Climate Smart Agriculture Technologies, Innovations and Management Practices for Mango Value Chain

TRAINING OF TRAINERS' MANUAL

Pole F.N., Gathambiri C., Kori J., Ambuko J., Kasina M.J., Otipa M., Wayua F., Wambua J., Mutisya D., Thuranira M., Ndambuki, J., Wasike V.W., Nasirembe W., Mwangi H.W., Momanyi V.N., Ndung'u J., Esilaba A.O., Lung'aho C., Kamau G.M., Nyabundi K.W., Ouda J.O, Kirigua V.O. and Wasilwa L.A.

JULY 2021

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Published by
Kenya Agricultural and Livestock Research Organization
KALRO Secretariat
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Nairobi, KENYA
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Design and layout: Nyaola E. and Mnene N.

Typesetting: Kibwage P.N.

ISBN: 978-9966-30-076-8

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FOREWORD

Kenya Climate-Smart Agriculture Project (KCSAP) tasked the Kenya Agricultural and Livestock Research Organization (KALRO) with the implementation of the project's Component 2, which is 'Strengthening Climate-Smart Agricultural Research and Seed Systems'. The component activities are geared towards the development, validation, adoption and delivery of context specific climate smart agriculture (CSA) technologies, innovation and management practices (TIMPs). It is also responsible for development of sustainable seed production and distribution systems of priority agricultural value chains to enhance availability and access to improved seeds, animal breeds and fingerlings by target beneficiaries. Against this background, KALRO and her National Agricultural Research System (NARS) partners have developed, validated and availed CSA TIMPs for dissemination and adoption. This Training of trainers (ToT) Manual is instructional guides to be used for teaching and learning step-by-step procedures of implementing CSA innovations for the Mango value chain. The training content is drawn from the inventory of TIMPs that has been documented.

The contents of training is arranged in progressive modules supported by extensive information from research and background data drawn from the TIMPs. Their relevance is based on the needs teased out of the value chain and the project objectives. The training design takes into consideration the delivery system, the partners and their roles, the duration of training and logical flow of the sessions. Similar content requiring similar delivery systems are grouped together while the roles of the partners are tapped in the training and planning of the training sessions. The Manual is divided into modules, which have a uniform outline that ensures every aspect of the TIMPs are fully covered in way that the trainees can absorb and relate to. Various delivery methods are deployed and where possible demonstrations and practical work are incorporated to enable the trainees learn by participating in the actual field activities. Furthermore, to ensure that the training across various groups is standardized, trainers' guidelines, program, training methods and training evaluation have been provided in the manual. Adhering to these lines, therefore, enables replicating the training in several locations without loss of details regardless of whether conducted by different trainers.

It is highly advised that the ToT Manuals should be used in conjunction with the respective value chain' TIMPs inventory document and facts sheets in order to provide valuable resource for both public and private extension service providers. The use of this Manual is therefore expected to enable achievement of the envisaged 'Triple Wins' of increased productivity, enhanced resilience and reduction of greenhouse gases emissions.

I am greatly indebted to the value chain leaders and all those who participated in the preparation of the Manual, which is expected to herald a new way of delivering training content in a changing agricultural environment.

Eliud K Kireger, PhD, OGW
Director General, KALRO

PREFACE

The Kenya Climate-Smart Agriculture Project (KCSAP) is a Government of Kenya project with support from both the World Bank and the government. The project runs for five years and implemented in 24 counties, mainly in the arid and semi-arid lands (ASALs), at an approximate cost of KES 25 billion. The project development objectives is "to increase agricultural productivity and build resilience to climate change risks in the targeted smallholder farming and pastoral communities, and in the event of an Eligible Crisis or Emergency, to provide immediate and effective response." This objective is to be achieved through the implementation of five key components, which are 1) Upscaling Climate-Smart Agricultural Practices, 2) Strengthening Climate-Smart Agricultural Research and Seed Systems, 3) Supporting Agro-weather, Market, Climate, and Advisory Services, 4) Project Coordination and Management and 5) Contingency Emergency Response.

Component 1 involves facilitating the empowering of farmers and communities to adopt technologies, innovations and management practices (TIMPs) to achieve the Climate Smart Agriculture (CSA) triple-wins of; increased productivity, enhanced resilience (adaptation), and reduced Greenhouse gas (GHG) emissions (mitigation). Component 2 is tasked with the responsibility of providing the TIMPs. Therefore, it supports the development, validation, and adoption of context specific CSA TIMPS to target beneficiaries under Components 1 and 3.

To catalyze uptake of TIMPs, Kenya Agricultural & Livestock Research Organization (KALRO) in conjunction with partners in the National Agricultural Research Systems (NARS) and Consultative Group for International Agricultural Research (CGIAR) compiled inventories of TIMPs for the prioritized value chains. The crop-based value chains are 19 and include roots and tubers (cassava, potato), pulses (dry beans, green gram and pigeon peas), vegetables (tomato, onion, indigenous vegetables, kale and cabbage), cereals (sorghum, millet, teff and maize) nuts (cashew nut), fruits (banana, mango and watermelon) and fibre (cotton). Those that are animal production based are five (5) and include apiculture, indigenous chicken (meat and eggs), dairy (cattle and camel), red meat (cattle, sheep and goats) and aquaculture. Also, there are three (3) cross cutting themes on pastures and fodder, natural resource management, and animal health. The TIMPs were categorized into those ready for up scaling and those requiring validation. Furthermore, gaps that required further research and development of TIMPs were identified. Training of Trainers (ToT) manuals focusing on TIMPs that are ready for up scaling for each of the value chains were subsequently developed to form the basis of training county extension staff, service providers and lead farmers. Those trained are in turn expected to cascade the training to beneficiaries in the targeted smallholder farming, agro-pastoral and pastoral communities in the 24 project counties of Marsabit, Isiolo, Tana River, Garissa, Wajir, Mandera, West Pokot, Baringo, Laikipia, Machakos, Nyeri, Tharaka Nithi, Lamu, Taita Taveta, Kajiado, Busia, Siaya, Nyandarua, Bomet, Kericho, Kakamega, Uasin Gishu, Elgeyo Marakwet and Kisumu.

KALRO having the mandate of implementing the activities under Component 2 has been instrumental in using its information resources and those of partners and collaborators to come up with the inventories of TIMPs and corresponding ToT Manuals. The use of these

information resources coupled with the accompanying training and the contribution of the other project components, will go a long way in enabling the KCSAP to meet its development objective.

The National Project Coordination Unit is grateful to all who participated in the development and production of this Climate Smart Training of Trainers Manual for Mango value chain. It is my hope that Counties and other users will put this resource to good use as they transform and reorient their agricultural systems to make them more productive and resilient while minimizing GHG emissions under the new realities of a changing climate

Francis Muthami
National Project Coordinator
Kenya Climate-Smart Agriculture Project

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LIST OF ABBREVIATIONS AND ACRONYMS

AEZ	Agroecological zone
AIP	Agricultural Innovation Platform
ASAL	Arid and Semi-Arid Land
CA	Conservation Agriculture
CCP	Critical Control Point
CIG	Common Interest Group
CL	Critical limit
CTT	Core Team of Trainers
ESMF	Environmental and Social Management Framework
FFBS	Farmer Field and Business School
FSMS	Food Safety Management System
GAP	Good Agricultural Practice
ha	Hectare
HACCP	Hazard Analysis Critical Control Points
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
KCSAP	Kenya Climate Smart Agriculture Project
TIMPs	Technologies, Innovations and Management Practices
ToT	Training of Trainers
VMG	Vulnerable and Marginalized Group

INTRODUCTION

About this manual

This training of trainers' manual consist of two parts; part 1 and part II. Part I comprises notes for the facilitators while part II is made up of training modules in the value chain.

PART I

This part consists of four sections including the Background of the Mango value chain, Content of the Training, Training Design and Facilitators Guidelines.

SECTION 1: BACKGROUND

1.1 The Role of Mango in the Kenyan Economy

Mango production in Kenya is dominated by small-scale farmers who constitute about 80% of the Total production. Mango is grown for export market especially to the Middle East Countries and domestic market. The main varieties for export are Apple, Keit, Tommy Atkins and Van dyke while Ngowe and other indigenous varieties are for domestic market. According to Horticultural Crop Directory (HCD) 2018, the area under mangoes decreased by 4% from 50,550 ha in 2017 to 48,541ha. In 2018, the volume of mango produced was about 766,377 tons valued at KES 12.9 billion. However, the value and volume in 2018 increased by 6 and 10% respectively compared to 2017. The increase in volume could have been attributed by alternate annual bearing in mangoes. The five leading Counties in mango production in terms of value are: Makueni (24%), Machakos (18%), Kilifi (15%), Kwale (5%) and Lamu (4%). Despite mango production having great potential in relation to economic and nutritional security especially for the smallholder farmers, this has not been fully exploited largely due to challenges at various segments of the value chain. On the production side, the main challenge facing mango farmers is lack of adequate knowledge on orchard management especially crop nutrition and pest management. Regarding crop nutrition, majority of the farmers lack information on site-specific fertilizer requirements which lead to low productivity, poor fruit quality and physiological disorders. After production, the main challenge is the high postharvest losses of about 40% and lack of access to the prime markets mainly due to quality concerns.

1.2 Role of Mango in Food and Nutrition Security

Mango fruit has a great potential in contributing to food, economic and nutritional security in the country. The mango compares favorably in food value with both temperate and tropical fruits. It is one of the most delicious fruits and has been referred to as “King of all fruits’. The fruit contains almost all the known vitamins and many essential minerals. However it is rich in Vitamin A, C, B-6, minerals such potassium and high in fibre content. Mango fruits are consumed across all gender. It is used to make many product such as chutney, juices, and jam among others. Due to many products processed from the fruit, it is a potential source of nutritional requirements, source of income small holder farmer and earns the country foreign exchange. Mangoes are mainly grown in semi-arid and arid areas thus providing food and nutrition security to the persons living in these areas.

1.3 Mango value chain as climate innovation

Mango is an exceptionally suitable crop for upscaling climate smart technologies and building resilience to climate change among the smallholder growers in the mango growing areas due to the following key factors:

- Mango is a perennial tree crop that has good tolerance to water stress.
- Mango is amenable to intercropping with short duration crops.
- There is high and increasing demand of fresh and processed mango products locally and internationally.
- There are diverse value added products that can be obtained from mango

- There are many opportunities for economic participation of women, youth, marginalized and vulnerable groups along various nodes in the mango value chain.

1.4 Objectives of the Training

The purpose of the training is to provide farmer trainers with knowledge and skills on facilitating and supporting farmers, for increased productivity thourough adoption of GAP. Specifically, the objectives of this training are to provide farmer trainers with:

1) Relevant attitude, knowledge and skill in farming as a business and market assessment techniques for market led production including establishment and management of Mango nurseries and tree orchards.

2) Knowledge and skills on mango post-harvest management and value addition.

3) Knowledge and skills in participatory techniques for effective facilitation of adult learning processes thourough FFBS and developing inclusive stakeholder partnership development for sustainable Upscaling of mango.

4) Knowledge on improved mango varieties and GAPs.

After the training, the Trainer of Trainers as facilitators will train lead farmers (LF) in various aspects of Mango value chain. The training will involve providing the LF with techniques in participatory preparation, mobilization, planning, implementation, monitoring and evaluation of training sessions. The lead farmers and County extension personnel will thereafter up scale the adoption of GAPs thourough farmer groups in their villages and those in the neighborhood.

SECTION 2: TRAINING CONTENT

2.1 Orientation of the Module

This section outlines the orientation and outline of the 14 modules**,** which are orientated to ensure adoption and Upscaling of Mango TIMPs, to improve productivity, resilience and mitigation of harmful greenhouse gases The purpose of these modules is to enhance the knowledge and capacities of trainers in understanding and disseminating the climate-smart mango practices to the intended beneficiaries, who are primarily farmers.

2.2 Module Outline

Each of the 14 modules consists of 8 parts. These parts are:

a) **Introduction** – context and background to training needs, knowledge and skills gaps being addressed

b) **Module learning outcomes** – what trainees are expected to learn

c) **Module target group**-trainee categories

d) **Module users** –facilitators

e) **Module duration** – number of hours of exposure to materials

f) **Module summary** –sequence of sessions, training methods, materials and duration

g) **Facilitators guideline** –detailed sessions, training methods, materials and session guides

h) **Participant's handouts** – detailed notes and reference materials for trainees

The outline of the **14** modules is presented in **Table 1**.

Table 1 Summary of 14 module outlines for the mango value chain

No.	Module Name	Need Addressed	Expected Training Outcomes	Duration
1	Climate change and climate smart agriculture	• The impact of climate crisis to mango production • The climate smart technologies for mango value chain	• Master trainers explain the potential impact of climate change on Mango production • Master trainers describe climate smart techniques for Mango	4 hours

2	Farmer Field and Business School (FFBS) approach in mango value chain	• Skills/ technologies for production, processing and marketing	• Improved technologies/ innovations and management practices of mango for dissemination availed	4 hours 30 minutes
3	Good Agricultural Practices (GAPs) and Food Safety Management System (FSMS)	• Enhance food safety thourough lowering presence of hazardous solids/ organisms/ and pollutants pathogens	• Techniques for determining pollutants in food material explored for adoption in mango value chain	6 hours 30 minutes
4	Mango production niche and climate requirements	• Identify areas that are suitable for mango production	• Master trainers explain mango niche in the respective counties	4 hours
5	Mango variety selection	• Awareness on improved mango varieties	• Master trainers made aware of the new improved varieties	4 hours 30 minutes
6	Mango seed systems	• Both formal and informaal seed systems operations.	• The formal and informal seed supply systems analyzed.	4 hours
7	Climate smart agronomics practices for mango production	• Options for innovating increased mango production	• Both water and input manipulations analyzed along benefits	4 hours 30 minutes
8	Integrated soil and water management practices for mango production	• Soil water and fertility enhancing techniques availed.	• All techniques for ISFM described	5 hours
9	Mango Crop Health	• All major pests (invertebrate and vertebrate) and diseases organisms control mechanisms availed to theMaster Trainers.	• Reduction of yield loss of Mango by the major pests and diseases	6 hours

10	Mango harvesting and Post- harvest management	• Postharvest technologies to reduce losses in quantity and quality	• Trainees sensitized on proper harvesting techniques and storage facilities, hygiene and monitoring	3 hours
11	Mango value addition	• Various mango value added products	• Value addition and Mango products identified for the farming communities and business entities • Opportunities Identified and Prioritized	6 hours
12	Mechanization of Mango production activities	• Adaptation of mechanized operations of Mango from crop establishment, crop management to post-harvest	• Options of mechanization for increased yield availed to farmer groups.	4 hours
13	Mango business and Marketing	• Review what business options are available in Mango	• Type of aggregations by farmers availed for considerations. Contract farming	2 hours
14	Mango Cross cutting issues (i) Innovation Platforms (ii) Gender mainstreaming and social inclusion (iii) Policy	• Articulate how Voluntary Marketing Groups can draw benefits from Mango value chain • Options of employment opportunities in Mango production • Sites for information profiled at the county levels	• Opportunities for marginalized groups identified and gains made • Farmers get access to more information on Mango production	6 hours
Total duration				**64 hours**

SECTION 3: TRAINING DESIGN

3.1 Delivery System

The delivery system designed for this training consists of two stages:

a) **Establishment of a team of facilitators**
   - A Core Team of Trainers (CTT) to train farmer trainers (service providers) as facilitators of a ToT course will be established. This will be done using this manual and modules contained therein.
   - Each of theMaster Trainers will facilitate trainers of farmers and other stakeholders to acquire knowledge and skills in facilitating Farmer-led Field and Business Schools thourough practical demonstrations.

b) **Upscaling –**This will be done by selecting lead farmers (LF) to be trained in facilitation skills.

3.2 Partners and their Roles

The partners envisioned in this training plan are:

a) **Core Team of Trainers** –Master Trainers drawn from KALRO, Universities, and Tertiary Institutions offering crop sciences and State Department of Agriculture, MoALFC will facilitate initial training of trainers of farmers and other stakeholders. They will also provide mentorship to farmers' trainers during the first year of LF trainings. They should also be available in the evaluation of the first round of LF trainings.

b) **County Government Department for Crops and Livestock**
   County Coordination Teams (CCT) including technical departments and service providers will play specific roles of LF trainers, mentors and coordinators at sub-county level. They will assist FFBSs to form partnership with stakeholders for sustainability and will also support LFs to form their training and mango TIMPs Upscaling networks.

c) **Lead Farmer Networks**-association of LFs in the counties to take up farmer trainings and Upscaling in the future. Lead farmer networks and groups will conduct exchange visits to learn best practices in other project implementing counties.

d) **Private Sector Service Providers** – Inputs suppliers, financial and business development service providers, market players and processors will partner and support growth of individual or Mango farmer groups.

3.3 Training Duration

The proposed ToT course forMaster Trainers for 14 modules in the mango value chain shall take a Total of 65 hours minutes of training period. This does not include break hours of mid-morning, afternoon and lunch breaks

3.4 Logic of Design and Flow of Session

The logic of design and flow of each module is such that the facilitator, paying attention to the proposed methods and sessions guidelines shall: (i) Introduce the module; (ii) Draw out the participant's expectations; (iii) Relate participants' expectations with module objectives or learning outcomes; (iv) Explore the concept and content, switching to different methods of delivery of the content(group exercise, brainstorming, excursions, plenary discussions, role plays) as the session progresses; (v) Review the module at the end using participatory approaches like on participant reads one summary message and its application; and, (vi) distribute the participants' handouts.

SECTION 4 FACILITATOR GUIDELINES

4.1 Preparation of Training Materials

The training materials suggested require adequate preparations and should be available before the actual training dates. Further:

1. The facilitators should familiarize themselves and internalize the guidelines provided by this manual prior to the training.
2. The stationery required should be available within the training institution 3 days before the training. These include name tags, writing materials, paper punch and medium size box files for filing of participants' handouts.
3. Flip charts and good quality felt pens could be used interchangeably with projections. Each participant will require one felt pen while the trainers will require two sets of felt pens.
4. Visual aids like field equipment and tools should also be arranged in time before the sessions start.
5. There should be adequate copies of participants' handouts (one per participant) to be distributed at the end of each session or as may be suitable.
6. Copies of the modules are distributed at the end of each module.

4.2 Preparation of Training Venue and Sites

The training venue will include the training room, field demonstration sites and market places.

a) **Training Room** – Should have adequate space for 25 participants seated in a semi-circle or U shape arrangement ensuring access and unobstructed view of the front. There should be adequate space for a desk and seats for 3 trainers preferably at the sides or at the back of the training room. There should also be a desk for the trainer, their training materials and projector, a flip charts holder and white wall to act as a projector screen.

b) **Demonstration Site** – Should be located within a walking distance with at least five distinct plots for demonstrations.

c) **Market Places** – these include cereal retail outlets (kiosks, stalls, shops and supermarkets), whole sale and aggregation points and processing sites if any. The operators should be informed in advance about the visits. These should not be very far away preferably less than 10 minutes' drive.

d) 4.3 The Trainees

The trainees who will participate are extension officers, lead farmers, educators, service providers and researchers with elaborate training back ground in extension and advisory services. They will be drawn from public and private sector based on considerable experience in training farmers but with minimal facilitative advisory or technology transfer skills. The facilitator should therefore act more of a facilitator than a lecturer and draw out and build on their knowledge, skills and experience that they shall bring in. As a golden rule, do not lecture them but facilitate and listen and let them feel like equals to each other and the CTT team members.

4.4 Training Program

The training program proposed consists of the actual training modules and the corresponding days and time allocation **(Annex 1).**

4.4 Training Methods

The training methods proposed for each session are suitable for adult learners and appropriate for addressing knowledge, skills and attitudes of the participants. The choice of the methods has been informed by the competency issues being addressed, time available and experiences of the author of this manual. Depending on time available, the facilitator can modify these training methods but as a golden rule no presentation by the facilitator should take more than 30 minutes continuously; but should be separated by the other participatory training methods. Table 2 presents a list of available training methods.

Table 2 Description of Training Method

Training Method	Description of Method
Plenary presentations	Use of PowerPoint or flip charts and plenary discussions in situations where knowledge and opinion or consensus is required
Group exercises, buzz groups, visits and brainstorming sessions	To be considered where skills are an issue requiring sharing and trying
Role plays and problem-solving exercises	Plenary discussions have been considered as training methods where attitude is an issue
On-farm practical demonstration and exchange visits	To be considered where hands-on practical skills are acquired thourough sharing and demonstration

4.5 Planning Schedule and Guideline for ToT Preparation

While planning for this training, the CTT leader should ensure the following before the training:

1. **Six weeks** – recruit Master Trainers, compose CTT, have at least 5 Mango demonstration plots planted with Mango

2. **Four weeks** – send out invitation letters to participants and special guests detailing purpose, venue and program. Follow up on demonstration sites. Brief CTT members

3. **Two weeks** – confirm names of participants; reproduce training materials for facilitators and package, confirm preparedness of the field sites to be visited. Hold briefing of CTT members to finalize training plan. Confirm special guests if any

4. **Four days** –Confirm training sites preparedness, prepare sitting arrangements, and brief assistants

5. **One day** - arrange training room furniture, place materials, equipment and stationery on the tables. Arrange for reception of trainees at residence proposed

6. **On first day** – arrange for reception of trainees at the training venue. Ensure climate setting is done before the course is officially opened. This includes:

    - Registration
    - Welcoming to venue by host
    - Elaborate introduction of CTT and participants
    - Introduction to the project and training course
    - Ground rules
    - Groups formation

4.6 Evaluation of the Training

Half a day has been allocated for planning for way forward and evaluation of the ToT on the last day of the training. This is as presented in the program just presented in section 4.4. The evaluation strategy should take two directions the first being the individual trainees evaluate thourough evaluation forms without conferring or refereeing to each other. The evaluation forms are then collected and analyzed by the CTT members.

