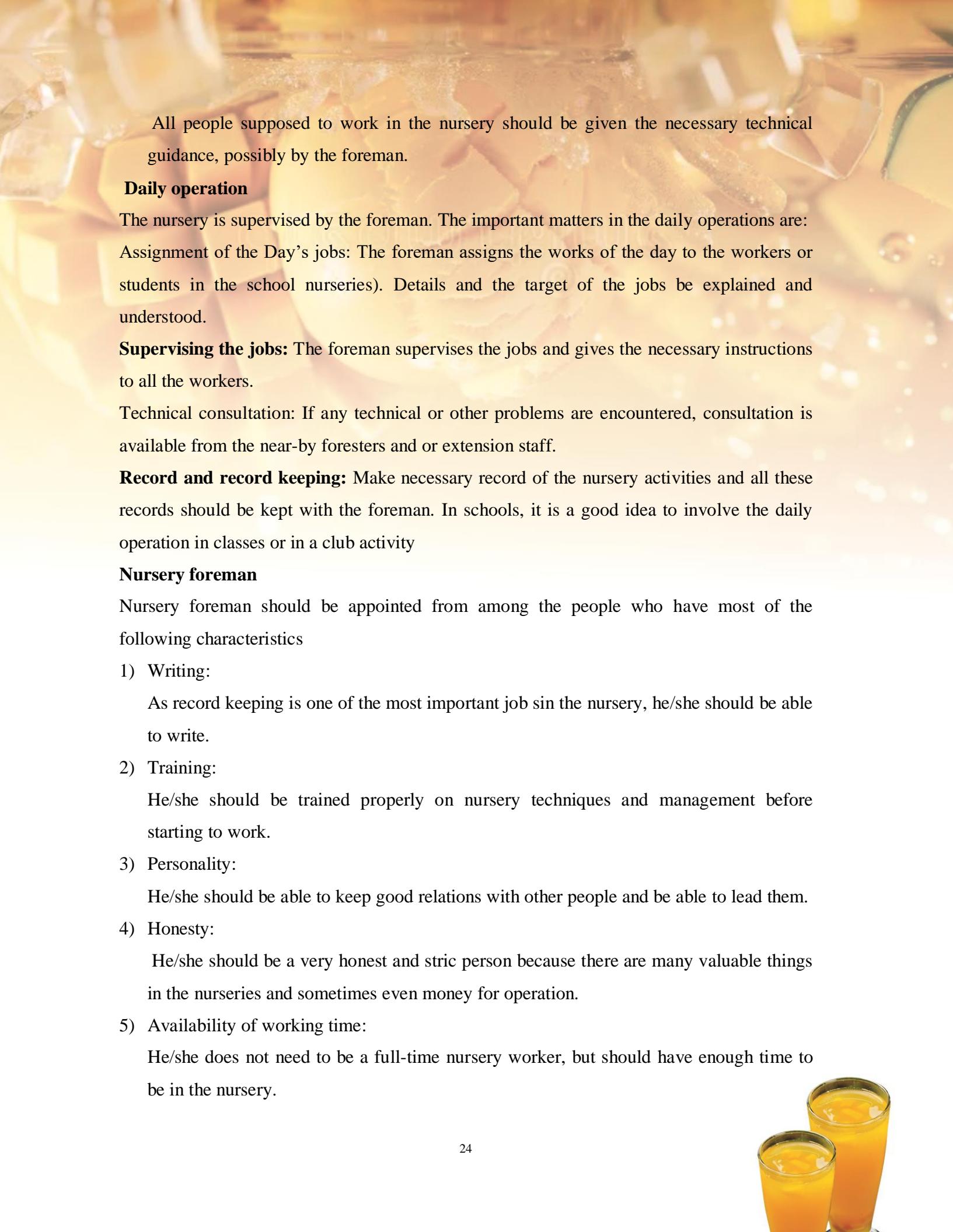
1) Assignment of staff:

Nursery foreman, storekeeper and other necessary staff should be assigned.

2) Condition to work:

In case of a group’s nursery, the mode and condition of work, and assignment of labor force should be agreed by all the members of the group.

Technical Guidance.



All people supposed to work in the nursery should be given the necessary technical guidance, possibly by the foreman.

### Daily operation

The nursery is supervised by the foreman. The important matters in the daily operations are:

**Assignment of the Day's jobs:** The foreman assigns the works of the day to the workers or students in the school nurseries). Details and the target of the jobs be explained and understood.

**Supervising the jobs:** The foreman supervises the jobs and gives the necessary instructions to all the workers.

**Technical consultation:** If any technical or other problems are encountered, consultation is available from the near-by foresters and or extension staff.

**Record and record keeping:** Make necessary record of the nursery activities and all these records should be kept with the foreman. In schools, it is a good idea to involve the daily operation in classes or in a club activity

### Nursery foreman

Nursery foreman should be appointed from among the people who have most of the following characteristics

1) Writing:

As record keeping is one of the most important job sin the nursery, he/she should be able to write.

2) Training:

He/she should be trained properly on nursery techniques and management before starting to work.

3) Personality:

He/she should be able to keep good relations with other people and be able to lead them.

4) Honesty:

He/she should be a very honest and stric person because there are many valuable things in the nurseries and sometimes even money for operation.

5) Availability of working time:

He/she does not need to be a full-time nursery worker, but should have enough time to be in the nursery.

## 2.14. Nursery records and record keeping

### **Introduction**

Recording all the work and progress is essential for nursery management, i.e management of daily operation, labor, cost etc. Well-maintained nursery records also help to improve techniques and to rationalize the works and it can also be used as basis for the next year's operation. To keep and accumulate the records is also important. Accumulated data may reveal some new findings and knowledge. Foresters and extension workers can trace the nursery operation carried out and can advise you properly.

### **Nursery records**

Several types of records are used and they mainly depend on the scale of the nursery. A large nursery needs an intimate record and many record books while a small nursery being operated by an individual farmer may need only a book. The necessary records for small nurseries operated by a group or a school are given below:

#### **Nursery Diary**

This is the most important record book. All the operations and observations of the day should be mentioned in this book as minutely as possible. The diary should be filled out in the morning after allocation of duties and in the evening before leaving for home

#### **Nursery Register**

This is the record on individual nursery bed basis. All the main nursery operations should be recorded on a board

#### **Nursery delivery Record**

This is to keep the record to show how the seedlings were distributed. Names of the people who received the seedlings from nursery and their addresses should also be recorded in sufficient details to enable a follow up. If the stocks were used for some plantation programmes, details should be recorded.

#### **Muster roll**

Daily attendance of all workers is recorded in this book.

#### **Visitors book**

This is not an essential record of the nursery operation. However, whenever there are some visitors, not only to ask them to sign on the book but also to comment about your nursery and to record their suggestion which may be useful.

## CHAPTER 3.0 CROP MANAGEMENT

### 3.1 Raising grafted mango seedlings

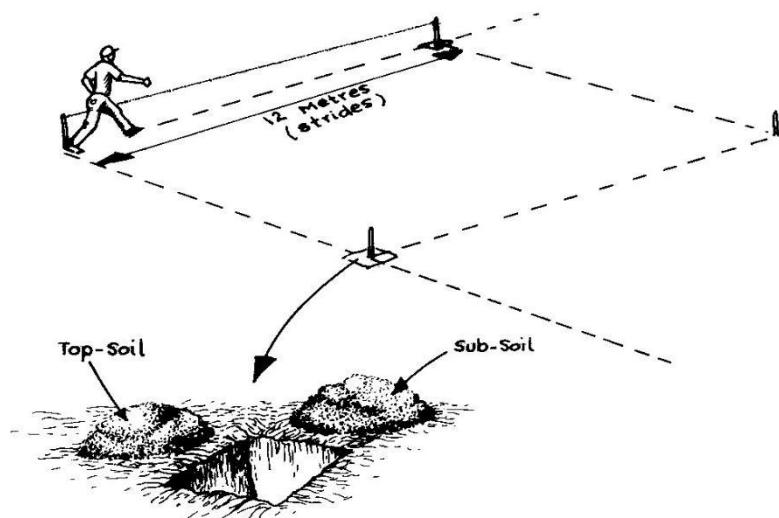
Since the mango is a long-lived perennial, the planting distance usually depends to a large extent on the vigour of the cultivar/rootstock and on the environment. Most orchards (either solely mango or a few trees on small farms) are planted too densely and trees are forced to grow upright and tall. Overcrowding results in the production of fewer fruits which are apt to be poorly coloured and infected with diseases. Tall trees also present a harvesting problem and create difficulties during spraying and pruning. Normally, grafted trees are spaced at  $8 \times 10$  m or  $10 \times 12$  m, though at the coast seedlings require  $12 \times 14$  m. Intercrops of short-lived fruit trees such as papaya or annual crops could be used for better utilization of land in widely spaced young plantations.

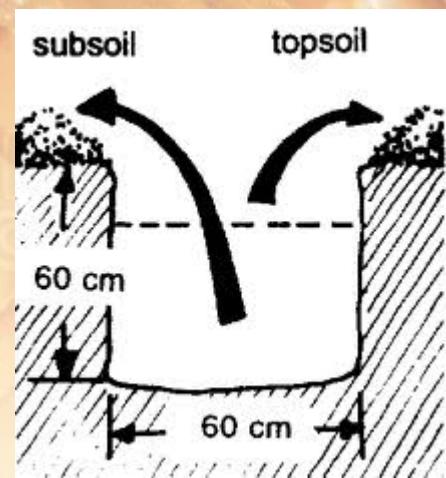
### 3.2. Orchard establishment

The land is ploughed thoroughly. The holes are spaced at  $9\text{m} \times 9\text{m}$  to  $12\text{m} \times 12\text{m}$  for grafted seedlings. The hole size should be  $60\text{cm} \times 60\text{cm} \times 60\text{cm}$ .

To establish a mango orchard, the following steps are recommended.

- Plough the land thoroughly, removing stems and roots
- Lay out the field by spacing holes  $12\text{m} \times 12\text{m}$

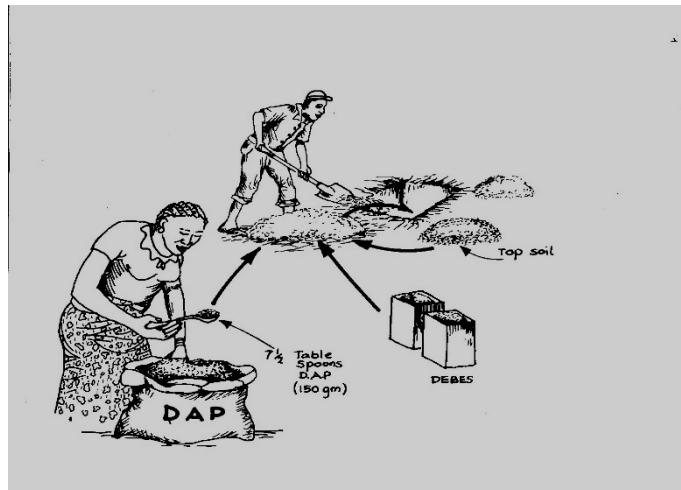




### Planting Hole dimensions

Source: MASPA ToT Manual

- Dig holes one or two months before planting. The depth should be 60cm x 60cm x 60 cm (2ft x 2ft x 2ft). In dry areas like eastern region e.g. makueni is 3ft x 3ft x 3ft



- Carefully remove polythene bag without disturbing the roots and plant at the centre of the hole. Plant the Mango seedlings on the same soil level as that of the soil when the seedling was in the polythene bag i.e avoid burying the graft union. Prepare a shallow basin and cover with mulch and water after planting



## Mango Planting Plate

### Source:

- Water the plant every 3-4 days until it has properly taken.
- Intercropping with short duration perennials e.g pawpaws or food crops e.g maize, cassava, cowpeas, vegetables e.g tomatoes, melons, pumpkins, chillies, brinjals in the first 5 years is recommended to maximize revenues until economical mango yield is attained.
- Mulching: it is recommended to suppress weeds and retain soil moisture.



- Ensure that the orchard is always free from all kinds of weeds

### **3.3 Canopy management in mango**

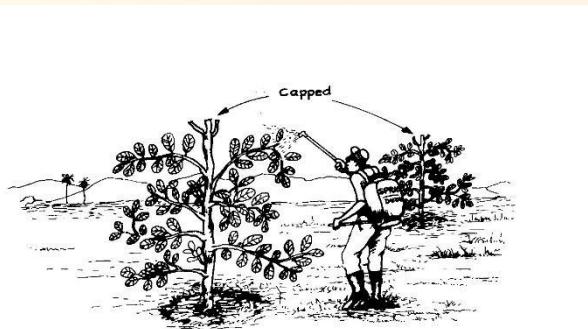
Canopy management is one of the most important factors to sustain the yield and quality of fruits in mango.

#### **(i) Young mango trees**

Frequent pruning of young mango plants is advised during the first months and years of grafting to ensure that the plants gain desired height and shape.

The following are the steps for pruning of young mango orchard.

1. Allow the seedlings to grow to a height of 1m from the ground (single stem)
2. Head back (cap) the plant at 60-70cm from the ground to induce primary branches.



3. Prune Primary branches to induce new secondary shoots (7-10 months after the first cut)
4. Thin the excessive secondary shoots retaining 2-3 shots per primary branch.
5. Tertiary branches (2-3) can be obtained by pruning the secondary branches at 60-70cm)

#### **(ii) Bearing mango trees**

Mango trees are terminal bearers i.e they flower from the end of the branches and will only flower on mature wood i.e shoots that are six weeks or older. Pruning can be done during two periods: First pruning and second pruning

- (a) First pruning after harvest. This includes



- **Skirting:** Removal of low hanging branches. It facilitates the operations such as fertilizer application and weeding.
- **Opening up.** Removal of branches which cross over or clutter up the centre of the tree restricting penetration of spray. One or two uprightly growing branches from centre of the tree are removed to reduce tree height and to increase that availability of light inside the canopy for better photosynthesis
- **Hygiene:** It involves the removal of any diseased or dead branch in the tree which could be a source of infection.

(b) Second pruning - pre-flowering. This is carried out before flowering and it involves:

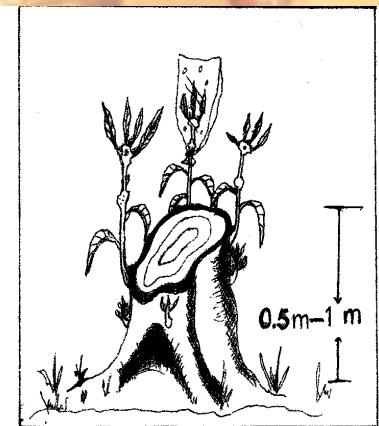
- **Skirting:** Low hanging branches which could cause fruits to drag on the ground are removed.
- **Opening up.** Twigs and disorderly branches are removed to have open canopy. This allows spray penetration for better insect and disease control and also allows light into the tree improving fruit colour.
- **Tip pruning.** This is practiced where the trees have a vegetative flush prior to flowering. The young flushes are cut back to mature wood. The new flush may result into a floral one. Tip pruning also reduces tree height.
- **Hygiene.** Removal of any diseased or dead branches before flowering.

