MESPT
MICRO ENTERPRISES SUPPORT PROGRAMME TRUST

MINISTRY OF FOREIGN AFFAIRS OF DENMARK
Danida

AQUACULTURE
VALUE CHAIN MANUAL

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Disclaimer

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

Compiled by: Khanyifu Benedict Wechuli & Moses Munialo Simiyu

Editors: Mwalimu Menza

Layout & Design: David Menza

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Micro-Enterprises Support Programme Trust
MESPT Plaza, 01 Tausi Rd
Westlands, between Westlands Rd & Muthithi Rd.
P.O Box 187-00606 Sarit Centre.
Email: info@mespt.org
Tel: 0722 207 905 | 0735 333 154

FOREWORD

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

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

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

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

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

Rebecca Amukhoye,

Chief Executive Officer, Micro-Enterprises Support Programme Trust

PREFACE

The Green Employment in Agriculture Programme (GEAP) is 5 years' programme (2021 to 2025) funded by DANIDA and implemented by Micro-Enterprises Support Programme Trust (MESPT). GEAP seeks to contribute directly to Kenya's vision 2030 and to one of Denmark-Kenya Strategic Framework on accelerated decent employment creation in MSMEs and improved competitiveness of targeted value chains in agriculture which will contribute to transforming the economy towards a greener and more inclusive growth.

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

MESPT through GEAP has worked with the 12 County Governments Agriculture and Livestock technical staff, Kenya Agricultural and Livestock Research Organization (KALRO), MESPT technical staff and Private sector players to constitute a multidisciplinary team that developed resource materials tailored for extension service providers and smallholder farmers.

The Aquaculture value chain Manual and Training Guide are among the materials that were developed. The materials are to be used as an instructional guide for training on the implementation of good agricultural practices, value addition and marketing for the Indigenous chicken value chain. Other cross cutting topics in the materials are Climate adaptation practices and technologies, Food safety and Gender and Social inclusion aspects. Relevance of the content is based on needs identified among value chain players, actors and aligned to GEAP project objectives. The training content is drawn from the Indigenous chicken value chain manual and other relevant resource materials.

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

Doreen Kinoti,

Programme Manager, Green Employment in Agriculture Programme

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

Abbreviation & Acronyms

ABW	Average Body Weight
ALA	Alpha-linolenic Acid
BFT	Biofloc Technology
BFT	Biofloc Technology
BMPs	Best Management Practices
CA	Competent Authority
CP	Crude Protein
DHA	Docosahexaenoic Acid
DO	Dissolved Oxygen
EAA	Essential Amino Acid
EAC	East African Community
EPA	Eicosa pentaenoic acid
ESP	Economic Stimulus Programme
FAO	Food and Agriculture Organization
FCR	Feed Conversion Ratio
FE	Feed Efficiency
GAqPs	Good Aquaculture Practices
Ha	Hectare
HACCP	Hazard Analysis Critical Control Points
IPRs	In-Pond Raceway System
Kg	Kilograms
MT	Metric Tones
MTH	Methyl Testosterone
PAT	Periphyton Aquaculture Technology

PVC	Polyethylene
RAS	Recirculating Aquaculture System
SOFIA	State of world Fisheries in Aquaculture
SOPs	Standard Operating Procedures

Definition of Terms

- **A fingerling** is a juvenile fish that is about the size of a human finger and has protective scales and extended fins. The term is used in aquaculture and fish stocking programs to describe this stage of a fish's life
- **A fish pond** is an enclosed body of water which may be either concrete or earthen with an outlet and inlet structure for growing fish.
- **Aquaculture** is the farming of aquatic organisms, including fish, mollusks, crustaceans and aquatic plants.
- **Aquaculture systems** are the facilities, practices, and sites used to farm aquatic organisms, such as fish, shellfish, and aquatic plants. Aquaculture is similar to farming on land, but in water.
- **Biofloc technology (BFT)** is a system that uses "microbial biotechnology to increase the efficacy and utilization of fish feeds, where toxic materials such as nitrogen components are treated and converted to a useful product, like a protein for using as supplementary feeds to the fish and crustaceans.
- **Feed conversion ratio (FCR)** is the ratio of feed consumed to the weight of fish or shrimp produced.
- **Fish broodstock**, also known as broodfish, are a group of mature fish that are used for breeding and producing offspring.
- **Fish feed:** Any substance or product intended to be fed to fish in aquaculture systems. Fish feed can be processed, partially processed, or unprocessed, and may include additives. The nutritional content of fish feed is important for the health and growth of the fish.
- **Fish Hatchery** is a facility where fish and other aquatic animals are raised and bred artificially, from eggs to early life stages.
- **Value addition** is the process of increasing the value of fish and fish products through a variety of methods.

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1.0 Background

Aquaculture is the farming of aquatic organisms, including fish, mollusks, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc, (FAO 1998).

In 2022 and for the first time in history, aquaculture surpassed capture fisheries as the main producer of aquatic animals. Global aquaculture production reached an unprecedented 130.9 million tonnes, of which 94.4 million tonnes are aquatic animals, 51 percent of the total aquatic.

1.1 Importance of Aquaculture

Aquaculture plays an important role in food and nutrition security. Aquaculture also plays a significant role in poverty reduction and employment creation. Marine and freshwater aquaculture have a high potential to spur national economic growth and development. Kenya is endowed with an extensive network of aquatic ecosystems, which support the commercial production of a critical volume of fish that is required to fill the growing gap in national fish supply and demand as captured fish catches decline.

The State Department of Fisheries estimated a total of 32,000 fish farmers countrywide, with the sub-sector employing 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. 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 Programme (ESP) between 2009 and 2013. Prior to the ESP project in 2008, there were only 4,742 fish farmers countrywide, with 7,530 fishponds 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.

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. Despite the enormous potential for commercialization of aquaculture, the subsector faces many constraints and challenges, including competition for land, water, energy, and feed resources.

Rome/San Jose, Costa Rica – World fisheries and aquaculture production has hit a new high, with aquaculture production of aquatic animals surpassing capture fisheries for the first time, according to a new report from the Food and Agriculture Organization of the United Nations (FAO).

The 2024 edition of The State of World Fisheries and Aquaculture (SOFIA) said global fisheries and aquaculture production in 2022 surged to 223.2 million tonnes, a 4.4

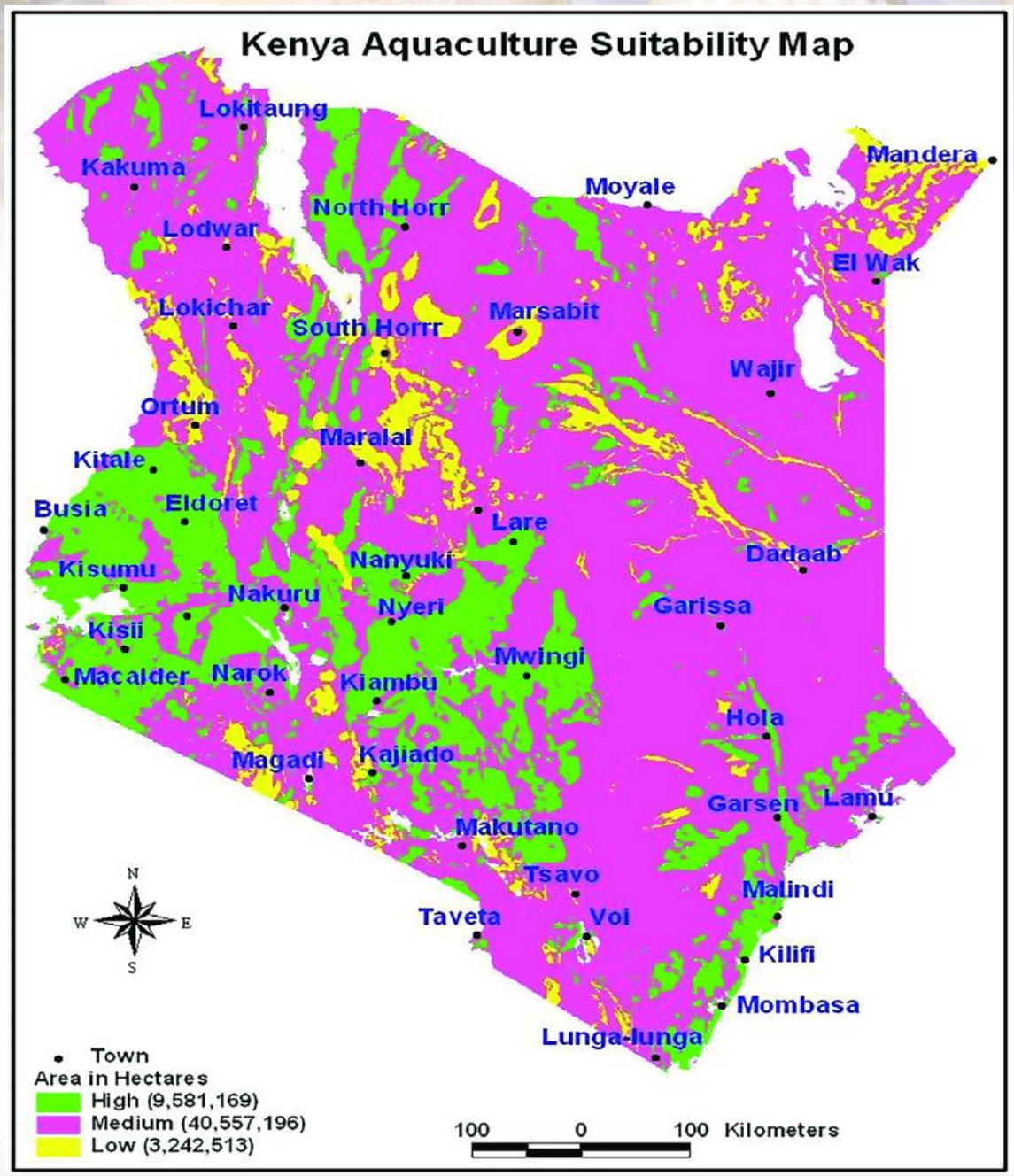
percent increase from the year 2020. Production comprised 185.4 million tonnes of aquatic animals and 37.8 million tonnes of algae.

1.2 Species suitable for culture in Kenya

Species cultured in Kenya include Nile tilapia (*Oreochromis niloticus*) followed by African catfish (*Clarias gariepinus*), while Rainbow trout (*Oncorhynchus mykiss*) an exotic species is limited to high altitude areas. Majority of the species used at any given site are mainly endemic to the region and more or less appropriate to the agro-ecological zone. Kenya is in the tropics and lies along the equator with six distinct agro-ecological zones. Most aquaculture suitable areas enjoy a prolonged wet and dry season to the south and relatively semi-arid regime to the north of the country. This has resulted in the dominance of Nile tilapia and African catfish as warm water fish in the country's aquaculture landscape.

When choosing species for culture, there are some desirable characteristics for cultured fish species that must be put into consideration. These include, but are not limited to, ease of reproduction, fast growth, acceptance of supplemental feeds, feeds low on the food chain, resistance to diseases, tolerance to relatively high stocking density and poor environmental conditions and market acceptability.

Not all indigenous species have all of these characteristics, but Nile tilapia, African catfish and Rainbow trout have undergone long term domestication and breeding that has resulted in them being the leading aquaculture species.



Map of Kenya indicating areas suitable for freshwater aquaculture: green, highly suitable, pink, medium suitable and yellow, low suitable aquaculture areas based on water availability, climatic conditions, soil type, topography, land use, access to inputs and markets. Source: https://www.ajol.info/index.php/ajfand/ article/view/149194 [19].

CHAPTER 2: OVERVIEW OF AQUACULTURE SYSTEMS

2.0 Introduction to Aquaculture systems

Aquaculture Systems in Kenya are based on the following classification:

1) Types of fish species under production
2) Size of the farm: small scale, medium or large scale
3) Fish farming intensification degree
4) Fish farming production units/structures
5) Integration of other animal husbandry into aquaculture

2.1 Commonly Cultured Fish Species in Kenya

Warm water species mainly Nile tilapia and African catfish predominate Kenya's aquaculture farmed fish production landscape. However, Rainbow trout though localized to temperatures below 19°C has been practiced for an equally longer period with minimal upscaling success. Carps, specifically Common carp is slowly gaining access to aquaculture farms while Ningu (*Labeo victorianus*) is still under culture trials.

