Climate Smart Agricultural Technologies, Innovations and Management Practices for Aquaculture Value Chain

TRAINING OF TRAINERS' MANUAL

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MARCH 2020

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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 on '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). The other responsibility was development of sustainable seed production and distribution systems for priority value chains to enhance availability and access to seed, breeds and fingerlings by target beneficiaries under Components 1 (Up scaling Climate-Smart Agricultural Practices). Against this background, KALRO and her NARS partners have developed, validated and availed CSA TIMPS for dissemination and adoption. The TIMPS have further been unpacked during the development of Training of Trainers (ToT) Manuals for use in training public and private extension service providers and lead farmers.

The ToT Manuals are instructional guides to be used for teaching and learning step-by-step procedures of implementing CSA innovations for each of the 13 value chains being addressed. The training content is drawn from the CSA TIMPS that support respective value chains. The content are arranged in progressive modules supported by extensive information from research information and background data drawn from the TIMPS. Their relevance are based on the needs teased out of the value chains and the project objectives. The ToT Manuals 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, detailed descriptions of the trainees, program, training methods and a training evaluation have been provided in the manual. Adhering to these guidelines, therefore, enables possibility to replicate 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 chains' TIMPs documents and facts sheets in order to provide valuable resource for both public and private extension service providers. The use of this Manual is 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. It is a five - year project implemented in 24 counties, mainly in the arid and semi-arid lands (ASALs), at a cost of Ksh. 25B. The project development objective (PDO) 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) Up scaling 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 Gases (GHG) emissions (mitigation). Component 2 is charged 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 as well as development of sustainable seed production and distribution systems.

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 each of the 13 prioritized value chains (cassava, green grams, sorghum, millet, pigeon peas, bananas, tomatoes, potatoes, apiculture, indigenous chicken (meat and eggs), dairy (cattle and camel), red meat (cattle, sheep and goats) and aquaculture and 3 cross cutting value chains (natural resource management, pastures & fodder and animal health). The TIMPs were categorized into those ready for upscaling, those that needed validation and gaps that required further research. Training of Trainers' (ToT) manuals focusing on TIMPs that are ready upscaling for each of the value chains were subsequently developed and form the basis of training county extension staff, service providers and lead farmers. They are in turn expected to cascade this 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 of 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 *Training of Trainers' Manual for Aquaculture 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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The Kenya Climate Smart Agricultral Project (KCSAP) wish to acknowledge the Government of Kenya (GoK), World Bank and the International Development Association (IDA) for provision of the financial support that enabled the production of this Training of Trainers' (ToT) manual. We also acknowledge the KCSAP National Project Coordination Unit (NPCU) and the KALRO KCSAP Coordinator for logistical support required for the preparation and completion of the Manual. The contribution of all Scientific and Technical Officers and Support Staff, who worked tirelessly in the successful compilation of this ToT Training Manual for the Aquaculture Value Chain, is highly appreciated. We are grateful to all participants from County Government Departments of Agriculture, Livestock, Fisheries and Water/Irrigation, Research Scientists from KALRO and KMFRI, Agricultural Colleges and Universities, Service Providers, Ministry of Agriculture, Livestock and Fisheries and Cooperatives Staff and farmers, who contributed to the compilation of this manual. We thank the editorial team led by Jonathan Munguti and Kevin Obiero for co-ordination the entire production process. Lastly, we are grateful to the contributions of the production editors: Karl Nyabundi, Patrick Maina, Koinange T. Mukundi for editing and compilation of this work; and to Emma Nyaola and Fredrick Muhia for designing this publication.

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List of Abbreviations

ASK	Agricultural Society of Kenya
BMPs	Best Management Practices
CCT	Core Team of Trainers
CLF	Crop Livestock Fish
CSA	Climate Smart Agriculture
EIA	Environmental Impact Assessment
ESP	Economic Stimulus Program
FCR	Feed Conversion Ratio
FFBS	Farmer Field and Business School
FFS	Farmer Field School
GAPs	Good Aquaculture Practices
GBCs	Gender Based Constraints
GDP	Gross Domestic Product
GHG	Green House Gasses
HDPE	High-Density Polyethylene
KALRO	Kenya Agriculture and Livestock Research Organization
KCSAP	Kenya Climate Smart Agriculture Project
KMFRI	Kenya Marine and Fisheries Research Institute
KWSTI	Kenya Wildlife Service Training Institute
LF	Lead Farmer
LVHD	Low Volume High Density
MTP	Medium Term Plan
NARDTC	National Aquaculture Research and Development Training Centre
NARs	National Agricultral System
Q&A	Question and Answer
RAS	Re-circulative Aquaculture Systems
RIAT	Ramogi Institute of Advanced Technology
SDGs	Sustainable Development Goals
TIMPs	Technologies, Innovations and Management Practices
ToT	Training of Trainers
VMGs	Vulnerable and Marginalized Groups

PART I

This part consists of four sections which include:

- Section 1: Background,
- Section 2: Module Training Content,
- Section 3: Training Duration
- Section 4: Facilitator's Guidelines.

SECTION 1: BACKGROUND

1.1 The Role of Aquaculture in the Kenyan Economy

Kenya's Vision 2030 together with policy and legislative frameworks, recognize aquaculture as an important source of human nutrition and food security. Aquaculture also plays a significant role in poverty reduction and employment creation. The Third Medium Term Plan (MTP III) 2018–2022 identified the Blue Economy, including the utilization of marine and freshwater fisheries resources, as one of the priority sectors that have a high potential to spur national economic growth and development. During the MTP II, marine and freshwater fisheries sub-sectors contributed an average of 0.6% to the country's annual Gross Domestic Product (GDP).

Kenya is endowed with an extensive network of aquatic ecosystems, which support commercial production of critical volume of fish that is required to fill the growing gap in national fish supply and demand, as captured fish catches decline. The country has fast growing fish production capacity and extensive freshwater resources that are suitable for pond-and cage-based culture systems. Overall, aquaculture production grew by 9.6% from over 1000 tons in 2006 to a peak of 24,096 tons in 2014. The massive growth occurred largely during the implementation of the Economic Stimulus Prramme (ESP) between 2009 and 2013. Prior to the ESP project in 2008, there were only 4,742 fish farmers countrywide with 7,530 fish ponds occupying 271 Ha. The number of farmers increased tremendously to 49,050, with an estimated 69,998 ponds occupying 2,063 Ha at the peak of the subsidy program in 2012. The State Department of Fisheries estimated a total of 32,000 fish farmers countrywide in 2015. Pond-based aquaculture production has however registered depressed performance for the third consecutive year, from 18,656 tons in 2015 to 12,356 tons in 2017.

Since land and water are becoming scarce due to competition from other sectors and resource users, technological innovations have been promoted to achieve sustainable intensification of aquaculture. These include the development of model farms with recirculating aquaculture systems (RAS), tank-based systems, hydroponics and aquaponics, as well as high density, high carrying capacity intensive production in cages in lakes and reservoirs. For instance, cage culture has emerged from relative obscurity over the past decade to become an important supply system of Nile tilapia to consumers, mostly in rural and urban areas. Currently, there are over 4,500 cages in Lake Victoria, with an estimated production of 5,000 tons of fish annually.

1.2 The Role of Aquaculture in Food and Nutrition Security

Aquaculture has been prioritized to contribute to the Food and Nutritional Security Pillar of Kenya's Big 4 Agenda through direct fish consumption and income stabilization among vulnerable groups by their involvement in the aquaculture value chain activities and linkages. Further, the aquaculture value chain contributes to employment creation, poverty alleviation, income generation among rural communities and other stakeholders

and the overall national economic growth. Currently, the sub-sector employs over 50,000 Kenyans along the fish value chain, who are engaged in aquaculture inputs and production, post-harvest handling and processing, services provision, marketing and trade.

1.3 Aquaculture as a Climate Smart Innovation

Aquaculture is one of the agricultural options for achieving food security under changing climate. At the same time, it delivers co-benefits for nutrition, improved livelihoods and environmental sustainability, through the integration of the crop-livestock systems. Most of the Sustainable Development Goals (SDGs) and associated targets are directly relevant to policy making, planning and management for aquaculture development and growth. However, the aquaculture sub-sector faces of constraints and challenges including; competition for land, water, energy and feed resources. In the absence of appropriate solutions, these constraints are becoming increasingly acute. Coupled with potentially adverse impacts of climate change on the aquatic environment,the constraints and challenges require immediate interventions.

1.4 Objectives of the Training

The purpose of this training is to provide farmer trainers with knowledge and skills to facilitate and support the Farmer Field and Business Schools (FFBSs) or any other applied extension methodology, to help beneficiaries achieve the triple-wins increase productivity, enhanced resilience (adaption) and reduce Green House Gasses (GHG) emmissions for increased productivity through adoption of Good Aquaculture Practices (GAPs). Specifically, the objectives of this training are:

a) To provide trainers with knowledge and skills on improved fish breeds and broodstocks including establishment and management of climate smart aquaculture Technologies, Innovations and Management Practices (TIMPs).
b) To provide trainers with knowledge and skills on designs and operations of semi-intensive and intensive culture systems and best management practices for improved fish production.
c) To provide trainers with knowledge and skills on formulation and production of high-quality cost-effective fish feeds for improved production.
d) To provide trainers with knowledge and skills on fish health management and biosecurity for enhanced productivity and resilience to emerging environmental stressors.
e) To provide trainers with knowledge and skills on fish post-harvest preservation and value addition techniques for increased profitability through market linkages and supply chains.
f) To provide trainers with knowledge and skills on fish marketing and aquaculture as a business enterprise that is responsive to demand and market supply chains.

g) To provide trainers with knowledge and skills in gender mainstreaming and social inclusion, group dynamics and social networks in the aquaculture value chain.

SECTION 2: TRAINING MODULE CONTENT

2.1 Orientation of the Modules

This section of the training manual deals with training content. It outlines the orientation of **10 modules** which have **28 sessions** covering **57 hours** spread over **10 days** training period excluding travelling day.

The purpose of these modules is to enhance the knowledge, skills and capacities of trainers in the understanding and application of the climate-smart aquaculture technologies, innovations and management practices in their daily activities.

2.2 Module Outline

The 10 modules have a similar outline consisting of the following 8 parts:

i. **Introduction to the module**- context and background to training needs, knowledge and skill gaps being addressed
ii. **Module learning outcomes**- what trainees are expected to learn and achieve
iii. **Module target group**- trainee categories
iv. **Module users**- facilitators
v. **Module duration** -The approximate number of hours of exposure to training materials
vi. **Module summary**- The sequence of sessions, training methods, materials and duration
vii. **Facilitators guideline**- detailed sessions, training methods, materials and session guides
viii. **Participants' handouts**-detailed training notes and reference materials for trainees.

The outline for each of the 10 modules is presented in **Table 1**:

Table 1: Summary of outline for 10 modules of the aquaculture value chain

No.	Module name	Need addressed	Expected training outcomes [Summarized from module learning outcomes]	Duration
1	Climate Smart Agriculture Practices	Rapid growth in food demand intensified by the effects of climate change on agricultural systems, including crops, livestock, forestry and fisheries.	Basics of climate science, the impacts of climate change and the linkages among climate, agriculture and food security understood	4 hours 30 minutes
2	Semi-Intensive Culture Systems and Management Practices	Low-medium levels of aquaculture productivity from culture systems	Skills in design and pond culture practices for increased productivity identified	6 hours
3	Intensive Culture Systems and Management Practices	Climate change adaptable intensive systems of fish production to counter extreme weather events and low adoption of best management practices and innovations	Skills on design and climate smart culture systems, adaptation and resilience measures identified Aquaculture best management practices and innovations learnt	7 hours
4	Fish Breeding and Genetics	Lack of quality certified fish seed and poor growth leading to lower yields	Skills on the production of high-quality certified seed learnt	4 hours 45 minutes
5	Fish Nutrition, Feed Formulation and Management Practices	Lack of affordable high-quality fish feed	Skills on formulation and production of high-quality fish feed learnt	4 hours 30 minutes
6	Fish Health Management and Biosecurity	Increased incidences of emerging fish diseases cause stock losses	Protocols and applications of fish biosecurity measures learnt and demonstrated by farmer trainers	6 hours
7	Fish Post-Harvest Technologies and Value Addition	High post-harvest losses, insufficient value-added products and product diversification from farmed fish	Causes and strategies of minimizing post-harvest losses, diversification and value addition methods identified	6 hours 30 minutes

8	Fish Markets, Marketing and Supply Chains	Lack of knowledge in fish market linkages and arrangements	Innovative marketing strategies, fish supply and marketing chains identified	4 hours 45 minutes
9	Aquaculture as a Business	Lack of business skills to commercialize aquaculture and improved income	Various aquaculture enterprises and commercialization skills appreciated by learners Business plans developed	5 hours
10	Cross-Cutting Issues • Gender Mainstreaming and Social Inclusion • Environmental and Social Impact Assessment • Group Dynamics, Cohesion and Leadership	Low gender and youth participation in projects Gender inequality and low integration of VMGs in aquaculture Lack of quantitative information on aquaculture sector performance. Limited group networks and cohesion among farmers	Gender, youth and VMG inclusion strategies learnt and disseminated Quantitative indicators on aquaculture sector performance learnt and developed Strong and effective group networks developed and appreciated	8 hours
	TOTAL DURATION			**57 hours**

SECTION 3: TRAINING DESIGN

3.1 Delivery System

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

1. Establishment of a team of facilitators

- ⇒ A Core Team of Trainers (CTT) trains farmer trainers (service providers and public and private extension agents and lead farmers), as trainers. This is done using this manual through the modules contained therein.
- ⇒ Each of the Master Trainers will facilitate farmer trainers to acquire knowledge and skills in facilitating Farmer-led Field and Business Schools through PowerPoint presentations, videos, practical demonstrations and provision of illustrated training notes/brochures.