### **(iii) Rejuvenating old mango trees**

Old trees often produce fruits and are difficult to harvest due to their size. They also harbour pests and diseases and it is difficult to reach whole tree while spraying to control them. It is possible to cut these trees and bring them to a more manageable size. Rejuvenation improves production, fruit size and quality once the trees recover. **Pollarding** or severe pruning of the tree at a height of about 3m from the ground is done to aged but productive trees with large canopies that are difficult to manage

**Coppicing:** Cutting down the tree at a height of 1.5 to 2 m is done to old unproductive or low yielding trees.

**Top working:** grafting of sprouts from coppiced trees can be done to convert them to a desired variety.



### ***Top-working a coppiced tree***

**Source:** Department of Agriculture Makueni- Mango Training Guide

#### **(iv) Tools and equipment for canopy management**

- (i) **Secateurs.** Used to prune small twigs and terminal shoots of mango (1-1.5cm diameter)
- (ii) **Pruning saw.** Used to prune small branches of 2.5 to 5 cm diameter
- (iii) **Tree pruner** (Pruning shears). Used to prune branches 5 to 7 cm diameter.
- (iv) **Chain saw.** Power operated saw used to prune big logs of any diameter
- (v) **Hydraulic fruit picking plat form.** It is a self-propelled machine which can be moved inside the orchard. It is fitted with chain saw and a cutter. Chain saw and cut any size, cutter can prune branches 6 to 8cm diameter. It can reach 25 to 30 feet from the ground.



- (vi) **Tractor mounted hydraulic platform.** Can be used to move inside the orchard and reach a height of 25feet from the ground. Pruning can be done using pruning saw, tree pruner, and chain saw by standing in the bucket provided



### ***Tools and equipment for canopy management***

#### **Fertilizers and manure recommendations**

A general criterion regarding mango nutrition is that care must be taken not to overfertilize thereby promoting vegetative vigour at the expense of flowering and fruit set. This is particularly true for nitrogen application since trees are subject to fertilizer burn. Correct fertilizer requirements can only be determined by means of leaf and soil analyses taken in different agro-climatic regions. With trees in fruit, proper timing is critical and it is recommended that fertilizer be applied just after harvesting, during the rains. Orchards should be kept clean, especially under the canopy of the trees where the fertilizer is spread uniformly in a circular belt around the drip line. This is the zone where the most absorption roots are located.

At planting mix 2 buckets (20-litre) of well decomposed manure and 60g (3 table spoons) of DAP with top soil and return this to the hole.

The following regime of fertilizer application is followed under medium and high level of management.

YEAR	MANURE (BUCKETS)		DAP (g)		CAN (g)		NPK (g)	
	Long rains	Short rains	Long rains	Short rains	Long rains	Short rains	Long rains	Short rains
1.	2	1	150		50	50	150	150
2.	2	2	150		100	100	200	200
3.	2	2	200		100	150	200	200
4.	3	2	200		200	200	200	200
5.	3	2	200		200	200	200	200
<b>Above 6 yrs</b>	<b>3</b>	<b>2</b>	<b>200</b>		<b>200</b>	<b>200</b>	<b>200</b>	<b>200</b>

The area under tree canopy should be kept free from weeds. Pruning established trees is important to remove dead or hanging branches and to open up the canopy to facilitate light penetration and reduce disease incidence. All branches that fall below 1m from the ground are removed.

### Flower induction

According to the Horticultural Crops Development Authority (HCDA), mangos in Kenya are available from November to April (and sometimes to July). Because of less competition better prices are fetched in Europe and the Middle East between November and December. Many techniques have been used in other countries to improve productivity and to alter the cropping season. Smudging (moist organic material—grass, leaves, etc.—is slowly burnt under the tree canopies and the resulting smoke induces flowering) is an old technique reported from the Philippines for enforcing off-season flowering, but this has largely given way to chemical induction. The application of potassium nitrate has been commercially accepted. The reasons are obvious: to have an altered earlier harvest, to take advantage of the good market price, to fill the gap of under-supply and to have flowering during a dry spell with little or no fungal diseases.

The readiness of a tree to flower is an important factor for a successful operation. For best results, choose trees with leaves that are dull green or greenish-brown and brittle when

crushed by hand. The trees should have an appearance of suspended growth or be dormant. It is easier to induce mango trees to flower towards the dry season, and older trees respond better than young ones. It is recommended that a 1% potassium nitrate solution mixed with a sticker agent (adhesive) be sprayed on to the tree, totally drenching its terminals and leaves. Make sure a knapsack sprayer has no residual herbicide in it before beginning to spray. If the timing is right, flowers will emerge 10-14 days after application. Tentative trials have been successfully implemented in Kenya.

## CHAPTER 4.0: PESTS AND DISEASE MANAGEMENT

### 4.1 Mango pests and Diseases

The following pests attack mangoes: Mango fruit fly, mango seed weevil, gall midges, and scales. The main diseases which affect mangoes are powdery mildew and anthracnose.

Pest	Pest Damage	Control methods
Mango fruit flies (Ceratitis spp./ Bactrocera invadens)	  <p>Fruit flies lay eggs under the skin of mature green and ripening fruit. Some fruit flies such as Bactrocera invadens, a new species recently introduced into East Africa, also lay eggs on small fruit. The eggs hatch into whitish maggots within 1 to 2 days. The maggots feed on the fruit flesh and the fruit starts to rot. After 4 to 17 days, the maggots leave the fruit, making holes in the skin.</p> 	<ul style="list-style-type: none"> <li><input type="checkbox"/> Collect and destroy all fallen fruits at least twice a week during the fruit season.</li> <li><input type="checkbox"/> Do not put collected damaged fruits into compost heaps. Instead, burn them or bury them at least 50 cm deep, so that the fruit flies cannot reach the soil surface.</li> <li><input type="checkbox"/> Remove fruits with dimples and those that ooze clear sap.</li> <li><input type="checkbox"/> Pick overripe fruits, as they attract fruit flies</li> <li>● Use of food baits (protein hydrolysate) mixed with toxicant</li> <li>● Biopesticide (Metarhizium anisopliae) treatment is aimed at targeting the pupariating stage of fruit flies in the soil or in bait stations for adult.</li> </ul>
The mango seed weevil ( <i>Sternochetus mangiferae</i> )	<p>It feeds on mango leaves, tender shoots or flower buds.</p>	<ul style="list-style-type: none"> <li>● Keep the orchards clean of all fallen fruit and plant</li> </ul>

 	<p>Female weevils lay one egg on the young fruit leaving a small, dark mark on the fruit skin. The larvae burrow through the flesh into the seed and destroy it. The larva develops and grows in the mango seed. When the larva has grown up to an adult beetle, it tunnels through the flesh and leaves a hole in the fruit skin. The tunnel gets hard and the fruit cannot be sold anymore.</p>	<p>material by collecting, burying or burning it.</p> <ul style="list-style-type: none"> <li>Sticky bands applied at the upper end of the trunk before it branches has been recommended to prevent weevils from migrating to branches for egg laying. However, there are some reports that, although these weevils are not strong flyers, they can fly, and could infest the trees in spite of the banding. A method for banding is described in detail under citrus trees/ants control.</li> </ul> <p>Scout fruit regularly and remove fruits with egg-laying marks and destroy weevils (larvae, pupa and adults) in mango seeds (stones).</p>
<b>Mealybugs (Rastrococcus spp.)</b>	<p>Mealybugs are small, flat, soft bodied insects. Their body is covered with a white woolly secretion. They suck sap from tender leaves, petioles and fruits. Seriously attacked leaves turn yellow and</p>	<ul style="list-style-type: none"> <li>Destroy affected parts at the beginning of the infestation. Heavily infested branches may be pruned to control the pest, especially on the tender branches before flowering begins.</li> </ul>



	<p>eventually dry. This can lead to shedding of leaves, inflorescences, and young fruit. Mealybugs excrete honeydew on which sooty mould developed. Heavy coating with honeydew blackens the leaves, branches and fruit. This reduces photosynthesis, can cause leaf drop and affect the market value of the fruit.</p>	<ul style="list-style-type: none"> <li>• Conserve natural enemies.</li> <li>• Avoid excessive spraying and the use of broad-spectrum pesticides, since they may kill natural enemies.</li> <li>• Control ants tending mealybugs - see also section on mealybugs on citrus datasheet.</li> </ul>
	<p>When necessary spray only the affected branches/trees (spot spraying). Mineral oils, neem products and soapy solutions (1 to 2%) are reported to give satisfactory control of mealybugs.</p>	
<p><b>Mango Gall Midge <i>cecidomyiidae</i></b></p>  	<p>The gall midges are small insects measuring about <b>3 mm</b> in length</p> <p><b>Damage</b></p> <p>Adults lay eggs on young tender leaves</p> <p>The larvae mine the leaves producing <b>galls</b> or <b>swelling tissues/pimples</b></p> <p><b>Dark green, circular galls</b> randomly distributed on the leaves blade</p>	<ul style="list-style-type: none"> <li>• <b>Orchard sanitation</b> is important</li> <li>• <b>Clear weedy areas</b> since adults prefer to stay on these plants</li> <li>• <b>Prune crowded branches</b> (particularly irregular branches) to allow light penetration</li> <li>• Use of <b>parasitic wasps</b></li> <li>• <b>Spray insecticides e.g.)</b></li> </ul>

	<p>Under heavy infestations, the leaves <b>wrinkle</b> and <b>remain necrotic</b> eventually drops</p>	<p><b>Deltamethrin such as Decis 2.5EC® mixed with mineral oil</b> (mineral oil should Not exceed 2 % i.e. 400 ml in 20 L of water) as soon as new shoots and leaves appear</p> <ul style="list-style-type: none"> <li>•</li> </ul>
<b>Mango Scales</b> 	<p>Small round reddish brown to white insects</p> <p>Usually found in clusters which are immobile</p> <p>Insects can be 1 – 7 mm long while the cluster can be 2 cm in diameter</p> <p>Clusters found on upper surface of leaves, branches, stem and fruit</p> <p>Females are circular in appearance, have dark spot on one side, have neither wings nor legs</p> <p>Adult males have two wings</p> <p><b>Damage:</b></p> <p>Scales suck the cell sap from the infested areas</p> <p>Infested leaves turn pale</p>	<p>Cut and burn infested tree parts</p> <p>Use of natural enemies e.g.) Parasitic Wasps, Ladybird Beetle, Lacewings etc.</p> <p>Spray with insecticide mixed with white mineral oils 2% : paraffin oil is sprayed as a 3 % water emulsion. Avoid spraying mineral oil during very hot periods of day</p> <p>Use of D-C Tron (Caltex oil) to suffocate the insects</p>

	<p>green to yellow eventually die and drop</p> <p>Infested fruits have pink blemishes and drop</p> <p>Poor growth and dieback of branches</p> <p>Infested young seedlings may die</p> <p>Honey dew is produced which form sooty mold, thus reduction of photosynthetic capacity</p>	
<b>Powdery mildew (<i>Oidium mangifera</i>)</b>	 <p>Appears as a white, powdery growth on leaves, flowers and young fruit. Infected leaves curl and flowers fail to open and drop from the tree without forming a fruit. It is spread by wind and is more prevalent in dry weather when humidity is high and nights are cool.</p>	<ul style="list-style-type: none"> <li>• Use of appropriate cultivars. Alphonse, Kent and Zill are highly susceptible to mildew. Haden and Keitt are moderately susceptible and Sensation and Tommy Atkins are tolerant.</li> <li>• Monitor for the disease weekly.</li> <li>• Spray a solution of: baking powder (6 teaspoonfuls), white oil (3 teaspoonfuls) and white bar soap foam in 15 litres of water. This</li> </ul>

		<p>solution has been shown to control powdery mildew.</p> <p>Sulphur based fungicides can effectively control powdery mildew if appropriately used.</p>
<b>Anthracnose (<i>Colletotrichum gloeosporioides</i>)</b>	 <p>Anthracnose initially appears as small black spots. On leaves, the spots can grow to form an irregular patch. On young fruit, pin-sized, brown or black, sunken spots develop. It is an important problem after harvesting the fruit, especially during transport and storage, where fruit can develop round, blackish sunken spots.</p>	<ul style="list-style-type: none"> <li>• Use tolerant varieties. "Tommy Atkins" is less susceptible to anthracnose than "Haden", "Sensation" and "Zill".</li> <li>• Cut-out dead branches and twigs and dead leaves. Completely remove them from the mango orchard.</li> </ul> <p>Monitor for the disease weekly</p>

**N.B For chemical control,** use products recommended by Pesticides Control Product Board (PCPB). **Read the label attached to the pesticide container carefully and use the manufacturers recommended rate.**



### 4.3 Expected Yields

Mangoes begin to bear 3-4 years after planting. Yields depend on variety.

Cultivar	Maturity (month s)	Fruit colour	Trees/h a <b>8x 10</b> <b>m</b> <b>7 x 9</b> <b>m</b>	t/ha per year						
				ond	3">	4th	5'h	6>>	<b>rh</b>	gm
Sensation	Februar	Purple/re	125	1.94	4.65	6.82	13.95	9.69	12.0	22.44
Kent	May	Red	159	1.65	10.48	13.30	20.37	37.058	5	14.367
Haden	Mar/Apr	Green/red / yellow	125		2.19	6.72	10.15	0.86	25.8	0.81
Maya	Jan/Feb	Yellow/red	125	0.42	1.38	3.10	11.98	2.54	1	7.36
Sabine	Jan/Feb	Yellow/red	125		7.15	13.79	20.95	28.87	2040	17.56
Van Dyke	Jan/Feb	Yellow/red	125		2.58	3.48	2.98		6.70	
	Jan/Feb	Yellow/red							26.8	
	Jan/Feb	Yellow/red							3	
For comparison										
Ngowe	Dec/Jan	Yellow/orange	125	1.57	2.14	6.28	14.13	10.92	15.49	10.56

## **CHAPTER 5.0: GREEN TECHNOLOGIES AND MECHANIZATION**

Green Technologies (GT) refers to those friendly technologies that reduce environmental damage and contribute to both poverty reduction and sustainable agricultural development. In Mango farming, the green technologies that are employed include the following: Soil and water conservation, Mulching, Terracing, Integrated soil fertility management, Cover cropping, Contour farming, Irrigation and integrated pest management as described below:

### **5.1 Soil and water conservation**

#### **What is soil conservation?**

It is the prevention and reduction of the amount of soil lost through erosion. It seeks to increase the amount of water seeping into the soil, reducing the speed and amount of water running off. Erosion is prevented by keeping enough vegetation to protect the soil surface and binds the soil together and maintains soil structure.

#### **What is water conservation?**

This is a way of tapping as much water as possible and storing it in tanks or reservoirs. It allows water to sink into the soil increasing soil moisture levels. It ensures a protective cover of vegetation on the soil surface, slowing down the flow of running water and spreads the water over a large area.

#### **Benefits of soil and water conservation**

- Conserving water makes it available for crops, livestock and domestic use over a longer period
- Controlling soil erosion improves crop and pasture yields.
- Conservation measures improve the supply of fuel and forest products.
- They increase the value of the land.
- Terraces make cultivating steep slopes easier.
- More and better livestock fodder is available.

#### **Soil management**

Inappropriate land Soil fertility management begins with soil nutrient analysis to establish nutrients the soil is deficient in.

Use activities often cause changes in soil conditions, which in turn contribute to soil erosion. Soil management is to create optimum conditions for plant growth through improved soil fertility and structure. It increases infiltration rates, improve water-holding capacity, and reduce runoff and erosion.

## **5.2 Cover cropping**

This is the growing of crops to cover cultivated ground, reducing erosion by raindrop splash and overland flow.

It protects the soil from excessive heat and creates a good environment for microorganisms.

The fallen leaves of the cover crop decompose and add organic matter to the soil.