Nile Tilapia
(Oreochromis niloticus)

Source: https://www.dreamstime.com/photos-images/tilapia-fish.html

i) Nile tilapia is indigenous to Africa, but have been introduced in many parts around the world.
ii) They are less susceptible to diseases.
iii) They are prolific breeders and reproduce easily under culture conditions
iv) Is low on food chain and feed on a wide variety of foods and tolerate poor water quality with low dissolved oxygen levels.
v) Can grow in brackish water and some will adapt to sea water
vi) Mainly grow under semi-intensive systems as monoculture (all males) or polyculture with African catfish
vii) Optimum temperature range 25-30^{0}C
viii) Very popular in Kenya and has a good market demand for sizes over 250g.
ix) Fillets yield is from 30% to 37%, depending on fillet size and final trim.

x) Males grow faster than the females.

African Catfish *(Clarias gariepinus)*

Source: https://www.dreamstime.com/photos-images/african-catfish.html

i) Indigenous to Africa.
ii) Its an omnivorous fish that feeds on vegetative matter, zooplankton, insects, snails, tadpoles, leeches, small fish etc
iii) Very hardy and can survive in low oxygen waters
iv) Grown in brackish water with varying salinity levels.
v) Do not breed in captivity and artificial spawning is used
vi) Grows very quickly if adequate high protein feed is available.
vii) Few bones; has higher fillet percentage than tilapia
viii) Grown in semi intensive polyculture systems to control Tilapia population
ix) Optimum temperature range 25-27^{0}C
x) Fillets yield up to 60%, depending on fillet size and final trim

Source: https://www.dreamstime.com/rainbow-trout.

Rainbow Trout ***(****Oncorhyn- chus mykiss****)***

i) A carnivorous fish which in natural waters consumes insects, crustacean and other small animals
ii) Grows well in cool fast flowing waters, 10-18℃, with high oxygen content
iii) Under culture conditions, require a water flow rate of 1 L/min/kg without aeration
iv) Do not spawn easily in aquaculture systems and require inducement to spawn.
v) Produced in intensive systems in tanks and raceways
vi) Requires high quality feed, >40% protein.
vii) High value species.

Common carp (*Cyprinus carpio*)

Source: https://thumbs.dreamstime.com

i) An exotic species that has established itself in natural water bodies in Kenya
ii) A bottom feeder, feeding on both plant and animal matter (omnivorous) making the pond turbid.
iii) Attains a large size and does not usually overpopulate a pond. mirror carp have excellent growth.
iv) Optimum temperature range, 23-26^{0}C
v) Growing market demands.

In Kenya, there are four types of fish production aquaculture investment approaches:

a) Seed: Nile tilapia, African catfish, Rainbow trout and Common carp

b) Food fish (Table size): Nile tilapia, African catfish, common carp and rainbow trout

c) Ornamental fish: Gold fish (*Carassius auratus*) (with several varieties such as Red comet, Yellow comet, Shubunkin, Orlanda, Black moore), Koi carps (*Cyprinus rubrofuscus*), Sword tail (*Xiphophorus hellerii*), Guppies (*Poecilia reticulata*) among others.

d) Inland recreational fisheries: Rainbow trout (*Oncorhynchus mykiss*), Brown trout (*Salmo trutta*) and Largemouth bass (*Micropterus salmoides*).

2.2 Critical Considerations in Aquaculture

One of the most important aspects of culture systems is site selection. Site selection depends on the type of culture system to be used but there are a number of generic considerations when selecting site for aquaculture regardless of the type of production unit. The decision on which type a fish production unit to construct depends on following outlined site selection criteria:

i) Land area: Adequate land should be allocated for any land-based fish farm bearing in mind that the most commonly used culture units are earthen ponds. The production system, projected expansion and /or intensity of aquaculture dictates the size of land required.

ii) Soil characteristics: For earthen ponds, the soil should be of good quality and having no gravel, rocks or boulders to a depth of 1.5 m. Clay soil is desirable at selected pond sites and below the surface to prevent downward seepage. Soil should contain at least 20% clay so that the dykes of the finished pond can hold water throughout the growing period. If the clay content is lower than 20%, then soil should be brought in from other places that contain 30 to 40% clay. This is used in packing the core trenches in the dykes. Other culture systems apart from the earthen ponds may not necessarily require high clay content in the soil. For areas with porous soils, farmers are advised to use liners.

iii) Water source: Most surface and groundwater supply are suitable for fish farming. Streams, springs and lakes as well as aquifers are generally used for fish farming in Kenya. The quantity of water required depends on the species to be cultured and on the anticipated management practices, for example whether ponds will be operated as static ponds (no water flowing through) or as flow-through systems. Even though all fish culture requires a lot of water, preferably flowing by gravity:

a) Coldwater species like trout require a lot of water because they prefer a continuous supply of clean water with high dissolved oxygen concentrations above 9 mg L^{-1}.

b) Warm water species like tilapia and catfish can tolerate water with lower dissolved oxygen levels, so their culture is often done in static water, that is, without water flowing through the ponds. Usually D.O levels above 4mg/l is ideal for their successful growth performance.

Relatively good quality soils require about 1 m^3 of water (1000 litres) per minute for each hectare of pond area while poor quality soils may require 2-3 m^3 per minute per hectare to compensate for losses that are likely to occur through seepage. Raceways require continuous water flow but Recirculating Aquaculture Systems (RAS) and Aquaponics are water conserving systems but require both intensive capital investment and skilled manpower to operate.

ii) Water quality/quantity: Both quantity and quality of water for aquaculture are critical thus ensuring enough water to support production. The quality of water directly affect feed utilization efficiency, growth rate, fish health and survival. Most fish kills, disease outbreaks, poor growth, poor feed conversion efficiency and similar management problems are directly related to poor water quality. Water quality in an aquaculture unit is a

product of – quality of the incoming water (water source),- quality of soils and immediate environment and production technology and management procedures employed.

iii) **Capital:** The capital required is dictated by the system and level of intensity.

iv) **Fish species:** The species popularly cultured in Kenya are Nile tilapia and African catfish in almost all suitable agro-ecological zones. The choice of culture species depends on:

a) Good knowledge of the ecology of the species to facilitate manipulation of breeding and feeding;
b) Level of tolerance to adverse water quality variations;
c) Resistance to disease;
d) Technology for captive breeding;
e) Availability of well-developed culture methods; and
f) Market demand. Among all these factors, the current paradigm shift is that fish farming should be economically viable and profitable.

v) **Topography:** A suitable land for aquaculture should be relatively level with a slope of about 1-3%. The cost of infrastructure investment increases with increased gradient, considering inlets and outlets. Topographically, it should not be prone to flooding. Seek weather history and indigenous knowledge to inform investment

vi) **Aquaculture resilience:** The seasonality of water supply, weather (environment), drought, availability of feeds and seeds must be considered when siting of culture facilities. Whereas these factors of seasonality may not seem to be important, they can greatly hamper the production cycle. Unpredictable climatic conditions demand investment on climate smart aquaculture technologies. This includes RAS, IPRS, Aquaponics among others.

vii) **Service provider:** Aquaculture investments require service providers to advise on investment, production, processing and marketing along the value chain. A farmer should take advantage of existing service provider networks or create new ones for synergies.

viii) **Infrastructure:** The farmers require infrastructure to support fish farming. Common and public infrastructure such as access roads, electricity, mobile phone network, and internet will add value to the aqua business in terms of access to markets and networking with other farmers.

ix) **Security**: The risk of insecurity arises from within and without investment. It is important for investors to secure their investment from theft, predation and other external interference.

ii) **Legal issues:** Any aquaculture facility should be placed where the farmer has a valid title or a legal lease on the land. It is common to have group owned aquaculture establishments and any disputes can be addressed when there are valid legal instruments of association. In addition to inter-personal and social conflicts, large aquaculture establishments are required to comply with existing policies, legislations and regulations. Prior to aquaculture investment, one is required to acquit with relevant legislations and regulations. This include and are not limited to the land act, water act environmental management and coordination act among others.

2.3 Classification of Aquaculture systems depending on the size of the farm

There are majorly two levels of farm size in relation to fish production

a) **Small scale:**

These farmers generally employ low level of farm management with fish feeding based on available farm by-products or compounded feeds and rarely use commercial feeds. It involves self-employment and fish produced are either for household consumption or sold to the surrounding communities. In Kenya, about 90% are in this category also referred to as subsistence with 1- 3 ponds per farmer.

b) **Large scale:**

Also referred to as commercial farming is aquaculture investment aimed at profit making. Though this encompasses a small proportion of Kenyan farmers, they are the major

producers of the aquaculture market-oriented fish. These farmers currently produce 70% of the total annual fish production in aquaculture.

The farms are elaborate with capital intensive infrastructural investment. These farms mostly integrate horizontally in their production process and may also integrate vertically in marketing. A few of these farms offer extension services to small scale farmers and are increasingly changing their business models to being production and marketing aggregators.

2.4 Classification of aquaculture systems depending on intensity of production

Aquaculture systems depending on intensification in Kenya range from extensive to super intensive based on the species, stocking density, input quality and quantity as well as general management. The systems are broadly categorized into four levels:

a) Extensive
b) Semi-intensive
c) Intensive
d) Super intensive

a) Extensive

Extensive fish farming is characterized by low productivity (1-2 tonnes/ha/Year) with a stocking density of 0.5 – 1 fish per m^2. It utilizes natural photosynthetic production of food and low trophic level organisms (algae, plankton, mollusks, and crustaceans) to feed the fish. This type of farming isn't the most productive, but it requires little labor, low overhead, and very little input from the farmer. Fish production in extensive systems is based on the use of organic and inorganic fertilizers. At its most effective, this type of production can be integrated with other types of crop or livestock production, using animal manure and agricultural by-products as sources to stimulate primary production. Some of the identified reasons for these trends are; limiting land area, cost coupled with unavailability of feeds, inadequate water supply, lack of training and attitude towards fish farming. Most tilapines and carps can be farmed using extensive methods.

Liner pond

Source: Photograph by Geoffrey Mangeni Fisheries Officer Kiminini Sub-County in Trans-Nzoia

b) Semi-Intensive

Semi-intensive aquaculture is a system that involves partially controlling the growth and production of aquatic species, while still relying on natural and artificial feeds. The production ranges between 2-4 MT/ha/Year. Here are some examples of semi-intensive aquaculture systems;

Polyculture: A common farming system that uses complementary species

Ponds: The most common type of system for finfish, often made of earth and fed by a stream

The main challenge of this system is lack of oxygen in the pond in early morning hours and cloudy days leading to massive death of fish (algae during the day makes oxygen but during the night uses the same oxygen for respiration).

c) Intensive

Under intensive culture systems, fish exclusively depend on complete diets. Densities of fish stocked within such rearing facilities are limited by species tolerance to water quality, ability to grow at very high stocking densities ($\geq$10 m^3 to $\leq$100 m^3) with a yields of 10 to 70
kgs/m^3 per production cycle and maintenance of environmental parameters..Critical environmental parameters are Temperature, Dissolved oxygen, Nitrites and Ammonia - in that order. This applies in tanks, raceways, cages, recirculatory aquaculture systems (RAS) and bio-flocs. The system is capital intensive, but with Best Management Practices (BMPs) a farmer is assured of high productivity (and good economic returns).
In a closed system water quality monitoring and management is key. Disease incidences, injuries and predation if not checked can lead to huge losses.

d) Super Intensive

The system involves very high stocking densities with yields of >80 kgs/m^3) coupled with high quality complete diets and high levels of water quality management mostly ammonia and nitrites. The system demands for high skilled management and commitment. It is highly capital intensive.

Source: https://www.standardmedia.co.ke/farmkenya/news/article.

CHAPTER 3: FISH BREEDING AND HATCHERY MANAGEMENT

3.0 Seed Production and Certification for Aquaculture production

Farmers should purchase good quality fingerlings from certified and authenticated fish hatcheries across the country. Seed quality, availability and accessibility are key to aquaculture success just as feed and management is. There are over 140 public and private hatcheries across the country with a majority producing Nile tilapia seed. Nile tilapia seed for grow-out should be sex reversed to ensure all male stocking since males have fast and uniform growth and this will further address the fear of uncontrolled breeding in grow-out culture facilities. Though there are different sex reversal techniques for Nile tilapia, use of methyl testosterone (MTH) is the most preferred method by hatchery operators with a 95-100% success depending on hatchery management levels. The hormone is confirmed to dissipate within 3 months of application and thus no cause for alarm by culture fish consumers. African catfish seed is production is preferably through complete artificial propagation. It is further recommended that hatcheries supply fingerlings of between 10g and 20g to reduce predation.