The second direction for evaluation is trainee's group evaluation. They retreat to one room and elect a chair and a secretary. Ask them to objectively and constructively evaluate the training in about 45 minutes in the absence of the CTT members. They then present their evaluation to the CTT members and as they present, the CTT members should only give points of clarifications if any misunderstanding occurred but not try to be defensive. The CTT members then use the two evaluation results to write a report highlighting aspects that went on well and can be replicated, challenges that were encountered, and opportunities for future ToT's improvement.

Table 3: Sample Evaluation Form

Aspect / Module	Rating		
	Very Useful (3 marks)	Useful (2 marks)	Of Limited Use (1 marks)
1. Climate change and Climate smart Agriculture			
2. Farmer Field and Business School Approach in Mango Production			
3. Good Agricultural Practices (GAPs) and Food Safety Management Systems (FSMS)			
4. Mango production Niches and Climatic Requirements			
5. Mango variety selection and access to quality seeds.			
6. Mango Seed Systems			
7. Climate Smart Agronomic Practices			
8. Integrated Soil and Water Management Practices for Mango			
9. Mango Crop Health			
10. Mango Harvesting and Post-harvest Management			
11. Mango Value Addition			
12. Mechanization of Mango production Activities			
13. Mango Business and Marketing			
14. Cross-Cutting Issues (Agricultural Innovation Platforms, Policy, Gender Mainstreaming and Social Inclusion)			

4.7 Facilitator's Training Notes and Reference Materials

4.8 Key references

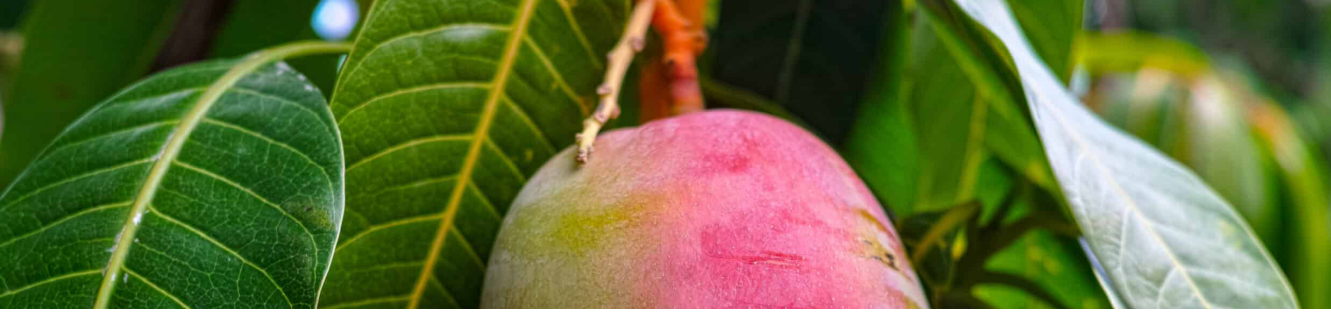
Two key references should be provided for each module plus a list of other relevant publications for reference.

4.8.1 Guide on the use of the information

The trainers will be advised to issue farmers with at most two publications for each of the training sessions. This is because if they go away with 10 publications in one visit, they may be overwhelmed with the material load and thus limit knowledge uptake. Also, some will just take away as many as they can if allowed.

The list of all individual publications will be stored and available as electronic copies – mainly PDFs. The service providers are strongly advised to keep these electronic copies on a memory stick, CD or portable hard drive to enable farmers easily access and if necessary, print any of them out at a local internet café.

Trainers will be advised to issue one General Mango farming manual to be accompanied by two other publications e.g. information sheets, brochures, factsheets and poster. With subsequent training modules, they can develop their collection of publications.

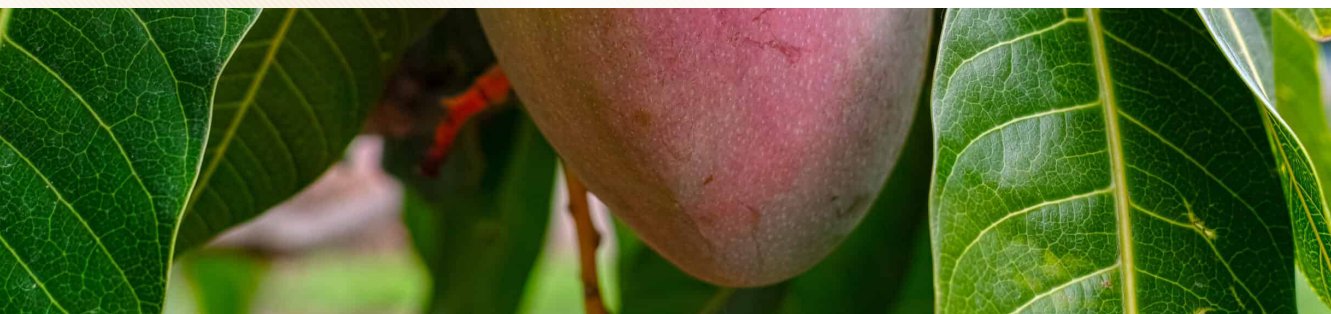


PART II: TRAINING MODULES

This part presents the content of 14 modules of training namely: Climate change and climate smart agriculture, Farmer Field and Business School (FFBS) approach, Mango production niche and climate requirements, Good Agricultural Practices (GAPs) and Food Safety Management System (FSMS), Mango variety selection, Mango seed systems, Mango climate smart agronomics practices, Integrated soil and water management practices for Mango, Mango Crop Health, Mango harvesting and Post-harvest management, Mango value addition, Mechanization of Mango production activities, Mango business and Marketing, and Mango Cross cutting issues (Innovation Platforms, Policy, gender mainstreaming and social inclusion).

All the modules will be divided into the following:

1. Introduction
2. Module learning outcomes
3. Module target group
4. Module users
5. Module duration
6. Module summary
7. Facilitator's guidelines
8. Participants' handouts



MODULE 1

CLIMATE CHANGE AND CLIMATE SMART AGRICULTURE

1.1 Introduction

The impacts of climate change and variability in agriculture, food systems and food security is a serious concern. Kenya's agricultural production systems are highly impacted upon, due to the low adaptive capacity and the high exposure to climate related risks. The major agricultural activities are prone to risks and uncertainties of nature, which is affected by climate change, either in intensity, scope or frequency. Climate change is expected to modify risks, vulnerabilities and the conditions that shape the resilience of agriculture systems as well as introducing new uncertainties. Adoption of climate smart agriculture (CSA) thourough application of tools and technologies and effective communications of weather information reduces the negative impacts of climate change and enhances access to food security in a changing environment. Thus, there is need to mainstream suitable climate resilient technologies, innovations and management practices (TIMPs) to increase productivity, resilience to climatic shocks and mitigate the causes of climate change.

1.2. Module Learning Outcomes

By the end of the module, the following outcomes should be achieved.

1. Concept of the climatic change and availability discussed and explained.
2. Impacts of the climate change and variability on agricultural and food security shared.
3. Concept of climate smart agriculture (CSA) shared and explained.
4. Future climate scenarios and how to manage projected and appreciated.

1.3 Module Target Group

This module targets public and private agricultural extension agents, service providers and lead farmers based at sub-county and ward level.

1.4 Module Users

This module is intended for use by Master Trainers who are members of the Core Team of Trainers (CTT) and Lead Farmers in the target counties. The trainers using this module should thoroughly familiarize themselves with the participants' handouts (training materials).

1.5 Module Duration

The module is estimated to take 4 hours.

1.6. Module Summary

Module 1: Climate Change and Climate Smart Agriculture in Mango Value Chain			
Sessions	**Training Methods**	**Training Materials**	**Duration**
1.6.1 Introduction and Leveling Expectations	• Personal • Introduction • PowerPoint Presentation • Plenary discussion	• Projector • Laptop • Flip charts	30 minutes
1.6.2Introduction to climate change and variability	• PowerPoint Presentation • Case study videos • Plenary discussion	• Projector • Laptop • Videos • Flip charts • Participants' handouts	1 hour 30 minutes
1.6.3. Concept of Climate smart agriculture (CSA) in Mango	• PowerPoint Presentation • Plenary discussion	• Projector • Laptop • Videos • Flip charts • Participants' handouts	1 hour
1.6.4 Projected future climate scenarios affecting Mango and how to manage them	• PowerPoint Presentation • Case study videos • Plenary discussion	• Projector • Laptop • Flip charts • Participants handouts	40 minutes
1.6.5. Module review	• Participants' questions and comments • Facilitator' summary	• Module review	20 minutes
TOTAL			**4 hours**

1.7 Facilitator's Guidelines

1.7.1. Introduction and Leveling Expectations (30 minutes)	Session Guide
(The trainer introduces the trainees to this module on climate change and climate smart agriculture). **Trainees' expectation (20 minutes)** *The facilitator organizes the trainees into groups to state and list their expectations.* **Module Objectives (10minutes)** *(The trainer presents module's objectives on power point).* By the end of the module training, the trainee should be able to: • Explain climate change and adaptations. • Describe Climate Smart Agriculture (CSA). • Describe and explain available climate smart crop management practices in Mango production. • Explain the benefits of selected climate smart crop management practices in Mango production.	• PowerPoint presentation • Distribute Participants 'handouts

1.7.2 Introduction to Climate Change and Climate Variability (1 hour 30 minutes)	Session guide
(*The trainer proceeds to introduce the module basics).* **Plenary presentation (70 minutes)** • Basic terminologies used in the module (weather, climate, variability, adaptation, coping) • Explain climate change and climate variability. • The causes of climate change • Climate risks impacting agriculture • Proposed adaptation and mitigation measures **Case study videos and discussion (20 minutes)** • The impact of climate change	• PowerPoint presentation • Plenary Discussion • Video Presentation

1.7.3 Concept of Climate Smart Agriculture (CSA) (1 hour)	Session Guide
(The trainer presents to the trainees the principles underpinning CSA and the link to deliverable of project objectives). **Plenary Presentation (45 minutes)** • Definition of the CSA approach and their characteristics • The thouree pillars of CSA (productivity, Adaptation and Mitigation • Why CSA is needed **Plenary discussion (15 minutes)** Discussions on the CSA concept	• PowerPoint presentation • Participants' handouts • Plenary discussion.

1.7.4 Projected Future Scenarios that will Impact Productivity (40 minutes)	Session Guide
(The trainer leads the trainees in discussing future climatic projections focusing on rainfall and temperature, which directly impacts on crop yields) are the long-term rainfall and temperature projections as impacted by climate change? **PowerPoint presentation (20 minutes)** • Projected impacts on food production and needed adaptation measures especially for Mango. **Video presentation and discussion (20 minutes)** • Short Video on showing projections of rainfall and temperature.	• PowerPoint presentation • Video presentation • Plenary discussion
1.7.5 Module Review (20 minutes)	**Session Guide**
(The trainer leads the trainees in summarizing the key points discussed in the module)	• Plenary discussion

1.8 Participants handouts

- Climate Change and CSA Factsheets
- Climate Change and CSA Leaf-lets

Reference

Esilaba. A. O.*et al*. (2019). KCEP-CRAL Climate Smart Agriculture Extension Manual. Kenya Agricultural and Livestock Research Organization, Nairobi, Kenya

MODULE 2

FARMER FIELD AND BUSINESS SCHOOL (FFBS) APPROACH IN MANGO VALUE CHAIN

2.1. Introduction to the module

This module is designed for training and exposing trainees to the Farmer Field and Business Schools (FFBS) approach and concepts. In addition, practitioners of FFBS need to have knowledge of this methodology in order to transfer various Technologies, Innovations and Management Practices (TIMPs) in Mango value chain to farmers. The trainees will thereafter facilitate farmers in the Common Interest Groups (CIGs) to learn by doing the available TIMPs from a common plot of FFBS and then implement what they have learnt in their individual farms in order to meet the KCSAP project objectives of sustainable increased productivity, building resilience to climate change risks and reduction of greenhouse gases. FFBS also empowers the learners with various skills in facilitation, communication and agri-business. Since the methodology is participatory, it improves the learners' observation skills and creates linkages with other value-chain players, thereby making Mango production profitable and sustainable.

2.2. Module Learning Outcomes.

By the end of the module the following outcomes should be achieved:

1. Have a clear understanding of Farmer Field and Business School approach in Mango value chain and be able to differentiate between teaching and facilitating.
2. Be equipped with practical skills that help them feel informed and confident about their roles and ability to facilitate a participatory learning process.
3. Be empowered with knowledge and analytical skills to design simple experiments to test and select the best option to mitigate the constraints in Mango value chain thourough applying the climate smart TIMPs.
4. Facilitate a shift from the domestic focus on Mango production to improving productivity towards farming business proposition.
5. Development of a clear road map of dissemination of TIMPs in Mango value chain thourough an action plan that is Specific, Measurable, Achievable, Realistic and Time bound (SMART).

2.3. Module Target Group

This module targets agricultural extension service providers based at sub-county and ward level. It will also be useful for private extension service providers dealing directly with farmer groups at community level and lead farmers.

2.4. Module Users

This module is intended for use by Master Trainers who are members of the Core Team of Trainers (CTT) and Lead Farmers in the Mango value chain target Counties. The Facilitators using this module should thoroughly familiarize themselves with the participants' Handouts (training materials).

2.5. Module Duration

The Module is estimated to take 4 hours 30 minutes.

2.6 Module Summary

Module 2. 6 Farmer Field and Business School Approach			
Sessions	**Training Methods**	**Training Materials**	**Time**
2.6.1 Introduction, Climate setting, leveling of expectations and objectives.	Setting norms and group discussions on expectations	Power point, Projector Flip charts and Mark pens	30 minutes
2.6.2 Overview of FFBS key activities	Presentations and plenary discussions	Pictorials, power point and projector	30 minutes
2.6.3 Introduction to Communication and communication skills	Presentation, group discussions and plenary	Power point, Projector, Flip charts and felt pens	30 minutes
2.6.4 Facilitation and leadership skills	Presentation and plenary	Power point and Projector.	30 minutes
2.6.5 Organization and management in FFBS	Presentation and plenary	Power point and Projector.	1 hour
2.6.6 Developing FFBS Curriculum for the Mango value chain	Group discussion and presentation, and plenary presentation	Power point, Projector, Flip charts and felt pens	1 hour
2.6.7 SMART County action plan development of Mango value chain on the transfer of TIMPs	Group discussions and presentations	Power point, Projector, flip charts and felt pens	20 minutes
2.6.8 Module review	Discussions Conclusions and way forward	Flip charts, Power point presentations and projectors	10 minutes
TOTAL			**4 hours 30 minutes**

2.7 Facilitators Guidelines

2.7.1 Introduction, climate setting Leveling Expectations and Objectives (30 miutes)	Session Guide
(The trainer welcomes trainees to the module on FFBS and climate change and introduces him/herself stating his profile and experience of working with farmers and leads in climate setting). **Trainee introduction and climate setting** Introduction of participants, setting training norms, formation of FFBS sub groups (Working groups) and trainees to share their expectations **Plenary presentation on module Objectives** The facilitator presents modules objective in power point By the end of the module the trainee should be able to: • Describe the concepts, characteristics, principles and plans of Farmer Field and Business School (FFBS) as a 'learning by doing approach as it applies in Mango • Identify main differences between teaching and facilitation • Understand how to conduct Agro Ecosystems Analysis (AESA) on the Mango value chain enterprise • Demonstrate how to successfully lay Participatory Technology Development (PTD) of the Mango value chain TIMPs • Develop FFBS Curriculum for the Mango value chain	• Provide checklist for introduction of trainees to help them build confidence in participation • Summarize and display trainees expectations • Assign roles to the Sub groups • Set Norms and nominate leaders • Power point presentation on the Objectives of the FFBS training module
2.7.2 Overview of FFBS key activities (30 minutes)	**Session guide**
Plenary presentation The facilitator takes the trainees thourough the main concepts and pillars of FFBS which includes: • The definition of FFBS • Participatory technology development (PTD) for the Mango value chain TIMPs • Agro ecosystems Analysis (AESA) of the Mango value chain • Concept of what is this what is that • FFBS principle of Integrated production and pest management (IPPM) • FFBS Business concept and opportunities in the Mango value chain stages	• Power point presentation on the overview of Key activities in FFBS

2.7.3 Introduction to Communication and Communication skills (30 minutes)	**Session guide**
Group exercise to gage the understanding of trainees on: • what communication is, • communication channels, • Barriers to effective communication and • how to effectively communicate **Plenary presentation** Communication and communication skills	Group exercise and presentations on flip charts and power point presentation Handouts
2.7.4 Facilitation and leadership skills (30 minutes)	**Session guide**
Plenary presentation • Definition of Facilitation, facilitator and effective facilitation. • Qualities of a good facilitator. • Golden rules of facilitation. • Roles and responsibilities of FFBS Facilitators. • Difference between facilitation and teaching • Definition of leadership • Elements of leadership • Types of leadership • Characteristics of a good leader	Power point presentation on Facilitation and leadership skills Handouts
2.7.5 Organization and management in FFBS (1 hour)	**Session guide**
Plenary presentation on FFBS implementation framework in the FFBS steps; • Ground working • Training of Facilitators • Establishing PTDs at the FFBS • Season long FFBS sessions • Evaluation of PTDs • Field days • Graduation • Establishment of Lead FFBS • Follow ups	Power point presentation Handouts
2.7.6 Developing FFBS Curriculum for the Mango value chain (1hour)	**Session guide**
Plenary presentations Steps of Participatory technology development on the Mango value chain production • Identify the major constraints to increased yields of Mango value chain production • Ranking of constraints in order from highest. • Identify list of TIMPs to address the constraints • Rank the TIMPs in order from the most preferred • Develop PTD on the most preferred TIMP objective	Group exercises on • pair wise matrix ranking of constraints and TIMPs in Mango value chain • curriculum development based on the value chain growth stages

• Decide on the parameters for AESA • Develop FFBS curriculum using crop growth stage calendar for the Mango value chain **Group exercises** • Constraint identification and ranking • TIMPs options identification and ranking • Identification of the growth stages of the value chain crop and development of FFBS training curriculum	GPresentations of the group exercises on flip charts • power point presentations on PTD and curriculum development
2.7.7 SMART County action plan development on Mango value chain of transfer of TIMPs (20 Minutes)	**Session guide**
Plenary presentation Plenary presentation of the action plan of Mango county value chain that has • Activities to be undertaken in the regular FFBS meetings • Time frame of the activities • Who is responsible for each of the activities • Required resources for the specific activity • Means of verification for the activity **Group exercise** The trainees do a group exercise of the action plan based on Sub counties and wards represented	Power point presentation on the template of County Mango value chain TIMPs transfer action plan Group exercise on development of County Mango action plan for the respective wards and sub Counties represented in the training
2.7.8 Module review (10 minutes)	**Session guide**
• Participants Questions and answers • Facilitators Summary	Power point presentation, projector, flip charts, felt pens

2.8 Participants' Handouts

References

1. FAO (2006) Farmer Field School FFS Manual.
2. Khisa Godrick: (2004) Farmer Field School Methodology: Training of Trainers Manual.
3. Sustainet East Africa; (2010) Farmer Field School: A Technical Manual.
4. FAO (2010) Food safety manual for Farmer field Schools: A training reference guide for food safety in global FFS programmes.

MODULE 3

GOOD AGRICULTURAL PRACTICES (GAPs) AND FOOD SAFETY MANAGEMENT SYSTEMS (FSMS)

3.1. Introduction

This module is designed for training and exposing trainees to good agricultural practices and food safety management system along the Mango value chain.

Declining food safety, reduced food quality, unsustainable farming practices and negative environmental impact from agricultural activities plague the food sector and impose risks in the agricultural sector. These can be mitigated by adoption of Good Agricultural Practices (GAPs). The GAPs mitigate risks through risk prevention, risk analysis and promotion of sustainable agriculture by means of Integrated Pest and Disease Management (IPDM) and Integrated Crop Management (ICM). On the other hand, worker safety and health along with traceability requirements are a major concern to modern consumers. The GAPs are vital in protecting consumer health by ensuring safety within the food chain. It is imperative to operate from the table upstream to include suppliers of agricultural inputs and providers of logistics and farm equipment. Therefore, GAPs constitute a certification system for agriculture, specifying procedures that must be implemented to produce and supply food that is safe for consumers and wholesome use of sustainable methods.