### **Intercropping Mango with Groundnuts**

**Source: CABI**

## **5.3 Integrated soil fertility management**

### **Applying organic manures and mineral fertilizers**

- Adding manure and fertilizers to the soil provides the required plant nutrients for vigorous crop growth.
- Fast growth gives quicker cover to the ground and higher yields.
- Inorganic fertilizers provide major plant nutrients - nitrogen, phosphorus, potassium, and occasionally sulphur - that are needed by plants.
- Inorganic fertilizers are no substitute for organic matter, and therefore should be used in combination. Sources of organic fertilizers include farmyard manure, compost, and green manuring.

### **5.4. Mulching and the use of crop residues**

Dead plant materials such as dry grass, straw, dry leaves, banana leaves, sugar cane trash, and other crop residues are spread on the bare soil surface or placed around the stem of the trees to control soil erosion and conserve moisture.



### **Ring Mulched Mango Tree with Dry Leaves or Wood Chips**

**Source:** Kamami G.N

## **5.5 Contour farming practices**

Contour farming involves ploughing, planting and weeding along the contour that is across the slope rather than up and down. Contour farming reduces soil erosion by as much as 50% on gentle slopes.

Contour ridges are used in semi-arid areas to harvest water, and in higher rainfall areas for growing potatoes.

Trash-lines are constructed by laying plant residues in lines along the contour. Trash-line help in slowing down the runoff and trapping eroded soil.

Grass barrier strips of Napier or other fodder grasses are planted along the contour.

## **5.6 Physical soil conservation measures**

Physical soil conservation structures are permanent features made of earth, stones or masonry, designed to protect the soil from uncontrolled runoff and erosion and retain water where needed. Some of the physical conservation measures include:

### **Cut – off drains.**

Cut-off drains are dug across a slope to intercept surface runoff and carry it safely to an outlet such as a canal or stream. They are used to protect cultivated land, compounds, and roads from uncontrolled runoff, and to divert water from gully heads.

### **Retention ditches**

These are dug along the contours to catch and retain incoming runoff and hold it until it seeps into the ground. They are an alternative to cut-off drains when there is no nearby waterway to discharge the runoff. They are often used to harvest water in semiarid areas.

### **Infiltration ditches**

This is a structure designed to harvest water from roads or other sources of runoff. They consist of a ditch 0.7-1.5m deep, dug along the contour, upslope from a crop field. Water is diverted from the roadside into the ditch, which is blocked at the other end. Water trapped in the ditch seeps into the soil.

### **Water-retaining pits**

Water-retaining pits trap runoff and allow it to seep into the soil. A series of pits are dug into the ground where runoff normally occurs. The soil from the pit is used to make banks around the pits. Furrows carry excess water from one pit to the next. The size of the pit depends on the amount of runoff: a typical size is 2m square and 1m deep.

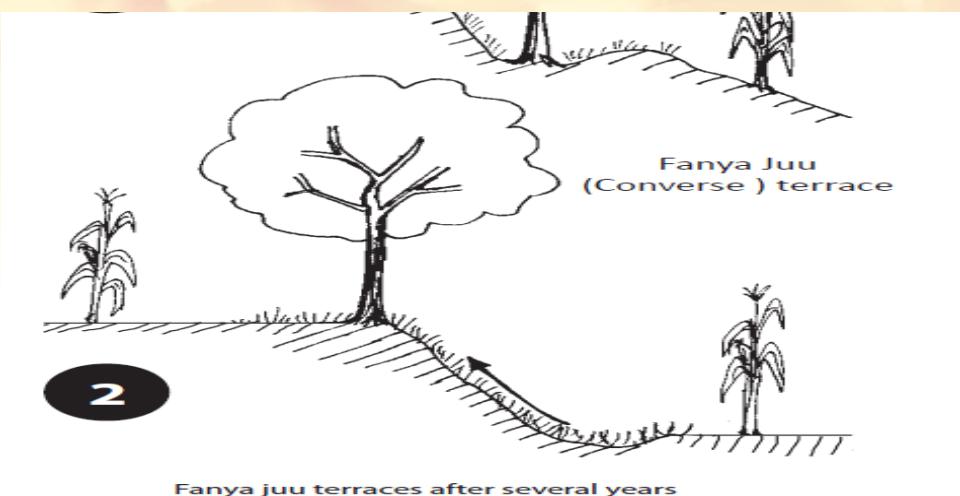
### **Broad beds and furrows**

In a broad bed and-furrow system, runoff water is diverted into field furrows (30cm wide and 30 cm deep). The field furrows are blocked at the lower end. When one furrow is full, the water backs up into the head furrow and flows into the next field furrow. Between the field furrows are broad beds about 170cm wide, where crops are grown.

### **Terracing**

#### Fanya Juu (Converse) terrace

*Fanya juu* terraces are made by digging a trench along the contour and throwing the soil uphill to form an embankment. The embankments are stabilized with fodder grasses and in between cultivated portions. Over time, the *fanya juu* develop into bench terraces. Useful in semi-arid areas to harvest and conserve water. The measure is suitable for soil too shallow for level bench terracing and moderate slopes below 20%. However, they are not applicable on stony soils.

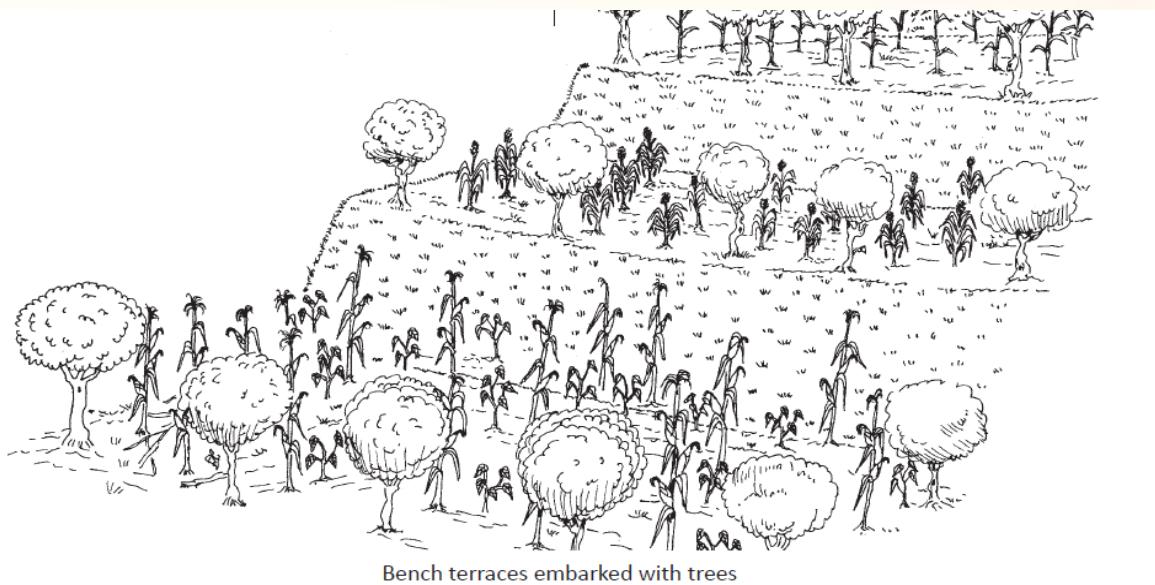
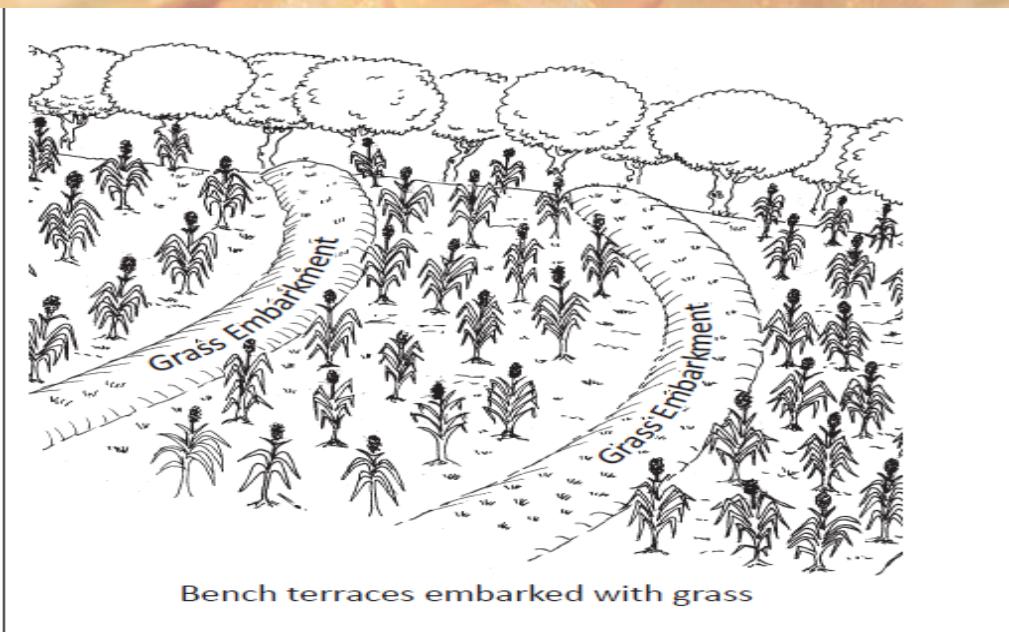


### **Fanya chini (narrow based channel)**

*Fanya chini* are made by digging a trench along the contour and the soil is put on the lower side of the contour trench. It is used to conserve soil and divert water into stone terraces and water retention pits the embankment can be used to grow fodder. This is applicable on slopes of up to 20%.

### **Bench terraces**

These are level or nearly level steps constructed or formed on the contour and separated by embankments known as risers. They are formed by excavation or developed from grass strips or fanya juu terraces. Suitable on slopes up to 55%.



### Stone terraces

Stone terraces are useful in areas with steep slopes but high population density and scarce land. The terrace risers are made of stones collected

### Farm fencing

It is important for every farmer to fence their fruit orchards in order to prevent crop damage from livestock or produce loss through theft.

## **5.7 Irrigation**

Irrigation is recommended in zones along main water supplies such as rivers and springs to take advantage of off season markets. Irrigation management is crucial to the production of quality fruit. Water inputs must be geared to tree water requirements, soil factors and fruit physiological requirements. In a new planting, trees must be irrigated throughout the year, including dry periods which occur during the wet season, to enable rapid establishment of the tree. Water inputs should be appropriate to tree size. In general up to 100 L/tree/week should be sufficient for the first two years. The soil type determines how early continuous irrigation can cease. Trees grown on light sandy and gravelly soils may require continuous irrigation for a longer period to allow them to develop an appropriate size canopy. In sandy and gravelly soils, irrigating two to three times per week will be appropriate for most sandy sites. Long irrigations on a sandy soil result in water draining beyond the depth of the effective root zone which is a waste of water and leaches away nutrients. Irrigation is critical at three main stages pre-flowering, from the end of the wet season to the commencement of flowering (April to June/July), flowering and fruiting from visible panicle bud differentiation to harvest (July to November) and during post harvest to the end of the wet season Phase one (November to April).

## **5.8 Mango Mechanization options**

Mechanization interventions in mango crop for production, post -harvest operations and value addition are relatively low and need to be focused on so as to improve crop productivity and profitability. Precision in operations at different stages of growth will address the challenge of enhancing productivity and profitability of mango crop. A review of mechanization technologies developed in other countries for mechanization of mango crop need to be introduced and farmers trained for adoption. It is clear that the mechanization options across the mango value chain can either be fabricated and developed or acquired for training and use to mango farmers to improve adoption.

Type of	Current Method	Mechanization Options	Remarks/Picture for Machinery
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<b>Operation</b>			
Land Preparation	Tractor plough/ oxen drawn plough / manual	Tractor drawn plough	Most of the farmers are already using tractors but training on how and when to prepare land for mango planting is very important.

Planting	the hoe, fork jembe mattock and shovel	Use of a tractor drawn planter	
Fertilizer Application	Manual by use of hand	Fertilizer applicator	

Weed Management	Use of chemicals/ use of jembe	Mechanical weeder / tractor drawn	
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Pest management	Use of knapsack sprayers	Air-carrier sprayers	
Pruning	Manually by use of pruning saw, machetes and secateurs	Using a pruning machine	

Harvesting/Picking	Hand picking	Portable mango harvesters	
Peeling	Use of knives/	Use of mango peelers	
Processing	Juice making machines by use of blenders and fruit pulpier		

			
Transportation	Use of motor cycles/bicycles/wheel barrows	Use of trucks with installed mango crates for safety	 



## **CHAPTER 6.0: POST HARVEST AND VALUE ADDITION**

The Mango fruit is highly perishable resulting to high postharvest losses and short shelf-life. Processing of mango into various products enhances shelf life thus ensuring availability during off season. Agro-processing add value to mango, increasing their economic value thus giving better returns to various value chain actors. A larger percentage of the mangoes produced in the country are marketed in their raw forms. Therefore, there is loss of opportunities for higher earnings and generating employment. The main constraints facing the agro processing industry include high operational costs, unavailability of appropriate processing equipment; and limited knowledge in value addition.

Value addition also diversifies markets and utilization of mango. Knowledge and skills in mango value addition is limited or lacking at grass-root levels. There is need for capacity building to address these challenges and promote mango value addition at cottage industry level as viable commercial enterprises. After harvest, mangos remain living and undergo many of the biological processes common to living plants. These include consumption of energy and oxygen, production of heat, production of carbon dioxide, and deterioration of quality. Additionally, as mangos are stored after harvest, they become increasingly susceptible to mold and decay. As such, the shelf life of mangos is limited, and significant losses occur due to spoilage. Processing can extend the shelf life of mangos by stopping many of the biological practices that decrease quality and by creating an adverse environment for microbes responsible for spoilage. Processed products such as juices and dried fruit are no longer living, thus spoilage is no longer related to biological factors, but rather microbial growth and chemical reactions related to quality loss. As such, processing conditions, the products, and packaging must be optimized to slow or prevent microbial growth and chemical degradation. It should be noted that some processed products, such as fresh cut fruit, are still living and thus biological processes should be considered along with microbial growth and chemical degradation.

### **6.1 Fresh Cut Mango**

Fresh cut mangos can be sold as a convenient snack or precut ingredient for customers of all ages. While processing of fresh cut mangos is simple some key factors must be considered.



First, fresh cut mangos are high in moisture and unpreserved. Thus, molds and bacteria can easily contaminate and grow on fresh cut mangos. Whole fruit should be washed and disinfected prior to processing. An example of an adequate disinfecting solution consists of 200 ppm (0.02%) bleach, which can be made by adding 5mL of 5% bleach to 1 liter of water. This solution should be changed regularly because the bleach loses effectiveness after multiple washes. Fresh cut mangos should be refrigerated at 4°C until consumption. Fresh cut mangos stored at 4°C have a shelf life of 7-10 days.

Second, mangos are damaged during the cutting process. Due to this damage, quality loss, particularly color change and flavor loss, will occur much faster than in whole mangos. Mangos should be dipped in an anti-browning solution, such as citrus juice in water, after cutting. Third, mangos will continue to ripen after cutting. While fully yellow mangos should be used, firm mangos can be cut and will continue to ripen and soften throughout storage.