2. Upscaling –This will be done through farmer field and business school (FFBS) training and demonstrations, participatory on-farm validation trials and demonstrations, ASK and NARS shows and 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:

1. **Core Team of Trainers** – Master trainers with the required competencies drawn from Kenya Marine and Fisheries Research Institute (KMFRI), Universities, Tertiary Institutions offering aquaculture courses e.g. Ramogi Institute of Advanced Technology (RIAT), Kenya Wildlife Service Training Institute (KWSTI), National Aquaculture Research Development & Training Centre (NARDTC) and the State Department of Fisheries and Blue Economy, will facilitate the initial training of trainers (ToTs) at County level. The team will also undertake an evaluation of the first round of LF training.
2. **County Government Department of Fisheries and Aquaculture** –Trainers and their supervisors referred to as County Coordination Teams (CCT) will take the role of LF trainers, mentors and coordinators at sub-county level. They will assist FFBS's to form partnership and networks with other stakeholders for sustainability.
3. **Lead Farmer Networks** - Association of LFs in the target counties to take up farmer training and upscaling in the future. Lead farmer networks and groups will conduct exchange visits to learn best practices in other project implementing counties.
4. **Private Sector Service Providers** – Inputs suppliers, financial and business development service providers, private extension service providers (Extension Consortia), market players and processors will partner to support the growth of individual fish farmers and/or fish farmer groups.

3.3 Training Duration

The proposed ToT course for 10 modules in the aquaculture value chain shall take **57 hours within ten (10) days training period** (Annex 1). This does not include break hours of mid-morning, afternoon and lunch breaks.

3.4 Logic of Design and Flow of Sessions

The logic of the design and flow of each module is that the facilitator/master trainer while paying attention to the proposed methods and sessions guidelines shall: (1) Introduce the module; (2) Draw out the participant's expectations; (3) Relate participants' expectations with learning outcomes; (4) Explore the concept and content, switching to different methods of delivery of the content (e.g. group exercises, brainstorming, excursions, role-plays etc.) as the session progresses; (5) Review the module at the end of the training using participatory approaches; and, (6) Distribute suitable handouts to the participants, but not exceeding three handouts per module.

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. Furthermore:

a) The facilitators should familiarize themselves and internalize the guidelines as provided by this manual prior to the training.
b) The stationery required should be available within the training institution, 3 days before the training. These include name tags, writing materials and paper punch.
c) Flip charts and good quality felt pens could be used interchangeably with LCD projections.
d) Visual aids, field equipment and tools should also be arranged in time before the respective sessions start.
e) 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.
f) Copies of the modules shall be distributed at the end of the training.

4.2 Preparation of Training Venue and Sites

The training venue should have adequate training rooms, field demonstration sites and market areas.

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 facilitator/master trainer, training materials, an LCD projector, a flip charts holder and white wall to act as a projector screen.
b) **Demonstration Site** – Should be within walking distance with at least two ponds for practical work during pond construction and design exercises and a field day for other culture systems.
c) **Market Areas** – these include fish retail outlets (kiosks, stalls, shops and supermarkets), wholesale 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 distance

4.3 The Trainees

The trainees who will participate in the ToT training include service providers, public and private extension agents, lead farmers,County technical officers with an elaborate training background in extension and advisory services. The trainer should therefore, act more as a facilitator than a lecturer and draw out and build on their knowledge, skills and experience. As a golden rule, facilitators should not lecture participants but facilitate and listen and allow participatory interactions for the trainees to feel like equal partners to the CTT teams.

4.4 Training Program

The training program proposed consists of actual training modules. Health breaks should be considered when drawing the training program. The training program should preferably be based on the outline presented in **Annex 1,** to allow the flow of ideas and topics. However, should the situation demand, the sequence and day of coverage for whole or parts of the modules can be modified to suit emerging situations. The training program assumes that the trainers report to the training venue on a the day before training starts as the first day and leave at a convenient time once training is accomplished as per the training program.

4.5 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, available time and experiences of the authors of this manual. Depending on time availability, a facilitator can modify these training methods but as a golden rule, no presentation by the facilitator should take more than 30 minutes continuously. Presentations should be separated by other participatory training methods and/or activities. The list of available training methods and activities is presented in Table 2.

Table 2: Description of training methods during ToT training

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, visits and brainstorming sessions	To be considered where skills are an issue requiring sharing and trying, and hands-on experiences
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 through sharing and demonstration

4.6 Planning Schedule and Guidance for ToT preparation

While planning for this training, the CTT leader will ensure that the following activities are done before the training, as outlined in Table 3.

Table 3: Duration of activities to be done before training

Duration to Training	Activities to be Done
Six weeks	Recruit master trainers, compose CTT, identify the practical demonstration sites
Four weeks	Send out invitation letters to participants and special guests detailing purpose, venue and program. Follow up on demonstration sites. Brief CTT members
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
Four days	Confirm training sites preparedness, prepare sitting arrangements, and brief assistants
One day	Arrange training room furniture, place materials, equipment and stationery on the tables. Arrange for the reception of trainees at residence proposed
On the first day	Arrange for the reception of trainees at the training venue. Ensure climate setting is done before the course is officially opened. This includes: (i) registration, (ii) welcome to the venue by the host; (iii) elaborate introduction of CTT and participants; setting of ground rules; and (iv) formation of groups.

4.7 Evaluation of the Training

About an hour has been allocated for planning for way forward and evaluation of the ToT on the last day of the training. The evaluation strategy should take two components: i)individual ii) group evaluation (Table 4). The evaluation forms are then collected and analyzed by the CTT members.

Table 4: Individual Sample Evaluation Form

Aspect / Module	Rating		
	Very useful (3 marks)	Useful (2 marks)	Least useful (1 mark)
Climate-Smart Agriculture Practices			
Semi-Intensive Culture Systems			
Intensive Culture Systems			
Fish Breeding and Genetics			
Fish Feed Formulation and Feed Management			
Fish Health Management and Biosecurity			
Fish Post-Harvest and Value Addition			
Fish Marketing and Supply Chains			

Aquaculture as a Business			
Cross-cutting Issues - Gender Mainstreaming and Social Inclusion - Environmental and Social Impact Assessment - Group Dynamics, Cohesion and Leadership			

The second evaluation is the trainee **group evaluation**. The trainees retreat to one room and elect a chair and a secretary. They are then asked 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.

4.8 Facilitators Training Notes and Reference Materials

4.8.1 List of aquaculture publications

The detailed list of all publications is summarized in **Annex 2**

4.8.2 Guide on the use of the information

The trainers will be advised to issue farmers with at most 2 publications for each of the training sessions. This is because if they go away with10 publications, for example, 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, or a portable hard drive to enable farmers easily access and if necessary, print any of them out at a local internet café.

Trainers are advised to issue a general fish farming manual to be accompanied by 2 other publications e.g. information sheets, brochures, factsheets, posters etc. With subsequent training modules, they can develop their collection of publications.

PART II

This part consists of 10 Modules namely: Climate Smart Agriculture Practices, Semi-Intensive Culture Systems; Intensive Culture Systems; Fish Breeding and Genetics; Fish Feed Formulation and Feed Management; Fish Health Management and Biosecurity; Fish Post-Harvest and Value Addition; Fish Markets, Marketing and Supply Chains; Aquaculture as a Business, and Cross-Cutting Issues comprising Gender Mainstreaming and Social Inclusion, Environmental and Social Impact Assessment and Group Dynamics, Cohesion and Leadership.

The 10 modules are divided into the following sections:

1.1 Introduction to the Module
1.2 Module Learning Outcomes
1.3 Module Target Groups
1.4 Module Users
1.5 Module Duration
1.6 Module Summary
1.7 Facilitator's Guidelines
1.8 Participants' Handouts and Training References

MODULE 1

CLIMATE-SMART AGRICULTURE PRACTICES

1.1 Introduction to the Module

This module on climate smart agriculture practices aims to introduce basic principles of climate science, the basis of current climate change scenario and the factors underlying the negative impacts of the climate change on agricultural productivity. The module also aims to establish that positive interventions made through the application of appropriate TIMPs, can result into increased adaptation to climate change and mitigation against its negative effects thereby enhancing resilience and food security.

Specifically, this module intends to answer the following questions:

- What is climate change and what are its causes?
- How does climate change affect aquaculture and pastoral practices?
- What is climate smart agriculture?
- What are the practical solutions that aquacultural and pastoral producers can put into practice to deal with climate change effects?

1.2 Module Learning Outcomes

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

- Climate change defined
- Causes of climate change explained
- The principles of climate-smart aquaculture described and expalined
- Climate change impacts on aquaculture and food security identified
- Role of climate smart aquaculturee practices in adaptation, resilience to climate change and in the reduction of GHG emissions explained.

1.3 Module Target Groups

This module is intended for use by service provider, lead farmers and public and private extension agents.

1.4 Module Users

This module is intended for use by trainers who are members of the Core Team of Trainers (CTT) and Farmer Trainers. The module user should thoroughly familiarize themselves with the participant's handouts and training reference materials relevant for this module.

1.5 Module duration

The Module is estimated to take **4 hours 30 minutes**

1.6 Module Summary

Climate Smart Agriculture Practices			
Sessions	**Training methods**	**Training materials**	**Time**
1.6.1 Introduction, module outcomes and expectations	▪ PowerPoint presentation	▪ Flips charts ▪ Felt pens ▪ LCD Projector	15 minutes
1.6.2 Understanding climate change	▪ PowerPoint presentations ▪ Plenary discussion	▪ Flips charts ▪ Felt pens ▪ LCD Projector ▪ Handout 1.6.2	45 minutes
1.6.3 Climate change impacts on agriculture and food security	▪ PowerPoint presentations ▪ Plenary discussion	▪ Flips charts ▪ Felt pens ▪ LCD Projector ▪ Handout 1.6.3	45 minutes
1.6.4 TIMPs definition and approaches to their validation and dissemination	▪ PowerPoint presentations ▪ Plenary discussion	▪ Flips charts ▪ Felt pens ▪ LCD Projector ▪ Handout 1.6.4	45 minutes
1.6.5 Climate smart agriculture and context specific practices	▪ PowerPoint presentations ▪ Plenary discussion ▪ Group work	▪ Flips charts ▪ Felt pens ▪ LCD Projector ▪ Handout 1.6.5	1 hour 45 minutes
1.6.6 Module review	▪ Power-Point presentations ▪ Plenary discussion	▪ Flips charts ▪ LCD Projector ▪ Handouts 1.6.6	30 minutes
TOTAL			**3 hours 45 minutes**

1.7 Trainers' Guidelines

Climate Smart Agriculture Practices	
1.7.1 Introduction, module objectives and expectations (15 minutes)	**Session Guide**
The trainer introduces the module and invites trainees to introduce themselves and state their expectations. *The trainer then presents module objectives and levels out expectations.* **Module objectives** By the end of the module the trainee should be able to: • Define climate change • Explain causes of climate change • Explain the principles of climate-smart agriculture • Identify climate change impacts on aquaculture and food security • Explain role of climate smart agriculture practices in adaptation, resilience to climate change and in the reduction of GHG emissions	• Summarize trainees expectations using cards or any appropriate method. • PowerPoint presentation • Distribution of training notes
1.7.2 Understanding climate change (45 minutes)	**Session guide**
The trainer makes a presentation on climate change; - causes, effects and mitigation) (**30 minutes**) • What is climate change? • What causes climate change? **Plenary discussion (15 minutes)**	• Power point presentation • Flip charts • Plenary discussion • Distribution of training notes

1.7.3 Climate changes impacts on aquaculture and food security (45 minutes)	**Session guide**
The trainer makes a presentation on the effects of climate change on agriculture and food security (30 minutes). • What are the effects of climate change on agriculture? • How does aquaculture contribute to climate change? The link between climate change and food security **Plenary discussion (15 minutes)** *(Trainer guides the trainees in discussing the impact of climate change on food security).* Questions on the presentation are answered and practical experiences on the effects of climate change on agriculture in their local context discussed. Further the impact on food security and some of the intervention taken identified.	• PowerPoint presentation • Flip charts • Plenary discussion • Distribution of training notes
1.7.4 Climate smart aquaculture and context specific practices (1 hour 45 minutes)	
The trainer presents important characteristics of CSA and context specific practices, which ameliorate the negative climate change effects in aquaculture; integrating practices from the project thematic areas including; agroforestry, soil and water management, irrigation systems, crop-livestock and fish integration, post-harvest management and value addition, and renewable energy (30 minutes). • Characteristics of CSA and why CSA? • Principles of climate-smart agriculture (Triple wins). **Plenary discussion (15 minutes)** **Group Work and Presentation (1 hour)** Trainees to conceptualize and provide examples of CSA TIMPs and climate smart aquaculture practices	• PowerPoint presentation • Flip charts • Plenary discussions • Group work/ presentation • Distribution of training notes
1.7.5 Module review (15 minutes)	**Session guide**
The trainer leads the trainee in reviewing the module Summarize and review the main points of the training with the trainees about climate-smart agriculture 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 the module? • What is your main take-home message?	Recap of the key take-home points using any of the following participatory methods: • Q & A session • Discussions • Questionnaires • Any other

1.8 Participants' Handouts and Training Reference Materials

1.8.1 Participant's Handouts

1. Fundamentals of Climate Smart Agriculture Practices

1.8.2 Training Reference Materials

1. FAO. (2019. Climate smart agriculture curriculum/module for training of trainers in Myanmar. Food and Agricultural Organization of the United Nations and AVSI Foundation, Naypyidaw, 2019. Licence: CC BY – NC – SA 3.0 IGO. 28 pp.
2. FAO. (2013). Climate smart agriculture sourcebook. Food and Agricultural Organization of the United Nations, Rome, Italy.
3. FAO. (2018). Climate smart agriculture training manual: A reference manual for agricultural extension agents. Food and Agricultural Organization of the United Nations. Rome, Italy, 106 pp.
4. GIZ-SLM. (2017). Climate smart agriculture: A manual for implementing the sustainable land management program (SLMP). Ethiopia and GIZ, Addis Ababa.
5. Climate smart agriculture manual for agricultural education in Zimbabwe, Climate Technology Centre and Network, Denmark.