3.1 Requirements for fish seed production

Fish seed is defined as fertilized egg, fry, fingerlings and post- fingerling of a particular fish species. Fish seeds should meet quality standards with the following characteristics: They should be genetically pure and true to the species; fast growing; high survival; uniform sizes within a batch; minimal deformities; free from diseases and parasites and with no external damage.

3.1.1 Requirements for a seed production facility

The seed production facility should have the following:

i. Approval documents from the Competent Authority (CA), a clear business plan and documented standard operating procedures for the production facility;

ii. Good quality, screened, adequate and unpolluted water supply all year round with means to monitor and maintain quality;

iii. Brood fish of known origins for traceability, qualified hatchery manager, trained staff, a management plan, adequate technology and reliable production facilities;

iv. An adequate feeding regime at each stage of fish production, from live feeds to complete feeds for grow-out and brood-stock;

v. Clean and clear designated areas for holding brood-stock, propagation, nursing, holding young fish and quarantine facilities;

vi. A quarantine facility which is a closed holding area kept some distance from the hatchery where fish from outside the farm are kept in individual tanks until the results of screening for known diseases or disorders are known;

vii. Use of only approved hormones and gonadotropins for sex reversal and propagation;

viii. Production and handling materials and equipment such as; aerators, graders, digital balances, nets, water quality meters, incubators, polythene bags, oxygen facilities, packaging materials and trays should be well maintained and stored in designated areas;

ix. Materials and equipment for conditioning and transportation of live fish which guarantee high survival rates;

x. Good records keeping of origin of inputs, stocking, growth performance, feeding, health, harvests by dates and seed customers should be maintained for planning and traceability for at least two years;

xi. Adequate biosecurity and biosafety measures in place, appropriate protective gear for farm production personnel and adequate and safe storage facilities for biological and chemical agents.

3.1.2 Requirements for production of quality brood-stock

Brood-stock production should observe the following:

a) Ensure parentage is known; only brooders from known authenticated sources approved by the CA should be used;
b) Keep stock lines in secure and separate holding facilities and maintain a systematic record of fish stocks;

c) Prevent any deliberate or accidental introduction of inferior fish species which may crossbreed with the desired fish species;
d) Reduce inbreeding (breeding between closely related fish) by maintaining a large population of brood-fish and ensuring that a large proportion of them get a chance to breed;
e) Eliminate from the breeding system any fish that have questionable characteristics, for example slow growth, deformities, signs of disease or parasites, blindness, or unusually large and hardened belly;
f) Manage brood-stock properly to prevent disease outbreaks;
g) Replace brood-fish every 36 months;
h) When replacing aging brood-fish, select fish from different parentage to minimize inbreeding.

3.2 Disease Control

In-case of a confirmed disease out-break, the owner must immediately report to the CA if the disease is contagious. The CA should quarantine the farm, investigate the outbreak and recommend corrective measures. In addition, the Competent Authority should inform other farms about the disease and preventive measures.

3.3 Packaging, labelling and traceability for fish seed

The following should be observed in packing, labelling and traceability:

i. Fish seeds should be packed in oxygenated and suitable weather-resistant material;

ii. Materials for fish seed packaging may include; aerated tanks with filtration, inflated oxygenated bags and clear polythene bags. The packaging container should be clean and durable for transportation;

iii. The number of fish seed in a package will be determined by the volume of oxygen, the average weight of the fish packed and duration of transportation;

iv. Each package for fish seed should be of correct water temperature that favours survival of the fish;

v. Packaging materials should adequately be labelled and contain the following information:

- Species name;

- Weight and quantity;
- Batch number;
- Name and physical address of the production facility;
- Instructions for handling;
- Name and address of consignee.

3.4 Requirements for fish seed transportation

Transportation of fish seed should be conducted in accordance with the rules and regulations of the CA as follows:

a) Seek approval from the CA;

b) Ensure that fish are free from any notifiable diseases;

c) Ensure that water used during transportation of live fish is safe and of good quality;

d) Starve the fish prior to transportation to reduce excretion and contamination of transport water;

e) Keep records on the condition of fish, quantities and type of fish;

f) Ensure that fish are handled in a manner that minimizes skin damage or stress;

g) Ensure that tanks/packages are adequately aerated to prevent oxygen depletion during transportation;

h) Put in place contingency plans in case of delayed transportation;

i) Ensure that transport equipment and gears are cleaned and disinfected to prevent contamination before and after transportation. Disinfectants may include sodium hypochlorite at 1% solution, Iodine-based solutions or drying equipment and gears for a minimum of 48 hours, preferentially in direct sunlight;

j) Prevent transportation from areas issued with fish health notifications without consulting CA.

3.5 Requirements for clearance of fish seed at border points

The following requirements should be met:

- Any fish seed for export/import should have a sanitary health certificate issued in respect of the batch or consignment according to the relevant regulations;
- All consignment should be accompanied by traceability documents such as sanitary health certificate, in-transit certificates, import/export permits and certificates of origin;
- Import/export permit should be from the relevant authority detailing fish species, origin and intended purpose for importation/exportation;
- The fish should meet the requirements for fish seed transportation as given above;
- Fish seed imported from outside the country should be put under quarantine for at least two weeks at the farm level;
- The fish seed should be inspected at the border point of entry/exit to confirm the consignment and vessel/carrier details.

3.6 Certification of fish seed production facilities

Certification of fish seed is a procedure by which the CA gives a written assurance that the fish seed production facilities conform to the national requirements. Certification is done to ensure placement of high-quality seed on the market and increased farmed production with minimum effect on the environment. The Competent Authority in collaboration with relevant institutions should develop national guidelines for the certification of fish seed and also put in place implementation process. The CA should also provide information regarding application for certification, inspection and should appoint a technical team to undertake the assessment and provide recommendations. The technical team should have representation from the Aquaculture management and research Institutions, National Bureau of Standards and representative of the fish seed producers Association.

The CA should perform the following:

i. Create awareness on the certification process and its importance;

ii. Prepare detailed inspection criteria for the technical team to use during assessment of productions;

iii. Appoint a technical team to undertake assessments and produce reports;

iv. Consider recommendations of technical team and approve those who met the set standards;

v. Issue species specific certification certificate;

vi. Ensure certification of fish seed production facilities across the country;

vii. Take up legal issues that may arise during the certification process;

viii. Review certification process when need arise.

Application for fish seed certification

The production facility should apply to the CA and include but not limited to the following:

- Date of application;
- Information on the production facility: Name, Telephone Number (office, mobile) and email;
- Location: District/County, Sub-County/Ward, Parish, village;
- Ownership: Government/Private/ Farmer group;
- Farm details: land area, water area, land ownership (own/lease/other), rearing space (number and area of broodstock ponds and nursery ponds);
- Broodstock information: origin of first broodstock (source, place, size and number), history of replenishment (source, place, year, size and number), own brooder raising program;
- Source of water (well, lake, river, stream) and energy used on the farm (electricity/generator), seed sales, fish species;
- Education qualification and experience of manager;
- History of disease outbreak, if any;
- Trade Licence Number-Year of incorporation/ registration.

Inspection criteria for seed production

The inspection criteria for the certification of fish seed should consider but not limited to the following areas:

- ❑ Good water source, adequate supply and quality. Presence of filtration, treatment and testing with waste management provisions;
- ❑ Appropriate farm equipment and gear (fry nets, sampling nets, harvesting nets, fish graders);
- ❑ Designated facilities for holding, separation, conditioning, spawning, rearing and nursing;

- Competence of hatchery operator – a qualified technician from a recognized fisheries institution with a minimum qualification of certificate in aquaculture management;
- Clear plan on brookstock sourcing and management;
- Bio-security measures-quarantine and disease treatment areas, personal hygiene measures, us of clean equipment and materials, etc;
- Mitigation measures where hormones are used;
- Record keeping at all levels and traceability measures to trace back the source of broodstock and destination of fingerlings;
- Live fish transportation facilities (polythene bags, oxygen cylinder, wooden box where to place bags);
- Electricity/stand by generator;
- Prevention measures of fish escape into the wild.

3.6.1 Inspection process of fish seed production facility by the technical team

The process of inspection should include reviewing submitted documentation, communicating to the production facilities the date of inspection, having an opening meeting, assessment of the facilities, review of the management records and procedures and a closing meeting. The opening meeting serves to have introductions, purpose of inspection, identify areas, documents and personnel to be involved, get information on the production systems and conditions and also discuss details of the inspection.

The technical team should give verbal feedback during the inspection. The closing meeting enables the management and the technical team to discuss the outcomes of the inspections, agree on the non- conformances identified and corrective action to be undertaken. The management of the facility should prepare a corrective action plan and submit to the CA within a period of two weeks after the date of inspection or any other agree period.

3.6.2 Frequency of compliance inspections

The CA should put in place compliance inspections. The production facilities which are more compliant should be inspected bi-annually but the less compliant ones should be inspected regularly to ensure that they become more compliant within a short time.

3.6.3 Certification of a facility where ownership changes

In case of change in the ownership of a fish seed production facility, apart from following national legal requirements for the same, both the new and old owners should inform the CA in writing of the changes along with the documents of the changes and apply for transfer of the certificate to the new owner. To obtain the certificate, the new owner should submit an

undertaking to maintain all the norms and quality standards required for certification.

3.6.4 Cancellation of certification

The certification of a production unit should be cancelled under one or more of the following circumstances:

i. The facility ceases to abide by the set requirements prescribed by the Competent Authority;
ii. The facility is not functional for more than one year without any valid reason;
iii. The facility fails to rectify faults noted and given in writing by the Competent Authority for a specified period of time;
iv. The facility is found using prohibited ingredients or species as per national regulations;
v. The facility obtained the certificate by submitting incorrect information.

3.6.5 Revalidation of Certification

Certification of fish seed producers should be valid for a period of three years and apply for re-assessment before the end of the validity period. The process should require all the processes required for certification of a new production unit.

3.6.6 Display of certificate

The certificate should be displayed at a visible prominent place within the production facility.

CHAPTER 4: FISH NUTRITION AND FEED FORMULATION

4.0 Fish feeds and feeding

The status of fish feeds and feeding has changed over time from reliance on kitchen wastes and farm by-products to use of manufactured and species-specific feeds. Research into appropriate fish feeds and growth in the feed processors and importers provides an assurance for the sustainability of aquaculture in Kenya. Fish feeds and feeding is an integral component in fish farming in Kenya, which the farmer should incorporate when planning for fish farming.

4.1 Why Feed Fish?

The objective of feeding fish is to provide their nutritional requirements for: good health, optimum growth, and optimum yield

- Feeding should be done in a manner that ensures minimum waste
- The feed cost should be reasonable so as to optimize profits
- Every farmer should be particular about the quality of feed because feed determines:
- Nutrient loading (and ultimately carrying capacity) in the pond, hence water quality within the culture system
- Fish growth rate,
- Economic viability of the enterprise. 60-70% of variable production costs is normally due to feed,
- Health status of the fish.

Feeding fish correctly means:

- Giving feed of the correct nutritional quality for the specified age of fish, and fish species
- Feeding the right feed size for easy consumption,
- Feeding the correct amounts,
- Feeding at the right time(s) each day.

When fish are fed correctly, growth rates are good and uniform across the population, feed conversion ratios (FCRs) are low and pond water quality is better managed.

4.2 Fish nutrition

Fish nutrition is a critical component of fish farming since fish like any other living organism requires various nutritional requirements for body development, gonadal development and resistance from diseases. Key nutritional requirements include protein, carbohydrates, lipids, vitamins and minerals. Fish nutrition is specific to age, production strategy (brooders, grow-out), species and health conditions. Fish food which naturally occurs in culture facilities or mass cultured under specific conditions include *Artemia*, rotifer and algae among others, while feed is supplemental or complete diet formulated from animal and plant ingredients.

Fish feed accounts for about 50-60% of the total variable production cost in fish farms, making it a key component in any fish-farming venture. While under semi-intensive fish farming, supplemental feed is provided to augment naturally produced fish food through pond fertilization, under intensive fish farming complete feeds are provided to meet all the cultured fish's nutritional requirements. Protein is the most important and limiting component of the fish nutritional requirements, and more specifically animal source, considering its demand for other animal feed formulation and human consumption. Further resolution of protein requirements into amino acids show that lysine and methionine are the limiting Essential Amino Acids (EEA) in fish diet and may have to be supplemented by premixes where and when they are deficient in the ingredients.