## 6.2 Juice Processing and Bottling

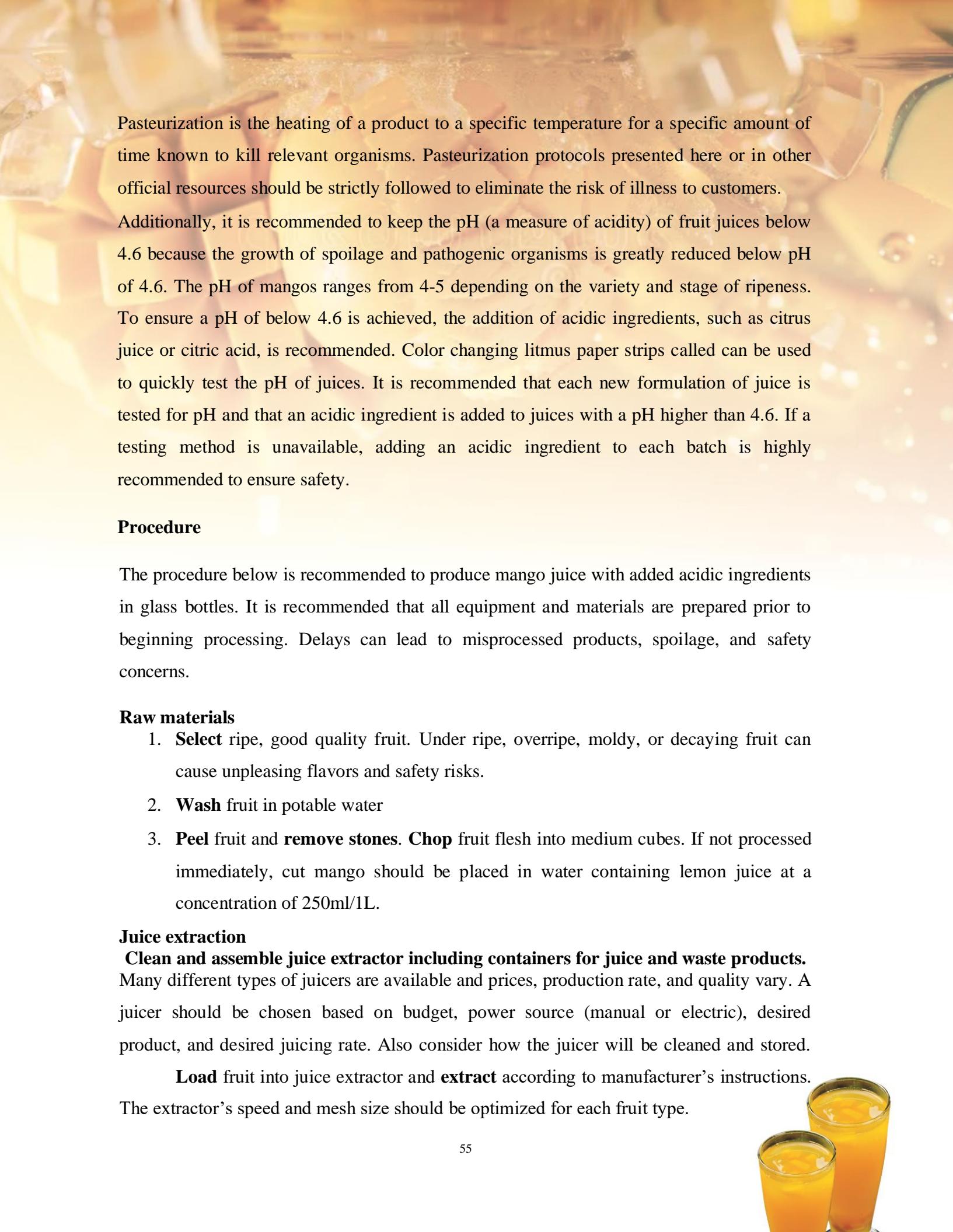
### Introduction

Fruit juice is a commonly consumed fruit product with a long shelf life and potential nutritional benefits. Many types of juice exist, most varying in the amount of added sugar or evaporation of water from the raw juice. As such, many different juices can be produced from the same raw products, increasing the marketing options of the producer.

### Safety considerations

A properly processed and packaged juice can have a shelf life of 6 months to a year. However, some safety issues should be considered. Pathogenic or spoilage organisms live on raw mangos and can contaminate juice products. Because juice is high in water and sugar, these organisms can grow in juices creating a dangerous or low-quality product. To eliminate this risk, juices should be pasteurized to kill spoilage and pathogenic organisms.





Pasteurization is the heating of a product to a specific temperature for a specific amount of time known to kill relevant organisms. Pasteurization protocols presented here or in other official resources should be strictly followed to eliminate the risk of illness to customers.

Additionally, it is recommended to keep the pH (a measure of acidity) of fruit juices below 4.6 because the growth of spoilage and pathogenic organisms is greatly reduced below pH of 4.6. The pH of mangos ranges from 4-5 depending on the variety and stage of ripeness. To ensure a pH of below 4.6 is achieved, the addition of acidic ingredients, such as citrus juice or citric acid, is recommended. Color changing litmus paper strips called can be used to quickly test the pH of juices. It is recommended that each new formulation of juice is tested for pH and that an acidic ingredient is added to juices with a pH higher than 4.6. If a testing method is unavailable, adding an acidic ingredient to each batch is highly recommended to ensure safety.

## Procedure

The procedure below is recommended to produce mango juice with added acidic ingredients in glass bottles. It is recommended that all equipment and materials are prepared prior to beginning processing. Delays can lead to misprocessed products, spoilage, and safety concerns.

### Raw materials

1. **Select** ripe, good quality fruit. Under ripe, overripe, moldy, or decaying fruit can cause unpleasing flavors and safety risks.
2. **Wash** fruit in potable water
3. **Peel** fruit and **remove stones**. **Chop** fruit flesh into medium cubes. If not processed immediately, cut mango should be placed in water containing lemon juice at a concentration of 250ml/1L.

### Juice extraction

**Clean and assemble juice extractor including containers for juice and waste products.** Many different types of juicers are available and prices, production rate, and quality vary. A juicer should be chosen based on budget, power source (manual or electric), desired product, and desired juicing rate. Also consider how the juicer will be cleaned and stored.

**Load** fruit into juice extractor and **extract** according to manufacturer's instructions.

The extractor's speed and mesh size should be optimized for each fruit type.



## **Collect juice and waste in clean containers for further processing**

Many options exist for juice processing. The most commonly used for mango is the pulping model shown in the figure below. This uses either hand or mechanical power to push fruit against a mesh, separating juice from fibrous pulp.

### **Filtering (optional)**

Filter juice using a clean cloth or metal filter

Filtering will produce a clearer juice, which may be preferable for some consumers.

Additional clarification can be achieved through the addition of pectic enzymes.

### **Standardization and additions**

Measure the soluble solids content and pH of the juice to ensure it meets your predetermined standards

Make additions of water, sugar, citric acid, or other juices as needed. A final soluble solid content of 10% and pH below 4.6 is recommended

### **Bottling**

#### **Clean bottles and caps/corks**

**Heat** juice to 60-80°C

Fill bottles with hot juice and **cap/cork**



### **Juice packaging line**

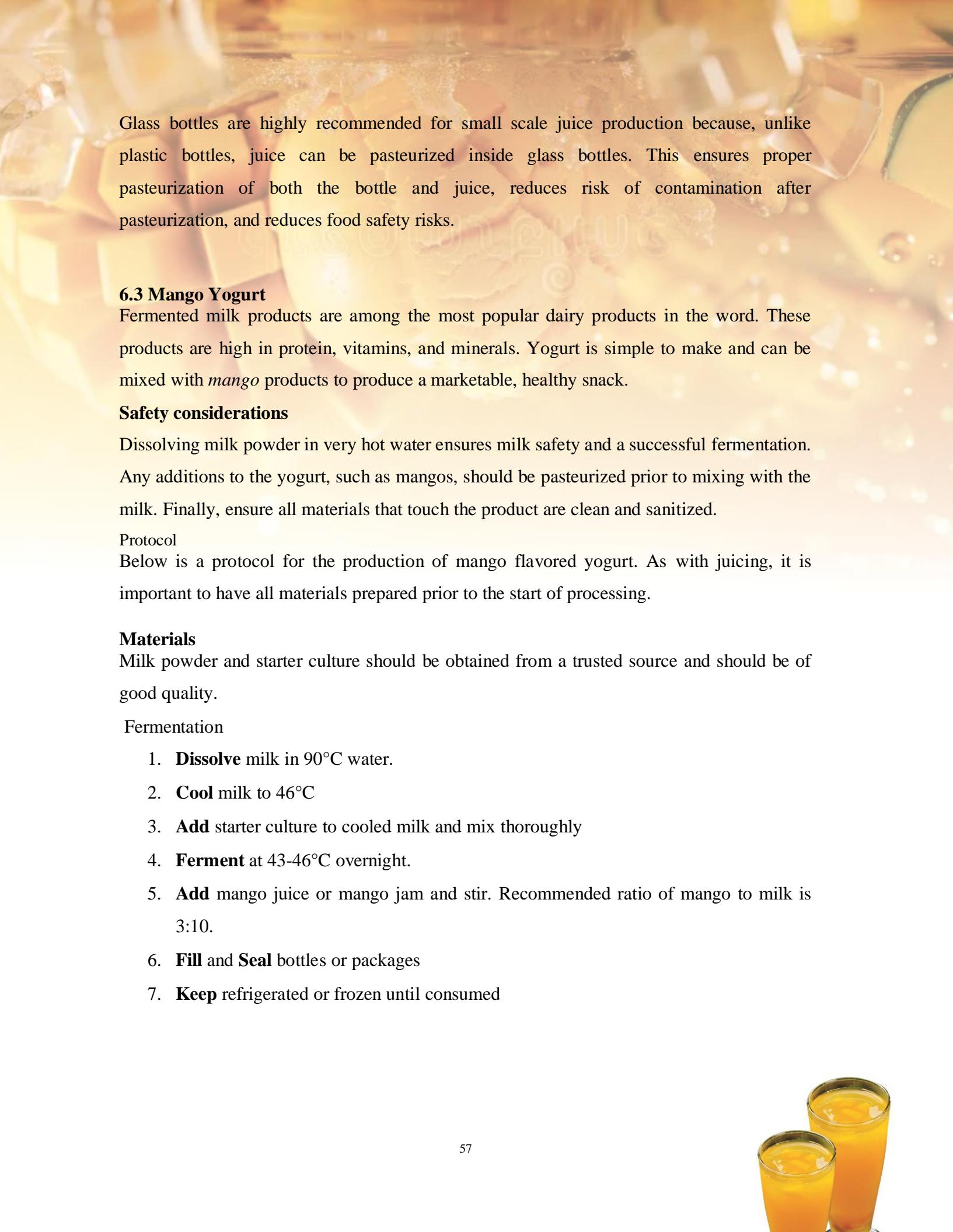
**Source:** Department of Agriculture-Makueni

### **Pasteurization**

13. **Pasteurize** bottles with juice by submerging in water and **heating** to 85°C for 35 minutes.
14. **Cool** by placing in cool water and store at room temperature. Do not store in direct sunlight.

### **Packaging**





Glass bottles are highly recommended for small scale juice production because, unlike plastic bottles, juice can be pasteurized inside glass bottles. This ensures proper pasteurization of both the bottle and juice, reduces risk of contamination after pasteurization, and reduces food safety risks.

### 6.3 Mango Yogurt

Fermented milk products are among the most popular dairy products in the world. These products are high in protein, vitamins, and minerals. Yogurt is simple to make and can be mixed with *mango* products to produce a marketable, healthy snack.

#### Safety considerations

Dissolving milk powder in very hot water ensures milk safety and a successful fermentation. Any additions to the yogurt, such as mangos, should be pasteurized prior to mixing with the milk. Finally, ensure all materials that touch the product are clean and sanitized.

#### Protocol

Below is a protocol for the production of mango flavored yogurt. As with juicing, it is important to have all materials prepared prior to the start of processing.

#### Materials

Milk powder and starter culture should be obtained from a trusted source and should be of good quality.

#### Fermentation

1. **Dissolve** milk in 90°C water.
2. **Cool** milk to 46°C
3. **Add** starter culture to cooled milk and mix thoroughly
4. **Ferment** at 43-46°C overnight.
5. **Add** mango juice or mango jam and stir. Recommended ratio of mango to milk is 3:10.
6. **Fill and Seal** bottles or packages
7. **Keep** refrigerated or frozen until consumed





## Mango Yoghurt Packaging

**Source:**

### 6.4 Mango Jam

#### **Introduction**

Mango jam is a versatile sweet tasting paste that is simple to make and has a long shelf life. Jams are made by cooking fruit, sugar, and sometimes acid for an extended period of time until thickened. Jams are most often jarred and held at room temperature.

#### **Protocol**

##### *Jam preparation*

1. **Sterilize** cleaned canning glass jars by placing in boiling water for at least 1 minute.
2. **Wash, peel, and dice** mangos
3. **Combine** diced mango, sugar, and lemon in a ratio of 1 liter of mango, 0.75 liters sugar, and 15 milliliters of lemon juice (or 5-10 grams citric acid).
4. **Boil and stir** mixture for around 45 minutes.
5. **Test consistency** to ensure proper thickness.

If not thickened, cook 4 minutes and test again.

##### *Canning*

6. **Sterilize** clean jars by placing them in boiling water for 10 minutes.
7. When at the desired thickness, **fill** jars immediately, while jam is still hot. Leave at least 1.25 centimeters of air space at the top of the jar.
8. **Clean** rims of jars and **seal lids** on jars
9. **Submerge** jars in boiling water. **Boil** for 10 minutes, starting from when the water returns to a boil.



10. Cool jars in cold water and check seals. Store out of direct sunlight at room temperature.



### Mango Jam

Source: KARLO Marketing of Mango Products Manual

### 6.5 Mango pulp

Mango pulp is the inner fleshy yellow, sweet part of the mango. It is processed by peeling mango, slicing and then blending or use fruit pulper to make the mango pulp. The mango pulp is pasteurized to enhance storage life. The pulp can then be used to make mango jam, juice, sweets among many other confectioneries



## **6.6 Harvesting and post-harvest handling of mangoes**

Harvest mango fruits at the mature-green stage; when they are hard and green. A mature fruit has well developed shoulders (region around the fruit stem) and when it is cut open 50% of the pericarp (flesh) has changed from greenish white to yellow-orange. During and after harvesting the highly perishable fruit must be handled with the greatest care. The fruit is removed from the tree by cutting the fruit stalk about 2 cm from the fruit. This will prevent the latex (exuded from the cut stalk) adhering to the skin of the fruit, staining it and rendering it unattractive. Ladders or long picking poles with a cutter blade and an attached canvas bag, held open by a ring, are also in use. To avoid physical damage, the picked mangos should be carefully placed into clean wooden or plastic containers and never into gunny bags. If there is a delay in the transfer of the fruits to a store or packing shed they should be kept in a sheltered place to minimize sunburn, loss of moisture and accumulation of dust

### **Harvesting Indices**

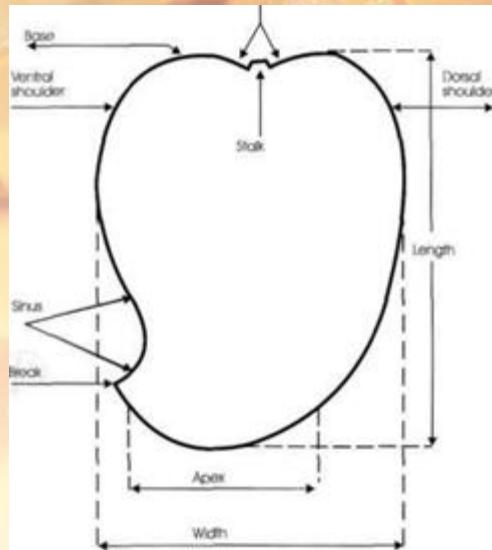
Maturity Period: 12 – 16 weeks after fruit set

Maturity: Some indicators of maturity include: Well developed shoulders, Skin changes from green to yellow

Colour of flesh: The flesh around the seed turn from white to yellow

Harvesting: Use secateurs. Do not knock or drop the fruits. Fruits should be harvested with 3 – 4 cm stalk. Drain the latex from the fruits.