MODULE 2

SEMI-INTENSIVE CULTURE SYSTEMS AND MANAGEMENT PRACTICES

1.1 Introduction to the Module

This module focuses on semi-intensive pond-based systems comprising of earthen, liner, concrete and wooden raised ponds. In Kenya, the bulk of aquaculture production still comes from small-scale pond-based culture systems and practices. Aquaculture systems are mainly characterized into three categories depending on scale of production *viz*: (i) extensive systems with low degree of control; low initial costs, low-level technology, and low production efficiency; (ii) semi-intensive systems where supplemental feed is required to maintain higher stocking rates; and (iii) intensive systems characterized by a high degree of control, high initial costs, high-level technology, and high production efficiency.

1.2 Module learning Outcomes

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

- Site selection and validation of pond-based culture systems demonstrated and explained
- Pond-based culture systems design explained and demonstrated
- Best Management practices (BMPs) in pond culture described and explained.

1.3 Module Target Group and Categories

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

1.4 Module Users

This module is intended for use by master trainers who are members of the Core Team of Trainers (CTT) and Farmer Trainers. The facilitator/trainer using this module should thoroughly familiarize themselves with the participant's handouts and training reference materials.

1.5 Module Duration

The module is estimated to take 6 hours.

1.6 Module Summary

Semi-Intensive Culture Systems and Best Management Practices			
Sessions	**Training methods**	**Training materials/ Equipment**	**Time**
2.6.1 Introduction, outcomes and expectations	▪ PowerPoint presentation	▪ LCD Projector	15 minutes
2.6.2 Criteria for pond site selection	▪ PowerPoint Presentation ▪ Field demonstration ▪ Group discussions	▪ LCD Projector ▪ Laptop ▪ Flip charts and pens ▪ Soil testing kit ▪ Buckets ▪ Timer ▪ Handout	1 hour 45 minutes
2.6.3 General guidelines for pond design and layout	▪ PowerPoint Presentations ▪ Field demonstration ▪ Group discussions	▪ Flip charts and felt pens ▪ Compactors/rollers ▪ Survey equipment ▪ Spades and Jembes ▪ String and spirit levels ▪ Tape measures and twines ▪ Liner materials- ▪ 2'*2' timber (70ft) ▪ Pegs and poles ▪ Handout	2 hours 45 minutes
2.6.4 Best Management Practices	▪ PowerPoint Presentations ▪ Plenary Class discussions	▪ LCD Projector ▪ Laptop ▪ Flips charts ▪ Felt pens ▪ Handouts	1 hour
2.6.5 Module review	▪ Presentations ▪ Plenary discussions	▪ Flips charts ▪ PowerPoint ▪ Handouts	15 minutes
Total			**6 hours**

2.7 Trainer's Guidelines

Semi-Intensive Culture Systems and Best Management Practices	
2.7.1. Introduction, module objectives and expectations (15 Minutes)	**Session Guide**
The trainer introduces the module and invites trainees to introduce themselves and state their expectations. The trainer then presents module objectives and levels out expectations. **Module objectives** By the end of the module training, the trainees' should be able to: 1. Demonstrate and explain site selection and validation of pond-based culture systems 2. Demonstrate and design pond-based culture systems 3. Describe and explain BMPs in pond culture.	• Summarize trainees' "Expectations" using cards or any appropriate method. • PowerPoint presentation
2.7.2. Criteria for pond site selection (1 hour 45 minutes)	**Session Guide**
The trainer makes a presentation on the criteria to be considered during pond (earthen, liner and wooden-raised ponds) site selection and validation. **(30 minutes)** **Plenary discussions (15 minutes)** **Field excursion practical in the field (1 hour)** Trainees will be divided into 2 groups one to deal with soil and the other water testing. ***Group 1:*** Trainees collect soil samples from different areas on the proposed or identified site to test their properties. ***Group 2:*** Trainees sample water from its source to check on turbidity, flow rate, and estimate quantity.	• PowerPoint presentation • Distribute Participants handouts at the end of the module. • Group exercise

2.7.3. General guidelines and requirements for pond design and layout (2 hours 45 minutes)	**Session Guide**
The trainer makes a presentation on the general guidelines for pond design and layout for earthen, liner based and wooden raised ponds. **(30 minutes)** **Practical demonstration on training site (2 hours)** Visit the pond demonstration plot with the trainees and demonstrate how to conduct site clearing, pegging, determination of elevations, free boards, core trench construction, determination of slopes, construction and completion of the dykes, inlet and outlet installations. **Plenary discussion (15 minutes)** Immediately after the practical session, the facilitator asks the trainees to recall what they have learned. Discuss any arising issues related to earthen, liner-based and wooden raised ponds in relation to: a) Criteria for site selection and validation b) Selection of materials to be used c) Pond design and construction d) Challenges and solutions in site selection and survey.	• PowerPoint presentation • Distribute Participants handouts at the end of the module. • Visit demonstration plot • Pond design and construction manual for earthen, liner and raised ponds • Demonstrate pond design (Including inner and outer toes, pond bottom and dyke slopes, canal and inlet and outlet slopes) and allow the trainees to fully design and peg a 10m by 10m pond. • Group discussions and group work
2.7.4 Best Management Practices (1 hour)	
The trainer guides trainees through PowerPoint presentation on common BMPs in the pond-based system **(30 minutes)** • Concept of aquaculture Best Management Practices • Common best practices in land based-aquaculture systems. • Benefits of adopting standardized management best practice. Group work on BMPs **(30 minutes)**	• PowerPoint Presentation\ • Group work - Discuss the task in groups and present findings

2.7.5. Module review (15 minutes)	Session Guide
The trainer leads the trainees in reviewing the module Summarize and review with the trainees, the main points of the training on the semi-intensive fish culture systems. • 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 the module? • What is the take-home message?	Recap of the key take-home points using any of the following participatory methods: • Q & A session • Discussions • Questionnaires etc.

2.8 Participants' Handouts and Training Reference Materials

2.8.1 Participants' Handouts

- Handout: Criteria for pond site selection
- Handout: General guidelines and requirements for pond design and layout
- Handout: Best management practices.

2.8.2 Training Reference Materials

1. Charo-Karisa H, Munguti J., Ouma H., Masai D.M., Opiyo M., Orina P.S & Okech J. K. (2011), Fish farmers manual, for beginner's students and hatchery managers, Kenya Marine & Fisheries Research Institute. River Brooks Communication Network Publishers, Nairobi Kenya
2. Lekang, O. I. (2020). *Aquaculture engineering*. John Wiley & Sons.
3. Ngugi, C. C., Bowman, J. R., and Omolo, B. (2007). A new guide to fish farming in Kenya.
4. Parker, R. (2011). *Aquaculture science*. Cengage learning.
5. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell Publishers LTD
6. Smart Fish Project (2014). FAO Smart Fish Project Aquaculture Training Manual

MODULE 3

INTENSIVE CULTURE SYSTEMS AND MANAGEMENT PRACTICES

3.1 Introduction to the Module

In this module, trainees will learn how to design, assemble and operate efficient, intensive culture systems e.g. recirculating aquaculture systems (RAS), raceway systems, cages and aquaponic systems. Different types of intensive culture systems and their associated designs, functions and operations will be highlighted. The module emphasizes on the design of low-cost small-scale aquaponics systems and highlights their associated challenges and lastly the use of Information Technology (IT) in managing and operating these systems. In addition, the module will focus on Best Management Practices (BMPs) and their importance in increasing aquaculture productivity and conservation of natural ecosystems. Finally, the module addresses the key roles of fish farmers and other stakeholders in implementing BMPs.

The module addresses the following key aspects:

- Type of intensive culture systems currently used in aquaculture
- Construction of the systems and materials used in construction
- The functions of various components and operations of the systems
- Criteria for site selection and installation procedures
- Best management strategies for increasing aquaculture production
- Best management strategies for water quality
- Practical solutions for the mitigation of climate change and environmental conservation.

3.2 Module Learning Outcomes

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

- Operations, design culture systems, implementation and operation of simple and low technology cage, Recirculating Aquaculture Sytems (RAS) and Aquaponics systems for running fish farms and hatcheries demonstrated and understood.
- Increasing productivity and food security using the cage, RAS and Aquaponic systems demonstrated.
- Intensive fish farming technologies/systems, their requirements and applications for increasing fish production explained and appreciated.
- Use of climate-smart technologies, innovations and best management practices in the aquaculture value chain demonstrated and understood.

3.3 Module Target Group

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

3.4 Module Users

This module is intended for use by trainers who are members of the Core Team of Trainers (CTT) and Farmer Trainers. The module users should thoroughly familiarize themselves with the relevant participant's handouts and training reference materials.

3.5 Module Duration

The module is estimated to take a minimum of **7 hours.**

3.6 Module Summary

Intensive Culture Systems and Best Management Practices			
Sessions	**Training methods**	**Training materials**	**Time**
3.6.1 Introduction, learning outcomes and expectations	▪ Plenary discussions	▪ Flips charts ▪ Felt pens ▪ LCD Projector	15 minutes
3.6.2 Recirculating and aquaponic systems	▪ PowerPoint presentations ▪ Plenary discussions ▪ Practicals	▪ Flips charts/Felt pens ▪ LCD Projector ▪ Field excursion ▪ Laptop	1 hour 45 minutes
3.6.3 Tank and Raceway Culture	▪ PowerPoint presentations ▪ Plenary discussions ▪ Practicals	▪ Flips charts ▪ Felt pens ▪ LCD projector ▪ Field excursion ▪ Laptop	1 hour 30 minutes
3.6.4 Cage culture system	▪ PowerPoint presentations ▪ Plenary discussions ▪ Practicals	▪ Flips charts ▪ Felt pens ▪ LCD projector ▪ Field excursion ▪ Laptop	1 hour 45 minutes
3.6.5 Integrated crop-livestock-fish (CLF) culture Systems	▪ PowerPoint presentations ▪ Plenary discussions ▪ Practicals	▪ Flips charts ▪ Felt pens ▪ LCD projector ▪ Laptop	45 minutes
3.6.6 Best Management Practices	▪ PowerPoint presentations ▪ Plenary discussions	▪ Flips charts ▪ Felt pens ▪ LCD projector ▪ Laptop	45 minutes

3.6.6 Module review	▪ Plenary discussions	▪ Flips charts ▪ PowerPoint ▪ Handouts	15 minutes
TOTAL			**7 hours**

3.7 Trainer's Guidelines

Intensive Culture Systems and Best Management Practices	
3.7.1 Introduction, module objective and expectations (15 minutes)	**Session Guide**
(The trainer introduces the module and invites trainees to introduce themselves and state their expectations. The trainer then presents modules learning outcomes and expectations). **Module objectives** By the end of the module the trainees should be able to: • Demonstrate understanding of operations, design culture systems, implement and operate simple and low technology cage, RAS and Aquaponics systems for running fish farms and hatcheries. • Apply knowledge and skills gained to increase productivity and food security using the cage, RAS and Aquaponic systems while keeping operating costs low. • Demonstrate use of intensive fish farming technologies/systems, their requirements and applications for increasing fish production. • Acquire skills for climate-smart technologies, innovations and best management practices in the aquaculture value chain.	• Summarize Trainees expectations using cards and any other appropriate method • PowerPoint presentation • Distribute notes and handouts at the end of the training of the module

3.7.2 Recirculatory and Aquaponic systems (1 hour 45 minutes)	**Session guide**
The trainer makes a PowerPoint presentation on recirculating and aquaponic systems (**30 minutes**). • Components • Component functions • Installation • Operations Plenary discussion **(15 minutes)** **Practical demonstrations in the field (1 hour)**	• PowerPoint presentation • Field visit to an established RAS/Aquaponic demonstration unit. • Biofiltration systems • Assembly of prototype RAS and Aquaponic systems
3.7.3 Tank and Raceway Culture (1 hour 45 minutes)	**Session guide**
The trainer makes a PowerPoint presentation on tanks and raceways (**30 minutes)**: • Components • Component functions • Installation • Operations **Practical demonstrations during field excursion (1 hour)**	• PowerPoint presentation • Distribute handouts to trainees at the end of the module • Tank culture and Raceway culture Brochures, Posters and Leaflets • Q & A sessions
3.7.4 The Cage Culture System (1 hour 45 minutes)	**Session guide**
The trainer makes a PowerPoint presentation on cage culture systems (**30 minutes**). • Site selection criteria - Suitability map for cage culture in both lakes and reservoirs • Cage materials and components acquisition and assembly • Cage design and construction - Low volume high density (LVHD) and High-density poly ethylene (HDPE) cages • Cage management - Feeds, seed, water quality, record keeping and disease prevention • Challenges and solutions associated with cage farming. **Plenary discussion (15 minutes)** **Practical demonstrations during field excursion (1 hour)**	• PowerPoint presentation • Plenary discussion • Q & A sessions

3.7.5 Integrated crop-livestock-fish (CLF) culture Systems (45 minutes)	**Session guide**
The trainer makes a PowerPoint presentation on CLF systems (**30 minutes**). • Types of integrated systems • Animal-fish integration • Crop-fish integration • Fish-fish integration **Plenary discussion 15 minutes**	• Distribute to trainees handouts of the presentation at the end of the module • PowerPoint presentation
3.7.6 Best Management Practices (45 minutes)	**Session guide**
The trainer makes a PowerPoint presentation on Best Management Practices **(30 minutes).** • Common best practices in intensive culture systems • Optimal water quality measurements and guidelines **Plenary discussions (15 minutes)**	• Discuss the task in groups and come with a presentation for plenary discussions/ inputs
3.7.7 Module review (15 minutes)	**Session guide**
The trainer should lead the trainees in reviewing the module. Summarize and review with the trainees, the main points of the training on intensive culture systems and best management practices. • What new things did you learn from this module? • Did the trainees feel that important aspects may have been left out by the facilitator • What are some of the problems and issues that they may have become more aware of in the module? • As per the knowledge gained, the changes they feel should be made on the current systems if there is an opportunity to do so. • Ask each participant stating their take-home message	Recap of the key take-home points using any of the following participatory methods: • Q & A session • Discussions • Questionnaires • Any other

3.8 Participants' Handouts and Training Reference Materials

3.8.1 Participants' Handouts

1. Trainers notes on intensive culture systems and best management practices.

3.8.2. Training Reference Materials

1. Parker, R. (2011). *Aquaculture science*. Cengage learning.

2. Engle, C. R. (2010). *Aquaculture economics and financing: management and analysis*. John Wiley & Sons.
3. Beveridge, M. C. (2008). *Cage aquaculture* (Vol. 5). John Wiley & Sons
4. Egna, H. S., & Boyd, C. E. (1997). *Dynamics of pond aquaculture*. CRC press.
5. Lin, C. K., Shrestha, M. K., Yi, Y., & Diana, J. S. (2001). Management to minimize the environmental impacts of pond effluent: harvest draining techniques and effluent quality. *Aquacultural Engineering*, *25*(2), 125-135

MODULE 4

FISH BREEDING AND GENETICS

4.1 Introduction to the Module

There is a high demand for quality certified fish seed in Kenya for improved aquaculture productivity. To enhance the production of quality seed, there are several documented fish breeding and genetics techniques available which include chromosomal manipulation, hybridization or cross-breeding, hormonal sex reversal, GIFT YY male technology, gene transfer and selective breeding. This module explains the protocols to be used in fish breeding of commercially important fish species in Kenya namely Nile tilapia, African catfish, African carps (*Barbus spp*, *Labeo victorianus)*, and ornamental fish.