Plant protein sources include soybean (*Glycine ma/*) cake, sunflower (*Helianthus annuus*) seed cake and cotton (*Gossypium hirsutum*) seed cake though most plant sources are characterized by high crude fibre levels and anti-nutritional factors. Some locally available raw materials used in formulation of fish feeds are shown in Plate 3.1: They are arranged from Wheat bran on the top left going clockwise to cotton seed on the bottom left.. Protein requirements for Nile tilapia and African catfish range between 28-40% and 30- 45% respectively. Normally protein requirements are low for herbivores (plant eating fish) and omnivorous fish (animals and plant eating fish), when compared to carnivorous (flesh eating) fish. On the other hand, protein requirement is higher for smaller fish, and as they grow larger, their protein requirement decreases. Apart from proteins below are other key components in fish feeds:

- Lipids/fats - these are high energy components of the feed and constitute about 15% of the requirements in fish diets

- Carbohydrates – these include starches and sugars and although not essential they are included in feeds to reduce feed costs and for binding during

feed manufacturing (and are specifically important in the extrusion process during the manufacture of floating feeds). When starches are cooked, they become more biologically available to fish.

- Minerals - these are inorganic elements necessary in the fish body for normal body functions and can be divided into macro and micro nutrients based on the quantity required by the fish diet and the amount present in the fish. Common trace mineral include copper, chromium, iodine, zinc and selenium.

4.2 Alternative feed and ingredients used by farmers

To reduce the costs of fish feeding, Kenyan fish farmers are known to use alternative protein sources to replace the expensive fish meal used in the production of fish feeds. Examples of alternative feed resources and protein sources are given in Table below.

Table 4.1. Alternative feed and feed ingredients.

Black soldier fly	Grown using kitchen wastes and fed to fish either as single feed source or as an ingredient in fish diets
Earthworms	Produced through vermicomposting techniques; Still under trial for use as animal protein source or as an ingredient in fish diets
Freshwater shrimps (Ochunga)	By-product of Omena harvested from Lake Victoria. Used to replace fish meal in on-farm formulation of diets for Nile tilapia. Availability limited by seasonality of quantities in Lake Victoria
Periphyton Aquaculture Technology (PAT)	Involves use of substrates like bamboo introduced in the pond to allow growth of microorganisms which are feed to fish. Both tilapia and catfish yields have been found to increase when PAT is used. Bamboo substrates are introduced into the pond where manure (especially pig manure) is added to stimulate faster growth of microorganisms

4.3 Types of feeds

Commercial fish feed industry has experienced tremendous development from home- based cottage feed production in the last decade. The entry of various fish feed commercial producers has made fish feed more accessible, affordable and of better quality. The value chain has further experienced importation of high quality fish feeds with distribution channels across the country's prime aquaculture areas. Feed provided to fish can either be complete feeds (used in intensive systems) or supplementary feeds (in semi-intensive systems) that also rely on natural productivity from the fish ponds.

Table 4.2. Description of feed types, forms and size

Feed Type	Description
Extruded (Floating or Buoyant)	More expensive due to the high manufacturing costs involved; advantageous to feed floating feed because farmer can observe feeding. Tilapia prefers floating feeds compared to sinking feeds
Pressure pelleted (Sinking)	Feeds that sink to the bottom of the water column. Could be fast or slow sinking They are preferable for fish that prefer feeding from the pond bottom like the catfish
Feed Form/size	
Fine powder	Fed to fry and early-stage fingerlings
Fine crumbles	Used to feed post fingerlings and small fish
Large pellets	½ inch or larger used to feed larger fish Pellet size should be approximately 20-30% of the size of the fish mouth gape Too small pellets result in inefficiencies in feeding too large pellets depress feeding and may cause choking

As the farmer embarks onto feeding his fish there are key considerations that the farmer needs to have at the back of his or her mind, so as to optimize on this important component of fish production:

i) Unlike other farm animals (like poultry, sheep, cattle etc), the temperature of the water in which the fish lives dictates its life part of which feeding is critical. It is important to reflect on the optimum temperatures for Nile tilapia or African catfish already discussed in introduction section above so as to enhance success in feeding

ii) When feeding fish, **PROTEINS** are key feed components in the diets. Fish feeds tend to have a higher protein content when compared to other livestock (poultry, dairy cows etc). The protein requirements also vary at different stages of the lifecycle (larval stage, grow- out stage, brooders). It is not suitable to give to fish commercial feed meant for poultry, dairy cattle or pigs. This is not only expensive to the farmer but may also not contribute to fish growth. On the other hand, in the past, farmers have fed their fish on cereal by- products (wheat bran, rice bran, maize bran). While the fish may not refuse such feeds, the nutritional value of such feed is very low and may not add value if the farmer is producing fish for commercial purposes

iii) Fish feeding and water quality go hand in hand. Due to the high level of protein content in fish feeds, there is normally a tendency for the feeds to compromise water quality. Since fish lives in the same water where it's fed from, there should be no wastage of feed during feeding as this will compromise the water quality. Poor water quality may lead to reduced dissolved oxygen, increased ammonia and nitrite levels (which could rise to toxic levels at low pH) as well as resulting in parasitic attacks. Fish feeding

guides are normally provided in numerous extension materials and generally available in Kenya.

4.4 The fish's feeding response depends on the:

- ***Suitability of the Feed*** - The feed's appearance, smell, texture/feel and taste also influence the fish's appetite. The more palatable the feed is, the better the feed response should be.
- ***Culture (Water) Environment*** -The most important water quality parameters that affect feeding response in ponds are water temperature and dissolved oxygen. The warmer the water and more dissolved oxygen it has, the more active fish will be and the better their feed consumption and FCR.
- ***Other Stressors:*** Such as pollutants in water, other water quality variables (notably of ammonia and pH), handling and social interactions also affect the fish's appetite. When fish are stressed, their appetite drops quickly.

There are several fish species cultured in Kenya as discussed in the previous chapters. However, this manual will focus on Nile tilapia and African catfish, the leading aquaculture species in the country. The following section will discuss the nutritional requirements for the two fish species, feed types, feed formulations, sources of raw materials, optimizing on natural and formulated feeds and how and when to feed the fish.

4.5 Feed conversion ratios and feeding efficiency

FCR is the amount of feed a fish requires to gain a kilogram of body weight. It's a ratio of inputs to outputs

$$\textbf{FCR} = \frac{\text{Total amount of Food given (Kg)}}{\text{Total amount of Fish Produced (Kg)}}$$

To optimize in fish feeding hence reducing on production costs, the farmer can calculate Feed Conversion Ratios (FCR) or Feed Efficiency (FE). These are used to determine feeding efficiency which can go a long way in cutting costs.

FCR can be calculated as the total weight of the feed fed to the fish over a given period of time divided by weight gained by the fish under the same growth period i.e. a fish stocked at 5g and harvested at 55g upon feeding it with 100g of feed, the FCR for the fish will be;

FCR = 100g/(55g-5g) = 2.0

An FCRs ranging between 1.5 and 2.0 is considered good for most species. In addition, FE is the reciprocal of FCR so following the above example FE will be given as: **FE = 50/100 = 0.5x100% = 50%**

FEs greater than 50% are considered good growth.

However, fish are not completely efficient and therefore FEs of 100% or FCRs of 1.0 is usually very difficult to attain in practice.

Framer feeding fish at pond site. Source: Internet

4.6 Nutritional requirements for Nile Tilapia and African Catfish

Species	Description of feeding and nutritional requirements
Tilapia	
Nutritional requirements	Age/size: Minimum dietary level of an amino acid-balanced protein required for optimum growth in absence of natural food is near 50% for tilapia fry and decreases to about 35% as fish increase to 30g in size. Practical requirements for larger fish have been reported from 25% to 35% of the feed; this varies with the size of fish, amount of natural food in the culture system, and dietary factors such as quality of protein and energy level. Fats or proteins are more digestible to tilapia than are carbohydrates. The dietary level of available phosphorus required for maximum growth and normal bone mineralization is estimated to be less than 0.9% Feeding ratio: Can be calculated by taking a sample of about 20 weighing them and getting the average body weight (ABW) Daily food ration = ABW x No. of fry x %food requirement
Other factors to consider when feeding tilapia	For fish produced in earthen ponds the farmer can use feeds with CP of 26-28% as long as the pond is well fertilized and at the right stocking densities with carrying capacity hardly higher than 0.8kg/m^2 with no aeration. However, for fish raised in raised ponds the farmer should insist on feeds with a CP not less than 32% since the fish will solely rely on the feed given by the farmer
African catfish	
Nutritional requirements	Age/Size:Upon yolk-sac absorption by day 3 post-hatching, feeding begins. After 8-10 days, (the stomach is completely functional), the fry can be weaned onto high protein formulated diets. 50% protein and 10-15% lipids is recommended for catfish larvae. To achieve good growth of catfish, good quality artificial feed is essential with dietary protein levels ranging from 35% to 50%, depending on age of the fish.

Species	Description of feeding and nutritional requirements
African catfish	
Nutritional requirements	Feeding rate: Complete feeds are given to larvae at a rate 0.5g/day in the 1st week then an addition of 0.25g/day every week for the next 4 weeks Feed conversion rates and recommended feeding rations for an 8 month production cycle are given in Table 6 and 7 The pellets must be palatable to the fish, otherwise the FCR will be far much higher, resulting in food waste and poor growth. Even though catfish is a bottom feeder under its natural habitat, it will feed on the surface immediately the artificial feed is introduced and hence the necessity for the feed to remain afloat for at least 15 minutes to enable rapid feeding and satiation Depending on their mouth gape and hence the recommended and right pellet sizes from 0.6 to 6 mm should be used.
Other factors to consider in catfish feeding	A good catfish feed should be highly water stable and does not disintegrate in water before ingestion by the fish. For intensive catfish production, the farmer should consider formulated feed with a crude protein content of 35-42%, Extruded or floating feed generally preferred when water temperature is above 18 ℃ Sinking pellets are better when temperatures fall below 18 ℃ because catfish reduce their feeding do not readily come to the surface Some regions in Kenya have excellent all year round temperatures that can allow for use of floating pellets to feed catfish. However, there are some aquaculture zones in Kenya where there are times of the year when temperatures are low. A farmer can therefore plan to use the sinking or floating pellets accordingly.

CHAPTER 5: FISH HEALTH MANAGEMENT

5.0 Introduction

Fish health management is a term used in aquaculture to describe management practices which are designed to prevent fish disease. Once fish get sick it can be difficult to salvage them.

Successful fish health management begins with prevention of disease rather than treatment. Prevention of fish disease is accomplished through good water quality management, nutrition and sanitation. Without this foundation it is impossible to prevent outbreaks of opportunistic diseases. The fish is constantly bathed in potential pathogens, including bacteria, fungi, and parasites. Even use of sterilization technology (ie, ultraviolet sterilizers, ozonation) does not eliminate all potential pathogens from the environment. Sub-optimal water quality, poor nutrition or immune system suppression generally associated with stressful conditions allow these potential pathogens to cause disease. Medications used to treat these diseases provide a means of buying time for fish and enabling them to overcome opportunistic infections, but are no substitute for proper animal husbandry.

Daily observation of fish behavior and feeding activity allows early detection of problems when they do occur so that a diagnosis can be made before the majority of the population becomes sick. If treatment is indicated, it will be most successful if it is implemented early in the course of the disease while the fish are still in good shape.

5.1 Types of fish diseases

There are two broad categories of fish diseases that affect fish, infectious and non-infectious diseases. Infectious diseases are caused by pathogenic organisms present in the environment or carried by other fish. They are contagious diseases, and some type of treatment may be necessary to control the disease outbreak. In contrast, non-infectious diseases are caused by environmental problems, nutritional deficiencies, or genetic anomalies; they are not contagious and usually cannot be cured by medications.

5.1.1 Infectious diseases

Infectious diseases are broadly categorized as parasitic, bacterial, viral, or fungal diseases.

Parasitic diseases of fish are most frequently caused by small microscopic organisms called protozoa which live in the aquatic environment. There are a variety of protozoans which infest the gills and skin of fish causing irritation, weight loss, and eventually death. Most protozoan infections are relatively easy to control using standard fishery chemicals such as copper sulfate, formalin, or potassium permanganate.