Yields: 10 - 15 tons per acre from the 7<sup>th</sup> year



Harvest the fruit with care. Use a ladder to pick them or use a bucket and hook method. The stalk should be about 3-5cm.



### Different Mango Harvesting Practices

Source: Department of Agriculture Makueni



## **CHAPTER 7.0: BUSINESS OPPORTUNITIES IN THE VALUE CHAIN**

### **7.1 Back ground**

**Business Opportunity:** Businesses opportunity exists where and when sellers of goods and services interact in one way or another with buyers for profit gains. It may be existing/being practiced or potential (existing but not explored yet). Value chain business and/or market opportunities are the circumstances in which the specific value chain nodes exist and are therefore influenced by time and geographic/space variation.

### **Factors to consider/Types of Business Opportunities**

Business opportunities are diverse. They include among others the following;

- Low competition due to the commodity characteristics (natural superior attributes and utility diversity)
- Potential for expansion/growth
- Emerging Markets
- Potential for strategic alliance
- A growing population which translates to an increasing demand
- Changing trends in market demand (demand for processed and/or certification of goods)
- Internet/On-line marketing (enabling wider networking)
- Existence of free Knowledge hubs (including knowledge on business planning)
- Existence of financial enablers

### **7.2 Business opportunities**

#### **7.2.1 Input Supply-Seeds and Seedlings**

Mango seeds range from poly-embryonic varieties (mostly traditional local varieties) that can be propagated by seeds, and mono-embryonic types (mostly improved varieties) that need to be vegetatively propagated. Seedling nurseries are registered by HCDA and certified by Kenya Plant Health Inspectorate Services (KEPHIS), which is responsible for certification of domestically produced seed and providing permits for seed imports.

#### **7.2.2 Input supply- Pesticides**

Pesticides are widely available through stockists and all major leading manufacturers are represented in Kenya. Small agro-dealers and stockists are the primary source of inputs for smallholder farmers, many of which also carry other items such as hardware and generalwares. Agro-dealers are required to have a license from local government authorities, as well as receive certification from the Pest Control Products Board to sell pesticides and other farm chemicals. Not all agro-dealers register with PCPB.

#### **7.2.3 Marketing agents**



Small-Scale Rural middlemen are an important link to markets given their ability to penetrate remote areas in search of mangoes. They purchase direct from farmers and transport to urban centers, where they sell to retailers in wholesale markets or agents that supply supermarket chains. In some cases they also sell directly to consumers in main urban centers. They tend to operate with little capital and therefore sell their purchases as soon as possible. These traders are affected by the seasonality of mango production as their business is more localized, while middlemen have the ability to move from region to region and also broker in other commodities.

#### **7.2.4 Exporters -Wholesalers**

Mango wholesalers either source mangoes directly from farmers in rural areas or use local agents to purchase mangoes from farmers on their behalf. Others operate in urban wholesale markets where they purchase directly from rural agents or transporters and then sell to retailers. Wholesalers are an important link between rural agents and retailers, although some of the rural assemblers also sell directly to retailers.

#### **7.2.5 Transportation**

Transporters Mangoes are mainly transported with hired or trader owned trucks (ranging from 3-ton to 30-ton) or pickups. In rural areas donkey carts and motorcycles are used to move the mangoes from the farm to market centers or roadsides where large trucks can pick them up. Mangoes destined for the local market are packed in bags, boxes or just loaded onto trucks unbagged for transportation to various markets. However, exporters pack their mangoes in special cartons before loading them into 3-ton trucks for transportation to their pack houses.

#### **7.2.6 Mango processing/Value addition**

Processors rely on brokers and in some cases organized farmer groups for delivery of mangoes. Rarely do they venture into production zones to purchase mangoes. Farmers may harvest and deliver their mangoes directly to the processing firm, or through brokers and traders. Once the mangoes are delivered at the factory, they are weighed, inspected, and sorted to meet the general requirements.

#### **7.2.7 Mango export**

Export markets demand a level of quality that is much higher than that demanded by domestic fresh markets or processors. To ensure quality fruit, exporters rely more on their



own staff to supervise harvesting, sorting, packaging and transportation. This guarantees minimal waste as only the right mangoes are harvested and transported in ideal packages to minimize damage. Fruits are picked on the basis of variety, color, and level of maturity, lack of spots and insect damage and size.



### 7.2.8 Retail

Mango retailers source their mangoes directly from farmers for those located in rural urban centers and from brokers and traders/transporters for those located in large urban centers such as Nairobi, Mombasa and Kisumu. The retailers also get mangoes from wholesale markets in the urban centers such as Kongoea in Mombasa, and Wakulima in Nairobi. Most retailers in rural urban centers and road sites have little to no infrastructure for storing and/or displaying their product, which tends to further damage the sensitive fruit. For the supermarkets, mango suppliers come from contracted agents and face high risk because the mangoes can ripen rapidly and deteriorate before being purchased



### **7.2.9 Grafting and Spray service provision**

Spray Service Providers (SSP) receives special training to apply pesticides and then hires out their services to farmers to spray their trees at a cost. Farmers will no longer handle pesticides, and that this application will only be undertaken by those who are properly trained and certified. When pesticides are only handled by those that are trained, the risk towards human health and the environment is greatly reduced, the correct pesticides are used at the correct time and rate thus ensuring efficient and effective control of pest and diseases, therefore increasing yields. The dosage of the products used will be correct, Maximum Residue Levels and certification requirements will be observed, the purchase of pesticides will be better planned so less obsolete pesticides will accumulate, and empty pesticide containers will be triple rinsed, punctured and collected leading to possible container management schemes. Because of the direct link to trusted suppliers, access to quality pesticides will ensure less counterfeit pesticides will be used. Therefore, an established network of Spray Service Providers is highly beneficial. Grafting seedlings at a fee is also carried out by trained grafters.

## **7.3 Marketing Plan**

### **7.3.1 Marketing & distribution plan**

***What are the markets? What is the market share? who are the competitors?***

Situational Analysis for each product and service

- Describe the market situation present situation – market outlets, who will be the competitors, the target market share.
- Define the niche the business expects to fill including

***How will the products get to the market?***

Describe the marketing channels and networks.

Remember that the best product is worthless until it gets to the person who needs it

### **7.3.2 Development of marketing strategies**

***How will the products be made known to the potential buyers? What will you tell the market and how?***

- Describe approaches, methods and techniques of reaching the potential buyers.

***How much will be sold, at what price and on which condition?***

- Define the marketing objective State the level of sales

***What marketing infrastructure will be required and when will it be put in place?***

- o Logistics of distribution and marketing ; time; at what cost and at whose cost

#### **7.4 Gross Margin Analysis under different levels of management**

<b>Gross Margin Analysis for 1 hectare of Apple mango under medium management</b>									
	<b>Year and Cost</b>								
<b>ITEM</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>
No. of plants per ha	123	123	123	123	123	123	123	123	123
Yield (No.of fruits/tree)	0	0	20	80	250	450	600	800	1000
Yield (Total Number of fruits per ha)	0	0	2460	9840	30750	55350	73800	98400	123000
Yield (Tons/ha)-1 fruit=0.4g	0	0	0.984	3.936	12.3	22.14	29.52	39.36	49.2
<b>Total returns/@shs 5 per fruit/ha</b>	<b>0</b>	<b>0</b>	<b>12300</b>	<b>49200</b>	<b>153750</b>	<b>276750</b>	<b>369000</b>	<b>492000</b>	<b>615000</b>
Land preparation	4000	0	0	0	0	0	0	0	0
Cost of grafted seedling (KES 100/Seedling)	12300	0	0	0	0	0	0	0	0
Hole preparation (Digging and filling)	4000	0	0	0	0	0	0	0	0
Planting	300	0	0	0	0	0	0	0	0
Manure/Year	2000	2000	2000	3000	3000	3000	3000	4000	4000
Fertilizer DAP /Year	600	0	0	0	0	0	0	0	0
Fertilizer CAN /Year	800	200	400	600	600	600	600	600	600
Pesticide cost	2000	2000	2000	2500	2500	2500	2500	2500	2500
Fungicide costs	14930	3780	4000	4000	4000	4000	4000	4000	4000
Labour cost/year	5000	5000	5000	7000	7000	8000	8000	10000	10000
<b>Total Cost/year</b>	<b>45930</b>	<b>12980</b>	<b>13400</b>	<b>17100</b>	<b>17100</b>	<b>18100</b>	<b>18100</b>	<b>21100</b>	<b>21100</b>
<b>Cash flow /year</b>	<b>-45930</b>	<b>12980</b>	<b>-1100</b>	<b>32100</b>	<b>136650</b>	<b>258650</b>	<b>350900</b>	<b>470900</b>	<b>593900</b>

Gross Margin Analysis for 1 hectare of Apple mango under low management									
	Year and Cost								
ITEM	1	2	3	4	5	6	7	8	9
No. of plants per ha	123	123	123	123	123	123	123	123	123
Yield (No.of fruits/tree)	0	0	15	40	80	160	200	350	400
Yield (Total Number of fruits per ha)	0	0	1845	4920	9840	19680	24600	43050	49200
Yield (Tons/ha)-1 fruit=0.4g	0	0	0.738	1.968	3.936	7.872	9.84	17.22	19.68
<b>Total returns/@shs 5 per fruit</b>	<b>0</b>	<b>0</b>	<b>9225</b>	<b>24600</b>	<b>49200</b>	<b>98400</b>	<b>123000</b>	<b>215250</b>	<b>246000</b>
Land preparation	4000	0	0	0	0	0	0	0	0
Cost of grafted seedling (KES 100/Seedling)	12300	0	0	0	0	0	0	0	0
Hole preparation (Digging and filling)	4000	0	0	0	0	0	0	0	0
Planting	300	0	0	0	0	0	0	0	0
Manure/Year	2000	0	0	0	0	0	0	0	0
Fertilizer DAP /Year	0	0	0	0	0	0	0	0	0
Fertilizer CAN /Year	0	0	0	0	0	0	0	0	0
Pesticide cost	0	0	0	0	0	0	0	0	0
Fungicide costs	0	0	0	0	0	0	0	0	0
Labour cost/year	2000	2000	2000	3000	4000	5000	5000	6000	7000
<b>Total Cost/year</b>	<b>24600</b>	<b>2000</b>	<b>2000</b>	<b>3000</b>	<b>4000</b>	<b>5000</b>	<b>5000</b>	<b>4000</b>	<b>7000</b>
<b>Cash flow /year</b>	<b>-24600</b>	<b>-2000</b>	<b>7225</b>	<b>21600</b>	<b>45200</b>	<b>93400</b>	<b>118000</b>	<b>211250</b>	<b>239000</b>



Gross Margin Analysis for 1 hectare of Apple mango under Excellent management									
	Year and Cost								
ITEM	1	2	3	4	5	6	7	8	9
No. of plants per ha	123	123	123	123	123	123	123	123	123
Yield (No.of fruits/tree)	0	0	30	100	350	500	800	1000	1300
Yield (Total Number of fruits per ha)	0	0	3690	12300	43050	61500	98400	123000	159900
Yield (Tons/ha)-1 fruit=0.4g	0	0	1.476	4.92	17.22	24.6	39.36	49.2	63.96
<b>Total returns/@shs 7 per fruit</b>	<b>0</b>	<b>0</b>	<b>25830</b>	<b>86100</b>	<b>301350</b>	<b>430500</b>	<b>688800</b>	<b>861000</b>	<b>1119300</b>
Land preparation	4000	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
Cost of grafted seedling (KES 100/Seedling)	12300	0	0	0	0	0	0	0	0
Hole preparation (Digging and filling)	4000	0	0	0	0	0	0	0	0
Planting	300	0	0	0	0	0	0	0	0
Manure/Year	2000	2000	2000	3000	3000	3000	3000	4000	4000
Fertilizer DAP /Year	600	0	0	0	0	0	0	0	0
Fertilizer CAN /Year	800	200	400	600	600	600	600	600	600
Pesticide cost	2000	2000	2000	2500	2500	2500	2500	2500	2500
Fungicide costs	14930	3780	4000	4000	4000	4000	4000	4000	4000
Labour cost/year	5000	5000	5000	7000	7000	8000	8000	10000	10000
Irrigation-Running and depreciation	300,000	15000	15000	20000	20000	25000	25000	30000	30000
<b>Total Cost/year</b>	<b>345930</b>	<b>27980</b>	<b>28400</b>	<b>37100</b>	<b>37100</b>	<b>43100</b>	<b>43100</b>	<b>51100</b>	<b>51100</b>
<b>Cash flow /year</b>	<b>-345930</b>	<b>-27980</b>	<b>-2570</b>	<b>49000</b>	<b>264250</b>	<b>387400</b>	<b>645700</b>	<b>809900</b>	<b>1068200</b>

Gross Margin Analysis for 1 hectare of Ngowe mango under medium management									
	Year and Cost								
ITEM	1	2	3	4	5	6	7	8	9
No. of plants per ha	123	123	123	123	123	123	123	123	123
No.of fruits/tree	0	0	30	120	300	500	800	1000	1300
Total Number of fruits per ha	0	0	3690	14760	36900	61500	98400	123000	159900
Yield (Tons/ha)--1 fruit=0.5g	0	0	1.845	7.38	18.45	30.75	49.2	61.5	79.95
<b>Total returns/@shs 4 per fruit</b>	<b>0</b>	<b>0</b>	<b>14760</b>	<b>59040</b>	<b>147600</b>	<b>246000</b>	<b>393600</b>	<b>492000</b>	<b>639600</b>
Land preparation	4000	0	0	0	0	0	0	0	0
Cost of grafted seedling (KES 100/Seedling)	12300	0	0	0	0	0	0	0	0
Hole preparation (Digging and filling)	4000	0	0	0	0	0	0	0	0
Planting	300	0	0	0	0	0	0	0	0
Manure/Year	2000	2000	2000	3000	3000	3000	3000	4000	4000
Fertilizer DAP /Year	600	0	0	0	0	0	0	0	0
Fertilizer CAN /Year	800	200	400	600	600	600	600	600	600
Pesticide cost	2000	2000	2000	2500	2500	2500	2500	2500	2500
Fungicide costs	14930	3780	4000	4000	4000	4000	4000	4000	4000
Labour cost/year	5000	5000	5000	7000	7000	8000	8000	10000	10000
<b>Total Cost/year</b>	<b>45930</b>	<b>12980</b>	<b>13400</b>	<b>17100</b>	<b>17100</b>	<b>18100</b>	<b>18100</b>	<b>21100</b>	<b>21100</b>
<b>Cash flow /year</b>	<b>-45930</b>	<b>-12980</b>	<b>1360</b>	<b>41940</b>	<b>130500</b>	<b>227900</b>	<b>375500</b>	<b>470900</b>	<b>618500</b>