4.2 Module Learning Outcomes

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

- Skills and knowledge in fish genetics and breeding of commercially important fish species developed and tested
- Skills and knowledge in commercially important wild fish stocks selection and domestication developed and tested
- Positive qualities for commercially important fish species to enhance production and market acceptability identified
- Skills and knowledge in fish breeding techniques for increased yields developed
- Knowledge in broodstock and fry/fingerling management acquired
- Skills and knowledge in broodstock genetic integrity and biosafety management developed and acquired
- Benefits of fish breeding and genetics in aquaculture development explained.

4.3 Module Target Group

This module targets all fisheries extension officers, public and private extension service agents and lead farmers.

4.4 Module Users

This module is intended for use by trainers who are members of the Core Team of Trainers (CTT) and Farmer Trainers. The facilitator using this module should exhaustively familiarize themselves with the participant's handouts and training reference materials.

4.5 Module Duration

The Module is estimated to take **4 hours 45 minutes**.

4.6 Module Summary

Fish Breeding and Genetics			
Sessions	**Training Methods**	**Training Materials**	**Time**
4.6.1 Introduction, learning outcomes and expectations	▪ Module introduction ▪ PowerPoint presentation	▪ PowerPoint notes ▪ LCD Projector ▪ Flip Charts ▪ Felt Pens ▪ Laptop	15 minutes
4.6.2 Wild fish stocks selection and domestication	▪ PowerPoint presentation ▪ Plenary discussions	▪ PowerPoint notes ▪ LCD Projector ▪ Flip charts ▪ Felt Pens ▪ Laptop	45 minutes
4.6.3 Broodstock traits	▪ PowerPoint presentation ▪ Group Discussions	▪ PowerPoint notes ▪ LCD Projector ▪ Flip Charts ▪ Felt Pens ▪ Laptop	1 hour
4.6.4 Fish breeding and genetics improvement techniques and management	▪ PowerPoint presentation ▪ Plenary discussions	▪ Flip charts ▪ Felt pens ▪ PowerPoint notes ▪ LCD Projector ▪ Handouts ▪ Laptop	45 minutes
4.6.5 Broodstock genetic integrity and biosafety	▪ PowerPoint presentation ▪ Plenary discussions	▪ Flip charts ▪ Felt pens ▪ PowerPoint notes ▪ LCD Projector ▪ Handouts ▪ Laptop	45 minutes
4.6.6 Practical aspects of fish production, incubation and larval rearing	▪ PowerPoint presentation ▪ Plenary discussion ▪ Practical sessions	▪ Hatchery site ▪ Broodstock ▪ Sex reversal Hormone ▪ Handouts ▪ Laptop	1 hour
4.6.7 Module review	▪ Plenary discussion	▪ Flip charts ▪ LCD Projector	15 minutes
TOTAL			**4 hour 45 minutes**

4.7 Trainers' Guidelines

Fish Breeding and Genetics	
4.7.1 Introduction, module objectives and expectations (15 Minutes)	**Session Guide**
The trainer introduces the module and invites trainees to introduce themselves and state their expectations. The trainer then presents modules objectives and levels out the expectations. **Module Objectives** By the end of the module the trainee should be able to: • Demonstrate acquisition of skills and knowledge in fish genetics and breeding of commercially important fish species. • Demonstrate acquisition of skills and knowledge in commercially important wild fish stocks selection and domestication. • Identify positive traits for commercially important fish species to enhance production and market acceptability. • Provide the trainee with adequate skills and knowledge in fish breeding techniques for increased yields. • Acquire skills and knowledge in broodstock and fry/fingerling management. • Demonstrate skills and knowledge in broodstock genetic integrity and biosafety management. • Explain the benefits of fish breeding and genetics in aquaculture development.	• Summarize Trainees' expectations using cards or any other appropriate method. • PowerPoint presentation • Distribute training notes and handouts at the end of the module.
4.7.2 Wild fish stocks selection and domestication (45 minutes)	**Session guide**
The trainer makes a presentation on wild broodstock selection techniques and domestication for main culture species **(30 minutes).** • Source • Access • Transportation mode • Genetic purity • Policies. Plenary Discussion **(15 minutes)**	• PowerPoint presentation • Plenary discussion

4.7.3 Broodstock traits (1 hour)	**Session guide**
The trainer makes a PowerPoint presentation on the topics **(30 minutes).** • Pure phenotypic traits • Crossbreeds traits • Causes of crossbreeds • Effects of crossbreeds. **Group work (30 minutes)**	• Flip Charts • Felt Pens • Group Discussions • Group Presentations
4.7.4 Fish breeding and genetics improvement techniques and management (45 minutes)	**Session guide**
The trainer makes a presentation on fish genetics and breeding techniques for main culture species in Kenya) **(30 minutes).** • Selective Breeding • Sex determination • Broodstock Management and feeding • Types of spawning e.g. natural, semi-natural, semi-artificial and complete artificial propagation • Hormonal Sex-reversal protocol • YY technology • Crossbreeding and hybridization • Egg, fry and fingerling management. **Plenary discussion (15 minutes)**	• PowerPoint presentation • Plenary discussion
4.7.5 Broodstock genetic integrity and biosafety (45 minutes)	**Session guide**
Present the following on PowerPoint and flip charts: **(30 minutes)** • Phenotypic identification of pure strains and crosses • Factors contributing to genetic pollution of broodstock • Genetic biosafety considerations in aquaculture **Plenary discussion (15 minutes)**	• PowerPoint presentation • Q & A sessions

4.7.5 Practical aspects of fish production, incubation and larval rearing (1 hour)	**Session guide**
The trainer demonstrates quality broodstock, fish sexing, fish seed production techniques, egg, fry/ fingerling management and hatchery seed production opportunities and challenges **(1 hour)** *Trainees are taken to the hatchery/laboratory and shown how to:* • Prepare for broodstock acquisition • Determine the population size of broodstock • Selection of broodstock and management • Handling and care of broodstock • How to count fish eggs and determine egg quality • Nursing and care of fish larvae • Control of reproduction and prevention of inbreeding • Environmental factors affecting breeding e.g. Dissolved oxygen, Ammonia, Nitrates, pH, invasive species.	• Practical demonstrations • Plenary discussions/ inputs
4.7.6 Module review (15 minutes)	**Session guide**
(The trainer leads the trainees in reviewing the module). Summarize and review with the trainees, the main points of the training on fish breeding and genetic techniques • 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 the module?	Recap of the key take-home points using any of the following participatory methods: • Q & A session • Discussion • Any other

4.8 Participants' Handouts and Training Reference Materials

4.8.1 Handouts

Introduction to Fish Genetics and Breeding, KEMFRI

4.8.2 Training Reference Materials

1. Charo-Karisa H., Munguti J., Ouma H., Masai M.D., Opiyo M., Orina P. & Okechi J. (2011). A fish farmer's manual for beginners, students and hatchery managers. Kenya Marine and Fisheries Research Institute. River Brooks Communication Network Publishers, Nairobi-Kenya.
2. SmartFish-FAO (2014). Aquaculture Training Manual- Program for the

implementation of a regional fisheries strategy for the Eastern and Southern Africa – Indian Ocean region. *GCP/RAF/466/EC SmartFish Project*.

3. FAO. (2008). *Aquaculture development. 3. Genetic resource management.* FAO Technical Guidelines for Responsible Fisheries. No. 5, Suppl. 3. Rome, FAO. 2008. 125p

MODULE 5

FISH NUTRITION, FEED FORMULATION AND MANAGEMENT PRACTICES

5.1 Introduction to the Module

The module specifies the training competencies required to produce cost-effective cottage/supplementary and commercial pelleted fish feeds. It involves; sourcing of especially locally available fish feed ingredients, feeds formulations using the locally available feed ingredients, feed processing for the different fish species and growth stages, feeds conversion ratio, feeding strategies; the relationship between feeding and water quality in culture systems, and feed storage.

5.2 Module Learning Outcomes

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

- Skills on sourcing of quality feed ingredients developed
- Knowledge on formulating highly quality feeds, targeting various species, the different developmental/growth stages and different culture systems developed.
- Knowledge and skills in fish feed processing provided and developed.
- Knowledge and skills on feed packaging and storage enhanced
- Knowledge in adequate management of feeding and water quality in culture systems developed
- Best management practices in fish feeds shared and enhanced.
- Knowledge for monitoring growth and feed conversion ratio of different formulations shared and enhanced.

5.3 Module Target Group

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

5.4 Module Users

This module is intended for use by trainers who are members of the Core Team of Trainers (CTT) and Farmer Trainers. The facilitator using this module should exhaustively familiarize themselves with the participants' handouts and training reference materials.

5.5 Module Duration

The Module is estimated to take **4 hours 30 minutes**.

5.6 Module summary

Fish Nutrition, Feed Formulation and Management Practices			
Sessions	**Training methods**	**Training materials**	**Time**
5.6.1 Introduction, learning outcomes and expectations	▪ PowerPoint Presentation	▪ LCD Projector ▪ Laptop	15 minutes
5.6.2 Fish Nutrition, Feeds and Feeding	▪ PowerPoint presentation ▪ Plenary discussions ▪ Questions & Answers	▪ Flips charts ▪ Felt pens ▪ LCD Projector ▪ Handouts ▪ Laptop	1 hour 45 minutes
5.6.3 Quality Assurance in Fish Feeds	▪ PowerPoint presentation ▪ Plenary discussions	▪ Flips charts ▪ Felt pens ▪ Handouts ▪ Laptop	45 minutes
5.6.4 Feed Selection, Storage and Administration	▪ PowerPoint presentation ▪ Plenary discussions ▪ demonstrations	▪ Flips charts ▪ Felt pens ▪ LCD Projector ▪ Handouts ▪ Laptop	45 minutes
5.6.5 Fish Feed Formulation and Conversion Ratio (FCR) and Feed Storage	▪ PowerPoint presentation ▪ Plenary discussions ▪ Practical demonstrations	▪ Flips charts ▪ Felt pens ▪ LCD Projector ▪ Handouts ▪ Assorted Feed Ingredients ▪ Laptop	45 minutes
5.6.6 Module review	▪ PowerPoint presentation ▪ Plenary discussions	▪ Flips charts ▪ LCD Projector ▪ Handouts	15 minutes
TOTAL			**4 hours 30 minutes**

5.7 Trainers' Guidelines

Fish Nutrition, Feed Formulation and Management Practices	
5.7.1 Introduction, module objectives and expectations (15 minutes)	**Session Guide**
The trainer introduces the module and invites trainees to introduce themselves and state their expectations. The trainer presents modules objectives and levels out expectations. **Module objectives** By the end of the module the trainee should be able to: • Explain sourcing of quality feed ingredients • Formulate highly efficient feeds, targeting various species, the different developmental/growth stages and different culture systems. • Demonstrate knowledge and skills in fish feed processing. • Demonstrate knowledge and skills on feed packaging and storage. • Adequately manage feeding and water quality in culture systems. • Apply best management practices in fish feeds. • Monitor growth and feed conversion ratio of different formulations.	• Summarize trainees "expectations" using cards or any other appropriate method. • PowerPoint presentation • Distribute training notes and handouts at the end of the module.
5.7.2 Fish Nutrition, Feeds and Feeding (1 hour 45 minutes)	**Session guide**
The trainer makes PowerPoint presentation on fish feeds and feeding and explains the main reasons for feeding fish **(30 minutes)** • Why feed fish? • Feeding rates for different culture systems • Sourcing of raw materials for feeds formulations and costing of fish feeds to optimize profits • Evaluating feed performance (feed records, FCR, etc.) • Nutrient loading in culture systems and water quality monitoring • Effects of feeding and water quality on fish growth rates • FCR of different feed formulations and managing FCRs. **Plenary discussion (15 minutes)** **Practical demonstration (1 hour)** Practical demonstration of feed ingredients and nutritional values	• PowerPoint presentation • Feeding Guidelines • Demonstration of live fish feeding • Distribution of Feeds and Feeding handouts to trainees

5.7.3 Quality Assurance in Fish Feeds (45 minutes)	Session guide
The trainer makes PowerPoint presentation the following aspects **(30 minutes)** • Nutritional and physical characteristics of the feeds • Nutrients requirements for the different fish species & growth stages - right quantities and proportions for good performance in terms of both growth and health • Accessibility of nutrients within the feeds - bioavailability • Effects of floating and sinking feeds. **Plenary Discussion (15 minutes)**	• PowerPoint presentation • Flip Charts • Plenary Discussion
5.7.4 Feeding Selection, Administration and Management Practices (45 minutes)	**Session guide**
Present the following on PowerPoint slides and flip charts **(30 minutes).** • Feeding schedules for different fish sizes/stages (Juvenile fish require higher protein in their feed than brooders) • Feeding rates for different fish species • Feeding methods (broadcasting, automated and demand-driven) and why? • Administering the feed and feeding response • When not to feed • Factors to consider when feeding fish. **Plenary Discussion (15 minutes)**	• PowerPoint presentation • Plenary Discussion • Flip charts
5.7.5 Fish Feed Conversion Ratio (FCR) and Feed Storage and calculation of FCR (45 minutes)	**Session guide**
The trainer guides trainees on the calculation of fish feed conversion ratio **(30 minutes)** • What is Fish Feed Conversion Ratio (FCR)? • Things to consider in feed formulation i.e., Factors that affect Fish Feed Storage • Type of feed stores and shelf life of fish feeds • The conditions under which the fish feed is stored. **Plenary Discussion (15 minutes)**	• PowerPoint presentation • Feeding schedules and protocols • Feed rates tables • Plenary Discussion