Food safety assures food quality based on the absence or occurrence of hazards that are risky to human and animal health, within acceptable limits. Hazards are common along food value chains that lack effective control measures and may be due to 'bad' agronomic practices or are introduced along the supply chain from the farm to fork continuum. Today, there is an increasing public concern on the negative environmental and health impacts of agro-chemicals as well as microbial pathogens and their toxins. Control of the hazards occurrence is done thourough the implementation of an effective Food Safety Management Systems (FSMS) thourough Hazard Analysis Critical Control Points (HACCP) management system. It involves a seven step management system that provides the framework for monitoring the entire food chain. This makes it more of a preventive, rather than a reactive tool designed to identify and control potential problems before they occur.

3.2. Module Learning Outcomes

By the end of the module, the following outcomes should be achieved:

1. GAPs on food safety and enhanced quality along the mango value chains discussed and appreciated.
2. Knowledge on optimization and utilization of resources (water, soil, manure, fertilizers and other inputs), environmental protection and conservation acquired and described.
3. Worker safety and health within the crop production system explained
4. Traceability in food safety and quality along the mango value chain mapped and implemented.

3.3. Module Target Group

This module targets public and private agricultural extension agents, service providers and lead farmers based at sub-county and ward level.

3.4. Module Users

This module is intended for use by Master Trainers who are members of the Core Team of Trainers (CTT) and Lead Farmers in the crops value chain target Counties. The facilitator using this module should thoroughly familiarize themselves with the participants' handouts (training materials).

3.5. Module Duration

The Module is estimated to take 6 hours and 30 minutes.

3.6 Module Summary

Module 3. Good Agricultural Practices (GAPs) and Food Safety Management Systems (FSMS)			
Sessions	**Training Methods**	**Training Materials**	**Time**
3.6.1 Introduction, objectives and leveling of expectations	• Groups to bring out expectations • Plenary presentation	• Module objectives • Marker pens • Flip charts • Projector • Laptop	30 minutes
3.6.2 Understanding GAP and its application in the Mango value chain	• Plenary presentations • Plenary discussion	• Flip charts • Marker pens • Projector • Laptop • Pictorials/video clips	30 minutes
3.6.3 Discussion of factors to consider when selecting a site for agricultural activities thourough Risk Assessment	• Plenary presentation • Plenary discussion	• Flip charts • Marker pens • Projector • Laptop • Pictorials/video clips • Data sheets	30 minutes
3.6.4 Review of GAP requirements for audit and types of protocols possible	• Plenary presentations • Plenary discussion	• Data forms • Flip charts • Marker pens • Projector • Laptop • Pictorials/video clips • Data sheets	30 minutes
3.6.5 Introduction to Site Selection	• Plenary Presentation • Plenary discussion	• Projector • Laptop	30 minutes

3.6.6 GAP checklists and Audit	• Plenary Presentation • Group exercise	• Flip charts • Marker pens • Projector • Laptop	30 minutes
3.6.7 Safe use of Pesticides and calibration of sprayers and nozzles	• Group work on nozzles • Rate of discharge • Safety guidelines	• Pictorials/video clips • Knapsacks • Measuring cylinders • Tape measure • Nozzles • Empty clean pesticide containers	1 hour
3.6.8 Understanding food safety management system in Mango value chains	• Plenary presentation • Plenary discussion	• Flip charts • Marker pens • Projector • Laptop, • Pictorials/video clips	30 minutes
3.6.9 Determination of food safety risk/hazards in Mango value chains (hazard analysis)	• Plenary presentation • Group exercise	• Projector • Laptop • Flip charts • Marker pens • Participants' hand outs	30 minutes
3.6.10 Determination of critical control points (CCPs) and Critical limits (CLs) in Mango value chain	• Plenary Presentation • Group Exercise	• Projector • Laptop • Flip charts • Marker pens	30 minutes
3.6.11 Prevention and corrective measures for CCPs in Mango value chain	• Plenary Presentation • Group exercise	• Flip charts • Marker pens • Power point projector • Laptop • Pictorials/video clips	30 minutes
3.6.12 Module review	• Participants' questions and comments • Facilitator's summary	• Participants' hand outs • Module review	30 minutes
TOTAL			**6 hours 30 minutes**

3.7 Facilitator's Guidelines

3.7.1 Introduction, Objectives and Leveling Expectations (30 Minutes)	Session Guide
(The facilitator welcomes trainees to the sub-module on GAPs and introduces him/herself stating profile and experience of working with farmers). **Trainees' introductions and expectations (20 minutes)** The facilitator invites the trainees to state their expectations after brain storming in their respective county groups **Module Objectives (10 minutes)** *The facilitator presents module's objectives in power point.* By the end of the module, the trainee should be able to: • Appreciate GAP's matters of food safety and quality along the crop value chain • Describe optimization and utilization of resources (water, soil, manure, fertilizers, and other inputs), environmental protection and conservation • Explain worker safety and health within the crop production system • Map and implement traceability in food safety and quality along the crop value chain	• Summarize trainees' Expectations on a flipchart • PowerPoint presentation
3.7.2 Understanding GAP and its application in the Mango value chain (30 minutes)	**Session Guide**
(Facilitator leads discussions on understanding of GAPs and its relevance to actors in the Mango value chain). **Plenary Presentation (10 minutes)** • Understanding GAP in the context of crop production • Explain the role of GAPs in safe and sustainable food production system for growers and consumers • Understanding GAPs as the key to high commodity market destinations **Plenary discussion** GAP application in the Mango value chain	• PowerPoint presentation • Participants handouts • Plenary discussion

3.7.3 Discussion of factors to consider when selecting a site for agricultural activities thourough Risk Assessment (30 minutes)	Session Guide
(Facilitator guides discussions on the key determinants of site suitability for agricultural activities). **Plenary presentation and discussion (30 minutes)** • Factors to be considered in an agricultural site selection (Site history, slope of land, type of soil versus crop, water sources and physical quality, soil and water analysis) • The need for documentation in a farm assurance system • Types of mandatory farm records • General guidelines to conservation agriculture (CA)	• PowerPoint presentation • Participants' handouts • Plenary discussion
3.7.4 Review of GAP requirements for audit and types of protocols possible (30 minutes)	**Session Guide**
(The facilitator leads the trainees in summarizing the key points discussed in the module). **Plenary presentation and discussion (30 minutes)** • Methods and procedures required at on-farm level to obtain GAP certification in crops production. • Good soil management practices (appropriate crop rotations, manure application) • Careful management of water resources and efficient use of water for rain-fed crop production via irrigation. • Selection of crop types and varieties to meet local consumer needs. • Adoption of IPM practices to minimize the potential impact of pest control actions on workers, food, and environmental and health safety. • Minimizing contamination at harvest, on-farm processing and storage.	• Power point presentation • Participants' handouts • Plenary session
3.7.5 Introduction to Site Selection (30 minutes)	**Session Guide**
(The facilitator introduces the various factors involved in site selection thourough Pictorials/video clips PPT's and farm walk). **Plenary Presentation and discussions (30 minutes)** • Factors to be considered in an agricultural site selection (Site history, slope of land, type of soil versus crop, water sources and physical quality, soil and water analysis) • The need for documentation in a farm assurance system • Types of mandatory farm records • General guidelines to conservation agriculture (CA)	• Power point presentation • Participants' handouts

3.7.6 GAP checklists and Audit(30 minutes)	Session Guide
(Facilitator guides the trainees on self-assessment (Internal audit and corrective measures for non-compliance) **Plenary presentation (15 minutes)** • Need for mandatory records in GAPs • Internal Audit procedures • Practical on Mock Audits • Interpretation of audit reports • Compliance and corrective actions **Group exercise (15 minutes)** • Groups audit a farm or a process within the training site • Present audit results and verdict and corrective actions	• PowerPoint presentation • Global GAP checklists • Participants' handouts • Group exercise
3.7.7 Safe use of Pesticides and calibration of sprayers and nozzles(1 hour 30 minutes)	**Session Guide**
(The facilitator organizes the groups to identify level of knowledge on pesticide use and safety; Determination of less hazardous pesticides, fungicides and herbicides, quantities to apply and respective PHIs). **Group exercise (30 minutes)** Practical session on how to handle different types of pesticides, fungicides and herbicides together with their calibrations **Plenary presentation (1hour 15 minutes)** • Guided knapsack calibration • Different types of nozzles and their uses • Pesticide safety	• Power point presentation • Pesticide containers • Knapsack sprayers • Nozzles • Participants hand outs • Group exercise
3.7.8 Understanding food safety management system in Mango value chains (30 minutes)	
(The facilitator introduces food safety system by defining it and sharing its benefits with the trainees). Power points **Plenary presentation and discussion(30 minutes)** • Overview of Food Safety Management Systems (FSMS) • Why food safety is important in crops production systems • Risks to human/animal health due to chemical, biological and physical hazards exposure • Legal and market requirements for food safety practice • Food safety practices that reduce risks/hazards • Use of HACCP tool/system for monitoring crop production	• PowerPoint presentation • Participants' handouts • Plenary discussion

3.7.9 Determination of food safety risks/hazards in Mango value chain (Hazard analysis) (30 minutes)	
Facilitator guides discussions on the steps of identification of food safety hazards FSMS **Plenary Presentation (15 minutes)** • Explain the concept of risk identification (Hazard analysis) in crop production chain. • Listing the types of hazards that cause illness or death. • Determine and identify factors influencing likely occurrence/severity of hazards. • List hazards alongside the possible control measures • Explain the concept in a flow diagram **Group Exercise (15 minutes)** • Groups to identify major risk/hazards at points of crop production • Produce flow diagrams for the crop	• Power point presentation • Participants hand outs • Group exercise
3.7.10 Determination of critical control points (CCPs) and Critical limits (CLs) in Mango value chain (30 minutes)	
The facilitator introduces the topic on determination of critical control points (CCP) **Plenary presentation (15 minutes)** • Why is important to determine CCP in production chain (preventing, eliminating or reducing risks) • How to monitor and measure the CCP (point, step or procedure) • How to document the CCP • How to establish critical limits (from standards or guidelines) for each CCP **Group Exercise (15 minutes)** • Groups to identify and establish critical control points and critical limits.	• Power point presentation • Participants hand outs • Group exercise
3.7.11 Prevention and corrective measures for CCP in Mango value chains (30 minutes)	**Session Guide**
The facilitator introduces the topic on prevention and control of possible hazards **Plenary presentation (15 minutes)** • Establishment of corrective actions against CCP • Establish verification procedures for CCP • Establish record-keeping and documentation procedures • How to develop HACCP plan and Food safety tool kit for the crop value chain	• Power point presentation • Participants hand outs • Group exercises

Group exercise (15 minutes) Groups to identify and establish corrective actions and verification procedures for crop value chain.	
3.7.12 Module Review (30 minutes)	**Session Guide**
(The facilitator leads the trainees in summarizing the key points discussed in the module)	Plenary discussion

3.8.Participants' Handouts

- Good Agricultural Practices (GAP) hand book
- HACCP hand book for crop production
- Farm management and production hand book

References

- Hazard Analysis Critical Control Point Principles and Application Guidelines (2018). National Advisory Committee on Hazards Criteria for Foods.
- Food Safety Manual for Farmer Field Schools (2010). A training reference guide on food safety in global FFS Programmes, FAO.
- Marcin Wysokiński, Piotr Gołasa and Wioletta Bieńkowska (2012). The importance of GLOBAL GAP for food safety in the supply chain: Global GAP Version V

MODULE 4

MANGO PRODUCTION NICHES AND CLIMATIC REQUIREMENTS

4.1 Introduction

This module exposes service providers, lead farmers and facilitators to the different types of production ecological conditions (altitudes, soils, AEZs and climate) suitable for Mango production. In Kenya Mango is grown in Coastal, Eastern, Rift Valley and Western regions. In the Coastal region it is grown in five counties of Kwale, Kilifi, Taita Taveta, Tana-River and Lamu, while in the Eastern region it is grown in the counties of Meru Machakos, Kitui, Embu, Makueni and Tharaka/Nithi. In Western region little cultivation occurs in Busia County and in the Rift valley it is grown in Baringo and Elgeyo Marakwet counties.

Mango is mainly grown by smallholder farmers under rain-fed conditions. The crop is either grown as a mono crop or is intercropped with annual crops such as Maize, Simsim, Cassava green grams and cowpeas. There is need to enhance the knowledge of the farming communities on the production niches and climatic conditions for increased productivity of the crop.

4.2 Module Learning outcomes

By the end of the module the following training outcomes must be achieved:

1. Importance of mango in Kenya's economy explained.
2. Suitable areas (altitudes and soil types/characteristics) for mango production identified and described.
3. Climatic conditions (temperatures, rainfall and humidity) required for mango production described.
4. Specific county agroecological zones for mango production identified.

4.3 Module Target Group

This module is intended for public agricultural extension providers in the Mango value chain target counties and lead farmers.

4.4 Module users

This module is intended for use by Master Trainers who are members of the Core Team of Trainers (CTT) and Lead Farmers in the Mango value chain target Counties. The facilitators using this module should thoroughly familiarize themselves with the participants' handouts (training materials).

4.5 Module Duration

The module is estimated to take 4 hours

4.6 Module Summary

Module 4: Mango production niches and climatic requirements			
Sessions	**Training methods**	**Training materials**	**Time**
4.6.1 Introductions and climate setting	▪ Presenter introduction ▪ Self-introduction of trainees (incl. individual involvement in Mango value chain ▪ Plenary discussion	▪ Flips charts ▪ Felt pens ▪ Laptop for power point Presentation	20 minutes
4.6.2 Objectives and expectations	▪ Presentations (guide on group work) ▪ County group exercise (trainees enlist expectations) ▪ Plenary discussions to share expectations	▪ Flips charts ▪ Felt pens ▪ Laptop for power point Presentation	30 minutes
4.6.3 Importance of Mango in Kenya's economy	▪ Presentations ▪ Plenary discussions	▪ Flips charts ▪ Felt pens ▪ Laptop for power point handouts (training notes)	1 hour
4.6.4 Mango production ecological/ climatic requirements for optimal yields	▪ Presentations ▪ Plenary discussions	▪ Flips charts ▪ Felt pens ▪ Laptop for power point presentations ▪ Handouts (training notes)	1 hour
4.6.5 Mango production Agro-ecological zones (AEZs)- average yields, and constraints in the target Counties	▪ Group work to identify mango production pockets in their sub-Counties/Counties ▪ Presentations ▪ Plenary discussions	▪ Flips charts ▪ Felt pens ▪ Laptop for power point presentations	1 hour
4.6.6 Mango module review	▪ Discussions/conclusion and way forward	▪ Flip charts ▪ Laptop for power point presentations	20 Minutes
TOTAL			**4 hours 10 minutes**

4.7 Facilitator's Guidelines

Module 4: Mango production and appropriate climatic requirements	
4.7.1. Introductions and climate setting (30 minutes)	**Session Guide**
(The facilitator welcomes trainees to the module and invites them to introduce themselves and state their expectations).	• Summarize the facilitator/trainees involvement in Mango value chains
4.7.2. Objectives (30 minutes)	
The facilitator presents module objectives. **Module Objectives** By the end of the module the trainee should be able to: • Explain the importance of Mango in Kenya's economy • Identify and described suitable areas (altitudes and soil types/characteristics) for Mango production • Describe climatic conditions (temperatures, rainfall and humidity) required for Mango production • Identify specific county agro-ecological zones for Mango production	• PowerPoint presentations • Group exercise (listing and presenting expectations). • Expectations lists kept for later reviewing
4.7.3 Importance of Mango in Kenya's economy (1 hour)	
Plenary Presentation (45 minutes) • Origin of Mango • Why Mango in Kenyan households • Key counties producing Mango in Kenya • General Mango production in Kenya **Plenary Discussion (15 minutes)** Questions/answers/comments	• PowerPoint presentation • Distribute to participants' Handouts
4.7.4 Mango production ecological/climatic requirements (1 hour)	
Plenary Presentation (45 minutes) • Altitude and Agro-ecological zones • Climatic conditions (Rainfall, Temperatures and humidity) • Soils (soil types, pH, general fertility for Mango) **Plenary Discussion (15 minutes)** Questions/answers/comments	• Power point presentation • Distribute to participants Handouts' (training materials)

4.7.5. Mango production AEZs (villages), average yields, and constraints in the target Counties (1 hour)	Session Guide
Plenary Presentation (45 Minutes) Facilitator guides in reviewing and discussing suitability map (County by County) **Group work (15 minutes)** Trainees to bring out specific county or sub-county AEZs, land size, yields and constraints to Mango production and present in the plenary: • Agro-ecological zones (AEZs) and % area suitable for Mango • Average land/farm size under Mango • Average Mango yield per farm • Constraints to Mango production **Plenary Discussions/presentations from the groups (15 minutes)** Let the trainees/groups share the group exercise outcomes.	• Power point presentations • Group work • Facilitator's guided discussions
4.7.6. Module review (20 minutes)	**Session Guide**
(The facilitator leads the trainees in reviewing the module). **Plenary Presentations (20 minutes)** Facilitator guides on the summary of the module. • What new thing(s) did trainees learn from the module? • Are there any unanswered questions the trainees still have?	• The last participants' Handouts/training materials • Summarize the main points of the module on a flip chart and display

4.8 Participants' Handouts

- Mango production Guides [2017]
- Mango Booklet [2017]

MODULE 5

MANGO VARIETY SELECTION

5.1 Introduction

The local mango varieties were probably introduced in Kenya from India by Arabs in the 14th Century (Griesbach, 2003). These local varieties are drought tolerant making them suitable for production in the dry areas. Although the local varieties have this desirable attribute, many of them produce fruits of low quality characterized by small size and fibrous flesh making them undesirable for the market. In addition, the trees grow very tall making it difficult to apply management practices such as pruning, spraying and harvesting. Mango improvement thourough breeding and selection aims at producing trees with desirable attributes such as reduced tree size, high quality fruits and improved tolerance to insect pests and diseases.

Many of the improved varieties were introduced in Kenya in the 1980's from USA, Israel, Brazil and South East Asia. Breeding and selection led to the development of superior varieties with desired attributes such as appealing skin colour, lack of fibre, smooth texture and improved tolerance to diseases. These exotic varieties have superior traits such high fruit quality desired by the consumers, improved shelf life and disease resistance. They have been propagated and disseminated to farmers in various parts of Kenya. This module therefore aims at familiarizing the trainees with some of the exotic varieties and their salient features.

5.2 Module Learning Outcomes

By the end of the module, the following outcomes should be achieved:

1. Characteristics of major exotic mango varieties appreciated.
2. Various exotic mango varieties for different agroecological zones appreciated

5.3 Module Target Group

This module targets public and private extension agents, service providers and lead farmers

5.4 Module Users

This module is intended for use by Master Trainers (ToTs) who are members of the Core Team of Trainers (CTT). The facilitators using this module should be well conversant with the participants' handouts.

5.5 Module Duration

The facilitation of this module is estimated to last for a period of 3 hours 30 minutes.

5.6 Module Summary

Module 5. Mango Variety Selection			
Sessions	**Training Methods**	**Training Materials**	Time
5.6.1. Introduction and Objectives Expectations	• Plenary presentation • Group discussion and presentation of expectations	• Flips charts • Felt pens • Laptop for power point presentations • Projector	30 minutes
5.6.2. Introduction to various improved mango varieties, their ecological areas of cultivation and their attributes	• Group Exercises to identify local mango varieties and the exotic varieties • Plenary Presentations • Plenary discussion	• Flips charts • Felt pens • Laptop for power point presentations • Projector • Manila papers	1hour 30minutes
5.6.3 Recommended varieties for specific regions	• Plenary Presentation • Group exercise • Field demonstration	• Flips charts • Felt pens • Laptop for power point presentations • Projector • Manila papers	1hour
5.6.4.Module review	• Group Exercise • Facilitator's summary	• Participants' handouts • Module review	30 minutes
TOTAL			**3 hours 30 minutes**

5.7 Facilitator's Guidelines

Module 5: Mango Variety Selection	
5.7. 1 Introduction and levelling of expectations and objectives (30 minutes)	**Session Guide**
Introduction (15 minutes) (*The facilitator welcomes trainees to the module on Mango varieties and introduces himself/herself by stating his/her profile and experience).* The facilitator invites the trainees to introduce themselves and state their expectations. **Module Objectives (15minutes)** (The facilitator presents modules objectives) By the end of the module the trainee should be able to: 1. Describe the mango crop and its climatic and ecological requirements.	• Summarize trainees' "expectations" and display. • Distribute participants' handouts • Module Objectives,

2. Identify the various improved Mango varieties their ecological areas of cultivation and their uses. 3. Identify the varieties suited to the counties of interest.	
5.7.2 Introduction to Mango and the various improved Mango varieties and their uses (I hour 45minutes)	**Session Guide**
(The facilitator describes the mango crop and guides the trainees in identifying the various mango improved varieties and their uses). **Group exercise and discussion(45 minutes)** Ask trainees highlight and describe some of the Mango varieties they know. **Plenary Presentation (1hour)** • What is Mango? • Improved Mango varieties • Categories of Mango varieties for grain, forage, dual purpose *Show trainees the photographs of each variety and the full description and its uses.*	• Distribute Participants' handouts • Group exercise • Plenary discussion
5.7.3 Recommended Mango varieties for the target counties (1 hour 30 minutes)	**Session Guide**
Plenary Presentation **Varieties for the target counties (30 minutes)** • Mango growing regions and the new regions which are being targeted for Mango cultivation in Kenya • Mango varieties suited for each county • County climate conditions for target county (semi-arid, hot dry low land, cold dry highlands and high potential) **Group exercises (30 minutes)** Trainees discuss and come up with Mango varieties in their county **Field demonstration (45 minutes)** *(Ensure there is an established plot of all the varieties or MANGO plant samples).* • Visit the Mango plots with the trainees and assist them identify and study the various varieties • After the field visit facilitate them to recall what they learned and discuss on any issue that may arise. (can also use Mango plant samples for the various varieties)	• Distribute participants' handouts. • Group exercise • Field demonstration

5.7.4 .Module review (30 minutes)	Session Guide
(The facilitator leads the trainees in reviewing the module) **Group Exercise** Summarize the main points of the training Together with the trainees review the main points about improved Mango varieties • What new things did you learn from this module? • What are some of the problems and issues that you have become more aware of in Mango varieties? • What questions do you still have about identification of mango varieties?	• The last Participants' Handouts • Summary of the main points from the module.