Gross Margin Analysis for 1 hectare of Ngowe mango under low management									
	Year and Cost								
ITEM	1	2	3	4	5	6	7	8	9
No. of plants per ha	123	123	123	123	123	123	123	123	123
Yield (No.of fruits/tree)	0	0	15	50	100	200	300	400	500
Yield (Total Number of fruits per ha)	0	0	1845	6150	12300	24600	36900	49200	61500
Yield (Tons/ha)--1 fruit=0.5g	0	0	0.9225	3.075	6.15	12.3	18.45	24.6	30.75
<b>Total returns/@shs 4 per fruit</b>	<b>0</b>	<b>0</b>	<b>7380</b>	<b>24600</b>	<b>49200</b>	<b>98400</b>	<b>147600</b>	<b>196800</b>	<b>246000</b>
Land preparation	4000	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
Cost of grafted seedling (KES 100/Seedling)	12300	0	0	0	0	0	0	0	0
Hole preparation (Digging and filling)	4000	0	0	0	0	0	0	0	0
Planting	300	0	0	0	0	0	0	0	0
Manure/Year	2000	0	0	0	0	0	0	0	0
Fertilizer DAP /Year	0	0	0	0	0	0	0	0	0
Fertilizer CAN /Year	0	0	0	0	0	0	0	0	0
Pesticide cost	0	0	0	0	0	0	0	0	0
Fungicide costs	0	0	0	0	0	0	0	0	0
Labour cost/year	2000	2000	2000	3000	4000	5000	5000	6000	7000
<b>Total Cost/year</b>	<b>24600</b>	<b>2000</b>	<b>2000</b>	<b>3000</b>	<b>4000</b>	<b>5000</b>	<b>5000</b>	<b>4000</b>	<b>7000</b>
<b>Cash flow /year</b>	<b>-24600</b>	<b>-2000</b>	<b>5380</b>	<b>21600</b>	<b>45200</b>	<b>93400</b>	<b>142600</b>	<b>192800</b>	<b>239000</b>

Gross Margin Analysis for 1 hectare of Ngowe mango under excellent management									
	Year and Cost								
ITEM	1	2	3	4	5	6	7	8	9
No. of plants per ha	123	123	123	123	123	123	123	123	123
Yield (No.of fruits/tree)	0	0	40	120	400	600	900	1100	1500
Yield (Total Number of fruits per ha)	0	0	4920	14760	49200	73800	110700	135300	184500
Yield (Tons/ha)--1 fruit=0.5g	0	0	2.46	7.38	24.6	36.9	55.35	67.65	92.25
<b>Total returns/@shs 6 per fruit</b>	<b>0</b>	<b>0</b>	<b>29520</b>	<b>88560</b>	<b>295200</b>	<b>442800</b>	<b>664200</b>	<b>811800</b>	<b>1107000</b>
Land preparation	4000	0	0	0	0	0	0	0	0
Cost of grafted seedling (KES 100/Seedling)	12300	0	0	0	0	0	0	0	0
Hole preparation (Digging and filling)	4000	0	0	0	0	0	0	0	0
Planting	300	0	0	0	0	0	0	0	0
Manure/Year	2000	2000	2000	3000	3000	3000	3000	4000	4000
Fertilizer DAP /Year	600	0	0	0	0	0	0	0	0
Fertilizer CAN /Year	800	200	400	600	600	600	600	600	600
Pesticide cost	2000	2000	2000	2500	2500	2500	2500	2500	2500
Fungicide costs	14930	3780	4000	4000	4000	4000	4000	4000	4000
Labour cost/year	5000	5000	5000	7000	7000	8000	8000	10000	10000
Irrigation-Running and depreciation	300,000	15000	15000	20000	20000	25000	25000	30000	30000
<b>Total Cost/year</b>	<b>345930</b>	<b>27980</b>	<b>28400</b>	<b>37100</b>	<b>37100</b>	<b>43100</b>	<b>43100</b>	<b>51100</b>	<b>51100</b>
<b>Cash flow /year</b>	<b>-345930</b>	<b>-27980</b>	<b>1120</b>	<b>51460</b>	<b>258100</b>	<b>399700</b>	<b>621100</b>	<b>760700</b>	<b>1055900</b>

## **7.5 MANGO MARKETING**

Mango fruits can be sold when unripe, ripe or processed into crisps or juice. In Makueni the mango fruits are mainly sold ripe for local market and unripe for export market.

The price element of the marketing mix is dominated by what is being charged for the mango fruits at the farm gates.

The pricing element not only affects the revenues that a farmer derives from his fruits sales, but also affects consumer's perceptions of the quality.

Prices are based on the law of supply and demand.

Fruits supply increases at particular months forcing the price downwards.

Place is the distribution method that the farmer adopts to provide the fruits to the market in a manner that meets consumer expectations.

Promotion encompasses all the tools that farmers can use to provide the market with information on its offerings: advertising, publicity, public relations and sales promotional efforts.

When one considers the wide variety of publics with which a farmer needs to communicate, the use of just the middlemen is likely to be ineffective.

The people element of the marketing mix includes all the players that are involved in buying and selling of mango fruits.

Processes are all the administrative and bureaucratic functions of the mango marketing: from the harvesting to consumption of the fruits or mango products.





### 7.5.1.1 Market led production of mangoes

Market led production of mangoes starts with identification of available markets outlets through continuous market surveys.

### 7.5.1.2 Market survey

Market survey entails an investigation into the state of the market for a particular product or service, including an analysis of consumers' needs, preferences and competition. The purpose of market research is to gather data on customers and potential customers. The collected data aids business decision making. This therefore reduces the risks involved in making these decisions. Market survey conducted for local and international markets to ascertain market availability, quantity required as well as quality standards requirements.

### 7.5.1.3 Contract production and marketing

This eliminates the exploitation by middlemen when the supply is high in the market.

Use formal contact (refer to samples of contract forms).

### 7.5.1.4 Export markets for Mangoes

They are hinged on farmers ability to adhere to stringent quality and quantity requirement for Mangoes. Farmers must meet MRLs levels for them to qualify to export. EUREP GAP/KS 1758 standards and certification (refer to EUREP GAP standards) dictates quality standards that farmers need to adhere to for Mangoes to be sold at local and international markets.



#### **7.5.1.5 Formation of producer organization for aggregation and marketing**

Producer organizations/cooperatives societies are very critical in marketing mangoes in Makueni. Farmers should be encouraged to enter and register such organizations to enable them access local markets such as Makueni Fruit processing plant at Kalamba, where they can sell the produce directly as an entity. Such organizations will also afford farmers a bargaining power in the market and cushion them from unscrupulous mango dealers. Regional markets for Mangoes Eastern Africa countries such as Uganda and Tanzania require produce in bulk that can be realized from organized groups.

## CHAPTER 8.0: GENDER EQUALITY, HUMAN RIGHTS AND SOCIAL INCLUSION

### 8.0 Background

Studies conducted during implementation of various value chains identified gender and human rights related challenges to participation of women and youth in the value chains. Women reported that **cultural issues** affected their rights to own land preventing their involvement in value chain activities since they could not make decisions on what to plant given that all agricultural activities are dependent on land as a factor of production. Cultural practices like wife cleansing and inheritance, especially in some counties, denied widows an opportunity to participate in the value chain activities. **Decision making** at the household level relating to value chain selection were mostly done by men, though in some instances, women also participated in the process. But where men had migrated to towns, women were the sole decision makers on selection of value chain(s). In some counties, men dominated in decision making concerning value addition, grading, marketing, savings, access to agricultural and marketing information as well as access to credit and training. Women and youth could not initiate any agriculture-based Income Generating Activities (IGAs) without permission from the husbands/fathers or the elderly men in the family due to cultural beliefs and patriarchy.

Youth attributed their inadequate participation in value chain production activities to lack of land ownership since the parents (fathers) were not willing to give them land on a permanent basis. As a result, there was serious conflict between the young men and their fathers in some counties. The fathers felt that the sons (youth) were irresponsible people who would sell the land upon being given, and the money spent on drinking alcohol. This would render the entire family landless. This stereotyping, attitudes and believes needed to be addressed.

**Widowhood** – Women in all the sampled counties were targeted because of their status as widows, and the fight for family land and other capital assets always started immediately after the husband died. Being a widow left them vulnerable to other families or even community members who want their land and other assets. In some cases, family members secretly altered particulars of ownership documents such as title deeds to the disadvantage of widowed women.

**High illiteracy** levels and low skills especially among women left them vulnerable in technical matters in the value chain activities. Trainers were said to use “a lot of English” when training which confused the farmers making language and methodologies used a barrier. They requested for the training to be in a language they can understand and closer to them.

**Lack of markets:** Exploitation by intermediaries affected the prices of most of the value chain produce. It was suggested that market linkages with potential external buyers be established and strengthened.

**Gender and extension services** - Extension services were provided to the farmers through group training and through telephone calls by private extension officers and county government extension officers. The youth indicated that the extension training courses were done early during the day when they had reported for other activities such as attending fishponds, harvesting excluding them from the services. Women complained that the time at which the extension trainings were done did not favour them as they are attending to domestic chores or farm activities denying them the opportunity to gain experience. This called for a gender analysis including understanding of gender roles.

People with disabilities often experience discrimination in their everyday life. Discrimination describes a situation where an individual is disadvantaged in some way because of a ‘protected characteristic.’ Discrimination takes place in different forms. It can be direct or indirect, manifest in the form of harassment, or there can be direct instructions to discriminate. Direct discrimination is based on negative attitudes, prejudice, and/or on discriminatory legislation. Indirect discrimination, for example, can be caused by physical barriers, such as stairs as the only means to get to vital locations, or using media. For example, people who are visually impaired or have difficulties hearing cannot use media without assistance.

Children by their very nature are dependent on adults to protect them. Their voices are rarely consulted in matters concerning them the household or in any other forums or institutions. They are often subjected to hazardous labour, retrogressive cultural practices like forced marriage, child labour, female genital cutting/mutilation, exploitation and abuse.

This chapter is therefore informed by the request made by participants in the studies to be trained on Gender equality and gender mainstreaming, gender-based violence , human rights and social inclusion. The findings came from the report (Masinde G.V and PHD Wambu CK 2021) and gender analysis of selected value chains conducted by the Gender Youth and Social Inclusion Advisor, MESPT in August 2024.

### 8.1 Gender Equality

The centrality of **gender equality** to development is its establishment as a goal (goal 5) of the Sustainable Development Goals (SDGs) and included as a target in other SDGs.

#### 8.1.1 Definition and key concepts

**Sex:** It identifies the biological differences between men and women. It is mostly concerned with the physical characteristics of a human being .Kenya recognized and counted intersex persons during the census in 2019.

**Intersex:** Intersexuality is an overarching term that refers to human bodies that fall outside the strict male and female binary. The term refers to the many variations—often present at birth—that can affect a person's reproductive or sexual anatomy, which may involve genitalia, hormones, reproductive organs, and chromosomes.

For example, these variations might include being born with "female" anatomy on the outside, such as a vaginal opening, but having "male" sexual organs on the inside.- [Intersex: What It Means, How It's Identified](#) accessed on 14/11/2024

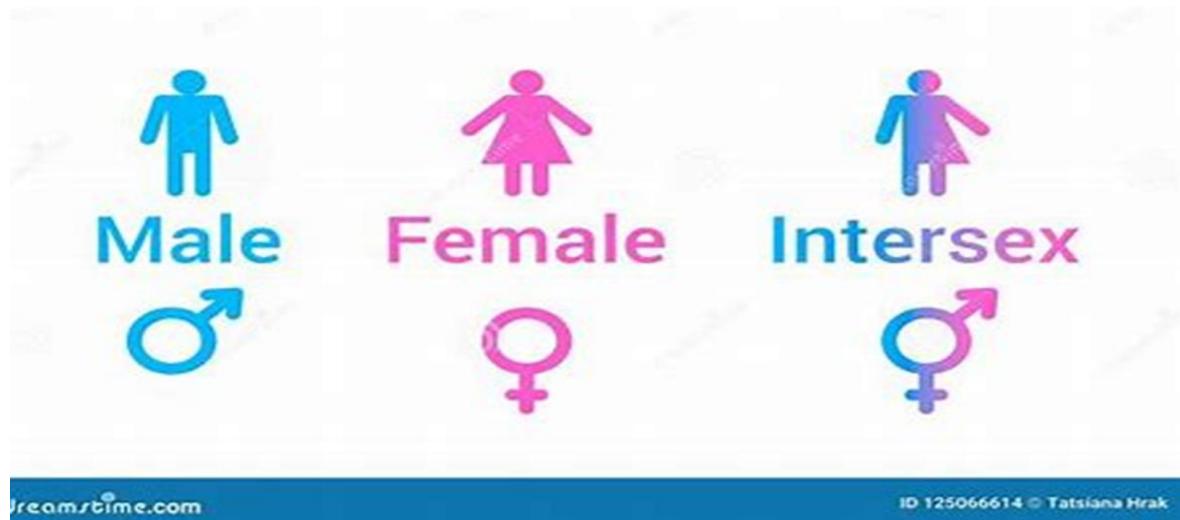


Figure 1:Kenya recognizes three genders [Two genders? No, we should recognize the three in Kenya | Nation](#) accessed on 14/11/2024.

**Gender :** Refers to the socio-cultural differences and relations between men and women that are learned, changeable over time, and have wide variations both within and between societies and cultures. The concept of gender also includes expectations held about the characteristics, attitudes and behavior of women and men (femininity and masculinity).

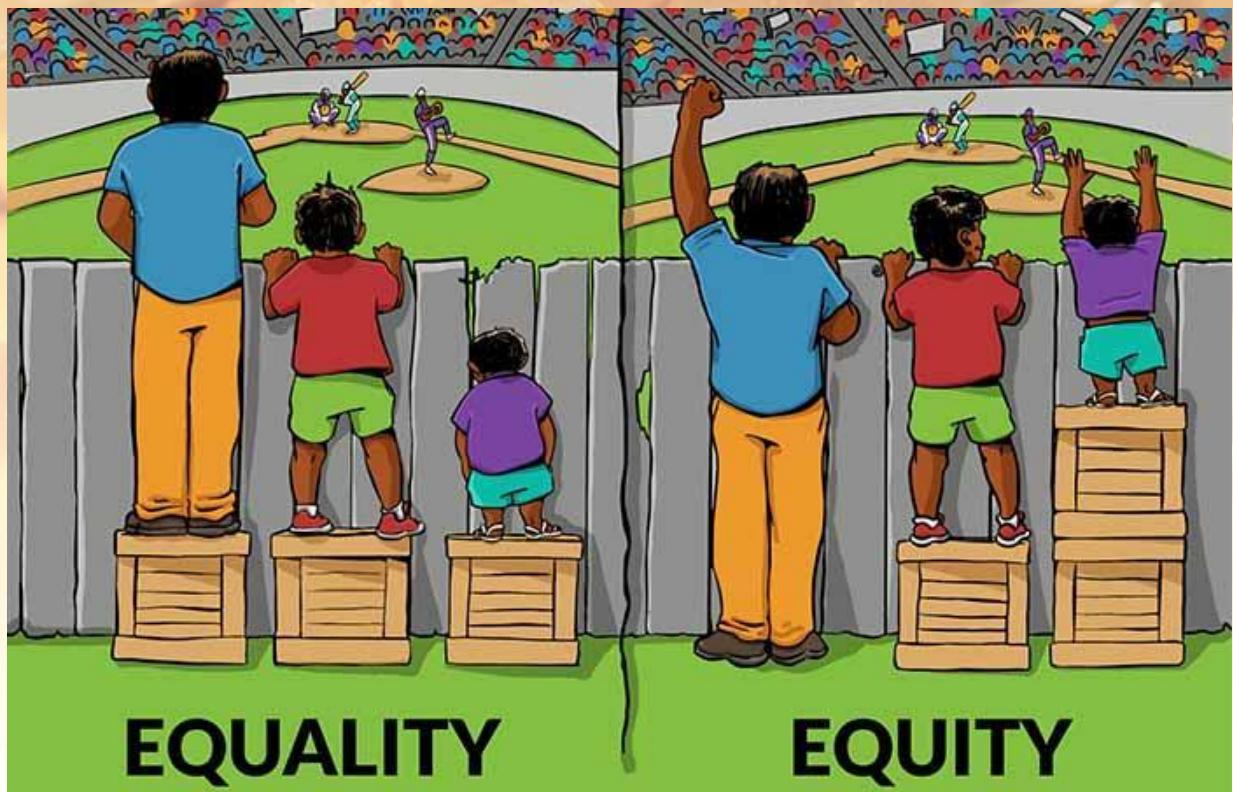


Figure 2 Equality and Equity illustrated [All You Need To Know About Gender Equity](#) Accessed on 14/11/2024

**Equality** does not mean that women and men are the same but that women's and men's rights, responsibilities and opportunities should not depend on whether they are born male or female. Gender equality implies that the interests, needs and priorities of both women and men are taken into consideration, recognizing the diversity of diverse groups of women and men(UN General Assembly, 1979).