5.7.6 Module review (15 minutes)	Session guide
(*The trainer leads the trainees in reviewing the module*) Summarize and review the main points of the Fish Nutrition, Feed Formulation and Management Practices training 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 the module?	Recap of the key take-home points using any of the following participatory methods: • Q & A session • Discussions • Questionnaires • Any other method

5.8 Participants' handouts and Training Reference Materials

5.8.1 Participants' handouts

1. Practical aspects of fish Nutrition: Fish feed formulation processing, storage and application

5.8.2 Training Reference Materials

1. Charo-Karisa H, Munguti J., Ouma H., Masai D.M., Opiyo M., Orina P.S & Okech J.K. (2011). Fish farmers manual, for beginner's students and hatchery managers, Kenya Marine & Fisheries Research Institute. River Brooks Communication Network Publishers, Nairobi Kenya
2. Craig, S., Helfrich, L. A., Kuhn, D., & Schwarz, M. H. (2017). Understanding fish nutrition, feeds, and feeding. Merrifield, D. L., & Ringo, E. (Eds.). (2014). *Aquaculture nutrition: gut health, probiotics and prebiotics*. John Wiley & Sons.]
3. Gasco, L., Gai, F., Maricchiolo, G., Genovese, L., Ragonese, S., Bottari, T., & Caruso, G. (2018). Fishmeal alternative protein sources for aquaculture feeds. In Feeds for the aquaculture sector (pp. 1-28). Springer, Cham.
4. Merrifield, D. L., & Ringo, E. (Eds.). (2014). *Aquaculture nutrition: gut health, probiotics and prebiotics*. John Wiley & Sons.
5. Munguti, J. M., Mugiranea, J. K. & Ogello, E. O. (2014). An overview of the Kenyan aquaculture sector: Current status, challenges and opportunities for future development. Fisheries and Aquatic Sciences, 17(1), 1-11.

MODULE 6

FISH HEALTH MANAGEMENT AND BIOSECURITY

6.1 Introduction to the Module

The module on fish health management and biosecurity specifies the training competencies required for fish health and biosecurity. It involves the practices, procedures and policies used to prevent the introduction of disease-causing organisms. The occurrence of disease outbreaks in fish farming may be due to poor husbandry practices since the disease-causing organisms are always in the environment. They cause problems until the fish are stressed through inadequate dietary or environmental conditions. Since fish consumers would want to have an assurance that fish products are safe to eat, retailers have a responsibility of ensuring the quality and safety of fish for human consumption. The farm management needs to ensure that biosecurity principles are observed in all farm operations.

6.2 Module Learning Outcomes

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

- Role of stress in disease development explained and understood
- Common diseases and predators in aquaculture identified
- Emerging diseases in aquaculture appreciated
- Control measures for fish diseases, parasites, predator and pest control developed and shared
- Important steps in biosecurity within a fish farm identified
- Comprehensive biosecurity plan within an aquaculture facility developed and shared.

6.3 Module Target Group

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

6.4 Module Users

This module is intended for use by trainers who are members of the Core Team of Trainers (CTT) and Farmer Trainers. The module user should thoroughly familiarize themselves with the participant's handouts and training reference materials.

6.5 Module Duration

The Module is estimated to take **6 hours**.

6.6 Module Summary

Fish Health Management and Biosecurity			
Sessions	**Training methods**	**Training materials**	**Time**
6.6.1 Introduction, learning outcomes and expectations	▪ PowerPoint presentation ▪ Plenary discussions	▪ Handouts ▪ LCD Projector ▪ Flip charts ▪ Felt pens/cards ▪ Laptop	15 minutes
6.6.2 The role of stress in fish disease development	▪ PowerPoint Presentation ▪ Plenary discussion ▪ Practical demonstration	▪ Handouts ▪ Flip charts ▪ LCD projector ▪ Laptop	45 minutes
6.6.3 Common and emerging fish diseases and their prevention	▪ PowerPoint presentation ▪ Plenary discussions ▪ Practical demonstration ▪ Field observations ▪ Group work	▪ Flips charts ▪ Felt pens ▪ Handouts ▪ LCD Projector ▪ Microscopes (compound & dissecting) ▪ Dissecting kit ▪ Dissecting trays ▪ Microscope slides and coverslips ▪ Fish specimens ▪ Laptop	1 hour 45 minutes
6.6.4 Fish predators and their control in aquaculture	▪ PowerPoint Presentation ▪ Plenary discussions ▪ Practical ▪ Group work	▪ Handouts ▪ LCD Projector ▪ Flip Charts ▪ Felt pens ▪ Laptop	45 minutes
6.6.5 Biosecurity facilities and important steps in biosecurity	▪ PowerPoint Presentation ▪ Plenary discussion	▪ Flips charts ▪ Felt pens ▪ Handouts ▪ LCD Projector ▪ Laptop	45 minutes
6.6.6 Comprehensive biosecurity plan for a farm	▪ PowerPoint presentation ▪ Plenary discussion ▪ Practical demonstration ▪ Group work	▪ Flips charts ▪ Felt pens ▪ Handouts ▪ LCD Projector ▪ Laptop	1 hour 30 minutes

6.6.7 Module review	▪ Plenary discussions	▪ Flips charts	15 minutes
TOTAL			**6 hours**

6.7 Trainers' Guidelines

Fish Health Management and Biosecurity	
6.7.1 Introduction, objectives and expectations (15 minutes)	**Session Guide**
Introduction (15 minutes) *(The trainer introduces the module and invites trainees to introduce themselves and state their expectations. The trainer then presents module objectives and levels out expectations).* **Module objectives** By the end of the training module the trainee should be able to: • Understand the role of stress in disease development • Identify common diseases and predators in aquaculture • Appreciate emerging diseases in aquaculture • Implement control measures for fish diseases, parasites, predator and pest control • Identify the important steps in biosecurity within a fish farm • Develop a comprehensive biosecurity plan within an aquaculture facility.	• Summarize trainees "expectations" and display using cards or any other appropriate method • PowerPoint Presentation • Distribute training notes and handouts at the end of the module
6.7.2 The role of stress in diseases development (45 minutes)	**Session guide**
The trainer makes presentations on the relationship between disease and stress in aquaculture **(30 minutes)** • The host-pathogen-environment relationship in stress development • Sources of stress in aquaculture • Good husbandry practices for management of stress in aquaculture. • Maintenance of good water quality for reducing stress in aquaculture. **Plenary discussion (15 minutes)**	• PowerPoint presentation • Plenary discussion

6.7.3 Common and emerging fish diseases and their prevention (1 hour 45 minutes)	**Session guide**
The trainer makes a presentation on the common diseases in aquaculture and their control measures **(30 minutes).** • Some common fish diseases and their prevention in aquaculture: parasitic, fungal, bacterial, viral diseases • Emerging diseases in aquaculture and their prevention: TiLV • Disease identification techniques • Control of diseases and parasites: water quality management, good husbandry, sanitation, handling, nutrition, treatment. **Plenary discussion (15 minutes)** **Group work** on calculation exercise and preparation of chemical treatments **(30 minutes)** Practical on-site **(30 minutes)**	• PowerPoint presentation • Demonstration on fish parasites • Exercises on calculation and preparation of chemical treatments
6.7.4 Fish predators and their control in aquaculture (45 minutes)	**Session guide**
The trainer makes presentations on fish predators and their control in aquaculture **(30 minutes)** • Common predators in aquaculture • Predators as hosts and vectors of disease agents • Role of predators in parasite life cycles • Controlling predators/ disease hosts in fish farms. **Plenary discussion (15 minutes)**	• PowerPoint presentation • Plenary discussion
6.7.5 Biosecurity facilities and important steps in biosecurity (45 minutes)	**Session guide**
The trainer makes presentations on biosecurity facilities and important steps in biosecurity **(30 minutes)** • Definition of terms: Biosecurity, biosecurity plan, epidemiological unit, aquaculture establishment, compartment, zone, • Biosecurity development process/steps in aquaculture: • Levels of biosecurity in aquaculture • Documentation and record-keeping in aquaculture biosecurity • Standards for biosecurity: construction, operation, disposal, disinfection, sanitation standards. **Plenary discussion** (15 minutes)	• PowerPoint presentation • Group work on hazards and risk identification • Plenary discussion

6.7.6 Comprehensive biosecurity plan for a farm (1 hour 30 minutes)	Session guide
The trainer makes presentations on developing a comprehensive biosecurity plan for a fish farm **(30 minutes)** • Need, purpose and regulatory requirements for a biosecurity plan • Identify the routes of transmission onto, within and from farm • Identify the major disease hazards to the farm • Document the layout of the farm • Document how biosecurity plan guidelines will be addressed on the farm • Implement the biosecurity plan measures on the farm • Implement a review cycle for the biosecurity plan **Group work (45 minutes)** **Plenary discussion (15 minutes)**	• PowerPoint presentation • Group work to develop a biosecurity plan • Plenary discussion
6.7.7 Module review (15 minutes)	**Session guide**
(The trainer leads the trainees in reviewing the module) Summarize and review with the trainees, the main points of the training on Fish Health Management and Biosecurity. • 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 the module?	Recap the key take-home points using any of the following participatory methods: • Brainstorming • Q&A session • Roleplays • Any other relevant method

6.8 Participants' handouts and Training and Reference Materials:

6.8.1 Participants' handouts

1. Training notes
2. Treatment and water quality calculations
3. Aquaculture farm biosecurity plan.
4. Generic guidelines and templates

6.8.2 Training Reference Materials

1. Arthur, J., Bondad-Reantaso, M. G., & Subasinghe, R. (2008). *Procedures for the quarantine of live aquatic animals: a manual.* Rome: FAO.
2. Noga E. (2010). *Fish disease diagnosis and treatment.* Wiley-Blackwell Publications.

3. Francis-Floyd. (2005). Introduction to fish health management. *Fisheries and Aquatic Sciences Department, Florida Coopreative Extensin Service. CIR921*.
4. Kamonporn, T., & Chinabut, S. (1997). Diseases of Tilapia. In C. E. Boyd, & H. S. Egna, *Dynamics of pond aquaculture.* CRC Press.
5. Palic, D., Scarfe , A. D., & Walster , C. (2015). A standardized approach for meeting national and interantional aquaculture biosecurity requirements for preventing, controlling and eradicating infectious diseases. *Journal of Applied Aquaculture, 27*(3), 185-219.
6. Scarfe, A. D., O'Breyen , J. P., & Lee, D. (2006). *Aquaculture Biosecurity: prevention, control and eradication of aquatic animal disease.* Blackwell Publishing.
7. Yanong, R. P., & Subasinghe, R. P. (2012). Biosecurity in aquaculture Part 1: An Overview. *Southern Regional Aquaculture Center . SRAC Publication No 4707*.

MODULE 7

FISH POST-HARVEST TECHNOLOGIES AND VALUE ADDITION

7.1 Introduction to the Module

Outlined in this module, the training specifies competencies required for fish post-harvest and value addition. Value addition aims at seizing opportunities offered by the market. It involves improving the quality of products, enhancing their value and in return better income. Post-harvest and value addition comprise several processes, including transportation and handling fish hygienically; processing fish using different value enhancing techniques; preparation of fish using different recipes; maintenance of good quality fish products; packaging, branding and certifying fish and fish products and preparation and storage of fish safely for longer shelf life.

There are two possibilities of adding value: (1) value capturing through the improvement of current production, processing, trading processes to increase productivity, reduce wastage and reduce costs, and by entering new markets with existing products. (2) value creation through product innovation (e.g. new processed products).

7.2 Module Learning Outcomes

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

- Skills in post-harvest handling of fish developed and shared
- Knowledge and skills personal hygiene in fish handling developed.
- Skills on best management practices in fish preservation and value addition developed and shared.
- Knowledge and practical skills in fish value addition shared.
- Monitoring the quality and safety of fish value-added products shared
- Practical skills in fish packaging and branding developed and shared

7.3 Module Target Group

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

7.4 Module Users

This module is intended for use by master trainers who are members of the Core Team of Trainers (CTT). The module user should thoroughly familiarize themselves with the relevant participant' handouts and training reference materials.