5.8. Participants' handouts

Fact sheets on mango varieties

MODULE 6
MANGO SEED SYSTEMS

6.1 Introduction

In most mango growing areas, farmers have established their mango orchards using their own seeds, or source seeds from their neighbors which give them minimal yields .Thourough grafting technology farmers are able to access improved planting materials of mango. Grafting has been identified as one of the most effective means of propagation and it is a skill that almost everybody can practice effectively. It only requires a lot of practicing to gain confidence when doing it.

As agricultural production increasingly becomes commercialized and global food markets become more competitive, farmers need to invest in improved mango varieties for high yields and sustainable income. This module exposes county extension officers, private service providers, lead farmers and facilitators to the various plant propagation systems and the importance of quality planting materials in Mango production. It also covers community plant seedling production and gives direction on how to interface public and private seedling production to enable farmers venture into commercial mango production.

6.2 Module learning outcomes

By the end of the module the following should be achieved:

1. The main mango propagation systems in Kenya appreciated and explained.
2. Mango seedling production in public and private seedling nurseries understood and described.
3. The importance of private nurseries, community nurseries and its interface with public nurseries for enhanced production of quality Mango understood and explained.

6.3 Module Target Group and Categories

This module is intended for private service providers and county public extension agents.

6..4 Module Users

This module is intended for use by Master Trainers who are members of the Core Team of Trainers (CTT) and Lead Farmers in the mango value chain target Counties. The facilitators using this module should thoroughly familiarize themselves with the participants' handouts (training materials).

6.5n Module Duration

The module is estimated to take 4 hours and 30 minutes.

6.6 Module Summary

Module 6: Mango Seed System			
Sessions	**Training methods**	**Training materials**	**Time**
6.6.1 Introduction, objectives and expectations	• Self-introduction • Presentations • Plenary discussions	• Flips charts • Marker pens • PowerPoint presentation	30 minutes
6.6.2 Definition of seed and seed system in Kenya	• Group work • Presentations	• Flips charts • Marker pens • PowerPoint Presentation	30 minutes
6.6.3 Formal seed system in Kenya	• Presentations • Discussions	• PowerPoint Presentation • Flips charts • Marker pens	1hour 30 minutes
6.6.4 Informal seed system in Kenya	• Presentations • Discussions	• PowerPoint Presentation • Flips charts • Marker pens	1 hours
6.6.5 Module review and discussions	• Group work • Discussions • presentation	• Flips charts	30minutes
TOTAL			**4 hours**

6.7 Facilitator's Guidelines

Module 6: Mango Seed System	
6.7.1. Introduction and levelling of expectations and objectives (1 hour)	**Session Guide**
Introduction (30 minutes) *(The facilitator welcomes trainees to the module on the main mango seed systems before inviting trainees to introduce themselves and state their expectations).* **6.7.1. Module Objectives (30 minutes)** *(The facilitator presents modules objectives)* By the end of the module the trainee should be able to: 1. Describe and explain mango propagation systems in Kenya.	• Summarize trainees' "expectations" and display. • PowerPoint Presentation • Distribute Participants' Handouts

2. Describe Mango seedling production systems in public and private seedling nurseries 3. Explain the role of private nurseries, community and public nurseries in the production of quality mango	
6.7.2. Definition of seed and seed system in Kenya (30 minutes)	**Session Guide**
Group work and presentation (15 Minutes) • What is quality seed? **Plenary Presentation (15 Minutes)** • Definition a seed system and characteristics of main seed systems (formal and informal seed system) • Commodity corridors	• Group work • PowerPoint Presentation • Distribute participants' handouts • Brochures, Leaflets,
6.7.3 Formal seed systems in Kenya (1 hour 30 Minutes)	**Session Guide**
Plenary presentation and Discussion(1 hour 30 Minutes) • Legal requirements for seed certification • Seed certification process • Post certification activities for enforcing the seed act cap 326 • Post certification activities for seed quality assurance • Seed importation and exportation requirements.	• PowerPoint Presentation • Distribute Participants' Handouts • Brochures, Leaflets
6.7.4 Informal seed system in Kenya (1 hour)	**Session Guide**
Plenary presentations: (30 minutes) • Seed multiplication • Mango seed standards and commercial production • Informal seed system • Community seed bulking and how is it implemented • Synergies for formal and informal seed systems **Group work and Discussion (30 minutes)** Calculate seedling requirements for the county/ward/farmer group and present.	• Group work • PowerPoint Presentation • Distribute Participants handouts • Brochures, Leaflets,
6.7.5 Module review (30 minutes)	**Session Guide**
(The facilitator leads the trainees in reviewing the module) **Plenary Discussion and presentation** Summarize the module together with the trainees and have a recap of the main components in: • Mango seed systems and their characteristics • Importance of using certified seed • Informal seed *(Discuss the knowledge acquired and skills learnt from this module with the trainees. What are the observations made by trainees from this module?)*	• The last Participants' handouts • Summarize the main points from the module on a flip chart and display

6.8 Participants' Handouts

- Mango production Guides [2019]
- Mango Booklet [2006]

MODULE 7

CLIMATE SMART AGRONOMIC PRACTICES FOR MANGO PRODUCTION

7.1 Introduction

Mango production has been an important income generating activity in Kenya. Due to poor crop management practices and unfavorable market structure, the production has declined drastically, thus reducing its economic importance. The Mango tree produces fruits during the rainy period of the year when food is in short supply in most parts of the mango growing areas. It is also drought tolerant with rainfall requirements of between 500 mm to 1200 mm per year. The tree has the potential of protecting the environment from the adverse effects of climate change. In addition, the mango plant is evergreen and has the ability of utilizing the carbon dioxide from the atmosphere thereby increasing the carbon sink and consequently reducing global warming.

Processed Mango products on the other hand still command favorable prices locally and globally and have a long shelf life. Mango remains a potential crop for income generation in Kenya. Various Mango production technologies have been developed over the years for use by farmers.

This module covers various aspects of climate smart agronomic practices. These includes; the importance of proper plant spacing in which the mango plants are established in the farm. Closer spacing will lead to overcrowding of the plants and hence lead to competition for nutrients as well as inadequate air and light penetration, As a result, the plants will harbor pests and diseases thereby leading to reduced yields. Pruning is also one of the major important agronomic practices that must be carried out on mangoes for the realization of high yields of quality fruits. The purpose of pruning is to remove dead and entangled branches as well as diseased branches. The canopy is also opened up during the process of pruning to allow more light and air penetration to the plant.

Coppicing and top working is yet another form of agronomic practice that is undertaken in mango orchards with the aim of rejuvenating the trees in order to ensure higher yields. The practice involves the cutting down of the upper portion of a tall mango tree and allowing it to sprout. The sprouted shoots are either grafted with scions of other mango varieties or left to grow in a well-managed manner to enable proper spraying and harvesting of fruits. In most cases, coppicing is done on old and tall mango trees that are difficult to manage as they are. Other forms of good agronomic practices include weeding of the mango fields to ensure that they are weed free at all times as well as fertilizer and manure application. The overall goal is to reduce the number of farmers obtaining low mango yields and to increase average yields of quality mangoes per tree in order to fetch better prices in the market.

7.2 Module Learning outcomes

By the end of the module the following training outcomes should be achieved:

1. The agronomic practices recommended for mango production identified.
2. Inputs and their right application rates for mango production described and explained.
3. Region-specific advice on agronomic practices for mango production explained.
4. The right timing for operations or inputs application in mango production described.

7.3 Module Target Group and Categories

This module is intended for county public agricultural extension staff and private service providers and lead farmesr in the mango value chain across the target counties.

7.4 Module users

This module is intended for use by Master Trainers who are members of the Core Team of Trainers (CTT) and Lead Farmers in the mango value chain target Counties. The facilitators using this module should thoroughly familiarize themselves with the participants' handouts (training materials).

7.5. Module Duration

The module is estimated to take 4 hours 30 minutes.

7.6 Module Summary

Module 7: Mango agronomic practices			
Sessions	**Training methods**	**Training materials**	**Time**
7.6.1 Introductions and climate setting	▪ Presenter introductions ▪ Self-introduction of trainees ▪ Plenary discussions	▪ Flips charts ▪ Marker pens ▪ Laptop ▪ Projector	30 minutes
7.6.2 Objectives and expectations	▪ Presentations ▪ Group work ▪ Plenary discussions to share expectations	▪ Flips charts ▪ Marker pens ▪ Laptop ▪ Projector	1 hour
7.6.3 Agronomic practices for Mango **production**	▪ Presentations ▪ Practical work ▪ Plenary discussions resulting from the farm visit	▪ Flips charts ▪ Marker pens ▪ Laptop ▪ Projector	1hour 30 minutes

7.6.4 Appropriate inputs and their application rates for optimum yields of Mango	▪ Presentations ▪ Group work ▪ Plenary discussions to share group work results	▪ Flips charts ▪ Marker pens ▪ Laptop ▪ Projector	1 hour
7.6.5 Module review and discussion	▪ Discussions/conclusion and way forward	▪ Flip charts ▪ Marker pens ▪ Laptop ▪ Projector	30 minutes
TOTAL			**4 hours 30 minutes**

7.7 Facilitator's Guidelines

Module 7: Climate smart agronomic practices for Mango	
7.7.1. Introduction, climate setting (30 minutes)	**Session Guide**
(The facilitator welcomes trainees to the module and invites them to introduce themselves and state their expectations).	• Summarize the facilitator/trainees involvement in mango value chains
7.7.2 Objectives and expectations (1 hour)	
Objectives (30 minutes) The facilitator presents the module objectives. By the end of the module training, the trainee should be able to: • Identify the agronomic practices recommended for Mango production. • Describe and explain inputs and their right application rates for mango production. • Explain region-specific advice on agronomic practices for mango production. • Describe the right timing for operations or inputs application in mango production. **Expectations (30 minutes)** The trainees to form discussion groups and list their expectations from the module.	• PowerPoint presentations • Group exercise • Expectations lists kept for later reviewing compliancy

7.7.3. Agronomic practices for Mango production (1 hour 30 minutes)	
Plenary Presentation (1 hour) The facilitator presents critical factors on: • Climate smart land preparation • Fertilizer recommendations • Climate smart optimal planting/ (seed rates, plant density) • Physiological maturity indices and harvesting • Innovative mango intercropping system • Mango orchard rehabilitation techniques **Discussions (30 minutes)** Questions/answers and comments	• PowerPoint Presentation • Groups discussions • Distribute participants' handouts/training materials
7.7.4. Appropriate inputs and their application rates for optimum yield of Mango (1 hour)	**Session Guide**
Group work (30 minutes) • The facilitator guides trainees to list and/or present the required inputs for use in mango production. • The trainees form county groups to provide lists of ,mango inputs and the application rates used by farmers. • The groups present their results in the plenary - opening up for some questions, answers and discussions. **Plenary presentation (30minutes)** The facilitator present on: • Recommended mango inputs (seeds, fertilizers, manures, etc.) • Input application rates • Input timing of their application for optimal yields of mangoes	• PowerPoint Presentation • Distribute participants • Groups discussions handouts/training materials
7.7.5. Module review (30 minutes)	**Session Guide**
(The facilitator leads the trainees in reviewing the module) Summary for the main points from the training • Objectives and expectations (review done on the basis of objectives and expectations listed earlier). • Trainees to randomly indicate new sets of skills and knowledge acquired from the module. • Randomly (average of 10 cases) Trainees to randomly highlight future undertakings in reference to the module.	• The last Participants' Handouts/training materials • Summarize the main points of the module on a flip chart and display

7.8 Participants' Handouts

1. Mango production Guides [2019]
2. Mango Booklet [2006]
3. Brochures on Soil and Water managements

MODULE 8

INTEGRATED SOIL AND WATER MANAGEMENT PRACTICES FOR MANGO PRODUCTION

8.1 Introduction

Poor soil conditions and unreliable availability of moisture in most smallholder Mango farming systems have been the main causes of low yields. Generally, Mango yields have continued to decline over the years due to increased soil acidity, mining of nutrients not supplied in the applied fertilizers and poor soil structure caused by failure to use the available sources of organic matter. Macronutrients [nitrogen (N), Phosphorus (P), Potassium (K) and Sulphur (S)] and micronutrients [zinc (Zn), Molybdenum (Mo) and Boron (B)] have been identified as deficient in Kenyan soils. Additionally, climate change has accelerated the decline of the agricultural sector performance thourough limited and unpredictable water availability for the Mango production systems.

Integrated Soil Fertility Management (ISFM), thourough conservation agriculture offers the best options for improving soil fertility in the advent of climate change adaptation. Mango as any other crop requires nutrient inputs for potential yield. If the nutrient is not balanced by application of manures and fertilizers, the yield and quality will decline apart from deterioration of soil health. Integrated use of organic manure and inorganic fertilizers provides sustainable yield while maintaining soil health.

Mango are mostly cultivated by smallholder farmers with minimal inputs. Drought management technologies to mitigate drought effects in Mango production are available. However, farmers have not realized the full benefits due to limited integration of the developed Integrated Natural Resource Management (INRM) and sustainable intensification practices in their Mango production systems.

This module introduces mango value chain to service providers, lead farmers, agriculture extension staff and facilitators to the importance of integrated soil and water management practices for enhanced mango production.

8.2 Module learning outcomes

By the end of the module, the following training outcomes should be achieved:

1. Soil composition, the various physical, chemical and biological properties, and what constitutes a healthy soil, including soil classification identified and explained
2. Soil and plant tissue sampling for laboratory analysis, interpretation and utilization of results from accredited laboratories in Kenya discussed and appreciated.
3. Soil fertility and plant nutrition for increased crop productivity (4R Stewardship that includes nutrient source and application rates, timing and placement) appreciated.
4. Soil health and Integrated Soil Fertility Management (ISFM) for climate resilient cropping explained
5. Water harvesting technologies, water quality for Mango production together with soil and water management identified

6. Knowledge and skills for identifying temporary or permanent decline in the productive capacity of land and how to solve soil degradation challenges identified
7. Occurrence of problematic soils and their management explained.

8.3 Module Target Group and Categories

This module is intended for Mango value chain service providers and County extension agents in the Mango producing regions.

8.4 Module Users

This module is intended for use by Master Trainers who are members of the Core Team of Trainers (CTT) and Lead Farmers in the Mango value chain target Counties. The facilitators using this module should thoroughly familiarize themselves with the participants' hand-outs (training materials).

8.5 Module Duration

The Module is estimated to take 7 hours.

8.6 Module Summary

Module 8: Integrated soil and water management practices for Mango production			
Sessions	**Training methods**	**Training materials**	**Duration**
8.6.1 Introduction, objectives and expectations	• Personal introduction • Presentations • Plenary discussions	• Flip charts • Marker pens • PowerPoint presentation	30 minutes
8.6.2 Soil composition, properties and health,	• Presentations • Practical's on how to conduct soil sampling and analysis	• Flip charts • Marker pens • PowerPoint presentation • Participants' handouts	30 minutes
8.6.3 Soil and plant tissue sampling and analysis	• Presentations • Field demonstrations (Conduct soil and plant tissue sampling and analysis)	• Flip charts • Marker pens • PowerPoint presentation • Participants' handouts	1 hour 30 minutes
8.6.4. Soil fertility and plant nutrition	• Presentations • Field demonstrations	• Flip charts • Marker pens • PowerPoint presentation • Participants' handouts	1 hour

8.6.5 Soil health and (ISFM) for climate resilient cropping systems	• Presentations • Field demonstrations	• Flip charts • Marker pens • PowerPoint presentation • Participants' handouts	1 hour
8.6.6 Soil and water management and water harvesting technologies	• Presentations • Field demonstrations	• Flip charts • Marker pens • PowerPoint presentation • Participants' handouts	1 hour
8.6.7 Soil degradation and reclamation	• Presentations • Field demonstrations	• Flip charts • Marker pens • PowerPoint presentation • Participants' handouts	30 minutes
8.6.8 Problematic soils and their management	• Presentations • Field demonstrations	• Flip charts • Marker pens • PowerPoint presentation • Participants' handouts	30 minutes
8.6.9 Module review and discussion	• Discussions	• Flip charts	30minutes
TOTAL			**7 hours**

8.7 Facilitator's Guidelines

Module 8: Integrated soil and water management practices for Mango production	
8.7.1. Introduction, Objectives and Expectations (45minutes)	**Session Guide**
(The facilitator welcomes trainees to the module and invites them to introduce themselves and state their expectations). **Module Objectives (30 minutes)** *(The facilitator presents modules objectives)* By the end of the module the trainee should be able to: • Explain soil composition and what constitutes a healthy soil, including soil classification. • Describe soil and plant tissue sampling for laboratory test analysis, interpretation and utilization of results from accredited laboratories in Kenya.	• Summarize trainees' "Expectations" and display. • PowerPoint presentation • Distribute participants' hand-outs on module • Objectives and training program

• Explain soil fertility and plant nutrition for increased crop productivity (4R Stewardship that includes Right source, Right application rates, Right timing and Right placement. • Describe soil health and Integrated Soil Fertility Management (ISFM) for climate resilient cropping systems. • Explain on water harvesting technologies, soil and water management • Demonstrate knowledge and skills for identifying temporary or permanent decline of land productive capacity and provide various solutions to soil degradation. • Describe the occurrence of problematic soils and their management.	
8.7.2. Soil composition, properties and health (1 hour)	**Session Guide**
(The facilitator presents on soil composition, properties and health) **Plenary Presentation (30 minutes)** Soil composition, properties and health • Description of soil composition • Description of soil properties • Describe what soil health is all about **Plenary Discussion (30 Minutes)** Let the trainees recall what they learnt and discuss any issues that may arise**.**	• PowerPoint presentation • Distribute participants' handouts • Brochures, leaflets and manual
8.7.3. Soil and plant tissue sampling and analysis (1 hour)	**Session Guide**
Plenary Presentation (30 minutes) • Overview of the soil sampling methods • Soil analysis results and interpretation • Overview of soil analysis results using available examples • Soil sampling guidelines **Practical exercise on soil sampling (30 minutes)** Demonstration on soil sampling method	• PowerPoint presentation • Distribute participants' handouts • Brochures, leaflets and manuals • Practical Demonstration

8.7.4. Soil fertility and plant nutrition (1 hour 15 minutes)	Session Guide
Plenary Presentation (1 hour) • Potential role of different soil management techniques in addressing soil fertility challenges in Mango smallholder farming systems • Integrated Soil Fertility Management techniques • Soil management guidelines **Plenary Discussion (15 Minutes)** Let the trainees recall what they learnt and discuss any issues that may arise.	• PowerPoint presentation • Distribute participants' hand-outs • Brochures, leaflets and manual
8.7.5 Soil health and (ISFM) for climate resilient cropping systems (30 minutes)	**Session Guide**
Plenary Presentation (20 Minutes) • Soil health • Introduce integrated soil fertility management (ISFM) • Soil health and ISFM for a climate resilient cropping system • Manure management, mulching, organic amendments and composting for increased use of organic manure for improving agricultural production • Conservation agriculture as a climate smart agriculture practice • Mango intercrop and crop rotation as climate resilient cropping systems such as (*Mucuna pruriens*, Dolichos Lab, *Clitoria ternatea*, cowpeas etc.). **Plenary Discussion (10 Minutes)** Let the trainees recall what they learnt and discuss any issues that may arise.	• PowerPoint presentation • Distribute participants' hand-outs • Brochures, leaflets and manual
8.7.6 Soil and water management and water harvesting technologies (1 hour)	**Session Guide**
Plenary Presentation (45 Minutes) • Principles of soil management for increased Mango productivity • Methods of tillage systems that conserve water for Mango use. • Principles of soil fertility management for increased Mango productivity	• PowerPoint presentation • Distribute participants' Handouts • Brochures, leaflets and manual

• Methods of soil fertility management for increased Mango productivity **Plenary Discussion (15 minutes)** Let the trainees recall what they learnt and discuss any issues that may arise.	
8.7.7 Soil degradation and reclamation (30 minutes)	**Session Guide**
Plenary Presentation (20 minutes) • Overview of soil degradation and reclamation. • Reclamation measures of degraded soil • Identification of the causes of soil degradation • Identification of reclamation measures of degraded soil **Plenary Discussion (10 minutes)** Let the trainees recall what they learnt and discuss any issues that may arise.	• PowerPoint presentation • Distribute participants handouts • Brochures, leaflets and manual
8.7.8 Problematic soils and their management (30 minutes)	**Session Guide**
Plenary Presentation (20 minutes) • Problematic soils and their management • Soils with unsuitable biological properties • Soils with unsuitable chemical properties • Soils with unsuitable physical properties **Plenary Discussion (10 Minutes)** Let the trainees recall what they learnt and discuss any issues that may arise.	• PowerPoint presentation • Distribute participants' Handouts • Brochures, leaflets and manual
8.7.9. Module review (30 minutes)	**Session Guide**
The facilitator leads the trainees in reviewing the module) Summarize the main points of the training review the main points together with the trainees. Discuss with trainees the new things learnt from this Module. Let them identify some of the problems and any other issues arising from the module.	• The last participants' handouts • Summary of the main points from the module on a flip chart and display

8.8 Reference Materials

8.8.1 Participants' Handouts

- Soil Management Extension Manual [KCEP-CRAL Manual 2019]
- Soil Management Leaflets [KCEP-CRAL PAMHPLETS 2019]
- OFRA Technical Training Manual

MODULE 9

MANGO CROP HEALTH

9.1 Introduction

The mango crop reliably yield highly in most arid and semi-arid lands (ASALs) of coastal, eastern and some parts of Rift valley. However, the cumulative effects of pests, disease pathogens and weeds on the yield, cost of production and quality of mango fruits cannot be underestimated. Further, an acute shortage of knowledge among mango farmers on the recommended crop health management options gets farmers frustrated and most of them may abandon the crop if timely interventions are not prioritized. Synthetic agro-chemicals are predominantly used as a control measure for most pests, disease pathogens and weeds and this practice poses long term hazardous impacts on soil biology and human health including terrestrial and aquatic ecosystems. Consequently, a proper insect pest, disease and weed management program is very crucial in minimizing losses and ensuring that both environmental and food safety concerns are adequately addressed. Available options for the control of these biotic impediments to high yields of mango fruit can cushion farmers. There is need to employ human and environmentally safe approaches to pest, disease and weed management so as to increase productivity and enhance food safety. Both cultural and chemical management are readily practical to farmers.