**Equity:** This is about fairness and being sensitive to the peculiarities of individuals, socio-economic groups, or communities

**Gender Equity:** It is about equality of outcome or result of an intervention. Gender equity involves considering the different social, cultural, and economic situations of women, men, girls, and boys right from the design of an intervention through implementation to monitoring and evaluation.

**Gender equality:** This is a human right that is enshrined in several declarations and conventions, including the legally binding Convention on the Elimination of All Forms of Discrimination against Women (CEDAW).

**Gender sensitivity:** The ability to recognize the differences in terms of roles, contributions, needs and experiences of both women and men, and create a conducive environment for effective application of their specific knowledge, skills, and experiences in meeting their prioritized needs.

**Gender integration:** This refers to strategies applied in programme assessment, design, implementation and evaluation to take gender norms into account and compensate for gender-based inequalities( see the diagram below for more information)

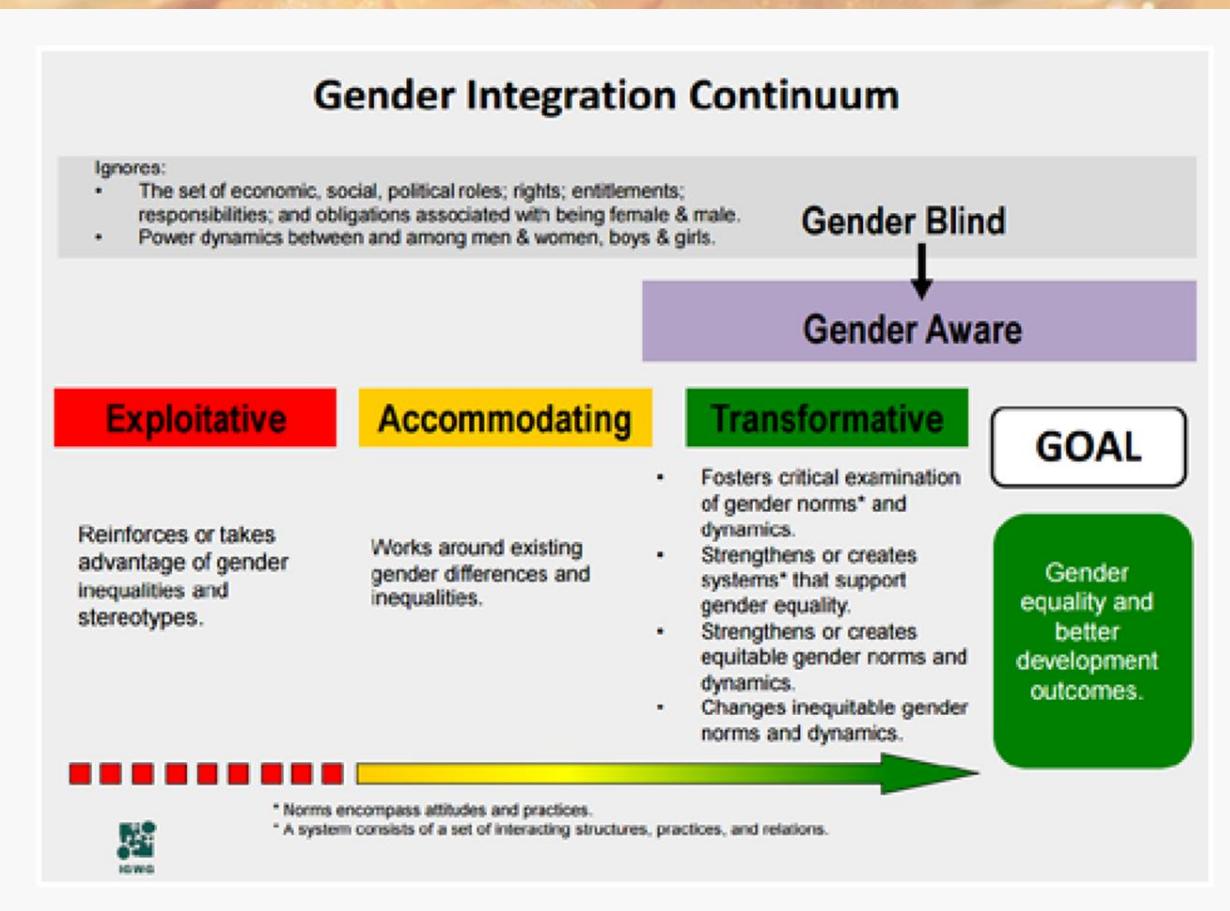


Figure 3: Gender Integration Continuum [About IGWG | IGWG](#) accessed on 14/11/2024

**Gender aware:** Recognizing or being aware of the existence of gender and gender differences in society; recognizing that men and women are positioned differently; that they have different experiences, different needs and interests, different strengths, and skills, and that these need to be considered while planning for any intervention.

**Gender exploitative:** refers to policies, projects and activities that intentionally manipulate or misuse knowledge of existing gender inequalities and stereotypes in pursuit of economic outcomes. The approach reinforces unequal power in the relations between women and men and potentially deepens existing inequalities.

**Gender accommodating** refers to policies, projects and activities that acknowledge inequities in gender relations and seek to develop actions that adjust to and often compensate for gender differences and inequities without addressing the underlying structures that perpetuate gender inequalities. While this approach considers the different roles and identities of women and men in the design of programmes, it does not deliberately challenge unequal relations of power. In the process of achieving desired development objects, projects following this approach may miss opportunities for improving gender equality.

#### Gender transformative

Addressing gender imbalances, changing gendered power relations, and actively building equitable social norms and structures. An organization is aware that women and men do not have equal opportunities in the household, at community level or at work. They may, for example, create equal working conditions for women and men, recognizing that special means may be required to increase the number of women in management positions or to achieve an environment free from gender-based violence (GBV). Gender transformative approaches are characterized by explicitly centering

gender norms and are thus common for interventions that have the primary goal of addressing gender issues and transforming gender relations to promote equality.

Transformative Gender Programming includes policies and programs that seek to transform gender relations to promote equality and achieve program objectives. This approach attempts to promote gender equality by:

1. fostering critical examination of inequalities and gender roles, norms, and dynamics,
2. recognizing and strengthening positive norms that support equality and an enabling environment,
3. promoting the relative position of women, girls, and marginalized groups, and transforming the underlying social structures, policies and broadly held social norms that perpetuate gender inequalities.
4. Most importantly, program/policy planners and managers should follow two gender integration principles:
  - First, under no circumstances should programs/policies adopt an exploitative approach since one of the fundamental principles of development is to “do no harm.”
  - Second, the overall objective of gender integration is to move toward gender transformative programs/policies, thus gradually challenging existing gender inequities and promoting positive changes in gender roles, norms, and power dynamics.

**Gender responsiveness:** This describes the policies, programmes and projects that focus on transforming existing gender disparities to create a more balanced relationship between women and men in terms of power and decision-making as well as access to and control over productive resources. Gender responsiveness is key in meeting **strategic gender needs**(strategic gender needs are the needs women identify because of their subordinate position in society. These needs are long-term and relate to the empowerment of women. Strategic gender needs for women might include land rights, more decision-making power, equal pay, and greater access to credit. Addressing these needs allows people to have control over their lives beyond socially defined restrictive roles) **Practical gender needs** are defined as: Needs that respond to immediate necessities such as adequate living conditions, water provision, health care, and employment. Gender-specific needs that do not challenge gender roles, such as access to healthcare, water availability, and employment opportunities.

**Empowerment:** Is about improving women’s and men’s status to enhance their decision making-capacity at all levels. It refers to the process in which women and men reflect upon their reality and question the reasons for their situation in society. It includes developing alternative options and taking opportunities to address existing inequalities. It enables them to live their lives to the fullest of their capabilities and their own choices in respect of their rights as human beings.

**Gender Mainstreaming:** Gender equality can be achieved by a strategy of mainstreaming which is defined by the United Nations, as ‘...the process of assessing the implications for women and men of any planned action, including legislation, policies, or programmes, in all areas and at all levels. It is a strategy for making women’s as well as men’s concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and programmes in all political, economic, and societal spheres so that women and men benefit equally, and inequality is not perpetuated. The goal is to achieve gender equality.’

**Gender mainstreaming** aims at ensuring that women and men, particularly those who are disadvantaged, equally participate in and benefit from the activities of a given organization, and that all implemented projects and programmes consider women’s and men’s concerns and experiences as an integral dimension of their cycles. This intervention ensures that existing democratic relations are

protected, at the same time preventing the further perpetuation of inequalities and the creation of new ones.

### **8.1.2 The Business case for gender mainstreaming**

- **Gender mainstreaming** in Agri-enterprises is not only a matter of social equity but also makes strong business sense. Here are some key points that highlight the business case for gender mainstreaming in this sector:
- **Increased Productivity:** Women make up a sizable portion of the agricultural workforce. By providing them with equal access to resources such as land, credit, and training, productivity can be significantly increased. Studies have shown that closing the gender gap in agriculture could increase yields on women's farms by 20-30%
- **Enhanced Innovation:** Diverse teams bring varied perspectives, leading to more innovative solutions. Women often bring unique insights into agricultural practices and market needs, which can drive innovation and improve business outcomes.
- **Market Expansion:** Women are key players in local markets and value chains. By empowering women, Agri-enterprises can tap into new markets and consumer bases, enhancing their market reach and profitability.
- **Improved Financial Performance:** Companies that invest in gender equality tend to perform better financially. Gender-diverse companies are more likely to have higher returns on equity and better financial performance overall.
- **Risk Mitigation:** Gender mainstreaming can help mitigate risks associated with labor shortages and community relations. Empowering women can lead to more stable and resilient communities, which in turn supports sustainable business operations.
- **Compliance and Reputation:** Increasingly, investors and consumers are looking for companies that adhere to social responsibility standards. Gender mainstreaming can enhance a company's reputation and compliance with international standards, attracting more investment and customer loyalty.

By integrating gender mainstreaming into their operations, Agri-enterprises can not only contribute to social equity but also enhance their competitiveness and sustainability.

### **8.1.3 Steps to Gender mainstreaming**

Gender mainstreaming in Agri-enterprises involves several strategic steps to ensure that gender considerations are integrated into all aspects of the business. Here are some specific strategies:

- **Conduct Gender Analysis:** Start with a thorough gender analysis to understand the distinct roles, needs, and challenges faced by men and women in the agricultural sector. This analysis should inform all stages of project planning and implementation.
- **Develop Gender-Responsive Policies:** Create policies that promote gender equality and address specific barriers faced by women and youth. This includes policies on equal access to resources, decision-making, and opportunities for training and development.

- **Capacity Building:** Provide training and capacity-building programs for both men and women to enhance their skills and knowledge. This can include technical training, leadership development, and financial literacy.
- **Gender-Responsive Budgeting:** Allocate budget specifically for gender mainstreaming activities. This ensures that there are sufficient resources to support gender equality initiatives.
- **Participatory Planning:** Involve both men and women in the planning and decision-making processes. This ensures that the perspectives and needs of both genders are considered and addressed.
- **Monitoring and Evaluation:** Establish gender-sensitive indicators and regularly monitor and evaluate the impact of gender mainstreaming activities. This helps in assessing progress and making necessary adjustments.
- **Promote Women's Leadership:** Encourage and support women to take on leadership roles within the enterprise. This can be achieved through mentorship programs, leadership training, and creating an enabling environment for women leaders.
- **Address Social Norms:** Work on changing discriminatory social norms and practices that hinder gender equality. This can be done through community engagement, gender transformative approaches including Gender action learning systems(GALS), community conversations, model families, among others that seek to address root causes of discrimination.

## 8.2 Human Rights

These are rights inherent to all human beings, independent of nationality, place of residence, sex, national or ethnic origin, race, religion, language, or any other status. All human beings are equally entitled to human rights without discrimination. These include the right to life, equality before the law, the right to work, social security, education, and the right to development. These rights are all interrelated, interdependent and indivisible.

# UN Universal Declaration of Human Rights

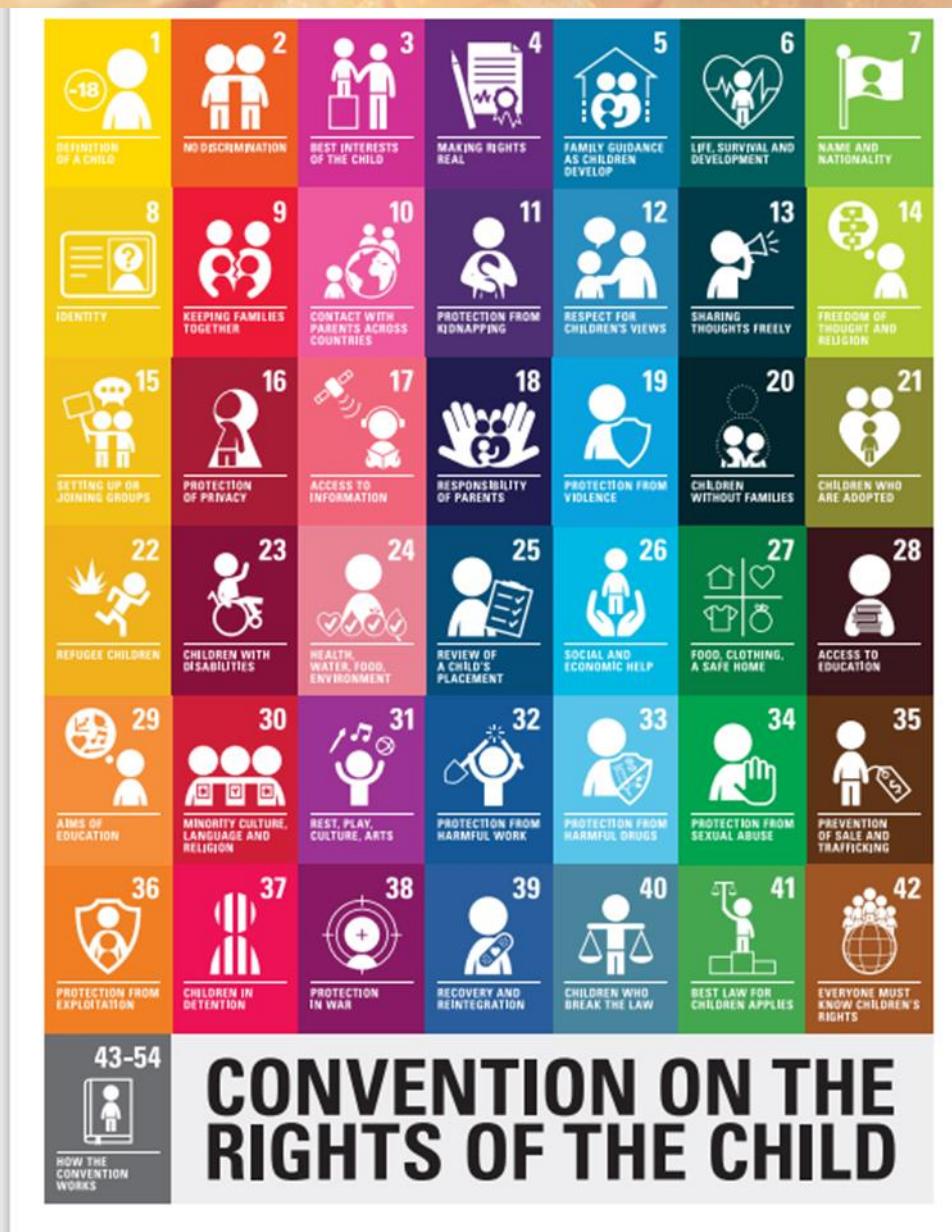
Adopted: December 10, 1948

- |   |  |
|---|--|
| 1. We are all born free and equal                 | 16. All may marry and establish families   |
| 2. Everyone has rights despite differences        | 17. All may own property   |
| 3. All have the right to live, and live in safety | 18. All may think freely, including religion   |
| 4. No one may enslave you                         | 19. All may freely express opinions  |
| 5. No one may torture you                         | 20. All may assemble peacefully  |
| 6. You have rights no matter where you travel     | 21. All may participate in governing   |
| 7. All are equal before the law                   | 22. All have rights to dignity and social protections  |
| 8. Human rights are protected by law              | 23. All have free choices of employment  |
| 9. No one should be unfairly detained             | 24. All have rights to rest and leisure  |
| 10. All have a right to a fair trial              | 25. All have the right to an adequate standard of living                                       |
| 11. All accused are innocent until proven guilty  | 26. All have a right to education  |
| 12. All have a right to privacy                   | 27. All have rights to intellectual property   |
| 13. All have the right to move freely             | 28. All have the right to a world that enables and protects rights                             |
| 14. All may enjoy asylum from persecution         | 29. All rights have responsibilities and can only be limited when infringing on others' rights |
| 15. All have a right to nationality               | 30. No one can take away your human rights   |