7.5 Module Duration

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

7.6 Module Summary

Fish Post-harvest and Value Addition			
Sessions	**Training methods**	**Training materials**	**Time**
7.6.1 Module learning outcomes and expectations	▪ PowerPoint presentation ▪ Cards or any other appropriate method	▪ Flips charts ▪ Felt pens ▪ LCD Projector ▪ Laptop	15 minutes
7.6.2 Fish handling and hygiene requirements	▪ Brainstorming ▪ Plenary discussions	▪ Flips charts ▪ Felt pens ▪ Handouts ▪ Laptop	45 minutes
7.6.3 Types of fish preservation methods	▪ PowerPoint presentation Audiovisuals ▪ Demonstrations/ Practicals	▪ Flips charts ▪ Felt pens ▪ LCD Projector ▪ Handouts ▪ Laptop	1 hour 45 minutes
7.6.4 Benefits and factors to consider in fish value addition	▪ Plenary discussions	▪ Flips charts ▪ Felt pens ▪ Handouts	45 minutes
7.6.5 Fish value-added production methods and recipes	▪ Practical demonstrations ▪ Group formation	▪ Flips charts ▪ Felt pens ▪ Handouts	2 hours 45 minutes
7.6.6 Module review	▪ Plenary discussions ▪ PowerPoint presentations	▪ Flips charts ▪ LCD Projector ▪ Handouts ▪ Laptop	15 minutes
TOTAL			**6 hours 30 minutes**

7.7 Facilitator's Guidelines

Fish Post-harvest and value addition	
7.7.1 Introduction, objectives and expectations (15 minutes)	**Session Guide**
The trainer introduces the module and invites trainees to introduce themselves and state their expectation. The trainer then presents module objectives and levels out expectations. **Module Objectives** By the end of the module the trainee should be able to: • Develop and share skills in post-harvest handling of fish • Enhance knowledge and skills in personal hygiene in fish handling. • Explain skills for best management practices in fish preservation and value addition. • Enhance knowledge and practical skills in fish value addition. • To monitor the quality and safety of fish value-added products • Appreciate the practical skills in fish packaging and branding.	• Summarize trainees "expectations" using cards or any appropriate method • PowerPoint presentation • Distribute handouts to trainees at the end of the module
7.7.2 Fish handling and hygiene requirements (45 minutes minutes)	• **Session guide**
The trainer explains how to prevent fish contamination for food safety and guides the trainees in discussing and play video clips on hygiene requirements for fish handlers **(30 minutes).** • Importance of Good Fish Handling Practices, • Hygiene requirements for fish handlers Fish quality aspects • What fish quality is and its importance • Factors affecting fish quality in farmed fish • Apply the good product handling practices in their farms to reduce fish contamination How to prevent Fish Contamination • Temperature control • Display units Sources of foodborne diseases • Humans • Food/Product • Environment	• Play video on food hygiene requirements Q&A sessions • Handouts • Good manufacturing practices manual

7.7.3 Basic principles of fish processing and preservation (1 hour 45 minutes)	**Session guide**
Present the following on PowerPoint and flip charts **(30 minutes)** • How to assess fish freshness • Factors contributing to spoilage • Stages of spoilage • How to slow down spoilage • Fresh fish assessment • Sampling plan for fish freshness • Fish freshness score forms • Utilization of various grades of fish **Types of fish preservation methods (30 minutes)** • Sun drying • Smoking (Traditional and Modern) • Gutting • Chilling and freezing (principles of good icing practice) • Salting (types of salting) • Canning • Fermentation **Plenary discussions (15 minutes)** **Group work and audio visuals (30 minutes)**	• PowerPoint presentation • Demonstration/ Practical • Fish Recipe Book and Brochures • Visual Videos on FTT Technology • Distribute handouts to trainees
7.7.4 Benefits and factors to consider in fish value addition (45 minutes)	**Session guide**
(The trainer guides trainees on factors to consider in fish value addition and make a PowerPoint presentation on the listed aspects) • Quality standards • Cost-benefit analysis • Increased product shelf life • Better product prices • The increased product mix in the market • Product quality assurance • Product traceability • Easy and safe commodity handling **Plenary discussions (15 minutes)**	• PowerPoint presentation • Distribute trainees handouts • Fish Recipe Book and Information Sheet • Q&A session

7.7.5 Fish value-added production methods and recipes (2 hours 45 minutes)	• **Session guide**
The trainer takes the trainees through product development practices and other value addition technologies **(30 minutes).** Why it is good to consume fish and fish products? • ***Improved handling:*** Washing the product, clean package, use plastic buckets in cleaning, transporting dried fish in plastic bags/ cooler boxes. • ***Value-added products and their recipes*** e.g. fish fillets, fish samosas, fish balls, fish fingers, fish sausages, fish sauce, fish soup, fish skewers, fish pie and fish burger. • ***Improved quality/ standardization***: Reduce use of paraffin, grading, proper selection of top-grade tilapia/ catfish in terms of sizes etc., standardization, develop price policy according to sizes/grades. • ***Improved technologies:*** Advanced fishing technology, proper dressing racks, proper storage, drying on racks before frying. • ***Improved marketing:*** Advertising product with an emphasis on its values, branding to transcend across all market chains, proper marketing strategies, be honest and reliable to customers, advertisement, neat packaging. • ***Use clear labels/Eco-labeling***; Use colourful packaging materials. **Plenary discussions (15 minutes)** **Practical and demonstrations (2 hours)**	• Distribute handouts to trainees • Fish Recipe Book • Q&A Session • Demonstrations and Practical
7.7.6 Module review (15 minutes)	**Session guide**
(*The trainer leads the trainees in reviewing the module*) Summarize and review with the trainees, the main points of the training on Post-harvest and value addition technologies. • 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 the module? • What are some of the problems and issues that you have become more aware of in the module? • What is your main take-home message?	• Recap of the key take-home points using any of the following participatory methods; • Discussions • Q&A session • Questionnaires • Any other

7.8 Participants' Handouts and Training and Reference Materials

1. SmartFish-FAO (2014). Aquaculture Training Manual- Program for the implementation of a regional fisheries strategy for the Eastern and Southern Africa – Indian Ocean region. *GCP/RAF/466/EC SmartFish Project*.
2. State Department of Fisheries (2015). Fish quality assurance guidelines for fish business operators in Kenya. Government Printer, Nairobi, Kenya
3. State Department of Fisheries (2016). Fisheries Development and Management Act Revised Edition 2012
4. Kyule-Muendo D., Munguti J.M, Opiyo M. A., Obiero K. O., Githukia C. M., Orina P.S., Njiru J.M.& Charo-Karisa H. (2017) Fish Recipe Book, Vol. 1, Kenya Marine and Fisheries Research Institute (KMFRI), Kenya Literature Bureau, Nairobi, Kenya. 45pp
5. State Department of Fisheries (2015). Manual of standard operating procedures for fish inspection and quality assurance in Kenya. Government Printer, Nairobi, Kenya

MODULE 8

FISH MARKETING AND SUPPLY CHAINS

8.1 Introduction to the Module

Providing trainers with skills that will enable them to assist farmers to engage with markets using participatory methods is the main aim of this module. The module guides on how to effectively market fish and fish products; formulate costing and pricing charts; prepare marketing tools; project supply and demand curve in the market; advertise and promote fish and fish products; maximize profit margin from fish sales and market fish in groups or clusters. Furthermore, it will guide the process of market identification and selection of attractive enterprise options, based on information gathered from the market chain and analysis of local supply and demand trends and market access options.

8.2 Module Learning Outcomes

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

- Fish markets and marketing appreciated and understood
- Concepts such as costs, income, prices and profits applied and understood.
- Concepts of basic market survey and analysis to determine the demand for specific products understood and shared.
- Knowledge and skills on fish supply and demand and setting of marketing targets appreciated.
- Assessing profitability of various marketing strategies understood.

8.3 Module Target Group

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

8.4 Module Users

This module is intended for use by master trainers who are members of the Core Team of Trainers (CTT). The module user should thoroughly familiarize themselves with the relevant participant's handouts and training reference materials.

8.5 Module Duration

The Module is estimated to take **4 hours 45 minutes**.

8.6 Module Summary

Fish Marketing and Supply Chains			
Sessions	**Training methods**	**Training materials**	**Time**
8.6.1 Introduction, learning outcomes and expectations	▪ PowerPoint Presentation	▪ Flips charts ▪ Cards ▪ Felt pens ▪ LCD Projector ▪ Laptop	15 minutes
8.6.2 Basics of Market and Marketing	▪ PowerPoint presentations ▪ Plenary discussions	▪ Flips charts ▪ Felt pens ▪ LCD Projector ▪ Laptop ▪ Handouts	1 hour 15 minutes
8.6.3 Fish Market channels, value chain analysis and distribution networks	▪ PowerPoint presentations ▪ Plenary discussions ▪ Group work	▪ Flips charts ▪ Felt pens ▪ LCD Projector ▪ Laptop ▪ Handouts	1 hour 30 minutes
8.6.4 Developing Marketing Strategies and Marketing Analysis	▪ PowerPoint presentations ▪ Plenary discussions	▪ Flips charts ▪ Felt pens ▪ LCD Projector ▪ Laptop ▪ Handouts	1 hour 30 minutes
8.6.5 Module review	▪ Plenary discussions	▪ Flips charts ▪ Handouts	15 minutes
TOTAL			**4 hours 45 minutes**

8.7 Facilitator's Guidelines

Fish Marketing and Supply Chains	
8.7.1 Introduction, objectives and expectations (15 minutes)	**Session Guide**
The trainer introduces the module and invites trainees to introduce themselves and state their expectation. The trainer then presents module objectives and levels out expectations **Module Objectives** By the end of the module the trainee should be able to: ▪ Appreciate fish markets and marketing ▪ Appreciate and apply concepts such as costs, income, prices and profits ▪ Conduct a basic market survey and analysis to determine the demand for specific products ▪ Prepare marketing tools in the fish value chain. ▪ Demonstrate knowledge and skills on fish supply and demand and setting of marketing targets. ▪ Develop skills of assessing profitability of various marketing strategies.	• Summarize trainees "expectations" using cards or any appropriate method • PowerPoint presentation • Distribute handouts to trainees at the end of the module
8.7.2 Basics of Markets and Marketing (1 hour 15 minutes)	**Session guide**
(*The trainer presents fish marketing on PowerPoint and flip charts* **(30 minutes)** • What are markets and marketing? • Supply and demand and how they affect prices • Types of markets • Fish costs, incomes, prices and profits • 4 Ps of Marketing and Marketing Mix • Trends and changes in markets and marketing. **Group Exercise:** Marketing Selection & Segmentation (30 minutes) **Plenary discussions: 15 minutes**	• PowerPoint presentation • Plenary discussions • Group exercise

8.7.3 Fish Market Channels, Value chain and Distribution Networks (1 hour 30 minutes)	**Session guide**
Present the following on PowerPoint slides and flip charts **(30 minutes)** • Types of value chain actors • Marketing functions and services • Marketing channels and distribution networks • Virtual and physical market aggregators • Marketing tools and applications **Group Exercise:** Fish Value Chain Analysis (**45 minutes**) **Plenary discussions** (**15 minutes**)	• PowerPoint presentation • Group exercise • Q& A session
8.7.4 Developing Marketing Strategies and Marketing Analysis (1 hour 45 minutes)	• **Session guide**
Present the following on PowerPoint slides and flip charts **(30 minutes)** • Market analysis • Market surveys tool (template of a basic questionnaire) • Analyzing and presenting market information • Development of group marketing strategies **Group Work: Developing fish marketing strategy (45 minutes)** **Plenary discussions (15 minutes)**	• Group presentations • Q&A session
8.7.5 Module review (15 minutes)	**Session guide**
(*The trainer leads the trainees in reviewing the module*). Summarize and review with the trainees, the main points of the training on Fish Marketing and Supply Chains. • 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 the module?	• Recap of the key take-home points using any of the following participatory methods; • Q&A session • Brainstorming sessions

8.8 Participants' Handouts and Training Reference Materials

8.8.1 Participants' handouts

1. Handout 8.7.2: Fish market and marketing basics & Guide to rapid market appraisal (Handout 8.7.4)

8.8.2 Training Reference Materials

1. Charo-Karisa H, Munguti J., Ouma H., Masai D.M., Opiyo M., Orina P.S & Okech J.K. (2011). Fish farmers manual, for beginner's students and hatchery

managers. KMFRI. River Brooks Communication Network Publishers, Nairobi Kenya
2. CRS and MEAS. (2015). Marketing basics: A SMART Skills manual. Catholic Relief Services, Baltimore, MD, and Modernizing Extension and Advisory Services project, University of Illinois at Urbana-Champaign
3. LVFO. (2014). LVFO Aqua-Business Training Curriculum Notes. FAO TCP/RAF/3102(A) Project
4. SmartFish-FAO. (2014). Aquaculture Training Manual- Program for the implementation of a regional fisheries strategy for the Eastern and Southern Africa – Indian Ocean region. GCP/RAF/466/EC SmartFish Project.

MODULE 9

AQUACULTURE AS A BUSINESS

9.1 Introduction to the Module

New approaches to aquaculture farming focus on the understanding of aquaculture as a business. This understanding represents a significant shift in technical requirements. Whereas early aquaculture practices were focused on limiting factors that were biological and technical in nature (i.e.identifying species and disseminating the best technologies), it is now understood that the technology must be accompanied by effective capacity building in business and market planning. This module intends to address the following aspects:

- Forms of business
- Business management
- Financial planning
- Evaluation of the economic performance of aquaculture
- Cashflow analysis
- Budget analysis and financial statements
- Preparation of a business plan

9.2 Module Learning Outcomes

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

- Information on fish farming as a business accessed and appreciated
- Application of production skills and making profits in the fish farming business shared and appreciated
- Need to keep business records for fish business shared and understood.
- Modern business skills and planning, record keeping formats in aquaculture smallholder farms shared and appreciated.

9.3 Module Target Group

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

9.4 Module Users

This module is intended for use by trainers who are members of the Core Team of Trainers (CTT). The module users should thoroughly familiarize themselves with the participant's handouts and training reference materials.