The right spacing of mango seedlings is the beginning of a health and reproductive crop. During vegetative growth the mango seedling/ tree need plenty of water moisture and fertile soil base. As weed, pests and diseases increase to compete and attack the young tree health management technologies/ techniques are required to keep the potential yield of the mango variety viable.

9.2 Module Learning Outcomes

By the end of the module, the following outcomes should be achieved:

1. Major pests, diseases and weeds identified.
2. Integrated pest, disease and weed management practices in Mango described.
3. Safe use of agro-chemicals (insecticides, fungicides and herbicides) appreciated and explained.

9.3 Module Target Group

This module targets public and private extension agents, service providers and lead farmers

9.4 Module Users

This module is intended for use by Master Trainers (ToTs) who are members of the Core Team of Trainers (CTT). The facilitators using this module should be well conversant with the participants' handouts.

9.5 Module Duration

This module is estimated to take 6 hours.

9.6 Module Summary

Module 9: Mango Crop Health			
Sessions	**Training methods**	**Training materials**	**Time**
9.6.1 Introduction, objectives and expectations	• Self-introductions • Group exercise • Plenary presentation • Plenary discussion	• Flips charts • Marker pens • PowerPoint presentation	30 minutes
9.6.2 Major pests that cause economic losses and their control methods	• Group work • Plenary presentation • Plenary discussion • Practical exercise	• Flips charts • Marker pens • Laptop/projector • Participants' handouts	1 hour
9.6.3 Sustainable Integrated Pests Management practices, scouting and thoureshold determination	• Plenary presentations • Plenary discussion	• Flip charts • Marker pens • Laptop/ projector • Participants/ handouts	30 minutes
9.6.4 Major Mango diseases that cause economic losses and conditions that favor their development including their control methods	• Group work • Plenary Presentation • Plenary discussion • Practical exercise	• Flip charts • Marker pens • Laptop/Projector • Participants' handouts	1 hours
9.6.5 Sustainable Integrated Management of Mango diseases and scouting for thoureshold determination	• Presentations • Plenary discussion • Field demonstration	• Flip charts • Marker pens • Laptop/ projector • Participants' handouts	1 hour
9.6.6 Integrated weed management (Major weeds of mango)	• Plenary Presentation • Plenary discussion • Field demonstration	• Flip charts • Marker pens • Projector • Laptop • Participants' handouts	1 hour
9.6.7 Safe use of agro-chemicals and update source for registered agro-chemicals (PCPB registered products)	• Presentations • Practical • Plenary discussion	• Laptop/projector • Flip charts • Marker pens • Participants' handouts	30 minutes

9.6.8 Module Review	• Plenary discussions • Take away messages	• Flip charts • Marker pens • Participants' handouts	30 minutes
TOTAL			**6 hours**

9.7 Facilitator's Guidelines

Module 9: Mango Crop Health	
9.7.1. Introduction and levelling of expectations and objectives (30 minutes)	**Session Guide**
Introduction (15 minutes) *(The facilitator welcomes trainees to the module on mango crop health. They are then invited to introduce themselves and state their expectations thourough group work)* **Module Objectives (15 minutes)** *(The facilitator presents modules objectives)* By the end of the module, the trainee should be able to: • Identify major pests, diseases and weeds • Describe and explain integrated pest, disease and weed management in Mango • Explain safe use of agro-chemicals (pesticides, fungicides and herbicides)	• Summarize trainees' "Expectations" • PowerPoint presentation • Participants' handouts
9.7.2. Major Mango pests that cause economic losses and their control methods; emerging/migratory pests (1 hour)	**Session Guide**
(The facilitator makes a presentation on the common Mango pests that are of economic importance) **Group work (15 minutes)** • Trainees to share mango pest information from their respective Counties **Plenary Presentation (20 minutes)** • Names of pests and their descriptions • Symptoms of their infestation/type of damage • Data on economic significance of the common mango pests **Practical exercise (15 minutes)** • Identification of mango pests from provided specimens **Discussion (10 minutes)** • Let the trainees recall what they learned and discuss any issue that may arise	• PowerPoint presentation • Group exercise • Practical exercise • Participants' handouts

9.7.3. Sustainable Integrated Pest Management (IPM) practices in Mango: scouting and thoureshold determination (30 minutes)	Session Guide
Plenary Presentation (20 minutes) • IPM principles; how to implement them with a focus on cultural, physical, biological and chemical pest management options. • Critical considerations for proper scouting • Thoureshold determination and when to implement control measures • An overview on the safe use of agro-chemicals (demonstration on how to select most suitable pesticides, for the management of pests in mango orchards). **Discussion (10 minutes)** Let the trainees recall what they learned and seek clarification on the principles of sustainable IPM options	• PowerPoint presentation on scouting for pests • Participants' handouts (brochures, • Leaflets and manuals on pest species on mango
9.7.4. Major Mango diseases that cause economic losses, conditions that favour their development and their control methods (1 hour)	**Session Guide**
Group work (15 minutes) • Determination of Mango diseases in specific counties **Plenary Presentation (15 Minutes)** • Presentations on Mango diseases and conditions that favor their development **Practical Exercise (30 Minutes)** • Identification of major disease species causing economic o damage based on samples presented	• PowerPoint presentation • Participants' handouts • Disease identification guidelines • Practical Exercise
9.7.5. Sustainable Integrated Diseases Management (IDM); scouting and thoureshold determination (1 hour)	**Session Guide**
Plenary presentation (30 minutes) • Critical considerations for scouting and when to implement Mango disease control measures • Presentation on Integrated Disease Management (IDM) in Mango • An overview on the safe use of recommended agro-chemicals (demonstration on how to select most suitable fungicides for the management of major Mango diseases) **Field visit (30 minutes)** - Visit to a nearby Mango field for collection and identification of diseased mango plant samples	• PowerPoint presentation • Participants' handouts • Disease management guidelines • Field demonstration

9.7.6 Integrated weed management of Major weeds of Mango (1 hour)	Session Guide
Plenary presentation (45 minutes) • Identification of weeds • Major types of weed in the mango field • Integrated Weed Management **Plenary discussion (15 minutes)** Integrated weed management	• PowerPoint presentation • Participants' Handouts • Plenary discussion
9.7.7. Module review (1 hour)	**Session Guide**
(The facilitator leads the trainees in reviewing the module) Summarize the main points of the training: The facilitator should review the following main points about climatic conditions suitable for Mango production: • Major pests of Mango and their economic impacts in production • Integrated Pest Management (IPM) options for mango crop • Major diseases of mango and their economic impact in production • Integrated Disease Management (IDM) options for mango • Major weeds of mango and their economic impacts in production • Integrated Weed Management (IWM) options for mango *(Discuss with trainees the new things learnt from this Module. What are some of the issues that need clarification)?*	• The last participants' handouts • Summarize the main points from the module on a flip chart and display

9.8. Participants' handouts

1. Fact sheets on mango pest identification and control.
2. Factsheets on mango disease identification and their control.
3. Factsheets on mango weeds identification and their management.
4. Weed Management Manual. by Mwangi, H.W. KALRO-Kabete.

MODULE 10

MANGO HARVESTING AND POSTHARVEST MANAGEMENT

10.1. Introduction

This module is designed for training facilitators of FFBS in knowledge and skills that are useful in postharvest handling of mango. Mango destined for markets should be harvested using appropriate harvesting techniques and at the right time. This ensures good quality of produce with long shelf-life. Many mango value chain actors are not familiar with the appropriate harvesting and postharvest handling of mango. Mangoes are delicate and highly perishable and if not handled properly after harvesting losses between 30-50% occur.

Careful handling of mango from harvesting up to market ensures maintenance of good quality. Farmers and other actors at these value chain levels do not always follow recommended practices. This leads to high postharvest losses. There is need to sensitize farmers and other mango value chain actors on importance of proper harvesting and postharvest handling of mango and capacity build them on best practices that include determination of maturity indices, harvesting technique, appropriate harvesting and holding containers, sorting and grading, precooling at farm level, packaging and transportation.

10.2 Module Learning Outcomes

By the end of the module the participants should be able to:

1. Identify the maturity indices for mango destined for various markets.
2. Identify quality attributes of mango that need to be preserved during postharvest handling.
3. Explain/demonstrate the appropriate harvesting technique and harvesting containers for mango.
4. Explain the whole range of postharvest practices for mango from harvesting to marketing.
5. Explain use the low cost cooling units at farm level namely charcoal cooler and Zero energy cooler.

10.3 Module Target Group

This module targets public and private agricultural extension agents, lead farmers and service providers, based at sub county and ward level.

10.4 Module Users

This module is intended for use by Master Trainers who are members of the Core Team of Trainers (CTT) and Lead Farmers in the mango value chain target Counties. The trainers using this module should thoroughly familiarize themselves with the participants' handouts (training materials).

10.5 Module Duration

The Module is estimated to take 3 hours.

10.6 Module summary

Module 10. Mango Harvesting and Postharvest management			
Sessions	**Training Methods**	**Training Materials**	**Time**
10.6. 1. Introduction, Expectations Objectives	• Personal introduction • Group exercise • Plenary presentation	• Flip charts • Felt pens • Projector • Laptop	30 minutes
10.6.2. Constraints and opportunities in postharvest handling of mango	• Group Exercise • Plenary presentations	• Flip charts • Felt pens • Participants' handouts • Videos	1 hour
10.6.3. Mango Postharvest chain TIMPs	• Group exercise • Plenary presentation • Practical demonstration • Video presentation	• PowerPoint • Participants' handouts • Materials for demos	1 hours 10 minutes
10.6.4. Module review	• Facilitator's summary • Group exercise	• Flip charts • Projector • Module evaluation forms	20 minutes
TOTAL			**3 hours**

10.7 Facilitator's guidelines

Module 10: Mango Harvesting and Postharvest management	
10.7.1 Introduction and levelling of expectations and objectives (30 minutes)	**Session Guide**
Introduction and Expectations *(The facilitator welcomes trainees to the module and thereafter trainees are invited to introduce themselves and state their expectations)* **Module objectives (20 minutes)** (The facilitator presents module's objectives) By the end of the module trainees should be able to: • Describe the whole range of postharvest handling practices for Mango	• Participants Handouts • PowerPoint presentation • Summarize trainees' expectations and display on flip chart/ board.

• Explain the constraints and opportunities in Mango postharvest value chain • Appreciate climate smart and gender-friendly postharvest TIMPs for minimizing the losses and enhancing quality of mango	
10.7.2 Constraints and opportunities in postharvest handling of Mango (1 hour)	**Session Guide**
(Highlight the Mango postharvest value chain – harvesting, and postharvest handling among others) **Group exercise (20 minutes)** • Trainees discuss constraints in the postharvest handling of Mango, and suggest solutions **Plenary presentation (40 minutes)** Trainees present results of group work in plenary	• PowerPoint presentation • Participants' Handouts
10.7.3 Mango postharvest handling practices TIMPs (1 hour 10 minutes)	**Session Guide**
(Facilitator uses slides to train) **PowerPoint Presentation (40 minutes)** PowerPoint presentation on the operations in mango harvesting and postharvest handling practices • Maturity indices and harvesting of mango (importance of harvesting at the right maturity index, advantages and disadvantages of harvesting too early or too late) • Preparations farmers need to make prior to harvesting • Mango harvesting methods • Harvesting containers • Mango cooling • Packaging and transportation **Practical demonstrations (30 minutes)** • Sorting and grading (a sample of mango purchased from the market and grading into various grades with reference to any existing standards)	• PowerPoint presentation • Participants' handouts

10.7.4 Training review (20 minutes)	Session Guide
(The facilitator should be able to lead the trainees in reviewing the module) **Plenary presentation (15 min)** Together with the trainees, summarize the main points of the training. **Group Exercise (5 min)** Together with the trainees review the main points about mango post-harvest handling practices • What new things did you learn from this module? • What are some of the problems and issues that you have become more aware of in harvesting and postharvest handling practices of mango? • What questions do you still have about post-harvest handling in mango?	• PowerPoint presentation • Participants' handouts • Summary of the main points from the Module

10.8. Participant's Handouts

- Mango post-harvest handling Fact sheets

MODULE 11

MANGO VALUE ADDITION

11.1. Introduction

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, this increases their economic value thus giving better returns to various value chain actors. 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. This module is therefore designed for training facilitators to acquire skills that are useful in adding value to mango.

11.2 Module Learning Outcomes

By the end of the module, the following outcomes should be achieved:

1. The role of mango as a food and nutrition security crop explained and appreciated.
2. Nutritional composition of mango and its health benefits, food security and income described.
3. Constraints in value addition and consumption of mango, and suggest solutions identified.
4. Mango-based value added products identified and explained.

11.3 Module Target Group

This module targets public and private extension agents, service providers and lead farmers.

11.4 Module Users

This module is intended for use by Master Trainers who are members of the Core Team of Trainers (CTT) and Lead Farmers in the mango value chain target Counties. The trainers using this module should thoroughly familiarize themselves with the participant's handouts (training materials).

11.5. Module Duration

The Module is estimated to take 6 hours.

11.6. Module Summary

Module 11. Mango value addition			
Sessions	**Training Methods**	**Training Materials**	**Time**
11.6.1. Introduction, Objectives Expectations	• Personal introduction • Group work • Plenary Presentation	• Flip charts • Projector • Laptop	30 minutes
11.6.2 Role of Mango as a food and nutrition security crop	• PowerPoint Presentation • Group exercise • Plenary Presentation	• Flip charts • Felt pens • Projector • laptop • Participants' handouts	50 minutes
11.6.3. Nutritional composition of Mango and its role in human health	• PowerPoint • Plenary presentation • Group exercise	• PowerPoint presentation • Flip charts • Felt pens • Participant handouts	50 minutes
11.6.4. Constraints in value addition and consumption of Mango	• Group exercise • Plenary Presentation	• List of value added products • Checklist for prioritization • Pair wise ranking tool • Flip charts • Felt pens • Participants' handouts • Projector • Laptop	1 hour 10 minutes
11.6.5 Mango based value added products:	• Plenary Presentations • Plenary discussion • Sensory evaluation of value added Mango products	• Projector • Laptop • Participant handouts • Assorted value addition equipment and ingredients (Mango pulp, Mango flours, among others.)	2 hours
11.6.6. Module review	• Plenary discussion • Presentations	• Flip charts • PowerPoint presentations • Module evaluation forms	40 minutes
TOTAL			**6 hours**

11.7. Facilitator's Guidelines

Module 11. Mango value addition	
11.7.1 Introduction, expectations and objectives (30 minutes)	**Session Guide**
Introduction and expectations (25 minutes) *(The facilitator welcomes trainees to the module on value addition of Mango. They are then invited to introduce themselves and state their expectations)* **Module Objectives (5 minutes)** *(The facilitator presents modules objectives.)* By the end of the module, the trainee should be able to • Appreciate the role of Mango as a food and nutrition security crop • Describe nutritional composition of Mango, health benefits, food security and income • Identify constraints in value addition and consumption of Mango, and suggest solutions • Explain how to make Mango-based value added products • Explain the use of Mango straw as a nutritive livestock feed (hay, feed block, pellets and silage, among others	• Participants' handouts • PowerPoint Presentation • Summarize trainees' expectations and display on flip chart/board.
11.7.2 Role of Mango as a food and nutrition security crop (50 minutes)	**Session Guide**
(The facilitator presents on malnutrition cases in Kenya and the importance of Mango in addressing food security and malnutrition challenges) **Plenary Presentation (15 minutes)** PowerPoint presentation highlighting the critical elements: • Micronutrient malnutrition cases in Kenya • Dietary nutrient requirements (focusing on VMGs) **Group Exercises (35 minutes)** Trainees discuss in groups, the main malnutrition challenges in their respective counties / regions	• PowerPoint presentation • Participants' handouts • Recipe books • Sample Mango and other processing ingredients • Group exercise

11.7.3 Mango nutritional composition and impact of consumption on human health (50 minutes)	
Plenary presentation (50 minutes) • Overview of the documented mango nutritional composition and their role in human health and nutrition	• PowerPoint • Participant handouts • Brochures, leaflets, manual, factsheets, posters
11.7.4. Constraints in value addition and consumption of Mango, and suggested solutions (1hour 10 minutes)	**Session Guide**
Group exercise(40 minutes) Groups discuss the constraints in Mango value addition and consumption **Plenary presentation (30 minutes)** Overview of constraints in value addition and consumption of Mango.	• PowerPoint presentation • Group Exercise
11.7.5 Mango based value added products (2 hours)	**Session Guide**
Plenary presentation (1 hour 30 minutes) • Overview of mango based value added products • Meaning of value addition • Requirements for value addition of mango • Mango based value added products **Practical exercise (30 minutes)** • Demonstration on formulation of mango based products	• Leaflets • Sensory evaluation forms • Assorted value addition equipment and ingredients
11.7.6 Training review (40 minutes)	**Session Guide**
(The facilitator leads the trainees in reviewing he module) Review the main points about Mango value addition together with the trainees. • What new things did you learn from this Module? • What are some of the problems and issues that you have become more aware of in Mango value addition? • What questions do you still have about Mango value addition?	Summary of the main points from the Module.

11.8. Participants' Handouts

- Mango Manual
- Pamphlets, leaflets.
- Recipe books

MODULE 12

MECHANIZATION OF MANGO PRODUCTION ACTIVITIES

12.1 Introduction to the module

Mechanization supports agriculture through enhancing production, productivity and profitability in agriculture by achieving timeliness of farm operations. It comes along with precision in metering and placement of inputs, reducing susceptibility to input losses, increasing utilization efficiency of costly inputs (seed, chemical, fertilizer, irrigation, water. etc.), reducing unit cost of production, enhancing profitability and competitiveness in the cost of operation. It also benefits conservation of agricultural produce and by-products from qualitative and quantitative damages; enables value addition and establishment of agro processing enterprises for additional income and employment generation from farm produce. Agricultural mechanization is one of the important inputs that has potential to revolutionize Mango farming in Kenya especially when applied to planting, weeding, pest control, harvesting and post-harvest activities.