Bacterial diseases are often internal infections and require treatment with medicated

feeds containing antibiotics which are approved for use in fish by the Food and Drug Administration. Typically, fish infected with a bacterial disease will have haemorrhagic spots or ulcers along the body wall and around the eyes and mouth. They may also have an enlarged, fluid-filled abdomen, and protruding eyes. Bacterial diseases can also be external, resulting in erosion of skin and ulceration. Columnaris is an example of an external bacterial infection which may be caused by rough handling.

Viral diseases are impossible to distinguish from bacterial diseases without special laboratory tests. They are difficult to diagnose and there are no specific medications available to cure viral infections of fish.

Fungal diseases are the fourth type of infectious disease. Fungal spores are common in the aquatic environment, but do not usually cause disease in healthy fish. When fish are infected with an external parasite, bacterial infection, or injured by handling, the fungi can colonize damaged tissue on the exterior of the fish. These areas appear to have a cottony growth or may appear as brown matted areas when the fish are removed from the water. Formalin or potassium permanganate are effective against most fungal infections. Since fungi are usually a secondary problem it is important to diagnose the original problem and correct it as well.

5.1.2 Non-infectious diseases

Non-infectious diseases can be broadly categorized as environmental, nutritional, or genetic.

Environmental diseases are the most important in commercial aquaculture. Environmental diseases include low dissolved oxygen, high ammonia, high nitrite or natural or man-made toxins in the aquatic environment. Proper techniques of managing water quality will enable producers to prevent most environmental diseases.

Nutritional diseases can be very difficult to diagnose. A classic example of a nutritional disease of catfish is "broken back disease," caused by vitamin C deficiency. The lack of dietary vitamin C contributes to improper bone development, resulting in deformation of the spinal column. Another important nutritional disease of catfish is "no blood disease" which may be related to a folic acid deficiency. Affected fish become anaemic and may die. The condition seems to disappear when the deficient feed is discarded and a new feed provided.

Genetic abnormalities include conformational oddities such as lack of a tail or presence of an extra tail. Most of these are of minimal significance; however, it is important to bring in unrelated fish for use as broodstock every few years to minimize inbreeding.

5.2 Biosecurity and GAqPs in the prevention and control of diseases and parasites.

Biosecurity is the sum total of activities aimed to prevent the inclusion, spread and escape of pathogens in a farming environment. It is focused on the management, minimization of the impact of disease and prevention of spread of a disease in the farm. Biosecurity can be applied at trans-border level, national, regional, local level up to the farm level and extending to farming units within a farm.

5.2.1 Avenues for monitoring;

i) Water source - potential sources of contaminants

ii) Feed source - raw material, transportation or processing contamination

iii) Fish sources – are fish coming from safe sources, history of infections, Trans aquatic animal diseases (TAADs)

iv) Predators, ecological risks – birds, reptiles

v) Movement – People and vehicles/visitors

vi) Husbandry practices – Possibility of workers transferring the infections into other sections from one part of the farm through equipment.

On the farm, biosecurity protocols fall under;

i) Restrictions – Restricted entry to some parts of the farm

ii) Controls – Managing processes through standard operating procedures (SOPs) and visitors' registers

iii) Disinfection – Continuous disinfection within the farm

iv) Sanitation – Sensitive sections of the farm should have sanitizers at entry points; sanitization of equipment

v) Hygiene – Maintaining high level of hygiene; having regular swabs to check on hygiene status.

5.2.2 Biosecurity measures to be put in place on an aquaculture set up would include;

i) Strict quarantine for incoming fish (whether locally sourced or imported)

ii) Frequent monitoring/ surveillance of fish for disease and documentation of this data

iii) Purchase of fish should be limited to suppliers with trusted and reliable fish health programmes

iv) Foot baths should be placed in all entrances and exits. They should also be kept clean and refreshed at all times

v) Each unit should have its own maintenance equipment

vi) Routine disinfection of all non-disposable equipment

vii) There should be a restricted access to the unit/ facility

viii) All the water and sludge from the facility must be disinfected

5.2.3 Good aquaculture practices geared to preventing fish diseases

i) Routine monitoring of water quality

ii) Ensuring the correct stocking density is maintained

iii) Ensuring that feeds are within the shelf life and have the right nutritional composition

iv) Proper disposal of dead fish (by burying)

v) Maintaining clean pond/ aquaculture unit environment

vi) Incoming water should be screened for possible wild fish which can be avenues of infection

vii) Predator control to prevent transmission by vectors and proliferation of diseases

5.2.4 Treatment/ Management of infected systems

In cases of infected ponds for which treatment is not an option, it should be drained and badly infected fish culled. The following procedure should then be followed before re- stocking the pond again;

i) Dry the pond under the sun for about seven days

ii) Dampen the pond bottom

iii) Spread Lime (Calcium carbonate) evenly over entire surface of pond bottom at the rate of 1500 kg/Ha

iv) Wait for 15 days then restock the pond with healthy stocks.

CHAPTER 6: FISH POST-HARVEST TECHNOLOGIES AND VALUE ADDITION

6.0 Introduction

The main objective of good fish handling techniques is to preserve the quality of fish. Nevertheless, factors such as poor handling of the catch, inefficient temperature control, and poor standards of gutting often affect the quality of fish. This can lead to loss of weight and reduction in shelf life.

6.1 Fish handling and hygiene requirements

6.1.1 post-harvest fish handling

Maintenance of fish quality usually begins with harvest and transport of fish products. It is advisable that the fish farmer handles with care his/her fish products during transportation. The surface of dead fish is an ideal place for bacterial growth that contributes to fish spoilage. Therefore, it is important for the fish farmer or trader to control the temperatures.

6.1.2 Fish handling during transportation

i) Fish is a highly perishable food product that necessitates proper handling and preservation to increase its shelf life and retain quality and nutritional aspects.

ii) Fish should be washed in clean water after harvesting to remove residues,

iii) Fish must be handled swiftly but cautiously when grading to minimize/eliminate damages or stress.

iv) If fish is sold dead, after stunning, it should be chilled the soonest possible using ice in clean containers or boxes.

v) Transport fish to the market as fast as possible. All equipment and boxes should be cleaned and disinfected after use.

6.2 Good fish handling practices

Best fish handling refers to the practices that are employed by the fish farmer after receiving fish and fish products at the processing facility. The fish farmer or trader washes the fish products to remove mud, sand and debris. In addition, the fish farmer sorts/grades according to species or sizes, prior to fish processing. Hence, fish processing determines the quality of the final fish products.

6.2.1 Recommended good fish handling practices during processing:

i) Control the temperature of the fish by using ice to cool the fish as fast as possible by any convenient methods.

ii) Avoid mishandling/throwing of fish;

iii) Fish caught at different times must be kept apart since they will be at different stage of spoilage.

iv) Smaller fishes are kept separate from larger fishes, as they tend to spoil more quickly than the latter.

v) The container used for the transportation of fish should be cleaned after every use.

vi) Fish handlers at every processing stage should learn and adopt good

hygiene practices.

vii) Fish that is processed should be fresh and in good condition.

viii) Fish should be washed thoroughly in clean water to remove blood, slime and scales.

ix) Fish processing should be done in a proper place where there is no chance for bacterial growth.

x) Equipment and utensils used for fish processing should be kept clean and in good condition.

xi) Fish waste products should be kept in a closed place that does not allow flies, rats and other pests to breed and be a nuisance.

xii) Waste products from processing must be disposed- off in such a way that does not harm the environment.

xiii) Final products must be handled and packaged in a careful way to avoid contamination.

xiv) Maintain hazard analysis critical control point (HACCP) at every stage from harvesting to packaging and transportation.

6.2 Types of fish preservation Methods

Fish is one of the rich protein food sources that need careful handling due to its fast degradation rate upon harvesting mainly accelerated by high temperatures. High temperatures accelerate the activities of bacteria, enzymes and chemical oxidation of fat in the fish. Optimal post-harvest management will ensure quality to the consumer and enhance product market value

Fish processing refers to those processes that are associated with fish and fishery products between fish harvesting and the delivery of the final products to the customers. Fish is processed for various reasons:

i) Minimize post-harvest losses

ii) Quality assurance

iii) Consumer preference

iv) Fully utilize the raw materials

v) Expand market base

vi) Assure the consumer of a safe product

vii) Create room for more production

The basic principle of fish preservation focuses on:

i) Temperature control (chilling, freezing, heat processing to kill bacteria and enzymes)

ii) Quality and taste preservation.

iii) Separation of bacteria and enzymes from the fish flesh through washing of the fish and removing stomach contents.

iv) Reducing the contact fish fats and oils have with oxygen in the air by using appropriate packaging.

6.3 Fish processing methods

a) Chilling and freezing

i) Ice should be made from potable water.

ii) Ice to fish weight ratio is 1:1(ice to fish) in temperate climates

and 2:1 for tropical temperatures.

iii) Fish should be chilled with ice soonest possible after harvesting. Ice and fish must be mixed well so that ice is all round the fish.

iv) Chilling prolongs shelf-life.

Benefits of Chilling and freezing

I) Freezing is used to preserve and store fish for long periods of time

ii) 75-80% of the weight of fish is water, by freezing this water reduces bacterial spoilage and slows down autolysis, thus extending the storage life of fish.

iii) Complete freezing is achieved when the product temperature reaches -18°c or lower at the thermal centre after thermal stabilization.

Cold storage

i) After freezing, fish should be stored under suitable storage conditions to maintain quality.

ii) At -20°c protein changes and denaturation by enzyme are minimized and bacterial action stopped.

Cold stores should:

i) Maintain a low temperature.

ii) Ensure a uniform temperature (minimal fluctuations).

iii) Have good air distribution.

iv) Have minimum air circulation.

v) Minimize air entry from outside

Chilling of Nile Tilapia using a cooler box/ at KMFRI, Sagana2. Freezing.

b) Smoking

There are four main methods of smoking:

i) Smoking and Roasting: This is a simple method of preservation, for consumption either directly after curing or within a short period of time. Re-smoking and roasting can further prolong the shelf life of fish.

ii) Cold smoking: Fish goes through the curing process where moisture is extracted to inhibit growth of bacteria. The fish remains raw throughout the smoking process. In cold smoking, fish is placed in a chamber. Smoke is then pumped through the chamber for a period of around 24- 48 hours. The temperature in the chamber is kept between 20-25°C.

iii) Hot Smoking: Hot smoking is an important method and can be used as a preservation process for surplus harvests by increasing shelf life.

a) Fish are hot smoked using traditional smoking kilns and firewood.

b) It can also be used to enhance flavour depending on various cultural taste e.g. using Rosemary leaves.

iv) Long smoking: The preservation of fish is affected by smoke. It's best to use wood which burns very slowly e.g. Mkoma so that fish is dry smoked after 48 hours. Smoked fish can be stored for long periods of time.

c) Salting and drying

Salting is one of the earliest preservation techniques and the salt used should be clean and fit for human consumption. Salting and drying extracts water from the fish thus lowering bacterial activity that leads to spoilage.

Type of salting

I) Wet Salting: The principle is to keep the fish for a long time in brine. Fish are placed in a solution of salt and water (brine) until the fish have absorbed the required levels of salt.

ii) Dry Salting: In this method, the fish is salted but the juices, slime and brine are allowed to flow away.

a) Dry salting can be done on a raised rack.

b) For two parts of fish, one needs one part of salt.

c) Layers of fish must be separated by layers of salt.

d) **Drying**

I) Drying is a simple way of preserving fish and is often done using sun, salt or smoking.

ii) Drying works by taking out water from the fish making it difficult for bacteria to survive and enzymes to work.

iii) During drying, water is removed by evaporation.

iv) Sun and wind are used to effect evaporative drying.

v) Smaller fish are mostly sun dried or suspended on racks, while larger fish are hanged when they are split.

6.4 Value Addition

Value addition is any process or service in the supply chain that adds to or enhances market value of products to consumers. In fish, it is the change of fish

from its raw state to diverse forms through processing.

6.4.1 Stages of Value addition

They include:

i) Partial processing in the early stage, resulting in minimal transformation of the raw product.

ii) Further processing of the raw product into an immediate product to be used as an input in another production process, or an input in a manufactured product for the consumer.

iii) Improvements in utilization the of by-products which would have otherwise been discarded

Market control strategies using fish value addition include

iv) Producing different varieties of particular product

v) Introducing quality standards

vi) Changing packaging and product presentation

vii) Providing expertise and/or other support to consumers on product preparation and use.