9.5 Module Duration

The Module is estimated to take **5 hours.**

9.6 Module Summary

Aquaculture as a Business			
Sessions	**Training methods**	**Training materials**	**Time**
9.6.1 Introduction, learning outcomes and expectations	▪ Plenary discussions	▪ Flips charts ▪ Felt pens ▪ LCD projector ▪ Laptop	15 minutes
9.6.2 Fish farming as a business	▪ PowerPoint Presentations ▪ Plenary discussions	▪ Flips charts ▪ Felt pens ▪ LCD projector ▪ Laptop	45 minutes
9.6.3 The basics of developing a business plan	▪ PowerPoint presentations ▪ Group work ▪ Plenary discussions	▪ Flips charts ▪ Felt pens ▪ LCD projector ▪ Laptop	1 hour 15 minutes
9.6.4 The techniques of business planning	▪ PowerPoint Presentations ▪ Plenary discussions	▪ Flips charts ▪ Felt pens ▪ LCD projector ▪ Laptop	1 hour 15 minutes
9.6.5 Record keeping and financial analysis for fish farms	▪ PowerPoint Presentations ▪ Group work ▪ Plenary discussions	▪ Flips charts ▪ Felt pens ▪ LCD projector ▪ Laptop	1 hour 15 minutes
9.6.6 Module review	▪ Plenary discussions	▪ Flips charts ▪ LCD Projector ▪ Laptop	15 minutes
TOTAL			**5 hours**

9.7 Trainers' Guidelines

Aquaculture as a Business	
9.7.1 Module objectives and expectations (15 minutes)	**Session Guide**
The trainer introduces the module and invites trainees to introduce themselves and state their expectations. The trainer then presents module objectives and levels out expectations. **Module Objectives** By the end of the module, the trainee should be able to: • Access and appreciate information on fish farming as a business. • Apply production skills to make profits in the fish farming business. • Demonstrate ability to keep business records for fish business. • Apply modern business skills and planning, record keeping formats in aquaculture smallholder farms.	• Summarize trainees "expectations" using cards or any appropriate method • PowerPoint presentation • Distribute handouts to trainees at the end of the module
9.7.2 Fish farming as a business (45 minutes)	• **Session guide**
The trainer makes a PowerPoint presentation on fish farming as a business by considering **(30 minutes)** • Factors considered in undertaking fish farming as a business • Facilities needed by farmers to practice fish farming as a business • Benefits of practicing aquaculture as a profitable enterprise • The short- and long-term goals in fish farming. **Plenary discussions (15 minutes)**	• PowerPoint presentation • Plenary discussion
9.7.3 The basics of developing a business plan (1 hour 15 minutes)	• **Session guide**
The trainer makes a PowerPoint presentation on the following listed aspects **(30 minutes):** • Definition and importance of a business plan • What it takes to develop a complete business plan • Fundamental questions addressed by a business plan • Evaluating and selecting suitable marketing alternatives **Plenary discussion (15 minutes)** **Group work exercises** to develop and present a business plan **(30 minutes)**	• PowerPoint presentation • Group work • Plenary discussion

9.7.4 The techniques of business planning (1 hour 15 minutes)	Session guide
Presentations of powepoint slides and practical exercises on the following aspects **(30 minutes)** • Elements of an enterprise budget; uses of an enterprise budget • The basic structure of an enterprise budget • Principle and steps in partial budgeting • Investment capital analysis e.g. payback period, net present value, internal rate of return • Financial analysis in aquaculture e.g. profit income statement, solvency and liquidity • Cash flow budget in an aquaculture enterprise. **Plenary discussions (15 minutes)** **Practical exercise to develop an enterprise budget (30 minutes)**	• PowerPoint presentation • Group work • Plenary discussion
9.7.5 Record keeping and risk analysis for fish farms (1 hour 15 minutes)	**Session guide**
The trainer makes PowerPoint presentations on the following listed topics (30 minutes): • Types of farm records (input records, output record, annual (seasonal) records; examples of record tables and sheets • Types of risks in aquaculture (social, economic, political) • Risk management. **Plenary discussions (15 minutes)** **Group work exercises (30 minutes)**	• PowerPoint presentation • Plenary presentation
9.7.6 Module review (15 minutes)	**Session guide**
The trainer leads the trainees in reviewing the module Summarize and review with the trainees the main points of the training on Aquaculture as a Business. • What new things did they learn from the module? • Discussion on the take-home points.	Recap of the key take-home points using any of the following participatory methods; • Q&A session • Brainstorming sessions

9.8 Participants' Handouts and Training and Reference Materials:

9.8.1 Participants' Handouts

1. Aqua-Business Training Notes

9.8.2 Training Reference Materials

1. Engle, C. R. (2010). *Aquaculture economics and financing: management and analysis*. John Wiley & Sons.
2. Pillay, T. V. R., & Kutty, M. N. (2005). *Aquaculture*. Blackwell Publishers.

MODULE 10

CROSS-CUTTING ISSUES

10.1 Introduction to the Module

This module introduces various cross-cutting issues in aquaculture which include gender and social inclusion, environmental and social impact assessment as well as group dynamics, cohesion and leadership. It aims at enabling the trainees to appreciate how the value chain interacts with the cross-cutting issues and how these interactions are applicable within the value chain in order to catalyze improved productivity and sustainability of the aquaculture value chain in the face of climate change. Specifically, the module intends to answer the following questions:

1. What is gender mainstreaming and social inclusion?
2. What are the common concepts in gender mainstreaming and social inclusion?
3. How are gender mainstreaming and social inclusion implemented?
4. What is gender analysis and how is it applied?
5. What are the strategies that can be used to implement social inclusion?
6. What are the main environmental and social impacts of aquaculture practices?
7. How can group dynamics, cohesion and leadership be implemented for sustainability?

10.2 Module Learning Outcomes

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

- The importance of gender mainstreaming and social inclusion in aquaculture appreciated
- Concepts and terminologies in gender and social inclusion shared and understood
- The steps to gender mainstreaming and social inclusion in aquaculture mapped and shared
- Carrying out gender analysis on TIMPs demonstrated
- Use of group formation, management dynamics and their importance in enhancing group performance in knowledge transfer shared and appreciated

10.3 Module Target Group

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

10.4 Module Users

This module is intended for use by trainers who are members of the Core Team of Trainers (CTT) and Farmer Trainers. The module user should thoroughly familiarize themselves with the participant handout and training reference materials.

10.5 Module Duration

The Module is estimated to take **8 hours.**

10.6 Module Summary

Cross-cutting Issues			
Sessions	**Training methods**	**Training materials**	**Time**
10.6.1 Introduction, learning outcomes and expectations	▪ Plenary discussions ▪ PowerPoint Presentation	▪ Flips charts ▪ Felt pens ▪ LCD Projector ▪ Laptop	15 minutes
10.6.2 Gender Mainstreaming in Aquaculture	▪ Presentations ▪ Group exercises ▪ Plenary discussion ▪ PowerPoint Presentation	▪ Flips charts ▪ Felt pens ▪ Cards ▪ Handouts ▪ LCD Projector ▪ Laptop	2 hours 45 minutes
10.6.3 Social Inclusion in Aquaculture	▪ PowerPoint Presentations ▪ Group exercises ▪ Plenary discussion	▪ Flips charts ▪ LCD Projector ▪ Laptop ▪ Handouts	1 hour
10.6.4 Environmental and social impacts of Aquaculture	▪ Presentations ▪ Plenary discussions ▪ Practical exercises	▪ Flips charts ▪ Felt pens ▪ PowerPoint ▪ Handouts	1 hour 45 minutes
10.6.5 Group dynamics, Cohesion and Leadership	▪ PowerPoint Presentations ▪ Plenary discussions ▪ Practical exercises	▪ Projector ▪ Flip charts and pens ▪ Handouts	2 hours
10.6.6 Module review	▪ PowerPoint Presentations ▪ Plenary discussions	▪ Flips charts ▪ LCD Projector ▪ Laptop ▪ Handouts	15 minutes
TOTAL			**8 hours**

10.7 Trainers' Guidelines

Cross-cutting Issues	
10.7.1 Introduction, objectives and expectations (15 minutes)	**Session Guide**
The trainer introduces to the module and invites trainees to introduce themselves and state their expectations. The trainer then presents modules objectives and levels out expectations. **Module objectives** By the end of the training module the trainee must be able to: • Appreciate importance of gender mainstreaming and social inclusion in aquaculture. • Define concepts and terminologies in gender and social inclusion. • List the steps to gender mainstreaming and social inclusion in aquaculture. • Outline steps to carrying out gender analysis on TIMPs. • Use group formation, management dynamics to enhance group performance in knowledge transfer.	• Summarize trainees "expectations" using cards or any other appropriate method • PowerPoint presentation • Distribute training notes and trainees handouts at the end of the module

10.7.2 Gender mainstreaming in aquaculture (2 hours 45 minutes)	**Session guide**
The trainer makes a PowerPoint presentation on the following listed aspects **(30 minutes)** • What is gender mainstreaming and social inclusion? • The concepts of gender: definition and steps in gender mainstreaming • What is Gender Analysis: (Frameworks, Tools, Processes). **Group exercise 1 (30 mins)** 1. Carry out an analysis of Aquaculture value chain TIMPs in the context of the dimensions provided by the framework (20 minutes) 2. Trainees makes presentation from the group exercise (10 minutes) *The trainer makes a presentation on Gender-based constraints* **(10 minutes)** • What are Gender-Based Constraints? • Identification and analysis of Gender-Based constraints **Group exercise 2 (30 minutes*)*** 1. Identify Gender-Based constraints common in the Aquaculture Value chain and suggest ways of targeting to resolve these GBCs *The trainer makes a presentation on gender disaggregated data* **(10 minutes*)*** • What is Gender Disaggregated Data? • What is the purpose of collecting Gender Disaggregated Data? ***Group exercise 3* (30 minutes) *(This exercise will be done using cards on the wall)*** 1. Identify a project where you will need to collect GDD 2. Identify types of data to be disaggregated by gender *The trainer makes a fourth presentation on Gender Awareness, Advocacy and Lobbying* **(10 minutes)** **Plenary discussions (15 minutes)**	• PowerPoint Presentation • Group exercises and presentations

10.7.3 Social Inclusion in Aquaculture (60 minutes)	**Session guide**
The trainer makes a presentation on Social Inclusion **(15 minutes)** • Understanding social inclusion (exclusion): Definition of terms/concepts, • Rationale: Why social inclusion • Definition/ identification of VMGs • Strategies/ steps towards social inclusion: Identification of barriers. **Group exercise 1 (30 minutes)** 1. Identify barriers that prevent Vulnerable and Maginalized Groups (VMGs) from participating in aquaculture 2. Suggest strategies for promoting/ enhancing social inclusion in aquaculture. (Outline clearly "who" should do "what") **Plenary discussions (15 minutes)**	• PowerPoint Presentation • Distribute participants handouts • SMART Aquaculture Manual • Gender Fact sheets
10.7.4 Environmental impacts of aquaculture (1 hour 45 minutes)	**Session guide**
The trainer guides trainees through PowerPoint presentations and practical exercises on the following listed activities **(30 minutes)** • General concepts of Environmental Impact Assessment (EIA). • EIA requirements of different aquaculture systems • EIA in Aquaculture • Environmental impacts in aquaculture • Social Impact assessment in aquaculture **Plenary discussion – 15 minutes** **Group Exercise** - Environmental impact assessment and audit of aquaculture farms (**1 hour**)	• PowerPoint presentation • Group exercises and presentations • Q&A session
10.7.5 Group dynamics and cohesion (2 hours)	**Session guide**
The trainer guides trainees through PowerPoint presentations on the listed activities **(45 minutes):** • Group dynamics and cohesion • Group Evolution (the 5 stages) • Types of groups • Group leadership • Leadership styles **Practical (1 hour)** **Plenary discussions (15 minutes)**	• PowerPoint presentation • Distribute participants handouts • Q &A Session

10.7.6 Module review (15 minutes)	Session guide
The trainer leads the trainees in reviewing the module Summarize and review the main points of the training with the trainees. • What new things did you learn from this module? • What are some of the problems and issues that you have experienced in the field?	• Group discussions • Q & A session • Recap the main points • Test understanding • Participatory evaluation of the session

10.8 Participants' Handouts and Training and Reference Materials

10.8.1 Participants' Handouts

1. Analyzing Local Innovation using gender Lens
2. Environmental and Social Impact Assessment of Aquaculture Notes

10.8.2 Training Reference Materials

1. FAO (2013). Mainstreaming gender in fisheries and aquaculture: A stock-taking exercise. Final Report. FAO, Rome
2. FAO (2016). Promoting gender equality and women empowerment in fisheries and aquaculture. FAO Rome
3. FARM AFRICA. Gender Impact Study of the Kenya Market-led Aquaculture Program, (KMAP). Unpublished Report
4. Levi David (2017). Group Dynamics for teams; 5th Edition, California Polytechnic State University, San Luis
5. Forsyth, Donelson R. (2019). *Group Dynamics*, 7th Edition, the University of Richmond.

Annex 1: Training Program

The training program presented here assumes that the trainees report on Sunday evening as the first day and leave nine (8) days later.

Time	Day 0 (Sunday)	Duration	Remarks / Facilitator
Late Evening	▪ Arrival of Trainees 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**
	Workshop objectives and expectations		The trainees relax and
	▪ Registration ▪ Welcome and Introductions	1 hour 15 minutes	the climate set for training
8.30am-9.45am	▪ Official Opening Ceremony (KCSAP Secretariat) ▪ Introduction to the training program (CTT)		
	▪ Formation of groups and set norms (CTT)		
9.45am-10.45am	**Module 1:** Introduction, outcomes and expectations Understanding climate change	1 hour	Presentations and plenary discussions
10.45am-11.15am	**Tea Break (Group Photo)**	**30 minutes**	**Health Break**
11.15am-12.00am	Climate change impacts on agriculture and food. security	45 minutes	Presentations and plenary discussions
12.00am-12.45am	TIMPs definition and approaches to their validation and dissemination	45 minutes	Presentations and plenary discussions

12.45pm-1.00pm	Group Formations	30 minutes	Plenary discussions
1.00pm-2.00pm	**Lunch Break**	**1 hour**	**Health Break**
2.00pm-3.45pm	Climate smart agriculture and context specific practices	1 hour 45 minutes	Presentations and plenary discussions
3.45pm-4.00pm	**Module review**	15 minutes	Plenary discussions
4.00pm-4.30pm	Coffee Break	30 minutes	**Health Break**
Close of Day 1			
Time	**Day 2 (Tuesday)**	**Duration**	**Remarks / Facilitator**
8.30am-8.45am	**Module 2: Introduction, outcomes & expectations**	15 minutes	Plenary discussions
8.45am-9.30am	Criteria for pond site selection	45 minutes	Presentations and plenary discussions
9.30am-10.15am	General guidelines for pond design and layout	45 minutes	Presentations and plenary discussions
10.15am-10.45am	**Tea Break**	**30 minutes**	**Health Break**
10.45am-1.00pm	On-site practical demonstration on pond design and layout	2 hours	Practical
1.00pm-2.00pm	**Lunch Break**	**1 hour**	**Health Break**
2.00pm-3.00pm	Best management practices (pond systems)	1 hour	Presentations and plenary discussions
3.00pm-3.15pm	**Module review**	15 minutes	Presentations and group exercises
3.15pm-3.30pm	**Module 3: Introduction, outcomes and expectations**	15 minutes	Plenary discussions
3.30pm-4.15pm	Recirculatory and Aquaponic systems	45 minutes	Presentations and plenary presentations