12.2 Module Learning outcomes

By the end of the module section the following outcomes should be achieved:

1. Climate smart tillage options identified and explained
2. Bush clearing machines demonstrated
3. Tractor mounted hole auger described and explained
4. Semi-automatic seedling grafting robot equipment demonstrated
5. Seedling planting machine demonstrated
6. Use of pest control implements and tools demonstrated
7. Use of tree crop power pruner explained
8. Harvesting machine equipment demonstrated

12.3. Module Target Group and Categories

This module is intended for private service providers and county public extension agents and lead farmers.

12.4. Module Users

This module is intended for use by Master Trainers who are members of the Core Team of Trainers (CTT). The facilitator using this module should thoroughly familiarize themselves with the participant's handouts.

12.5. Module Duration

The Module is estimated to take 4 hours.

12. 6. Module Summary

Module 12. Mechanization of Mango production activities			
Sessions	**Training methods**	**Training materials**	**Duration**
12.6.1 Introduction, objectives and expectations	• Personal introductions/ know your audience • Presentations • Plenary discussions	• Flip charts • Power Point Presentations	20 minutes
12.6.2 Climate smart tillage options	• Presentations • Plenary discussions	• Flip chart • Power Point presentation • Participants' handouts	10 minutes
12.6.3 Bush clearing machines	• Presentations • Plenary discussions	• Flip chart • Power Point presentation • Participants' handouts	30 minutes
12.6.4 Tractor mounted hole digger described and explained	• Presentations • Plenary discussions	• Flip chart • Power Point presentation • Participants' handouts • Practical	15 minutes
12.6.5 Semi-automatic seedling grafting robot equipment explained	• Presentations • Plenary discussions	• Flip chart • Power Point presentation • Participants' handouts • Practical	30 minutes
12.6.6 Seedling planting machine	• Presentations • Plenary discussions	• Flip chart • Power Point presentation • Participants' handouts • Practical	15 minutes
12.6.7 Pest control equipment and tools	• Presentations • Plenary discussions	• Flip chart • PowerPoint presentation • Participants' handouts • Practical	1 hour

12.6.8 Tree crop power pruner equipment	• Presentations • Plenary discussions	• Flip chart • PowerPoint presentation • Participants' handouts • Practical	30 minutes
12.6.9 Harvesting machine equipment operating principles	• Presentations • Plenary discussions • Demonstrations	• Flip chart • PowerPoint presentation • Participants. handouts • Practical	15 minutes
12,6.10 Module review	• Presentations	• PowerPoint presentation	15 minutes
TOTAL			**4 hours**

12.7 Facilitator's Guidelines

Module 12: Mechanization of Mango production activities	
12.7.1 Introduction, Objectives and Expectations (20 minutes)	**Session Guide**
(The facilitator welcomes trainees to the module on Mango harvesting and post-harvest management that help reduce the post-harvest losses. They are then invited to introduce themselves and state their expectations) **Module Objectives (20 minutes)** The facilitator presents modules objectives By the end of the module the trainee should be able to: • Identify and explain various climate smart tillage operations • Describe and explain tractor mounted hole digging operations • Describe and explain tractor mounted bush clearing operations • Describe a tractor mounted hole digger • Demonstrate semi-automatic seedling grafting robot equipment • Demonstrate planting seedling machine • Demonstrate pest control equipment and tools, usage • Demonstrate Tree crop power pruner equipment • Demonstrate harvesting machine equipment *In each case stating approximate prices and availability of machines	• Summarize trainees' "Expectations" and display. • PowerPoint Presentation • Distribute Participants' Handouts on Module Objectives and Training Program

12.7.2. Mango climate smart land preparation tools (30 minutes)	Session Guide
(The facilitator presents on the commonly known Mango pests that are of economic importance) **Plenary Presentation (20 minutes)** PowerPoint Presentation Highlighting: • Overview of the Mango mechanization activities • Climate smart tillage options **Discussion (10 minutes)** Let the trainees recall what they learned and discuss any issue that may arise	• PowerPoint presentation • Distribute participants' handouts • Brochures, leaflets and manual • All participants
12.7.3. Bush clearing machines (10 minutes)	**Session Guide**
Plenary Presentation (5 minutes) PowerPoint Presentation Highlighting on: • Description and explanation of bush clearing machines **Discussion (5 Minutes)** Let the trainees recall what they learned and discuss any issue that may arise.	• PowerPoint presentation • Distribute participants' handouts • Brochures, leaflets and manual
12.7.4 Tractor mounted hole digger (15 minutes)	**Session Guide**
Plenary Presentation (20 minutes) PowerPoint Presentation Highlighting on: • Description and explanation of tractor mounted hole digging operations **Discussion (5 Minutes)** Let the trainees recall what they learned and discuss any issue that may arise.	• PowerPoint presentation • Distribute participants' handouts • Brochures, leaflets and manual
12.7.5 Demonstration of semi-automatic seedling grafting robot equipment (30 minutes)	**Session Guide**
Plenary Presentation (20 minutes) PowerPoint Presentation Highlighting on: • Description and explanation of semi automatic seedling grafting robot **Discussion (10 Minutes)** Let the trainees recall what they learned and discuss any issue that may arise.	• PowerPoint presentation • Distribute participants' handouts • Brochures, leaflets and manual

12.7.6 Demonstration seedling planting machine (30 minutes)	Session Guide
Plenary Presentation (20 minutes) PowerPoint Presentation Highlighting on: • Description and explanation of seedling planting machine **Discussion (10 minutes)** Let the trainees recall what they learned and discuss any issue that may arise.	• PowerPoint presentation • Distribute participants' handouts • Brochures, leaflets and manual
12.7.7 Demonstration of pest control implements and tools	**Session Guide**
Plenary Presentation (40 minutes) PowerPoint Presentation Highlighting on: • Description and explanation of pest control implements and tools usage **Discussion (20 minutes)** Let the trainees recall what they learned and discuss any issue that may arise.	• PowerPoint presentation • Distribute participants' handouts • Brochures, leaflets and manual
12.7.8 Demonstration of tree crop power pruner	**Session Guide**
Plenary Presentation (20 minutes) PowerPoint Presentation Highlighting on: • Description and explanation of tree crop power pruner **Discussion (10 minutes)** Let the trainees recall what they learned and discuss any issue that may arise.	• PowerPoint presentation • Distribute participants' handouts • Brochures, leaflets and manual
12.7.9 Mango harvesting machine operating principles (15 minutes)	**Session Guide**
Plenary Presentation (10 minutes) PowerPoint Presentation Highlighting on: • Techniques and methods of harvesting machine operating **Discussion (5 minutes)** Let the trainees recall what they learnt and discuss any issues that may arise	• PowerPoint presentation • Distribute participants' handouts • Brochures, leaflets and manual

12.7.7 Module review (15 minutes)	Session Guide
The facilitator leads the trainees in reviewing the module) Summarize the main points of the training and together with the participants review the main points: • Demonstrate; • Various climate smart tillage operations • Various tractor mounted hole auger • Operations of a semi-automatic seedling grafting robot equipment • Describe and demonstrate seedling planting machine • Demonstrate and describe chemical implements and tools operations • Demonstrate and describe a tree crop power pruner equipment • Demonstrate and describe a harvesting machine equipment *(Discuss with trainees about new things learnt from this Module. What are some of the problems and issues that they have become more aware of in the module?)*	· The last participants' handouts · Summarize the main points from the module on a flip chart and display

12.8. Participants' Handouts

- KCSAP Mango Manual
- Pamphlets, leaflets.

MODULE 13

MANGO BUSINESS AND MARKERTING

13.1 Introduction

Mangoes are produced in nearly all Kenya's regions. The main growing areas are Eastern and Coast regions which, combined, have 79% of national acreage. Currently, the Lower Eastern region is the leading producer of mangoes in Kenya, where the subsector supports livelihoods of over 60,000 rural households. Over the past decade, Mango *(Mangifera indica)* farming in Kenya has expanded considerably, both in acreage and geographical spread. The exponential growth of the industry has been stimulated by increasing demand for mangoes in domestic, regional and international markets, and the fruit is considered a major income earner for many smallholder farming households in arid and semi-arid regions. Nationally, there is a high variance in mango productivity in the different regions: among the two leading mango-producing regions, Coast region has lower productivity compared to Eastern region. The key driver of variance in productivity per unit is the level of farm management practices. Therefore, there is need to improve production of mangoes through market-orientation. This module is designed to train Trainer of Trainers (ToT) in skills that are useful in Mango farming business and marketing in Kenya.

13.2 Module Learning Outcomes

By the end of this module, participants are expected to:

1. The business concept, transitioning from subsistence to commercialization, risk management, and emerging farming business models explained and appreciated
2. Planning a farm business using SWOT Analysis, farm budgeting and business plan described
3. Tools for managing and implementing a farm business, record keeping, performance (break-even, gross-margin, benefit-cost ratios) and entrepreneurship skills explained and described.
4. Details of a Small Farm Business Plan and financing developed and shared
5. Marketing approaches and strategies of Mango mapped and identified

13.3 Module Target Group

This module targets agricultural extension, service providers and lead farmers.

13.4 Module Users

This module is intended to be used by a Master Trainer who is among the members of the core team trainers. The facilitator using this module should thoroughly familiarize and avail the participants' handouts.

13.5 Module Duration

The Module is estimated to take 2 hours.

13.6. Module Summary

Module 13. Mango Business and Marketing			
Sessions	**Training Methods**	**Training Materials**	**Time**
13.6.1. Levelling of participants' expectations about the module	Personal introduction Discussion	PowerPoint Flip charts	15 minutes
13.6.2. Module introduction, Objectives Expectations	Personal introduction Presentation Plenary presentations	Flip charts PowerPoint	10 minutes
13.6.3. Business concept and emerging farming business models	Plenary presentations Plenary Discussion	Power point Flip charts, pelt pens	10 minutes
13.6.4. Building a business plan	Plenary presentations	PowerPoint	20 minutes
13.6.5 Marketing as a group - collective marketing	Plenary presentations Plenary Discussion	PowerPoint	10 minutes
13.6.6 Profitability analysis - Reviewing Mango agro enterprise performance	Plenary presentations	PowerPoint	10 minutes
13.6.7 Scaling up plan	Plenary presentations	PowerPoint	10 minutes
13.6.8 Contracted production model	Plenary presentations	PowerPoint	10 minutes
13.6.9 Mango marketing entrepreneurship model	Plenary presentations	PowerPoint	10 minutes
13.6.10 Internet/mobile marketing	Plenary presentations	PowerPoint	10 minutes
13.6.11. Training review	Facilitator's summary: Takeaways	Module review Participants Handouts	5 minutes
TOTAL			**2 hours**

13.7 Facilitators Guidelines

Module 13. Mango Business and Marketing	
13.7.1 Levelling participants' expectations about the module (15 minutes)	**Session Guide**
(The facilitator welcomes trainees to the module on Mango farming as a business and marketing strategies and introduces him/herself by stating his/her profile and experience.)	• Handouts • Program • Note books • pens • PowerPoint slides
13.7.1.2 Participants expectations (15 minutes)	
(The facilitator asks the trainees to state their expectations by listing on a flip chart) Plenary Discussion .	• Summarize trainees' "Expectations" and display on flip chart/board.
13.7.2 Module introduction, objectives and expectations (10 minutes)	
(The facilitator introduces the module and states the objectives and expectations) By the end of this module, participants are expected to: • Understand business concept and appreciate emerging farming business models for organizing farmer groups • Acquire skills for building a business plan • Be able to facilitate marketing as a group - collective marketing • Acquire skills for profitability analysis - Reviewing Mango agro - enterprise performance • Be able to facilitate scaling up plan mango production • Understand the benefits and challenges in implementation of contracts. • Understand the farmer as an entrepreneur • Acquire skills for Internet/mobile marketing	• PowerPoint slides • Factsheets
13.7.3 Business concept and emerging farming business models (10 minutes)	**Session Guide**
(The facilitator to highlight elements of business concept and emerging farming business models) **Plenary Presentation (5 minutes)** Make presentation on the business concept and emerging farming business models **Group Exercise (5 minutes)** Discuss areas of improvement in the models	• PowerPoint slides • Handouts • Flipcharts

13.7.4 building a business plan (20 minutes)	Session Guide
(The facilitator highlights the components of a business plan and how to build it) Plenary Presentation **(15 minutes)** Plenary Discussion **(5 minutes)**	• Handouts • Flip charts, • Manila papers, • Pelt pens
13.7.5 Marketing as a group - collective marketing (10 minutes)	**Session Guide**
Plenary Presentation **(5 minutes)** (*The facilitator describes how the farmers should organize themselves to market Mango)* • Advantages of collective marketing • Problems with collective marketing • Organizing collective marketing Plenary Discussion **(5 minutes)**	• Use power point • Handouts
13.7.6 Profitability analysis - Reviewing Mango agro-enterprise performance (10 minutes)	**Session Guide**
Plenary Presentation **(5 minutes)** (*The facilitator highlights the usefulness of the profitability analysis)* • Reworking the profitability analysis using actual amounts of produce that were sold, actual material and labour costs and actual sales prices • Reworking sales amounts with the farmers in the group to determine their levels of profit • Calculating costs, income and profits Plenary Discussion **(5 minutes)**	• Use power point • Handouts
13.7.7 Scaling up plan (10 minutes)	**Session Guide**
Plenary Presentation **(10 minutes)** (*The facilitator highlights how farmers begin to organize a new plan with higher targets, or more lucrative markets and more farmers involved in production and sales, to target buyers).* • Reviewing market strategy • Fixing the new target • Identifying the appropriate scaling method	• Use power point • Handouts
13.7.8 Contracted production model (10 minutes)	**Session Guide**
Plenary Presentation **(5 minutes)** (*The facilitator highlights the details of contracted mango production* • Essence and objectives of contract farming • Key components of a contract	• Use power point • Handouts

• Benefits and challenges in implementation of contracts • Critical issues to look at before signing a contract • The role of government and its arms in contract management Plenary Discussion (5 minutes)	
13.7.9 Mango marketing entrepreurship model (10 minutes)	**Session Guide**
Plenary Presentation **(5 minutes)** (*The facilitator highlights the characteristics of farmers as entrepreneurs)* • The role of entrepreurship in mango marketing • The characteristics of farmers as entrepreneurs *Plenary Discussion **(5 minutes)***	• Use power point • Handouts
13.7.10 Internet/mobile marketing (10 minutes)	**Session Guide**
Plenary Presentation **(5 minutes)** (*The facilitator highlights the usefulness of Internet/mobile marketing)* • Advantages of internet/mobile marketing • How to interact with buyers thourough the use of internet **Plenary Discussion (5 mi*nutes)***	• Use power point • Handouts
13.7.11 Training review (5 minutes)	**Session Guide**
(The facilitator leads the trainees in reviewing the module. Conclude by thanking the trainees) **Plenary Discussion (5 minutes)** Summarize the main points of the training	Summary of the main points from the Module.

13.8 References

Financial Sector Deepening Kenya (FSD Kenya) (2015). Financing the mango value chain: A case study of Lower Eastern Kenya.

Kenya Horticultural Development Program (KHDP) (2010). Market Opportunities for Mango Growers.

MODULE 14

MANGO CROSS-CUTTING ISSUES (AGRICULTURAL INNOVATION PLATFORMS, POLICY, GENDER MAINSTREAMING AND SOCIAL INCLUSION)

14.1 Introduction

This module on cross-cutting issues comprises of issues that influence the uptake and up-scaling of TIMPs within the Onion value chain. The issues are namely Agricultural Innovation Platforms (AIPs), Gender and social-environmental concerns and Climate smart agricultural policy. The AIPs provide a forum for stakeholders to interact and develop technical, institutional and organizational innovations to solve value chain challenges. Additionally, Gender and social-environmental concerns are considerations aimed at providing appropriate solutions to value chain challenges with due regard to graduated gender considerations. Finally, Climate smart agricultural policy creates awareness on policy formulation and the various regulations that are put in place to facilitate the development of value chains. The methodology of delivery for each of these sub modules are presented here.

SUB-MODULE 14.1
AGRICULTURAL INNOVATION PLATFORMS

14.1.1. Introduction

This module exposes the extension staff, service providers, lead farmers and facilitators to an innovation systems based configuration of stakeholders called the Agricultural Innovation Platform (AIP). It is an organizational model for stimulating innovation and development and brings actors together in a way that pools together skills and knowledge to address challenges and utilize opportunities. The AIP configuration emanated from the realization that innovations arise from multiple sources and have to be adapted to specific contexts. The adaptation process requires systems that foster partnerships and reflexive institutions which allow for learning and innovation. The actors or partners within innovation platforms include individuals, private and public sector organizations, policy makers and other value chain stakeholders. These actors are brought together to seek technical, institutional or organizational solutions to a critical challenge hindering agricultural productivity within a value chain. The Agricultural Innovation Platform facilitates actors to interact, innovate, learn and change with time as they seek a solution to the common challenge. In an innovation platform every actor's contribution is valued and benefits accrue to all in a win-win situation. The AIP is a useful methodology for developing, testing and scaling of innovations in the Mango value chain.

14.1.2. Sub-Module learning Outcomes

By the end of the module, the following outcomes must be achieved:

1. The definition of agricultural innovation systems and innovations clearly described and understood.
2. The characteristics of an innovation platform described and understood.

3. Mobilization of stakeholders for initiation, establishment, management and sustainability of an Agricultural Innovation Platform explained and demonstrated.
4. The benefits and challenges of Innovation Platforms explained and understood.

14.1.3 Sub-Module Target Group and Categories

The target users are public county extension officers, private agricultural service providers, and lead farmers.

14.1.4 Sub-Module Users

This module is intended for use by Master Trainers who are members of the Core Team of Trainers (CTT). The facilitator using this module should thoroughly familiarize themselves with the participants' handouts.

14.1.5 Sub-Module Duration

The Module is estimated to take a duration of 2 hours.

14.1.6 Module Summary

Sub-Module 14.1 Agricultural Innovation Platforms (AIP)			
Sessions	**Training methods**	**Training materials**	**Time**
14.1.6.1 Introduction, objectives and expectations	• Personal introduction • Plenary presentations • Plenary discussion	• Flips charts • Felt pens • Projector • PPT presentation	10 minutes
14.1.6.2 Definition of Agricultural Innovation Systems and different types of innovations (technical, institutional and organizational	• PowerPoint Presentations • Plenary discussion • Group exercise	• Flips charts • Felt pens • Projector • PPT presentation	30 minutes
14.1.6.3 Characteristics of an Agricultural Innovation Platform	• PowerPoint Presentation • Plenary discussion	• Flip charts • Felt pens • Projector • PPT presentation • Participants Handouts	20 minutes
14.1.6.4 Phases of an innovation platform (Initiation, Establishment, Management and Sustainability)	• PowerPoint presentations • Plenary discussion • Group Exercise	• Flips charts • Felt pens • Projector • Handouts • PPT presentation	20minutes

14.1.6.5 Case studies of successful Agricultural Innovation Platforms	• PowerPoint presentations • Plenary discussion • Role plays	• Flips charts • Felt pens • Projector • PPT presentation • Participants' handouts	10minutes
14.1.6.6 Benefits and challenges of Agricultural Innovation Platforms	• PowerPoint presentations • Plenary discussion Role plays •	• Flips charts • Felt pens • Projector • PPT presentation • Participants' handouts	10 minutes
14.1.6.7 Module review	• Discussion	• Flip Charts • Felt pens • Fact Sheets	10 minutes
TOTAL			**2 hours**

14.1.7 Facilitator's Guidelines

Sub Module 14.1 Agricultural Innovation Platform (AIP)	
14.1.7.1. Introduction, levelling of expectations and objectives (20 Minutes)	**Session Guide**
Introduction *The facilitator welcomes trainees to the module on Agricultural Innovation Platforms. They are then invited to introduce themselves and state their expectations*) **Module Objectives** *(The facilitator presents modules objectives and levels out expectations)* By the end of the module, the trainee should be able to: • Define agricultural innovation systems, innovation process and innovations • Describe characteristics of an innovation platform • Describe how to initiate, establish, manage and sustain an • agricultural Innovation Platform • Describe the benefits and challenges of Agricultural innovation platforms	• Summarize Trainees' "Expectations" and display. • PowerPoint Presentation

13.1.7.2 A definition of Agricultural Innovation Systems and different types of innovations (technical, institutional and organizational) (30 minutes)	Session Guide
• Past progression of research and extension models and their shortcomings • Agricultural Innovation Systems model and actualization thourough Agricultural Innovation Platforms • Definition of innovation process • Types of innovations (products of innovation process)	• PowerPoint Presentation • Plenary discussion
14.1.7.3. Characteristics of an Agricultural Innovation Platform (20minutes)	**Session Guide**
The facilitator should present an overview of innovation platforms and their main characteristics **Plenary Presentation (10 minutes)** • Characteristics of Agricultural Innovation Platforms • Why Agricultural innovation platforms are used • Where to form Agricultural Innovation Platforms • Establishment of linkages between value chain actors in agricultural innovation platforms **Plenary discussion (10 minutes)** Let the trainees recall what they learned and discuss any issue that may arise.	• PowerPoint Presentation • Participants' handouts • Plenary discussion
14.1.7.4 Phases of an innovation platform (Initiation, Establishment, Management and Sustenance (20minutes)	**Session Guide**
Plenary Presentation (15 minutes) **Initiation phase** • Mobilization of stakeholders in the Mango value chain for challenge identification • General description of the value chain within a specific area **Establishment Phase** • Clear prioritization of the key value Chain challenge or compelling agenda in the (weakness in the chain) • Vision of the AIP formulated with clear goals • Development of a business plan with clear milestones to guide operations of the AIP • Formation of a main committee to coordinate platform activities. • Formation of diverse sub-committees with clear roles	• PowerPoint Presentation • Participants Handouts • Plenary discussion

Management Phase • Keeping stakeholders focused on the business plan to ensure an inclusive and transparent process • Neutral facilitation to ensure joint strategy building and action and the coordination of support activities Managing emerging experts taking up leading roles and issues as champions.**Sustainability and scaling Phase** • Changing roles of initiator, local stakeholders and Private sector • Local stakeholders lead and own AIP while Initiator backstops and private sector supports and seize opportunity • Embarking on fresh issues or challenges • Maintaining capacity acquired to address new issues or challenges in subsequent cycles **Plenary discussion (10 minutes)** Let the trainees recall what they learned and discuss any issue that may arise.	
14.1.7. 5 Case studies of successful AIPS (10 minutes)	**Session Guide**
Plenary Presentation and discussion • successful innovation platforms and their achievements	• PowerPoint Presentation • Plenary discussion
14.1.7. 6 Benefits and challenges of AIPS (10 minutes)	**Session Guide**
Plenary Presentation • Benefits of Agricultural innovation platforms • Challenges of Agricultural Innovation platforms	• PowerPoint Presentation • Plenary discussion
14.1.7.5. Module review (30 minutes)	**Session Guide**
(The facilitator leads the trainees in reviewing the module) Summarize the main points of the training and together with the trainees review the main points on: • Agricultural Innovation Systems, Innovation process and different Innovations • AIP characteristics, why and where to form them • The four Phases of Innovation Platforms • The benefits and challenges of innovation Platforms *(Discuss with trainees' new things learnt from this Module. What are some of the problems and issues that they have become more aware of in the module?)*	• Participants' Handouts • Summarize the main points from the module on a flip chart and display

14.1.7. Participants' Handouts

Kamau G. (2020) Agricultural Innovation Platform Factsheet

Kamau G. (2020) Agricultural Innovation Platform Phases Fact sheets

References

1. Kamau, G.M. and Makini F.W. (2019). Agricultural Innovation Platforms for knowledge exchange and learning for technical, economic, social and institutional change.
2. Makini F., Mulinge W., Mose L., Salasya B., Kamau G., Makelo M., and On'gala, J. (2018). Impact of Agricultural Innovation Platforms on Smallholder livelihoods in Eastern and Western Kenya. FARA Research Results Vol2(6).
3. Makini F., Kamau G., Makello M., Adekunle A., Mburathi G., (2013). Operational field guide for developing and managing local agricultural innovation platforms KARI ISSBN 978-9966-30-004-1.