6.4.2 Why Fish Value Addition?

i) To upgrade fish and fishery products and eliminate waste to maximize the value of fish production.

ii) To meet consumer demand for better quality and appealing products.

iii) To meet the changing consumer preferences for easy to prepare processed fishery products.

iv) Customer habits and lifestyles evolve over time. Products must adapt to changing needs and expectations of the customer.

v) The products must meet market demand.

6.5 Fish Value Added Products

6.5.1 Filleting

Fillets are strips of flesh cut parallel to the backbone of the fish. Filleting can be done by hands or by using a filleting machine. Fillet fetches a higher price in the luxurious market.

Fish fillet. Source: https://www.google.com/imgres?imgurl.

6.5.2 Fish mince

This is flesh separated in a comminute form, from the flames, scale, bone and fins of fish. It can be prepared either mechanically by the use of flesh bone separator (deboning machine) or use of hands. Fish mince is very versatile and can be used to make a variety of products such as fish fingers

Fish Fingers. Source: https://www.dreamstime.com

6.5.3 Gelatine from fish scales

Fish gelatine is a protein product extracted by thermal hydrolysis from pre-treated collagen sources, mainly fish skins, scales and bones. Gelatin plays an important role in the processing of human hair and skin products. The gelatine is composed of amino acids that perform an imperative function in the building of connective tissues in human.

6.6 Significance of Omega 3 Fatty Acids to Human Health

Omega- 3-fats are essential nutrients obtained from fish. These essential fatty acids provide nutritional benefits to human health. There are three types of Omega-3 -fatty acids:

i) Alpha-linoleic acid (ALA) (Short-chain omega-3 polyunsaturated fatty acids)

ii) Eicosapentaenoic acid (EPA) (Long-chain omega-3 polyunsaturated fatty acids)

iii) Docosahexaenoic acid (DHA)(Long-chain omega-3 polyunsaturated fatty acids)

I. Brain development

The major omega-3- fatty acids present in the central nervous system, DHA is vital for brain development. Omega-3-fatty acids are used as energy during brain metabolism and are also helpful in managing degenerative brain disorders. Deficiency of omega-3 in the body can cause communication breakdown in the brain.

ii. Optimal visual function

Omega-3-fatty acids, DHA is found in extremely high concentrations in the cell membranes of the retina, and is essential for the normal development and function of the retina.

iii. Important in Pregnancy and Lactation

Maternal intake level of DHA determines the status of DHA of the new-born and breast- fed infant (maternal diet affects the brain DHA status of offspring). Omega-3 fatty acids are known to lower the incidence of preterm births.

iv. Prevention and treatment of heart disease

DHA reduce chances of heart attack or cardiac arrest. Omega-3 supplements have been used to treat heart diseases.

v. Lowers chances of suffering a stroke

Increased intake of omega -3- fatty acids may lower the risk of blood clot strokes (thrombotic stroke).

vi. Lowers chances of getting cancer

Studies have established important inverse relationships between Omega-3 fatty acids intake and the risk for breast, prostate, or colorectal cancers.

vii. Prevention against diabetes

Omega-3 fatty acids significantly lower the levels of blood fat in diabetic individuals and improves the ability of muscle cells to take up glucose in the presence of insulin.

viii. Prevention against arthritis

Fish oils increase levels of calcium in the body, improve bone strength and the overall function of joints. They also have anti-inflammatory effects.

ix. Helps in lowering the severity of Asthma

Omega-3 fatty acid supplementation can reduce the production of inflammatory mediators in asthmatic patients.

iix. Stress management

Intake of DHA can prevent and or treat neuropsychiatric diseases mainly depression and anxiety.

6.7 African Catfish Recipe

Baked Catfish Fillet

Ingredients

i) 4 tablespoons vegetable oil, divided into two

ii) 1 cup cornmeal

iii) 1 tbsp. seasoning

iv) Catfish fillets

v) Salt

vi) Freshly ground black pepper

vii) Lemon wedges, for serving

Method

I) Preheat the oven to 218℃ and drizzle 2 tablespoons of oil on a large baking sheet. On a large plate, combine cornmeal and seasoning. Season catfish with salt and pepper, then dredge fish in seasoned cornmeal, pressing to coat.

ii) Place fish on a prepared baking sheet and drizzle with remaining 2 tablespoons of oil. Bake for 15 minutes until golden, and fish flakes easily with a fork. Serve with lemon wedges.

6.8 Legislative requirements concerning food safety includes:

1. Fisheries management and development Act No 35 of 2016 on fish quality and safety, import, export, trade and marketing of fish and fish products.
2. Manual of standards operating procedures for fish inspection and quality assurance in Kenya, 2015 outlining procedures and requirements for fish inspection and quality assurance in aquaculture and capture fisheries in Kenya.
3. Fisheries (Safety of Fish, Fishery Products and Fish Feed) Regulations, 2007.
4. Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs,
5. Commission Regulation (EC) No 2073/2005 of 15 November 2005 on microbiological criteria for foodstuffs
6. Regulation (EC) No 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs
7. Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific hygiene rules for food of animal origin,
8. Regulation (EC) No 854/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific rules for the organization of official controls on products of animal origin intended for human consumption

CHAPTER 7: FISH BUSINESS AND MARKETING

7.0 Introduction

Aquaculture has received a lot of attention in Kenya recently because of increased demand for fish and the declining wild catches. Aquaculture is therefore expanding to capture the resulting markets and many investors see business opportunities in aquaculture. Investing in aquaculture at any level of operation require making significant investment decisions involving capital intended to be grown. This calls for serious planning and commitment. This is always true when making decisions on any other economic investment, and as in all businesses there is need to invest in knowledge, capital and provide the required workforce and technologies.

There are many viable investment opportunities in the aquaculture industry. However, investing comes with risks similar to those of any farming enterprise. The information provided in this booklet (manual) highlights many important factors to consider before investing in aquaculture enterprise.

Planning for aquaculture investment will involve a detailed evaluation of the biological, economic, and socio-legal feasibility of production. It is very important to remember that economic considerations are as important as biological considerations. Socio-legal issues are potentially capable of limiting or even making it completely impossible to undertake aquaculture production.

It is essential to ascertain that the proposed aquaculture business concept is sound. All investors in aquaculture and aqua-business should ask whether:

I) There are adequate and profitable markets for proposed product(s)

ii) The site is suitable for the proposed production

iii) There is enough resources to meet the projected targets

iv) The financial projections are realistic, robust and consistent

v) There is the expertise for production and marketing

vi) There is access to adequate and essential support services

vii) The proposed undertaking meets all the environmental and social requirements as required by the government

7.1 Research and Planning of Fish Farming in Kenya

Before starting a fish farming business in Kenya, it is essential to conduct thorough research and planning to ensure success. This section outlines some critical aspects to consider during the research and planning phase.

7.2 Conducting market research:

Market research is a crucial aspect of starting any business, including fish farming. It involves gathering information about the market, including consumer demand, supply, pricing, and competition. In the fish farming industry, it is essential to research the demand for different fish species, their prices, and the competition in the market. This information will help you make informed decisions about the fish species to farm, the production capacity, and the pricing strategy.

7.3 Choosing a suitable location for the fish farm:

The location of your fish farm plays a significant role in the success of your business. Factors to consider when selecting a location include access to water, soil type, topography, and the availability of infrastructure such as electricity and roads. The location should also be easily accessible to markets to minimize transport costs.

7.4 Identifying the fish species to farm:

The choice of fish species to farm depends on several factors, including market demand, the suitability of the water body, and the production costs. Common fish species farmed in Kenya include tilapia and catfish.

Both tilapia and catfish have their own advantages and disadvantages, and the decision on which species to farm in Kenya ultimately depends on several factors including the farmer's goals, available resources, and the local market demand. Here are some key points to consider:

7.5 Advantages of Tilapia farming in Kenya:

1. Widely consumed: Tilapia is a popular fish species in Kenya and is widely consumed, which means there is a high demand for it in the market.

2. Easy to farm: Tilapia is relatively easy to farm, as it is hardy and adaptable to a variety of environmental conditions. Additionally, tilapia can feed on a wide range of feeds, including commercial feeds and locally available materials.

3. Fast growth rate: Tilapia has a relatively fast growth rate and can reach market size within 6-8 months, which can be advantageous for farmers looking for a quick return on investment.

7.6 Advantages of Catfish farming in Kenya:

1. High protein content: Catfish is known for its high protein content, which makes it a nutritious food source and can be attractive to health-conscious consumers.

2. Tolerant of poor water quality: Catfish is known for its tolerance of poor water quality, which means it can be farmed in areas with limited access to clean water sources.

3. Larger size potential: Catfish can grow to larger sizes than tilapia, which can be advantageous for farmers looking to produce larger fish for a premium market.

Ultimately, the decision on which species to farm in Kenya will depend on the farmer's goals, available resources, and local market demand. Both species have their own advantages and disadvantages, and farmers may choose to farm either or both depending on their circumstances. It's recommended to research the market demand for both species in the local area and evaluate the feasibility of farming each species based on the available resources and infrastructure.

7.7 Calculating the startup costs of fish farming

Starting a fish farming business requires significant capital investment. The startup costs include the cost of land or lease, construction of ponds, purchase of fingerlings, fish feed, and equipment. It is crucial to calculate these costs accurately to ensure adequate financial planning and sourcing of capital. It is also important to factor in operating costs, such as labor, maintenance, and marketing expenses, when determining the profitability of the business.

7.8 Setting Up the Fish Farm

Once you have decided on the type of fish you want to farm and have conducted research on the market demand, the next step is to set up your fish farm. Here are some key steps to consider:

1. Acquiring the necessary permits and licenses: Depending on the size and scope of your fish farm, you may need to obtain various permits and licenses from the local authorities. This may include environmental permits, water use permits, and business licenses. It's important to research the specific requirements in your area and obtain all necessary permits before starting your fish farm.

2. Constructing fish ponds or tanks: The next step is to construct fish ponds or tanks that are suitable for the species you plan to farm. The design and construction of fish ponds or tanks will depend on several factors, including the type of fish, the size of your farm, and the available resources. It's important to ensure that your fish ponds or tanks provide suitable water quality and temperature, adequate aeration, and appropriate space for the fish to grow and thrive.

3. Choosing and sourcing fish fingerlings or juveniles: Once you have constructed your fish ponds or tanks, the next step is to choose and source fish fingerlings or juveniles. It's important to select high-quality fish stock from reputable suppliers to ensure that your fish have a good chance of survival and growth. The size and number of fish fingerlings or juveniles you need will depend on the size of your ponds or tanks and the desired stocking density.

4. Installing necessary equipment and infrastructure: Finally, you will need to install necessary equipment and infrastructure to support your fish farm. This may include pumps and filters for water circulation and filtration, aerators for

oxygenation, and feeding equipment. You may also need to install fencing or netting to protect your fish from predators.

7.9 Types of Fish Ponds in Kenya

There are several types of fish ponds used in Kenya for fish farming. These include:

- **Earthen ponds**: These are the most common type of fish ponds in Kenya. They are dug into the ground and lined with clay soil to prevent water seepage. Earthen ponds are suitable for small to medium-scale fish farming.
- **Concrete ponds**: These are made of concrete and are more durable than earthen ponds. They are also easier to maintain and can be used for both small and large-scale fish farming.
- **Plastic ponds**: These are pre-fabricated plastic containers that are easy to install and relocate. They are ideal for small-scale fish farming and can be used indoors or outdoors.
- **Geomembrane ponds**: These are ponds made of synthetic liners such as polyethylene or PVC. They are suitable for large-scale fish farming and are more durable than earthen ponds. These are the most popular for farmers with enough land in Kenya.
- **Raised fish ponds**: These are made out of geomembrane liners and raised on the ground about a meter high with the support of wooden planks. They are popular with farmers practicing catfish farming inside greenhouses.
- In conclusion, the type of fish pond to use in Kenya depends on the scale of the fish farming operation, location, and budget. Earthen ponds are the most common and suitable for small to medium-scale fish farming, while concrete and geomembrane ponds are more durable and suitable for larger-scale operations. Plastic ponds and cage ponds are ideal for small-scale and large-scale fish farming, respectively.