4.15pm-5.00pm	Tank and Raceway Culture and Review	45 minutes	Presentations and plenary presentations
5.00pm-5.30pm	**Coffee Break**	**30 minutes**	**Health Break**
Close of Day 2			
Time	**Day 3 (Wednesday)**	**Duration**	**Remarks / Facilitator**
8.30am-9.15am	Cage culture systems	45 minutes	Presentations and plenary presentations
9.15am-10.00am	Integrated crop-livestock-fish (CLF) culture Systems	45 minutes	Presentations and plenary presentations
10.00am-10.45am	Best Management Practices	45 minutes	Presentations and plenary presentations
10.45am -11.15am	**Tea Break**	**30 minutes**	**Health Break**
11.15am-11.30am	**Module 3 Review**	15 minutes	Presentations and plenary presentations
11.30am-11.45am	**Module 4: Introduction, outcome and expectations**	15 minutes	Presentations and plenary presentations
11.45am-12.30pm	Wild fish stocks selection and domestication	45 minutes	Presentations and plenary presentations
12.30pm-1.00pm	Broodstock traits	30 minutes	Presentation
1.00pm-2.00pm	**Lunch Break**	**1 hour**	**Health Break**
2.00pm-2.30pm	Broodstock strains	15 minutes	Group exercise
2.30pm-3.15pm	Fish breeding and genetics improvement techniques and management	45 minutes	Presentations and plenary presentations

3.15pm-4.00pm	Broodstock genetic integrity and biosafety	45minutes	Presentations and plenary presentations
4.00pm-4.15pm	Module 4 review	15 minutes	Plenary discussion
4.15pm-4.30pm	Module 5: Introduction, outcome and expectations	15 minutes	Presentations and plenary presentations
4.30pm-5.15pm	Fish Nutrition, Feeds and Feeding	45 minutes	Presentations and plenary presentations
5.15pm-5.45pm	**Coffee Break**	**30 minutes**	**Health Break**
Close of Day 3			
Time	**Day 4 (Thursday)**	**Duration**	**Remarks / Facilitator**
8.30am-9.15am	Quality assurance in fish feeds	45 minutes	Presentations and plenary presentations
9.15am-10.00am	Feeding Selection, Administration and Management Practices	45 minutes	Presentations and plenary presentations
10.00am-11.00am	Practical demonstration of feed formulation	1 hour	Practical Demo
11.00am-11.30am	**Tea Break**	**30 minutes**	**Health Break**
11.30am-12.15pm	Fish Feed Conversion Ratio (FCR) and Feed Storage and calculation of FCR	45 minutes	Presentations and plenary presentations
12.15pm-12.45pm	Group exercises and presentations	30 minutes	Group exercises and Presentations
12.30pm-1.00pm	**Module 5 Review**	15 minutes	Presentations and plenary presentations
1.00pm-2.00pm	**Lunch Break**	**1 hour**	**Health Break**

2.00pm-2.15pm	**Module 6: Introduction, outcomes and expectations**	15 minutes	Presentations and plenary presentations
2.15pm-3.00pm	The role of stress in fish disease development	45minutes	Presentations and plenary presentations
3.00pm-3.45pm	Common and emerging fish diseases and their prevention	45minutes	Presentations and plenary presentations
3.45pm-5.00pm	Practical and group exercises		
5.00pm-5.30pm	Coffee Break	30 minutes	**Health Break**
Close of Day 4			
Time	**Day 5 (Friday)**	**Duration**	**Remarks / Facilitator**
8.30am-9.15am	Fish predators and their control in aquaculture	45 minutes	Presentations and plenary presentations
9.15am-10.00am	Biosecurity facilities and important steps in biosecurity	45 minutes	Presentations and plenary presentations
10.00am-11.00am	Comprehensive biosecurity plan for a farm	45 minutes	Group work and plenary discussions
11.00am-11.30am	**Tea Break**	**30 minutes**	**Health Break**
11.30am-11.45pm	**Module 6 Review**	15 minutes	Presentations and plenary presentations
11.45pm-12.00pm	**Module 7 Introduction, outcomes and expectations**	15 minutes	Presentations and plenary presentations
12.00pm-1.00pm	Fish handling and hygiene requirements	1 hour	Presentations and plenary presentations
1.00pm-2.00pm	**Lunch Break**	**1 hour**	**Health Break**

2.00pm-3.00pm	Basic principles of fish processing and preservation	1 hour	Presentations and plenary presentations
3.00pm-4.15pm	Benefits and factors to consider in fish value addition	1 hour 45 minutes	Presentations and plenary presentations
4.15pm-5.00pm	Fish value-added production methods and recipes	45 minutes	Presentations and plenary presentations
5.00pm-5.30pm	Coffee Break	30 minutes	**Health Break**
Close of Day 5			
Time	**Day 6 (Saturday)**	**Duration**	**Remarks / Facilitator**
8.30am-10.30am	Fish value-added production methods and recipes (practical)	2 hours es	Practical
10.30am-10.45am	Module 7 review		
10.45am-11.15am	**Tea Break**	**30 minutes**	**Health Break**
11.15am-11.30pm	**Module 8 Introduction, outcome and expectations**	15 minutes	Presentations and plenary presentations
11.30pm-12.45pm	Basics of Market and Marketing	1 hour 15 minutes	Presentations and plenary presentations
1.00pm-2.00pm	**Lunch Break**	**1 hour**	**Health Break**
2.00pm-2.45pm	Fish Market Channels, Value chain and Distribution Networks	45 minutes	Presentations and plenary presentations
2.45pm-3.30	Fish Value Chain Analysis (group exercises)	45 minutes	Group exercises

3.30pm-4.45pm	**Developing Marketing Strategies and Marketing Analysis** Group exercises on developing fish market strategy	1 hour 15 minutes	Presentations, group work and plenary presentations
4.15pm-5.00pm	**Module 8 Review**	15 minutes	Presentations and plenary presentations
5.00pm-5.30pm	**Coffee Break**	**30 minutes**	**Health Break**
Close of Day 6			
Time	**Day 7 (Monday)**	**Duration**	**Remarks / Facilitator**
8.30am-8.15am	Module 9 Introduction, outcome and expectations	15 minutes	Presentations and plenary presentations
8.15am-9.00am	Fish farming as a business	45 minutes	Presentations and plenary presentations
9.00am-10.15am	The basics of developing a business plan	1 hour 15 minutes	Presentations and plenary presentations
10.15am-10.45am	**Tea Break**	**30 minutes**	**Health Break**
10.45am-12.00pm	The techniques of business planning	1 hour 15 minutes	Presentations and plenary presentations
12.00pm-1.00pm	Record keeping and risk analysis for fish farms	1 hour	Presentations and plenary presentations
1.00pm-2.00pm	**Lunch Break**	**1 hour**	**Health Break**
2.00pm-2.30pm	Module 9 review and plenary discussions	30 minutes	Presentations and plenary presentations
2.30pm-2.15pm	Module 10: Introduction, outcome and expectations	15 minutes	Presentations and plenary presentations

2.15pm-5.00pm	Gender Mainstreaming in Aquaculture	2 hours 45 minutes	Presentations and plenary presentations
5.00pm-5.30pm	**Coffee Break**	**30 minutes**	
Close of Day 7			
Time	**Day 8 (Tuesday)**	**Duration**	**Remarks / Facilitator**
8.30 am–9.30 am	Social Inclusion in Aquaculture	1 hour	Presentations and plenary presentations
9.30 am–10.30 am	Environmental and social impacts of Aquaculture	1 hour	Presentations and plenary presentations
10.30am–11.00am	**Tea Break**	**30 minutes**	**Health Break**
11.00am–11.45pm	EIA – practical	45 minutes	Practical
11.45pm–1.00pm	Group dynamics, Cohesion and Leadership	1 hour 15 minutes	Presentations and plenary presentations
1.00pm–2.00pm	**Lunch Break**	1 hour	
2.00pm–4.30pm	Group dynamics, Cohesion and Leadership	45 minutes	Presentations and plenary presentations
4.30pm–5.00pm	Module review and recap	30minutes	Presentations and plenary presentations
5.00pm–5.30pm	**Coffee Break**	**30 minutes**	**Health Break**
Close of Day 8			
Time	**Day 9 (Wednesday)**	**Duration**	**Remarks / Facilitator**
	Field excursion activities		

8.30 am–10.00 am	▪ Travel to venue	1 hour 30 minutes	
10.00am–13.00am	**Tea Break**	**30 minutes**	**Health Break**
10.00am-11.00am	Pond construction requirements and demonstration	1 hour	Practical Demo
10.00am-12.00pm	Recirculatory and Aquaponic systems	1 hour	Practical Demo
12.00pm-1.00pm	Tank and Raceway Culture	1 hour	Practical Demo
1.00pm-2.00pm	**Lunch break**	**1 hour**	**Health break**
2.00pm-3.00pm	Cage Culture System	1 hour	Practical Demo
3.00pm-4.00pm	Practical aspects of fish production, incubation and larval rearing	1 hour	Practical Demo
4.00pm-5.00pm	Fish health management and biosecurity		
Close of Day 9			
Day 10: Departure			

Annex 2: Training Reference Materials

Category / Modules	Publication title	Reference types	No Pages	Farmer Category A= New entrant/ fish farmer B=Established Fish Farmer
General Fish Farming Manuals	New Guide to Fish Farming in Kenya	Manual	100	**A/B**
	A fish farmer's manual - For beginners, students and hatchery managers (KMFRI 2011)	Training manual	97	**A/B**
	Aquaculture Training Manual (SmartFish Project Manual)	Training manual	65	**A/B**
	Status of Aquaculture in Kenya (KMFRI 2017)	Book		
Fish Culture Systems	Starting Aquaculture	Information sheet	2	**A**
	Aquaculture Production Systems in Kenya	Infosheet	2	**A/B**
	Fish Pond Site Selection and Fish Pond Construction	Brochure	9	**A/B**
	Fish Pond Management, Fertilization and Stocking	Brochure	6	**A/B**
	Pond Management Fact Sheet: Liming	Fact Sheet	2	**A/B**
	Pond Management Fact Sheet: Fertilization	Fact Sheet	2	**A/B**
	Pond Management Fact Sheet: Stocking and Harvesting	Fact Sheet	2	**A/B**
	Pond Management Fact Sheet: Feeding	Fact Sheet	2	**A/B**
	Subsistence Fish Farming in Africa	Training manual	294	**A/B**

Cage Culture	Status of cage Culture in Lake Victoria	Book	68	**A/B**
	Cage Culture in Africa by FAO	Book	127	**B**
	Growing Fish in Cages	Book	2	**A/B**
Fish feeds and feed management	Feeding guidelines for Tilapia and Clarias	Book	2	**A/B**
Tilapia and catfish	Clarias Hatchery and Production Manual by J Miller	Manual	30	**A/B**
	Concrete tank fish farming in Nigeria	Manual	4	**A/B**
	Introduction to *Clarias* Catfish Farming	Book	11	**A/B**
	Profitability Assessment for *Clarias* Farming	Article	24	**B**
	Small scalecultureof *Tilapia* in concretetanks	Manual	13	**B/A**
Fish Farm Business Management	Running a fish farm as a business	Manual	21	**B/A**
	Keeping Production Records	Booklet	21	**B**
	Economic profitability of Nile tilapia culture in Kenya	Booklet	8	**B/A**
	Developing Business Proposals For Aquaculture Loans	Paper	6	**B**
	Tilapia Farm Business Management and Economics: A Manual	Manual	43	**B**
	Profitability Assessment Tilapia and Catfish Farming in Lake Victoria Basin	Thesis	24	**B/A**

Fish health and biosecurity	Fish Health and Predator Control	Poster	16	**A/B**
	Fish Diseases and Fish pond predators	Poster	5	**A**
Government Policy and General Reports Hatchery	Kenya: High aquaculture growth needed to improve food security and nutrition	Policy brief	10	**A/B**
	19 steps to efficient catfish hatchery breeding	Manual	24	**B**
	Manual on Catfish Breeding by Coppens	Manual	20	**B**
	Clarias Hatchery Manual –DeGraaf		109	**B**
	Hatchery Management of Clarias	Manual	11	**B**
Live Fish Transportation	Transport of Live Fish Review FAO	Book	79	**B**
Markets and Marketing	Markets and Marketing Basics	Booklet	8	**A/B**
Nutrition Feeds and Feeding	Feeds and Feeding Fish by Karen Veverica	Information sheet	23	**A/B**
	Yields for feeding tilapia different local feeds Ngugi	Information sheet	13	**B**
	Short catfish feeds handbook	Book	26	**B**
Pond Requirements and Preparation for stocking	Pond Requirements and stocking b y Karen Veverica	Information sheet	23	**A/B**
Stocking Ponds	Stocking your Ponds b Karen Veverica	Information sheet	19	**A/B**

Tilapia	Tilapia Fingerling Production Manual Pacific Islands	Manual	41	**B**
Water Quality and General Pond Management	Water Quality and General Pond Management by Karen Veverica	Manual	29	**A/B**
Aquaculture as a business	Doing aquaculture as a business for small- and medium-scale farmers Practical training manual	Book		**A/B**

Annex 3: List of Contributors

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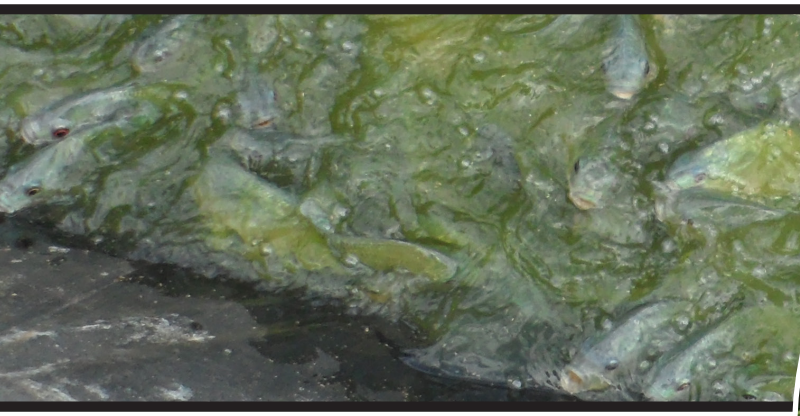

KCSAP
Kenya Climate Smart Agriculture Project

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