SUB-MODULE 14.2

MANGO GENDER, VULNERABLE AND MARGINALIZED GROUPS (VMGs), SOCIAL, ENVIRONMENTAL CONCERNS AND COHESION

14.2.1 Introduction

Mango is a major agro-enterprise and therefore all the gender categories (men, women, youth vulnerable marginalized groups (VMGs) are involved in its value chain from production, marketing and consumption. However, women perform most of the crop's production activities such as planting and weeding while men mostly perform the task of marketing. Despite this huge women's contribution, gender inequalities exist in all areas of the value chains. Some of these gender inequalities include: division of labour, access to and control of resources and decision making within and beyond the household. These inequalities limit women, youth and VMGs access to and benefits from the various Technologies Innovations and Management Practices (TIMPs) at different nodes of the value chain. At the macro-level, effective participation of women and youth in groups and market activities is constrained by their low decision-making power, lack of voice and lack of access to financial resources. Gender analysis examines the productive, community and reproductive roles of men and women; access, control and ownership of resources; levels of power relations; differential needs, constraints and opportunities; and impact of these differences (positive/ negative) on lives of men, women, youth and the VMGs.

Mango value chain TIMPs interventions, when designed and implemented with gender equitable principles, can foster adoption leading to increased productivity as well as enhanced social and environmental impacts.

The overall objective of this module is to ensure that gender mainstreaming and social inclusion in MangoTIMPs is enhanced by field agricultural practitioners and extension officers. This will enhance the effort geared towards achieving Climate Smart Agriculture "triple win" in target counties.

14.2.2 Sub-Module learning outcomes

By the end of the training module, the following outcomes must be achieved:
The concept of gender mainstreaming and social inclusion in Mango value chain understood and appreciated.

1. Youth empowerment in Mango value chain explained and understood.
2. Women empowerment in Mango value chain explained and understood.
3. Strategies for inclusion of vulnerable and marginalized groups in Mango value chain understood and applied.
4. Knowledge on environmental and social management framework (ESMF) tool enhanced.

14.2.3 Sub-Module Target Group

This module is intended for lead farmers, service providers and county public and private extension agents.

14.2.4 Sub-Module Users

This module is intended for use by Master Trainers who are members of the Core Team of Trainers (CTT). This module outlines the learning outcomes, the category of trainees targeted, module summary, and participants' handouts. The facilitator using this module should thoroughly familiarize themselves with the participants' handouts.

14.2.5 Sub-Module Duration

The Module is estimated to take a duration of 3 hours and 30 minutes.

14.2.6 Sub-Module Summary

Sub-Module 14.2Gender mainstreaming and social inclusion in the Mango value chain			
Sessions	**Training methods**	**Training materials**	**Duration**
14.2.6.1 Introduction, expectations and objectives	• Personal introductions • Presentations • Plenary discussion	• Flips charts • Felt pens • PowerPoint Presentation • Laptop • Participants' handouts	30 minutes
14.2.6.2 Gender mainstreaming in Mango value chain	• PowerPoint Presentations • Group Exercise • Plenary discussion	• Flips charts • Felt pens • PowerPoint Presentation • Participants handouts	30 minutes
14.2.6.3 Youth empowerment in Mango value chain	• PowerPoint Presentations • Group exercise • Plenary discussion	• Flips charts • Felt pens • PowerPoint Presentation • Participants handouts	30 minutes
14.2.6.4 Women empowerment in Mango value chain	• PowerPoint Presentations • Plenary discussion	• Flips charts • Felt pens • PowerPoint Presentation • Participants handouts	30 minutes

14.2.6.5 Strategies for inclusion of vulnerable and marginalized groups	• PowerPoint Presentations • Plenary discussion	• Flips charts • Felt pens • PowerPoint Presentation • Participants handouts	30 minutes
14.2.6.6 Environmental and Social Management Framework	• PowerPoint Presentations • Plenary discussion	• Flips charts • Felt pens • PowerPoint Presentation • Participants handouts	30 minutes
14.2.6.7 Module Review	• Plenary discussion	• Flips charts • Felt pens	30 Minutes
TOTAL			**3 hours 30 minutes**

14.2.7 Facilitator's Guidelines

Sub Module 14.2: Gender mainstreaming and social inclusion in Mango value	
14.2.7.1 Introduction, Objectives and Expectations (30 Minutes)	**Session Guide**
(The facilitator welcomes trainees to the module and thereafter invites them to state their expectations) **Module Objectives (30 Minutes)** *The facilitator presents modules objectives* By the end of the module training, the trainee must be to: - • Explain gender mainstreaming and social inclusion, in Mango value chain • Describe youth empowerment in Mango value chain • Identify women empowerment in Mango value chain • Identify strategies for inclusion of vulnerable and marginalized groups in Mango value chain • Describe the environmental and social management framework (ESMF) tool	• Summarize Trainees "Expectations" and display. • PowerPoint Presentation • Group exercise • Objectives and Training Program

14.2.7.2 Gender mainstreaming and social inclusion in Mango value chain (30 Minutes)	Session Guide
(The facilitator presents and explains gender mainstreaming, who does what activity, who has access to what resources among others. and why gender mainstreaming is important in Mango value chain). **Plenary Presentation (20 minutes)** • Definition of gender • What is gender mainstreaming and why it is important? • Who does what? (gender division of roles in Mango value chain) • Who owns what? (access and control of resources and benefits) • Who makes which decisions? • Existing policies in support of gender mainstreaming **Group exercise and discussion (10 Minutes)** Let the trainees recall what they learned and discuss any issue that may arise	• PowerPoint presentation, Group exercise • Plenary discussion • Participants' handouts • Group exercise • Plenary discussion
14.2.7.3 Youth empowerment in Mango value chain s (30 minutes)	**Session Guide**
Plenary Presentation (20 minutes) • Why agriculture is not attractive to youth • Youth's role in the value chain • Strategies to empower youth in Mango value chain **Group exerciseand discussion (10 Minute)** Let the trainees recall what they learned and discuss any issue that may arise.	• PowerPoint Presentation • Group exercise • Plenary discussion • Participants' handouts
14.2.7.4 Women empowerment in Mango value chain (30 minutes)	**Session Guide**
Plenary Presentation (20 minutes) • Women's role in the value chain • Challenges facing women in the value chain • Strategies for empowering women in the value chain **Plenary discussion (10 minutes)** Let the trainees recall what they learned and discuss any issue that may arise	• PowerPoint Presentation • Distribute participants' handouts • Plenary discussion • Participants' handouts

14.2.7.5. Strategies for inclusion of vulnerable and marginalized groups in Mango value chain (30 minutes)	Session Guide
Plenary presentation (20 min) • Who are vulnerable and marginalized groups (VMGs) • Why gender inequality exists • Social inclusion and why • Strategies of inclusion of VMG **Plenary discussion (10 minutes*)*** Let the trainees recall what they learned and discuss any issue that may arise	• PowerPoint Presentation • Plenary discussion • Participants' handouts
14.2.7.6. Environmental and social management framework (ESMF) (30 minutes)	**Session Guide**
Plenary presentation (20 minutes) • Objective of ESMF in Mango value chain • Environmental and social safeguards of Mango • Safeguard policies triggered by the project **Plenary discussion (10 minutes)** Let the trainees recall what they learned and discuss any issue that may arise.	• PowerPoint Presentation • Plenary discussion
14.2.7.7. Module review (30 Minutes)	**Session Guide**
The facilitator leads the participants in reviewing the module) Summarize the main points of the training and together with the trainees review the main points: • What is gender mainstreaming and why it is important? • Youth empowerment in Mango value chain • Women empowerment in Mango value chain • Strategies for inclusion of vulnerable and marginalized groups in Mango value chain • Environmental and Social Management Framework of Mango activities Let the trainees recall what they learned and discuss any issue that may arise.	• Summary of the main points on from the module on a flip chart and display

14.2.8 Participants' Handouts

- Gender mainstreaming and social inclusion factsheets
- Gender mainstreaming and social inclusion guides

Reference

Commonwealth secretariat, (2001). Gender Mainstreaming in Agriculture and Rural Development: A Reference Manual for Governments and Other Stakeholders. Marlborough house, London.

SUB-MODULE 14.3

AGRICULTURAL POLICY OPTIONS FOR SUPPORTING SMALLHOLDER FARMERS' MANGO PRODUCTION AND MARKETING

14.3.1 Introduction

Kenya's Vision 2030 identifies Agriculture as the engine of growth through transformation of smallholder and subsistence agriculture to innovatively and commercially oriented agriculture. The new constitution promulgated in 2010 establishes two levels of governments (national and county) with defined functions. Agriculture is one of the devolved governance functions. In Kenya, agriculture faces many challenges and threats such as climate change, declining agricultural performance, limited high potential agricultural land and over-reliance on rain fed agriculture, limited diversification of Agricultural production, poor and inadequate rural infrastructure, inadequate and declining research in agriculture, low financing of agricultural sector and related activities and low technical capacity among the actors. Therefore, agricultural policy in Kenya revolves around the main goals of increasing productivity and income growth, especially for smallholders; enhanced food security and equity, emphasis on irrigation to introduce stability in agricultural output, commercialization and intensification of production especially among small scale farmers; appropriate and participatory policy formulation and environmental sustainability. The existing policy related to Mango is National Horticulture Policy. This module introduces the national and county governments, service providers, lead farmers, facilitators and relevant stakeholders in the design and implementation of effective climate-smart-sensitive agricultural policy options to promote the transition to climate-smart agriculture at the smallholder level.

14.3.2 Module Learning Outcomes

By the end of this module, participants are expected to:

1. Appreciate the failure of the existing National agricultural policies with smallholder farmers' agency.
2. Identify relevant areas in the agricultural policy options with the mango smallholder central agency.
3. Be able to classify the policy instruments for achieving policy objectives.
4. Understand the use of policy cycle in the development of new agricultural policies.
5. Understand the use of policy validation cycle to update agricultural policies.

14.3.3 Module Target Group

This module targets agricultural extension, service providers and lead farmers.

14.3.4 Module Users

This module is intended to be used by a Master Trainer who is among the members of the core team trainers. The facilitator using this module should thoroughly familiarize and avail the participants' handouts.

14.3.5 Module Duration

The Module is estimated to take 2 hours.

14.3.6. Module Summary

Module 14.3 Agricultural policy options for influencing mango production and marketing			
Sessions	**Training Methods**	**Training Materials**	**Time**
14.6.1. Levelling of participants' expectations about the module	• Personal introduction • Discussion	• PowerPoint • Flip charts	15 minut
14.6.2. Module introduction, Objectives Expectations	• Personal introduction Presentation	• PowerPoint	10 minut
14.6.3 National agricultural policies with smallholder farmers agency	• Personal introduction • Presentation	• PowerPoint	15 minut
14.6.4. Policy options and their objectives	• Plenary presentation	• Power point	10 minu
14.6.5. Policy instruments	• Plenary presentation • Plenary discussion	• PowerPoint	20 minu
14.6.6. Policy development cycle	• Plenary presentation • Plenary discussion	• PowerPoint	20 minu
14.6.7. Policy validation cycle	• Plenary presentation • Plenary discussion	• PowerPoint	20 minu
14.6.8. Training review	• Facilitator's summary: • Takeaways	• Module review • Participants Handouts	10 minu
TOTAL			**2 hours**

14.3.7 Facilitators Guidelines

Module 14.3 Agricultural policy options to support mango production and marketing	
14.3.7.1 Levelling participants' expectations about the module (15 minutes)	**Session Guide**
14.3.7.1.1 Module Title *(The facilitator welcomes trainees to the module on Agricultural policy options and introduces him/herself by stating his/her profile and experience).*	• Handouts • Program • Note books • Felt pens • PowerPoint slides
14.3.7.1.2 Participants expectations (15 minutes)	
(The facilitator asks the trainees to state their expectations by listing on a flip chart) **Plenary Discussion** .	• Summarize trainees' "Expectations" and display on flip chart/board.
14.3.7.2 Module introduction, objectives and expectations (10 minutes)	
(The facilitator introduces the module and states the objectives and expectations) By the end of this module, participants are expected to: • Identify crucial areas in the policy options that you feel have the most impact on farmers • Be able to classify the policy instruments for achieving policy objectives • Understand the use of policy development cycle in the development of new agricultural policies • Understand the use of policy validation cycle to update agricultural policies	• PowerPoint slides • Factsheets
14.3.7.3 National agricultural policies with smallholder farmers agency (15 minutes)	**Session Guide**
(The facilitator to highlight the types of the National agricultural policies) **Plenary Presentation (10 minutes)** Make presentation on the available agricultural policies Discuss how the National agricultural policies fail to make smallholder farmers' agency central **(5 minutes)**	• PowerPoint slides • Handouts • Flipcharts

14.3.7.4 Policy options and their objectives (10 minutes)	Session Guide
(The facilitator to highlight the types of policy options and their objectives relevant to mango production and marketing) **Plenary Presentation (5 minutes)** Make presentation on the available policy options and their objectives Discuss which policy options are applicable to mango production and marketing **(5 minutes)**	• PowerPoint slides • Handouts • Flipcharts
14.3.7.5 Policy instruments (20 minutes)	**Session Guide**
(The facilitator describes the policy instruments). **Plenary Presentation (10 minutes)** **Group Exercise (10 minutes)** Discuss successes and failures of policy instruments in influencing production and marketing of mango.	• Handouts • Flip charts, • Manila papers, • Pelt pens
14.3.7.6 Policy development cycle (20 minutes)	**Session Guide**
Plenary Presentation (10 minutes) (*The facilitator discusses the components of policy cycle and their relationship to the production and marketing of mango)* **Plenary Discussion (10 minutes)**	• Use power point • Handouts
14.3.7.7 Policy validation cycle (20 minutes)	**Session Guide**
Plenary Presentation (10 minutes) (*The facilitator highlights the components of policy validation cycle. The facilitator also discusses the relevance of policy validation in the production and marketing of mango)* **Plenary Discussion (10 minutes)**	• Use power point • Handouts
14.3.7.8 Training review (10 minutes)	**Session Guide**
(The facilitator leads the trainees in reviewing the module. Conclude by thanking the trainees). **Plenary Presentation (10 minutes)** Summarize the main points of the training.	Summary of the main points from the Module.

References

Financial Sector Deepening Kenya (FSD Kenya) (2015). Financing the mango value chain: A case study of Lower Eastern Kenya.

Kenya Horticultural Development Program (KHDP) (2010). Market Opportunities for Mango Growers.

Republic of Kenya (RoK) (2012). National horticulture policy.

ANNEXES

ANNEX 1: TRAINING PROGRAM

The training program presented here assumes that the trainees report on Sunday evening and Monday is the first day.

KENYA CLIMATE SMART AGRICULTURE PROJECT
TRAINING OF TRAINERS FOR MANGO VALUE CHAIN FOR MACHAKOS COUNTY
VENUE: XXXX

Time	Day 0 (Sunday) Travel to Venue	Duration	Remarks / Facilitator
Late Evening	▪ **Arrival of participants and registration – Host** ▪ **Setting up and prepare training venue and materials – CTT**	**2 Hours**	**The training venue and materials are ready for use**
Close of Day 0			
Time	**Day 1 (Monday)**	**Duration**	**Remarks / Facilitator**
8.00am-9.30am	**Session 1: Introduction, objectives & expectations** ▪ Welcome by host and Prayers ▪ Self-introductions –(CTT) ▪ Introduction to KCSAP project ▪ Official opening Ceremony (CEC) Introduction to the training program (CTT)	10 minutes 20 minutes 20 minutes 20 minutes 20 minutes	The trainees relax and climate set for the ten-day training
9.30 - 10.30 am	**Module 1: Climate Change and Climate Smart Agriculture in Mango value chain** 1.1. Introductions and objectives	1 hour	
10.30 - 11.00 am	**Tea Break**	**30 minutes**	
11.00-12.00 pm	**1.2. Introduction to Climate Change and Climate Variability (1 hour)**	1 hour	
12.00-01.00 pm	**1.3. Concept of Climate Smart Agriculture (CSA) (1 hour)**	1 hour	

1.00 -2.00 pm	**Lunch Break**	**1 Hour**	
2.00 -2.40 pm	**1.4. Selected Future Scenarios that will Impact Productivity Video/Power point presentation**	40 minutes	
2.40 -3.00 pm	**1.5. Module Review** Summary of key points in the module	20 minutes	
	End of Module 1		
3.00 -4.00 pm	**Module 2: Farmer Field and Business School Approach 2.1. Introductions and objectives**	1 hour	
4.00 -5.00 pm	**2.2 Overview of FFBS key activities**	1 hour	
5.00 -6.00 pm	Tea Break	1 hour	
Close of Day 1			

Time	**Day 2 (Tuesday)**	**Duration**	**Remarks / Facilitator**
8.00-9.00am	Registration for second day participation Recap of day 1 activities	30 minutes 30 minutes	CTT
8.00-9.00am	**Continuation of Module 2**	1 hour	
9.00-10.00am	**2.4 Communication skills**	30 minutes	
10.00 - 10.30 am	**Tea break**	**30 minutes**	
10.30 - 11.00 am	**2.5 Facilitation skills**	30 minutes	
11.00 - 11.30 am	**2.6 Organization, management and Leadership of FFBS**	30 minutes	
11.30 - 12.00 pm	**2.7. Module Review**	30 minutes	
	End of Module 2		
12.00 -01.00 pm	**Module 3. Good Agricultural Practices (GAPs) and Food Safety Management Systems (FSMS)**		
12.00-12.30pm	3.6.1 Introduction, objectives and levelling of expectations	30 minutes	
12.30-1.00pm	3.6.2 Understanding GAP and its application in the crop value chains	30 minutes	
1.00 -2.00 pm	**Lunch Break**	**1 Hour**	
2.00-2.30 pm	3.6.3 Discussion of what factors to consider when selecting a site for agricultural activities thourough Risk Assessment	30 minutes	
2.30-3.30 pm	3.6.4 Review of GAP requirements for audit and types of protocols possible	1 hour	
3.30-4.00 pm	3.6.5 Introduction to Site Selection	30 minutes	
4.00-4.30 pm	3.6.6 GAP checklists and Audit	30 Minutes	