7.10 Managing the Fish Farm

After setting up your fish farm in Kenya, the next step is to manage it effectively to ensure the health and growth of your fish, as well as the profitability of your business. Here are some key aspects of managing a fish farm:

1. Feeding and caring for the fish: Proper feeding and care are crucial to the health and growth of your fish. Fish need a balanced diet that provides the necessary nutrients for growth and development. Feeding schedules and amounts will depend on the species of fish and their age and size. In addition to feeding, fish farmers must also monitor the water quality in their ponds or tanks, maintain appropriate water temperature and pH levels, and ensure adequate aeration and oxygenation.

2. Monitoring water quality and managing disease outbreaks: Maintaining high water quality is essential to prevent diseases and promote fish health. Fish farmers should regularly test their water quality and monitor for signs of disease outbreaks. Common fish diseases in Kenya include bacterial infections, parasites, and viral diseases. It's important to have a plan in place to manage disease outbreaks, including isolation and treatment of infected fish.

3. Harvesting and processing the fish: Once the fish have reached the desired size and maturity, they can be harvested and processed for sale. Harvesting methods will depend on the species of fish and the size of the farm. Fish can be harvested either by draining the pond or tank or by using a net to catch the fish. Once harvested, the fish must be processed, which may involve cleaning, gutting, and filleting the fish, depending on market demands.

4. Marketing and selling the fish: Finally, fish farmers must market and sell their fish to make a profit. This may involve selling directly to local markets or restaurants or working with wholesalers or distributors. It's important to understand market demands and prices to ensure profitability. Developing a strong brand and reputation for quality fish can also help attract customers and build a loyal customer base.

7.11 How to feed your fish and where to source your fish feeds in Kenya

Feeding your fish is a critical aspect of fish farming, and it is essential to ensure that the fish are getting a balanced diet for optimal growth and health. In Kenya, there are several options for sourcing fish feeds, including commercial feeds and locally sourced ingredients. Here is an overview of how to feed your fish and where to source fish feeds in Kenya.

1. **Determine the nutritional requirements of your fish**: Different fish species have varying nutritional requirements, and it is essential to ensure that you are feeding your fish a balanced diet that meets their nutritional needs.

2. **Choose the right type of feed:** There are different types of fish feeds available, including pellets, flakes, and crumbles. It is essential to choose the right type of feed based on the size and species of your fish.

3. **Feed the fish regularly**: Fish should be fed small amounts of food several times a day. Overfeeding can lead to water pollution and health problems for the fish.

4. **Monitor the fish behavior**: Observing the fish's behavior can help determine if they are getting enough food. If the fish are constantly swimming to the surface or seem agitated, they may not be getting enough food.

7.12 Where to source fish feeds in Kenya:

1. **Commercial fish feeds**: There are several commercial fish feed manufacturers in Kenya that produce high-quality feeds for different fish species. These feeds are formulated to meet the nutritional requirements of the fish and are available in different sizes and types.

2. **Locally sourced ingredients**: Fish farmers can also source feed ingredients locally and mix their own fish feeds. Common ingredients include maize, soybean meal, wheat bran, and fishmeal. These ingredients can be purchased from local markets or feed stores.

3. **Online stores**: Some companies offer online sales of fish feeds, making it easy for farmers to order and receive their feeds without having to travel to the store.

In conclusion, feeding your fish a balanced diet is critical to their growth and health. Choosing the right type of feed and feeding the fish regularly is important to ensure that they are getting enough food. In Kenya, there are several options for sourcing fish feeds, including commercial feeds and locally sourced ingredients. Fish farmers can choose the option that best suits their needs and budget to ensure that their fish are getting the nutrition they need for optimal growth and health.

7.13 Strategies on how to market and sell tilapia and catfish in Kenya to get the most profit

Here are some strategies for marketing and selling tilapia and catfish in Kenya to maximize profits:

1. Identify your target market: Before you start selling your fish, it's important to identify your target market. This may include local restaurants, fish markets, or individual consumers. Understanding your target market will help you tailor your marketing and sales strategies to their specific needs and preferences.

2. Build a strong brand: Developing a strong brand for your fish can help differentiate your product from competitors and attract loyal customers. This may include developing a unique brand name and logo, creating attractive packaging, and emphasizing the quality and sustainability of your product.

3. Offer competitive pricing: Pricing your fish competitively is important to attract customers and maximize profits. Research market prices for tilapia and catfish in your area and price your product accordingly. Offering discounts for bulk purchases or repeat customers can also help increase sales.

4. Utilize social media and online platforms: social media and online platforms can be powerful marketing tools for fish farmers in Kenya. Consider creating a website or social media pages to showcase your product and attract customers. You can also use these platforms to share information about your farm and the sustainability practices you use.

5. Attend local markets and agricultural events: Attending local markets and events can be a great way to showcase your product and connect with potential customers. Consider setting up a booth at local farmers' markets or attending food festivals and events to promote your fish.

6. Develop partnerships with restaurants and wholesalers: Developing partnerships with local restaurants and wholesalers can provide a reliable source of income for your fish farm. Consider reaching out to local restaurants or wholesalers to establish relationships and negotiate pricing and terms.

7.14 Scaling and Expanding the Business

Once the fish farming business is up and running, it is essential to scale and expand to increase profitability and competitiveness. This section outlines some critical aspects to consider when scaling and expanding the business.

7.15 Reinvesting profits and expanding the fish farm:

One way to scale and expand the fish farming business is to reinvest profits back into the business. This can include expanding the size of the fish farm, improving infrastructure, purchasing new equipment, and increasing production capacity. It is essential to carefully plan and manage the expansion to ensure that it is financially viable and sustainable.

7.16 Developing new product lines and diversifying the business:

Another way to scale and expand the fish farming business is to develop new product lines and diversify the business. For example, the business can start producing fish feeds, fingerlings, and other inputs for the fish farming industry. Alternatively, the business can diversify into related sectors such as poultry farming or agribusiness. Diversification can help spread risks, increase revenue streams, and create new opportunities for growth.

7.17 Hiring and training employees to help run the business:

As the fish farming business grows, it becomes necessary to hire and train employees to help run the business. This can include hiring farm managers, technicians, and sales representatives. It is important to hire qualified and experienced staff who understand the fish farming industry and can help the business achieve its goals. Providing training and development opportunities can help improve staff skills and increase productivity.

In conclusion, scaling and expanding the fish farming business is essential for long-term success and profitability. Reinvesting profits, developing new product lines, diversifying the business, and hiring and training employees are critical aspects to consider when scaling and expanding the business. It is important to plan and manage the expansion carefully to ensure that it is financially viable and sustainable.

7.18 Challenges and Risks

Fish farming, like any other business venture, is not without its challenges and risks. This section outlines some common challenges and risks associated with fish farming and strategies for mitigating and managing them.

Identifying common challenges and risks in fish farming:

Some common challenges and risks in fish farming include disease outbreaks, poor water quality, theft, market fluctuations, and adverse weather conditions such as droughts and floods. These challenges can have significant financial implications and can threaten the viability of the business.

7.19 Strategies for mitigating and managing risks:

There are several strategies that fish farmers can use to mitigate and manage risks in their operations. These include:

1. Conducting regular water quality tests and monitoring for disease outbreaks to identify and address problems early.
2. Investing in high-quality equipment and infrastructure to prevent theft and vandalism.
3. Diversifying the fish species and products to reduce the impact of market fluctuations.
4. Maintaining an emergency fund to help manage unexpected events and emergencies.
5. Purchasing insurance to protect against unforeseen events such as natural disasters or crop failures.

7.20 Preparing for unforeseen circumstances and emergencies:

Despite the best-laid plans, unforeseen circumstances and emergencies can still occur. It is essential to prepare for these events by creating an emergency plan that outlines what to do in the event of a crisis. This plan should include contact information for emergency services, procedures for evacuating the fish farm, and backup plans for essential equipment and infrastructure.

In conclusion, fish farming is not without its challenges and risks, but there are strategies that fish farmers can use to mitigate and manage these risks. Regular monitoring, high-quality equipment and infrastructure, diversification, emergency funds, and insurance can help reduce the impact of challenges and risks. Preparing for emergencies by creating an emergency plan is also essential to help ensure the continuity of the business in the event of a crisis.

CHARPTER 8: GREEN TRANSFORMATION-TECHNOLOGIES AND INNOVATION

8.0 Introduction

Aquaculture is evolving very fast and a number of new technologies have come to be adapted in recent years that are environmentally friendly as there is no or minimal water exchange between the production system and the environment. These include

1. Recirculating aquaculture systems (RAS) which increased yield but is expensive in cost of infrastructure development and maintenance of the same not forgetting the high cost of energy to run making it to be inhibitive to most farmers.
2. Aquaponics- this is the integration of fish and crops in the same system. In this system fish depend on crops for oxygen while the crops use the fish refuse as a source of nutrients for growth. And therefore, there is minimal or no water exchange with the environment. The challenge with this system is that it can only be done on small scale and therefore it is not economically viable on a large scale.
3. Cage and raceway fish farming- In these methods high number of fish are stocked in a small surface area and are fed with high nutritive feeds giving high yields. This is mostly done in open waters in lakes, dams and fast flowing rivers. These results in very high yields to farmers but since there is no control of fish feed given to fish in cages and raceways and most of it escapes to the open waters away from cages. These results in serious environmental degradation and pollution of waters bodies leading to massive fish death and algae bloom affecting other water users.

8.1 Biofloc technology system (BFT)

This is a system that depends on the pond bio ie different aquatic micro-organisms eg algae, bacteria, fungi, protozoa that are made to floc together to make bigger sizes that can be eaten by fish as a protein source. Proper manipulation of the water environment can lead to better floc formation which not only servers as feed, but also maintains water quality and increases production per unit area without degrading the environment since there is no or minimal water exchange.

8.2 Benefits of biofloc system

1.There is high stocking rate of between 10 t0 150 fingerlings per m3 as compared to conventional stocking rates of 3 fish per m2. This leads to high yields and therefore better returns on investment.

e.g 10,000m3 tank stocked with 200,000 fingerlings with survival rate of 90% can yield 180,000 pieces of 300 g translating into 54,000 kg of fish that can give gross income of 16,200,000 in 8 months.

2. Since this system is closed, there is totally no water exchange, it is both environmentally friendly and saves the high water demands that has become very scarce in recent days. It also enables farmers who have little water to practice it

since once the tank is initially filled with water, there is minimal water additions during the growth period.

3. Improves water quality management. Fish normally eat about 50% of the feed its given and the rest is wasted in water. And out of the feed it consumes almost another 50% is released in water through feaces. These is up to 75% of the feed that is consumed ends up in water and when it rots it not only uses dissolved oxygen but also releases poisonous gases ie ammonia and nitric compounds that are harmful to fish. In biofloc system this is addressed by feeding the excess food to microbes that become food to fish and carbon feeds are added to enable the microbes to convert the ammonia and nitric compounds to nitrates which are not harmful to fish and hence maintaining good water quality.

4. Reduced fish feed requirements and hence lowering production cost. Fish feed account for almost 60% of all production costs in aquaculture. In BFT, the total amount of fish feed required is reduced to half as the fish feed on bio floc and the cost is further reduced as carbon feeds are used instead of high protein feeds which more expensive.

5. Reduced fish mortality in early morning hours and on cloudy days due to drop in dissolved oxygen in water. In extensive and semi-intensive culture systems where fish depend on autotrophic algae for feeds oxygen deficient in the morning and on cloudy days leading to massive death of fish is common. During the day the Algae use light to make energy through photosynthesis during the day and at night and on cloudy days use the same oxygen for respiration and hence deny fish of the much-needed oxygen leading to fish death. In BFT this is not possible since heterotrophic micro-organisms that do not depend on light to make energy dominate the floc and the tank is well aerated day and night.

6. Reduced cost of energy consumption. In BFT solar driven aerators which use invertors are used to reduce the energy consumption. Alternatively airlift water pumping technology is used to pump water without the use of energy. This lowers the production cost as energy cost is the main production cost in RAS and aquaponics systems.

8.3 Critical issues to consider to ensure the success of Biofloc technology

1. Species of fish to be cultured. Currently Tilapia and shrimps are the only fish species which have been extensively researched and commercially reared. Other species are still under research.
2. Construction of the tank. In order to have a well aerated tank, it must be circular in nature and must be slanting at the center in order to minimize sludge formation. Any other shape will result in sections of the tank having areas with reduced oxygen and therefore may lead to death of fish since the stocking rate is quite high.
3. Proper tank and water preparation before stocking of fingerlings. Before stocking is done, cleaning of the tank should be done in order to do away with bad micro-organisms which may affect the growth of the biofloc. At the same time water should be well treated to allow the right organisms to form.