Figure 4: 30 articles of Human rights <https://rvalibrary.org/shelf-respect/law-library/national-human-rights-month/>  
Accessed on 14/11/2024

(Access the comprehensive text here [30 articles on the 30 Articles of the Universal Declaration of Human Rights | OHCHR](#)

Children rights are enshrined in the convention on the rights of the child(1989). Kenya enacted this into a children's act 2022.



## CONVENTION ON THE RIGHTS OF THE CHILD

[convention-rights-child-text-child-friendly-version.pdf](#) accessed on 13/11/2024.  
Access the full text here [file](#)

### Human rights in agriculture

- **Right to food and adequate nutrition:** Ensuring all smallholder farmers, regardless of gender or age, have access to the resources and opportunities needed to grow food for their families and communities.



- **Right to land:** Recognizing the right of women and youth to access, own, and control land as a crucial resource for agricultural production and economic stability.
- **Right to education and information:** Providing women, youth, and marginalized groups with the knowledge, skills, and information necessary for agricultural development, including access to extension services and training on agricultural technologies.
- **Right to participation:** Ensuring that women and youth are actively involved in decision-making at all levels—from household to national policies that affect agriculture

### Key Human Rights Issues in Agricultural Value Chains

- **Gender-based violence (GBV):** In some rural areas, women farmers face physical, psychological, and economic violence related to their roles in agriculture and control over income.
- **Exclusion from market access:** Women and youth may be excluded from agricultural markets, either due to lack of capital, information, or social exclusion from trade networks.
- **Unequal benefit-sharing:** Despite their contribution to agricultural production, women and youth often do not share equally in the profits or benefits from agricultural activities

### Human rights -based Approach (HRBA)

This is a conceptual framework based on international human rights standards and directed towards promoting and protecting human rights. HRBA seeks to analyze the inequalities which lie at the heart of development problems and redress discriminatory practices and unjust distributions of power that impede development progress. It is concerned with empowering people to know and claim their rights and increasing the ability and accountability of individuals and institutions who are responsible for respecting, protecting, and fulfilling rights. The HRBA approach aims to eliminate or at least diminish the impediments of existing exclusion and discrimination within the implementation of any programme or project. HRBA gives equal attention to both achieving development goals and to the processes that are chosen to achieve these goals. So, within HRBA, the processes that enable the participation and inclusion of all stakeholders are important.

#### 8.2.1 About HRBA and Participation, Accountability, Non-Discrimination and Transparency (PANT) Principles

The HRBA builds on the norms and principles outlined in the Universal Declaration of Human Rights, and the subsequent legally binding UN treaties, which form the basis for all development cooperation. Application of the HRBA contributes to effective development cooperation processes and sustainable development outcomes. It challenges unequal power relations and social exclusion that deny people their human rights and often keep them in poverty and oppression. Microenterprise support Programme Trust (MESPT) is committed to the HRBA in all interventions.

HRBA places people living in poverty and oppression (rights holders) at the center. It is about:

- Empowering rights-holders to enable them to take action to address their situation and to claim their rights individually and collectively.
- Developing capacities and interests of duty-bearers to fulfil their obligations to respect, protect and fulfil human rights.

PANT is a tool that guides staff and other users on the practical application of the HRBA.

It has four elements: Participation. Accountability , Non-Discrimination and Transparency. Each interrogates different issues.

- **Participation:** Everyone has a right to freely participate in decision making that affects them and their environment. People of power have an obligation to offer meaningful participation and consultations to people affected. Everyone has the right to organize and

hold opinions without any interference, and to seek, receive and impart information and ideas through any media regardless of frontiers. Promoting participation is essential for the outcome of projects and programmes. It is stated in international treaties that women, men, girls, and boys have a right to participate in decision-making that affects them. Social and cultural roles that are prescribed women and men have impact on their possibilities of choices, economic independence, access to natural resources, access to land tenure, access to clean and safe water, and decisiveness on housing, education, and livelihood.

**The main question is:** Do all stakeholders engage actively, in a way which allows rights-holders to contribute meaningfully and influence processes and outcomes?

- **Accountability:** The state has an obligation to respect, fulfil and protect the rights of its population. It entails a functional regulatory system for climate and environmental issues, labour law, land systems ; concrete plans for disaster risk reduction and response; rule of law including a justice system providing legal aid to poor and marginalized people and their organisations; and functional and accessible complaints mechanisms. Emphasizing the accountability of all actors (both state and non-state), whose actions impact the environment and natural resources, is a central element of HRBA. Asserting human rights without supporting effective and precise frameworks to hold duty bearers accountable is of little practical use. Strengthening the governance of natural resource management and securing natural resources tenure while also taking rights of local people, women and men, ethnic minorities, nomadic or other marginalized groups into account, can ,
  - i. minimize corruption.
  - ii. have positive effects on conflict management.
  - iii. be a key step towards alleviating tensions in society and consolidating peace in post-conflict societies.

**Key question:** Who are the duty bearers on various levels, and do they have sufficient capacity and interest to be accountable to rights holders?

- **Non-discrimination:** All women, men, girls, and boys are, without any discrimination, entitled to equal access to ecosystem services, market systems and natural resources as well as resilience for a standard of living adequate for their health and well-being. Discrimination may be expressed in law (explicit discrimination) and hence be part of official policy such as lack of land rights; or it may be found in practice and behavior (implicit discrimination)such as where a remote group cannot access water services because drinking wells provided by the state are too far away.

**Key question:** Are rights holders and the root causes of their lack of human rights identified and considered, particularly those most subjected to discrimination, marginalization, and vulnerability?

- **Transparency :** All people have the right to obtain information in an accessible and timely manner, e.g., about pollution levels, water quality, environmental health risks,

exploitation plans, land use plans and disaster preparedness plans. Granting sufficient and accessible information to affected women and men in planning and policy making processes is of key importance to their ability to influence and monitor developments. It is also important to consider local traditions, survival strategies and indigenous people's dependence on natural resources, and ensuring that separate views are documented. It is also essential to consider access to natural resources for people living in poverty and that a long-term sustainable development can be promoted, to avoid future opposition and conflicts.

**Key question:** What measures are put in place to ensure that all stakeholders can access relevant information and knowledge regarding the contribution?

### 8.3 Social Inclusion

Social inclusion is the process of improving the terms on which individuals and groups take part in society—improving the ability, opportunity, and dignity of those disadvantaged based on their identity.

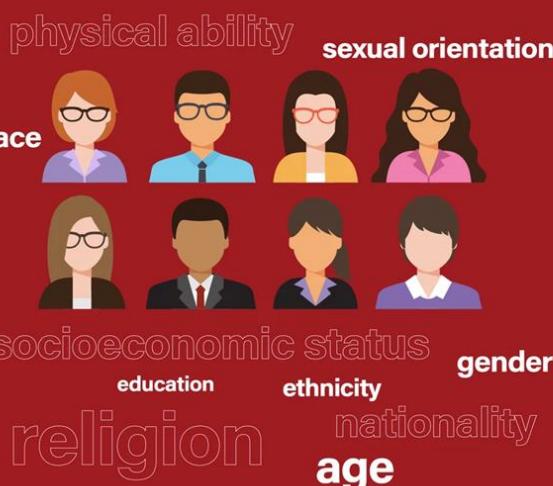
## what is the difference between diversity and inclusion?

diversity is a fact,  
inclusion is an act

### DIVERSITY

Diversity refers to who's at work: who is recruited, hired, and promoted by a company.

Diversity is the full spectrum of human demographic differences.



### INCLUSION

Inclusion refers to how people feel at work.

Inclusion is all about concrete methods and strategies to make all team members feel accepted and engaged when different people are in the same territory.



*Figure 5 Diversity vs Inclusion DRP Group. (n.d.). What is the difference between diversity and inclusion? DRP Group. Retrieved November 14, 2024, from <https://www.drpgroup.com/en/blog/what-is-the-difference-between-diversity-and-inclusion>.*

In every country, some groups confront barriers that prevent them from fully participating in political, economic, and social life. These groups may be excluded not only through legal systems, land, and labor markets, but also discriminatory or stigmatizing attitudes, beliefs, or perceptions. Disadvantages are often based on gender, age, location, occupation, race, ethnicity, religion, citizenship status, disability, and sexual orientation and gender identity among other factors. This kind of social exclusion robs individuals of dignity, security, and the opportunity to lead a better life. Unless the root causes of structural exclusion and discrimination are addressed, it will be challenging to support sustainable inclusive growth and rapid poverty reduction.

Social inclusion is the right thing to do, and it also makes good economic sense. Left unaddressed, the exclusion of disadvantaged groups can be costly. At the individual level, the most measured impacts include the loss of wages, lifetime earnings, poor education, and employment outcomes. Racism and discrimination also have physical and mental health costs. At the national level, the economic cost of social exclusion can be captured by foregone gross domestic product (GDP) and human capital wealth. Exclusion, or the perception of exclusion, may cause certain groups to opt out of markets, services, and spaces, with costs to both individuals and the economy.

Ensuring inclusivity means no one is left behind (leave no one behind-LNOB). The following steps make this possible.

### **8.3.1 Leave no one Behind**

#### **STEP 1: Who is being left behind? Gather data.**

Identify who is being left behind and in what ways, and who among them is the furthest behind.

- Gather and analyze all data and information on who in the community is left behind in group activities and project interventions-sub populations and geographic localities among others with due attention to the human rights-based approach and gender considerations.
- Include and analyze data and information from a range of sources, including from national statistical offices, national human rights institutions, international human rights mechanisms, ILO(international labour organisation) supervisory bodies, civil society organizations, particularly organizations of marginalized communities as well as women's organizations, and/or community-level data, citizen science initiatives and scientific journals.
- Seek feedback and input from diverse stakeholders, including groups and populations left behind, throughout the process, from initial gathering of data to review and analysis.
- Identify data gaps.
- Complement existing data where needed, to further understand which subpopulations may be left behind, and which ones are furthest behind, using participatory approaches to gathering data.
- Combine relevant national and UN development, human rights, conflict, inequalities, political, risk and humanitarian analysis for more joined up assessment of who is left behind and why – with a view to identifying the furthest behind.

- Triangulate the data from the above sources through a consultative analytical process to develop a mutual understanding across all interventions that consider the voices and experiences of communities together with other data sources.

#### **STEP 2: Why? Prioritization and analysis**

- Frame as problems the LNOB assessment's main findings are about the ways in which people are left behind. Identify the relevant human rights and international labour standards.
- Conduct a root cause analysis to identify why people are being left behind and to enable responses to the root and underlying causes of inequalities, including gender inequalities, vulnerability, deprivation, discrimination, displacement, and exclusion.
- Conduct a role pattern analysis.
- Conduct a capacity gap analysis.
- Questions to be asked at each step: Causal analysis WHY? Which rights are implicated that explain why there is a problem? Role pattern analysis WHO? Who is the duty-bearers? Who are the rights holders? Who must do something about it? Capacity gap analysis WHAT? What capacity gaps are preventing duty-bearers from fulfilling their duties? What capacity gaps are preventing rights holders from claiming their rights? What do they (each) need to act?

#### **STEP 3: What? What should be done?**

Identifying what should be done and by whom.

- Identify actions and interventions to address challenges, barriers, and capacity gaps. Areas include advocacy, enabling the environment, capacity development, community empowerment, quality and accessibility of services, partnerships including civil society.
- Prioritize, considering the commitment to address the furthest behind first.

#### **STEP 4: How? How to measure and monitor progress**

- Help identify and contextualize LNOB indicators and targets – having a clear overview of data and data gaps and a plan for monitoring progress is an important precondition for effective follow-up and review.
- Quantitative and qualitative indicators will be necessary – measuring commitments, processes, and outcomes.
- Support innovative ways of tracking, visualizing, and sharing information.
- Develop the stakeholder capacity to monitor inequalities, including gender inequality and discrimination, including that of governments (national, subnational) and communities.

#### **STEP 5: Advancing accountability for LNOB.**

- Ensure accountability for LNOB within the organization and the interventions.

- Support the integration of LNOB in interventions follow-up and review processes, including in narrative reports.
- Support national accountability to people left behind.

According to the world bank social inclusion assessment tool is based on the adage that asking the right questions is key to the right solutions. It is based on four questions:

- **Identification**

1. Are excluded groups identified? Who is excluded? Are some groups less likely to benefit from a project/program/policy because of their identity?

#### **Analysis**

2. Is there ex ante analysis on social inclusion? How and why is the particular group (or groups) excluded? What drives the exclusion?

#### **Actions**

3. Are there actions intended to advance social inclusion? Social Inclusion is not always about doing more: it is often about doing things differently. What actions are built into project, program or policy design?

#### **Monitoring**

4. Are there indicators to monitor social inclusion? How would we know if we have made progress? In projects, does the results framework contain indicators on inclusion?

In conclusion, this chapter equips trainers with the tools to deliver **gender-transformative, human rights-aligned** training programs that will empower **smallholder farmers**, particularly **men, women** and **youth**, in agricultural value chains and Agri-enterprises. By applying these principles, trainers will play a key role in dismantling barriers, promoting equality, and ensuring that agriculture becomes a pathway to **inclusive development** for all. It is however important to note that the materials in this chapter are not prescriptive nor are they exhaustive. The trainer needs to customize this to their circumstances and value chain keeping in mind that in pursuit for results it is possible to do harm to project participants and other stakeholders.

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