4.30-5.30 pm	3.6.7 Safe use of Pesticides and calibration of sprayers and nozzles	1 hour	
5.30 -6.00 pm	Tea Break	1 Hour	
Time	**Day 3 (Wednesday)**	**Duration**	**Remarks / Facilitator**
8.00-9.00am	Registration for second day participation Recap of day 1 activities	30 minutes 30 minutes	CTT
9.00-9.30 am	**Continuation of Module 3** 3.6.8 Understanding of food safety management system in crop value chains	30 minutes	
9.30-10.00 am	3.6.9 Determination of food safety risk/ hazards in crop value chains (hazard analysis)	30 minutes	
10.00-10.30 am	**Tea break**	**30 minutes**	
10.30-11.30 am	3.6.10 Determination of critical control points (CCPs) and Critical limits (CLs) in crop value chain	1 hour	
11.30-12.30 pm	3.6.11 Prevention and corrective measures for CCPs in Mango value chain	1 hour	
12.30-1.00 pm	3.6.12 Module review	30 Minutes	
1.00- 2.00 pm	Lunch break	1 hour	All
2.00 -3.00 pm	**Module 4: Mango production and appropriate climatic requirements** **4.1. Introductions and objectives**	1 hour	
3.00 -4.00 pm	**4.2 Importance of Mango in Kenya's economy**	1 hour	Facilitator
4.00 -5.00 pm	**4.3 Mango production ecological/climatic requirements**	1 hour	
5.00 -6.00 pm	**Tea Break**	**1 Hour**	**All**
Close of day 3			
Time	**Day 4 (Thursday)**	**Duration**	**Remarks / Facilitator**
8.00-9.00am	Registration for third day participation Recap of day 3 activities	30 minutes 30 minutes	CTT
9.00-9.45 am	**4.4. Mango production AEZs , average yields and constraints in the target Counties**	45 minutes	
9.45-10.00 am	**4.5. Module review**	15 minutes	
	End of Module 4		
10.00-10.30 am	**Tea break**	**30 minutes**	

10.30 – 11.30 am	**Module 5**: **Mango Variety Selection** **5.1. Introduction and levelling of expectations and objectives**	1 hour	Facilitator
11.30 - 12.00 pm	**5.2 Introduction to Mango and the various improved Mango varieties and their uses**	30 minutes	Facilitator
12.00 – 1.00 pm	**5.3 Recommended Mango varieties for the target counties**	1 hour 30 minutes	
1.00- 2.00 pm	**Lunch break**	**1 hour**	**All**
2.00 - 2.30 pm	**5.4 .Module review** Summary of the main points of the training	30 minutes	Facilitator
	End of Module 5		
2.30 – 3.30 pm	**Module 6. Mango Seed System** **6.1. Introduction and levelling of expectations and objectives**	1 hour	Facilitator
3.30 - 4.30 pm	**6.2. Definition of seed and seed system in Kenya**	1 hour	Facilitator
4.30 – 5.30 pm	**6. 3 Formal seed system in Kenya**	30 minutes	Facilitator
5.30 – 6.00 pm	**Tea Break**	30 minutes	All
Close of day 4			
Time	**Day 5 (Friday)**	**Duration**	**Remarks / Facilitator**
8.00-9.00am	Registration for fourth day participation Recap of day 3 activities	30 minutes 30 minutes	CTT
9.00-10.00am	**Continuation of Module 6……..**	1 hour	Facilitator
10.00 -10.30 am	**Tea Break**	**30 minutes**	
10.30 – 11.00 am	**6.5. Module review**	30 minutes	
	End of Module 6		
11.30 – 12.00 pm	**Module 7: Mango climate smart agronomic practices** **7.1. Introductions, climate setting**	30 minutes	Facilitator
12.00 – 1.00 pm	**Objectives and expectations**	1 hour	
1.00 -2.00 pm	**Lunch Break**	**1 hour**	
2.00 -3.00 pm	**7.3. Agronomic practices for Mango production**	1 hour	
3.00 -4.00 pm	**7.4. Appropriate inputs for Mango optimal production and their correct doses**	1 hour	
4.00 -5.00 pm	**7. 5. Module review**	30 minutes	
5.00 – 5.30 pm	**Tea Break**	**30 minutes**	

	End of Module 7		
Close of day 5			
Time	**Day 6 (Saturday)**	**Duration**	**Remarks / Facilitator**
8.00-9.00 am	Registration day five participation Recap of day 4 activities	30 minutes 30 minutes	CTT
9.00-10.00 am	**Module 8: Integrated soil and water management practices for Mango production** **8.1. Introduction, Objectives and Expectations**	30 minutes	
10.00 -10.30 am	**Tea Break**	**30 minutes**	
10.30 – 11.00 am	**8.2. Soil composition, properties and health**	30 minutes	
11.00 – 12.00 pm	**8.3. Soil and plant tissue sampling and analysis**	1 hour	
12.00-1.00 pm	**Lunch Break**	**1 hour**	
1.00 – 1.30 pm	**8.4. Soil fertility and plant nutrition**	30 minutes	
1.30 – 2.00 pm	**8.5 Soil health and (ISFM) for climate resilient cropping systems**	30 minutes	
2.00 – 2.30 pm	**8.6 Soil and water management and water harvesting technologies .**	30 minutes	
2.30 – 3.00 pm	**8.7. Soil degradation and reclamation**	30 minutes	
3.00 – 3.30 pm	**8.8 Problematic soils and their management**	40 minutes	
3.30 – 4.00 pm	**8.9. Module review** Summary of the main points of the training module	30 minutes	
	End of Module 8		
4.30 – 5.00 pm	**Module 9: Crop Health** **9.1. Introduction, Objectives and Expectations**	30 minutes	
5.00 - 5.30 pm	**Tea Break**	**30 minutes**	
Close of day 5			

Time	Day 7 (Sunday)	Duration	Remarks / Facilitator
8.00 - 9.00 am	Registration day six participation Recap of day 5 activities	30 minutes 30 minutes	CTT
9.00 - 10.00 am	**Module 9 continued…….** **9.2. Major Mango pests that cause economic losses and their control**	1 hour	
10.30 -10.30 am	Tea Break	30 minutes	
10.30 – 11.00am	**9.3. Sustainable Integrated Mango pests management practices; scouting, and thoureshold determination**	30 minutes	
11.00 – 12.00pm	**9.4. Major Mango diseases that cause economic losses, conditions that favour their development and their control methods**	1 hour	
12.00 – 1.00pm	**9.5. Sustainable Integrated Diseases Management (IDM) ; scouting and thoureshold determination**	1 hour	
1.00 - 2.00 pm	Lunch Break	1 hour	
2.00 - 2.30 pm	**9.6. Safe use of pesticides and update source for registered pesticides**	30 minutes	
2.30 - 3.30 pm	**9.7. Module review** Summary of the main points of the training	30 minutes	
	End of Module 9		
4.00 – 4.30 pm	**Module 10. Mango harvesting and post-harvest management** **10. 1 Introduction and levelling of expectations and objectives**	30 minutes	
4.30 – 5.00 pm	**Module 10 continued…** **10. 2 Mango harvesting to maintain quality** **Presentation** • quality standards for Mango in Kenya and harvesting **Dissuasion** Issues on harvesting	 20 minutes 10 minutes	
5.00 – 5.30 pm	**Tea Break**	**30 minutes**	
Close of day 7			

Time	Day 8 (Monday)	Duration	Remarks / Facilitator
8.00 – 9.00 am	Registration day seven participation Recap of day 7 activities	30 minutes 30 minutes	CTT

9.00 – 9.30 am	**10.3 Proper Mango sorting and grading**	30 minutes	
9.30 – 10.30 am	**10.4 Mango cooling/storage techniques** **Field Trip:** Travel to KALRO Matuga Mango Variety trial field	1 hour	
10.30 -11.00 am	**Tea Break**	**30 minutes**	
11.00 -11.30 am	**10.5 Training review** Summary of the main points of the training	30 minutes	
	End of Module 10		
12.00 -1.00 pm	**Module 11. Mango value addition** **11.1 Introduction and levelling of expectations and objective**	30 minutes	
1.30 - 2.00 pm	Lunch Break	1 hour	
2.00 – 3.00 pm	**11. 2 Introduction to recipes for Mango value added products**	1 hour	Facilitator
3.00- 5.00 pm	**11. 3. Making of different Mango value added products** **Practical's**	2 hours	
5.00 – 5.30 pm	Tea Break	30 minutes	
Close of day 8			

Time	**Day 9 (Tuesday)**	**Duration**	**Remarks / Facilitator**
8.00 - 9.00 am	Registration day 9 participation Recap of day 8 activities	30 minutes 30 minutes	CTT
9.00 - 10.00 am	**11.4 Prioritizing opportunities in Mango value addition**	1 hour	
10.00 -10.30 am	Tea Break	30 minutes	
10.30 -12.00 pm	**11.5 Value addition strategy development** **Focused group discussion**	1 hour 30 minutes	
12.00 -12.30 pm	**11.6 Training review** Review the main points about Mango Value addition	30 minutes	
	End of Module 11		
1.00 - 2.00 pm	Lunch break	1 hour	All
2.00 – 2.30 pm	**Module 12: Mechanization of Mango production activities**	30 minutes	
2.30 – 3.00 pm	**12.2. Mango climate smart land preparation tools**	30 minutes	
3.00 – 3.30 pm	**12.3. Mango calibration of fertilizer and seed rate for planters**	30 minutes	
3.30 – 4.00 pm	**12. 4. Mango Chemical implements and tools operations**	30 minutes	

4.00 – 5.00 pm	**12.5. Mango harvesting machine operating principles**	1 hour	
5.00 – 5.30 pm	Tea Break	30 minutes	
Close of Day 9			
Time	**Day 10 (Wednesday)**	**Duration**	**Remarks / Facilitator**
8.00 - 9.00 am	Registration day 9 participation Recap of day 8 activities	30 minutes 30 minutes	CTT
9.00 – 9.30 am	**Module 12 continued…….** **12.6 Machine and procedure for Mango grading**	30 minutes	
9.30 -10.00 am	**12.7 Module review** Review the main points about Mango mechanization	30 minutes	
	End of Module 12		
10.00 -10.30 am	Tea Break	30 minutes	
10.30 -11.30 am	**Module 13. Mango Business and Marketing** **13.1 Introduction and levelling of expectations and objectives**	1 hour	
11.30 -12.00 pm	**13.2 Introduction to marketing channels and strategies**	30 minutes	
12.00 -1.30 pm	**13.3 Identification and prioritization of market opportunities in Mango value chain**	1 hour 30 minutes	
1.30 - 2.30 pm	Lunch break	1 hour	All
2.30 – 3.30 pm	**13.4 Mango Community production, aggregation and marketing models (COPMAS)**	1 hour	
3.30 – 4.30 pm	**13.5 Training review** Summary and discussion of the main points of the training	30 minutes	
4.30 – 5.00 pm	**Tea Break**	30 minutes	All
	End of module 13		
Close of day 10			
Time	**Day 11 (Thursday)**	**Duration**	**Remarks / Facilitator**
8.00 - 9.00 am	Registration day 11 participation Recap of day 9 activities	30 minutes 30 minutes	CTT

9.00 - 9.30 am	**Sub-Module 13.1 Agricultural Innovation Platforms (AIP)** **13.1.1 Introduction, Objectives and Expectations**	30 minutes	
9.30 - 10.30 am	**13.1.2. The characteristics of an innovation platform**	1 hour	
10.30 - 11.00 am	Tea break	30 minutes	All
11.00 - 12.00 pm	**13.1.3 Preformation and formation phases of the Mango AIP**	1 hour	
12.00 - 12.30 pm	**13.1.4. Module review** Summary of main points	30 minutes	
	End of sub module 13.1		
1.00 - 2.00 pm	Lunch break	1 hour	All
1.00 - 1.30 pm	**Sub Module 13.2 Gender mainstreaming and social inclusions in the Mango value chain** **13.2.1 Introduction, Objectives and Expectations**	30 minutes	
1.30 - 2.00 pm	**13.2.2 Gender mainstreaming and social inclusion in Mango value chain**	30 minutes	
2.00 - 2.30 pm	**13.2.3 youth empowerment in Mango value chain**	30 minutes	
2.30 - 3.00 pm	**13.2.4 Women empowerment in Mango value chain**	30 minutes	
3.00 - 3.30 pm	**13.2.5. Strategies for inclusion of vulnerable and marginalized groups in Mango value chain**	30 minutes	
3.30 - 4.00 pm	**13.2.7.6. Environmental and social management framework (ESMF)**	30 minutes	
4.00 - 4.30 pm	**13.2.7. Module review** Plenary summary of the module	30 minutes	
4.30 – 5.00 pm	**Tea Break**	30 minutes	All
	End of sub-module 13.2		
Close of day 10			
Time	**Day 12 (Friday)**	**Duration**	**Remarks / Facilitator**
8.00 - 9.00 am	Registration day 12 participation Recap of day 11 activities	30 minutes 30 minutes	CTT

9.00 - 9.30 am	**Sub-Module 13.3: Climate-Smart Agricultural Policy Options** **13.3.1 Introduction, Objectives and Expectations**	30 minutes	
9.30 - 10.00 am	**13.3.2 Agricultural Policy Frameworks in Kenya**	30 minutes	
10.00 - 10.30 am	Tea break	30 minutes	All
10.30 - 11.30 am	**13.3.3 Climate-smart agriculture practices, policy options and approaches**	1 hour	
11.30 - 11.50 am	**13.3.7.4 Climate-smart-sensitive policy cycle**	20 minutes	
11.50 - 12.40 pm	**13.3.7.5 Implementation of the climate-smart-sensitive policy at the county level Plenary Presentation**	50 minutes	
12.40 - 2.00 pm	Lunch break	1 hour	All
2.00 - 3.00 pm	**13.3.6 Policy financing and investments for Climate-smart Agriculture**	1 hour	
3.00 - 3.20 pm	**13.3.7 Need of Technology Policy**	20 minutes	
3.20 - 3.40 pm	**13.3.8 Module review** Summary of module main points	20 minutes	
	End of module 13.3		
3.40 - 4.00 pm	• Course Evaluation	20 minutes	All
4.00 - 4.30 pm	• Announcements • Way Forward • Closing remarks	30 minutes	CCT
4.30 - 5.00 pm	Tea Break	30 minutes	
Close of day 12			
Time	**Day 13 (Saturday)**	**Duration**	**Remarks / Facilitator**
	• Departure to various destinations		All

ANNEX 2: GENERAL REFERENCE MATERIALS

Category / Modules	Publication title	Reference types	No Pages	Farmer Category A= New entrant/Mango Elite farmer B=Elite Mango Farmer
General Mango production	Mango production Guide in Kenya	Manual	25	**A/B**
	A Manual for Mango	Training Manual	26	**A/B**
Mango Varietal Selection		Leaflet	2	**A/B**
		Leaflet	2	**A/B**
		Leaflet	2	**A/B**
	Variety Characteristics and Production Guidelines of Traditional Crops	Training Manual	38	**A/B**
Mango Crop Health	Crop Management Guidelines			
	Integrated Pest Management (Cost saving Techniques for Smallholder Farmers)	Manual	34	**B/A**

Mango Business Management	Mango Production Guide	Manual	30	**B/A**
		Booklet	89	**B**
Gender Mainstreaming	Gender Mainstreaming in Agriculture and Rural Development: A Reference Manual for Governments and Other Stakeholders. Marlborough house, London.	Manual	100	**B**

ANNEX 3: GENERAL REFERENCE MATERIALS

PARTICIPATORY TECHNOLOGY DEVELOPMENT (PTD) FOR MANGO SOIL FERTILITY MGT:

Value Chain	Mango
Learning Enterprise	Mango
Funded Enterprise	Mango VC at production level
Background Problem	Low Mango production due to low soil fertility
Objective	To increase production thourough improved soil fertility mgt strategies

Factors to consider:

- Land topography
- Runs (blocks should face East to West)
- Certified seeds of Mango variety
- Organic and inorganic fertilizer use in Mango

Setting the P.T.D blocks:

- 6 trees are selected randomly in 4 equal blocks of the orchard to be the plots.
- Preferred Mango variety
- Different soil fertility management treatment
- Collect the data from 6 plants in each block.
- Other TIMPs should be applied equally in each block.
- Weeding and spraying should also be done the same time for each plot

Parameters Measurement

- No of leaves per crop
- Leaf width and length
- Crop height
- No of Mangoes per plant
- Average weight of mango fruit
- Yield /unit area

Setting of Blocks

Plot 1 Inorganic fertilizer P Source		Plot 2 Inorganic compound fertilizer		Plot 3 Inorganic compound and organic manure		Plot 4 Farmers practice

AGRO ECOSYSTEMS ANALYSIS (AESA) MANGO.

AESA NO ……

General information

Variety …….

Planting date……

Agronomic data

Average Leaf length…….....…

Average plant height…….....……

Average Leaf width…….....……..

No of Mangoes per plant…….....…

Average weight of mango…….....……

Yield in tons per acre……..

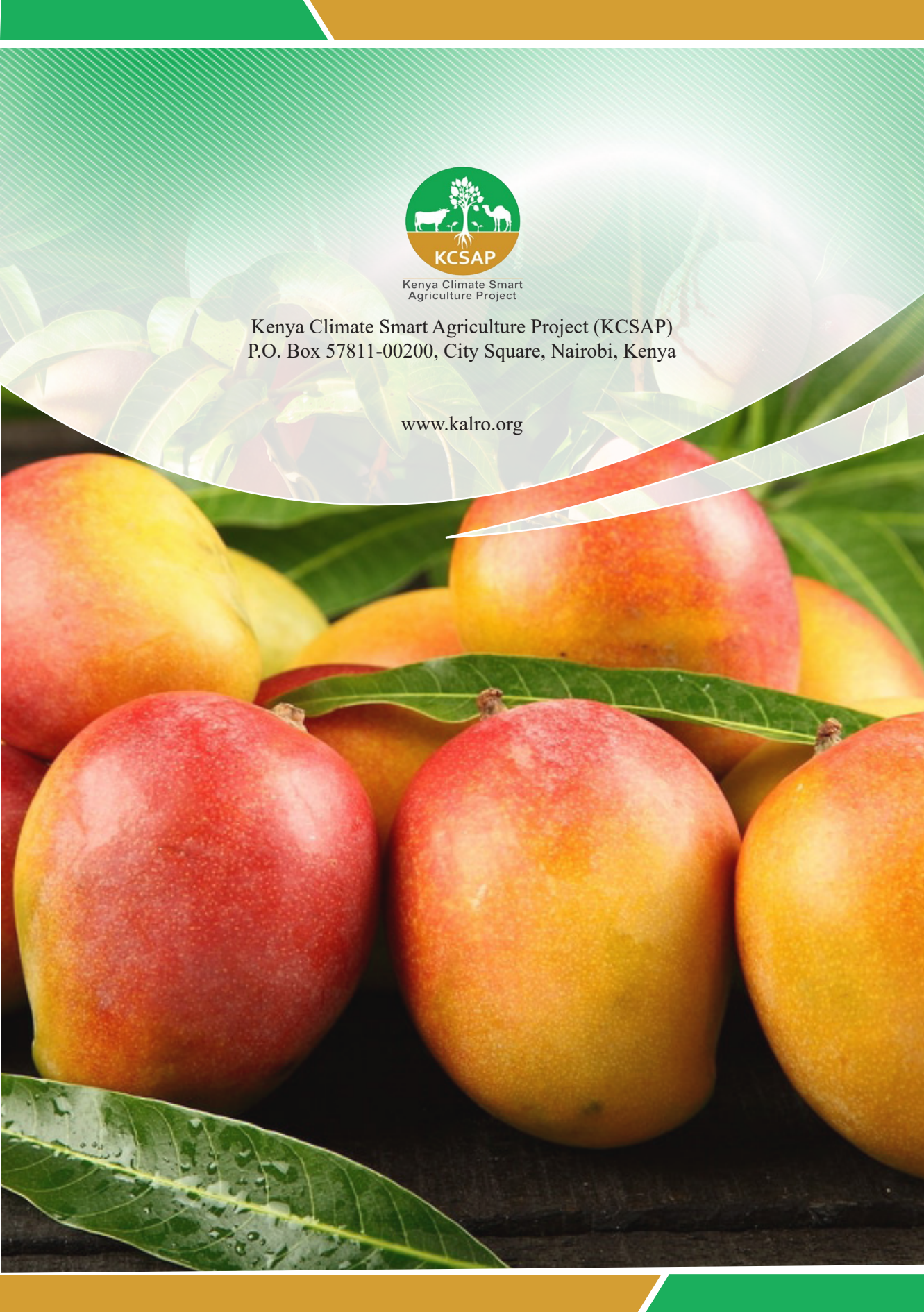
Weather: …….

Time of observation: ……

Diagram of crop of enemies and insects observed

Natural Enemies	**Insects observed**
1.	1.
2.	2.
3.	3.

Observation	**Recommendation**
1. weeds	Weeding after 2 weeks
2. Holes on the leaves	Keep monitoring and control pests
3. Yellow leaves	Add foliar feeds or control disease



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