4. Aeration. The success of Biofloc depends on a great degree on aeration of the tank. Failure to aerate will lead to massive losses of the fish. And using expensive aeration methods will lead to increase of cost of production and hence reduced returns.
5. Proper use of carbon feeds. Ammonia and nitrite compounds that are formed from unused feeds and incomplete digested feeds pollute the water and may kill the fish. Use of feeds that are rich in carbon are used to enable the flocs to build their bodies and as a result clean the tank and by so doing they eliminate ammonia and nitrite compounds from the tank. The best ratio of carbon to nitrogen in the feeds is 20:1. Failure to get this ratio may lead to poor results.

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CHAPTER 9 GENDER EQUALITY, HUMAN RIGHTS AND SOCIAL INCLUSION

11.1 Background

Studies conducted during implementation of the various value chains identified gender and human rights related challenges to participation. Women reported that cultural issues affected their rights to own land preventing their involvement in value chain activities as they could not make decisions on what to plant since all agricultural activities are dependent on land as a factor of production.

Gender roles, triple roles for women-Reproductive. Productive and community management for women while Men's role is productive, and community politics were also sited as a hindrance to women's involvement in value chains.

Cultural practices like wife cleansing and inheritance, especially in some counties, denied widows an opportunity to participate in the value chain activities. Decision making at the household level relating to value chain selection were mostly done by men, though in some instances, women also participated in the process. But where men had migrated to towns, women were the sole decision makers on selection of value chain(s). in some counties, men dominated in decision making concerning value addition, grading, marketing, savings, access to agricultural and marketing information, as well as access to credit and training. Women and youth could not initiate any agriculture-based Income Generating Activities (IGAs) without permission from the husbands/fathers or the elderly men in the family due to cultural beliefs and patriarchy.

High illiteracy levels and low skills especially among women left them vulnerable in terms of technical matters in the value chain activities. Several farmer groups believed both English and Kiswahili languages be adopted during training, Trainers were said to use a lot of English when training and it confused the farmers making language and methodologies used a barrier.

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

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

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

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

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

Most of the respondents requested special training on gender mainstreaming and gender-based violence and human rights, hence this manual. The findings came from the report below and gender analysis of selected value chains conducted by the Gender Youth and Social Inclusion Advisor, MESPT in August 2024 (G.V. Masinde and C.K. Wambu, PhD November, 2021Final draft report *A Gender Equality and Human Rights Approach for The Green Employment in Agriculture Programme (GEAP), MESPT)*

9.1.1 Definition and key concepts

Sex: It identifies the biological differences between men and women. Kenya recognized and counted intersex persons during the census in 2019.

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

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

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

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

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

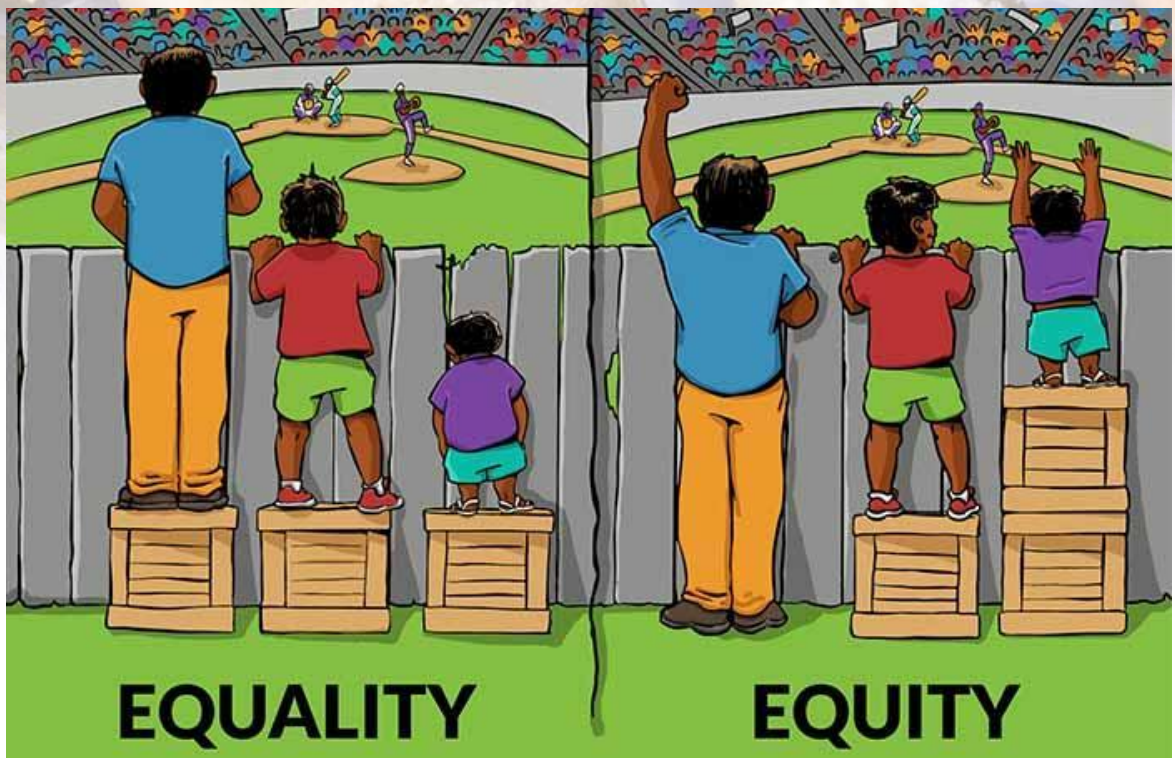

Figure 2 Equality and Equity illustrated All You Need To Know About Gender Equity Accessed on 14/11/2024

Equality does not mean that women and men are the same but that women's and men's rights, responsibilities and opportunities should not depend on whether they are born male or female. Gender equality implies that the interests, needs and priorities of both women and men are taken into consideration, recognizing the diversity of diverse groups of women and men(UN General Assembly, 1979). The centrality of **gender equality** to development is its establishment as a goal (goal 5) of the Sustainable Development Goals (SDGs) and included as a target in other SDGs.

Gender Equity: This is about fairness and being sensitive to the peculiarities of individuals, socio-economic groups, or communities. It is about equality of outcome or result of an intervention. Gender equity involves considering the different social, cultural, and economic situations of women, men, girls, and boys right from the design of an intervention through implementation to monitoring and evaluation.

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

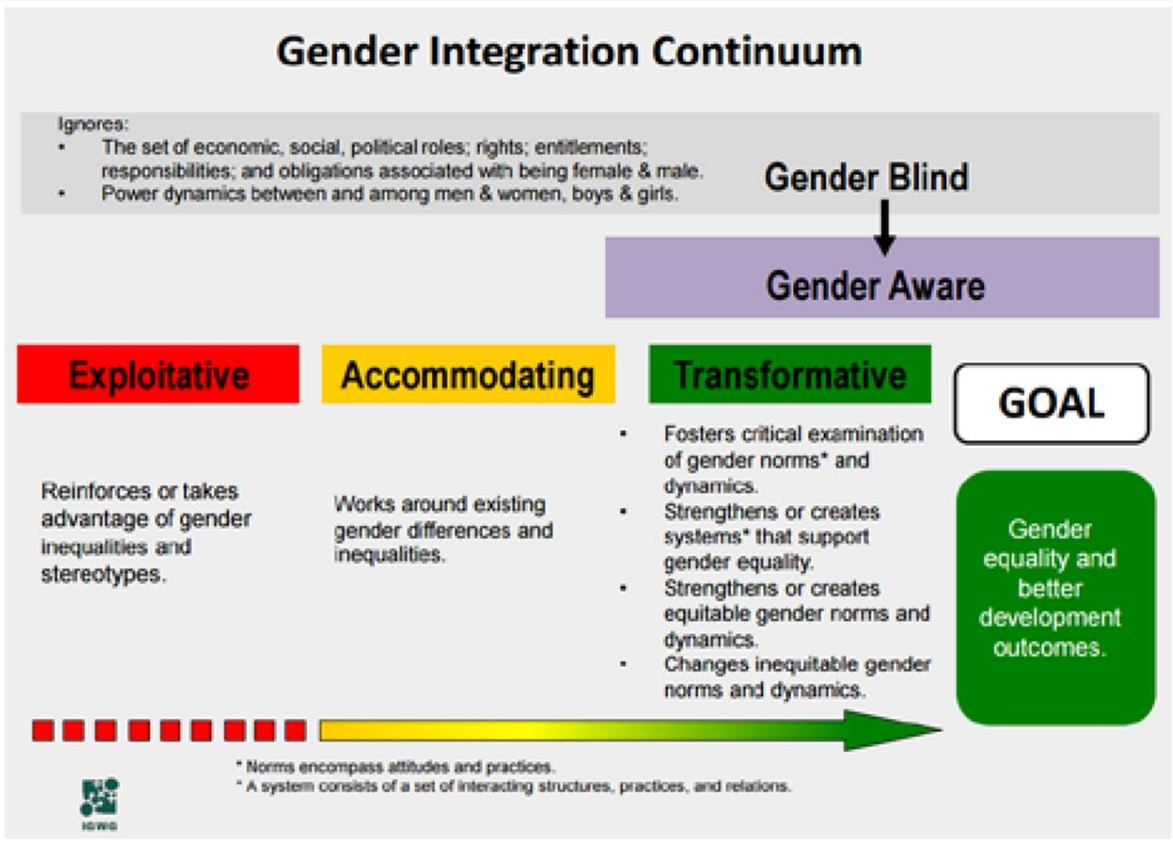

Figure 3: Gender Integration Continuum About IGWG | IGWG *accessed on 14/11/2024*

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

Gender responsiveness: This describes the policies, programmes and projects that focus on transforming existing gender disparities to create a more balanced relationship between women and men in terms of power and decision-making as well as access to and control over productive resources. Gender responsiveness is key in meeting strategic gender needs(strategic gender needs are the needs women identify because of their subordinate position in society. These needs are long-term and relate to the empowerment of women. Strategic gender needs for women might include land rights, more decision-making power, equal pay, and greater access to credit. Addressing these needs allows people to have control over their lives beyond socially defined restrictive roles)

Practical gender needs are defined as: Needs that respond to immediate necessities such as adequate living conditions, water provision, health care, and employment. Gender-specific needs that do not challenge gender roles, such as access to healthcare, water availability, and employment opportunities.

Gender transformative

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

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

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

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

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

Gender mainstreaming aims to ensure that women and men, particularly those who are disadvantaged, equally participate in and benefit from the activities of a given organization, and that all implemented projects and programmes consider women's and men's concerns and experiences as an integral dimension of their cycles. This intervention ensures that existing democratic relations are protected, at the same time preventing the further perpetuation of inequalities and the creation of new ones.

9.1.2 The Business case for gender mainstreaming

Gender mainstreaming in Agri-enterprises is not only a matter of social equity but also makes strong business sense. Here are some key points that highlight the business case for gender mainstreaming in this sector:

Increased Productivity: Women make up a sizable portion of the agricultural workforce. By providing them with equal access to resources such as land, credit, and training, productivity can be significantly increased. Studies have shown that closing the gender gap in agriculture could increase yields on women's farms by 20-30%

Enhanced Innovation: Diverse teams bring varied perspectives, leading to more innovative solutions. Women often bring unique insights into agricultural practices and market needs, which can drive innovation and improve business outcomes.

Market Expansion: Women are key players in local markets and value chains. By empowering women, Agri-enterprises can tap into new markets and consumer bases, enhancing their market reach and profitability.

Improved Financial Performance: Companies that invest in gender equality tend to perform better financially. Gender-diverse companies are more likely to have higher returns on equity and better financial performance overall.

Risk Mitigation: Gender mainstreaming can help mitigate risks associated with labor shortages and community relations. Empowering women can lead to more stable and resilient communities, which in turn supports sustainable business operations.

Compliance and Reputation: Increasingly, investors and consumers are looking for companies that adhere to social responsibility standards. Gender mainstreaming can enhance a company's reputation and compliance with international standards, attracting more investment and customer loyalty.

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

9.1.3 Steps to mainstream Gender

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

1. **Conduct Gender Analysis**: Start with a thorough gender analysis to understand the distinct roles, needs, and challenges faced by men and

women in the agricultural sector. This analysis should inform all stages of project planning and implementation.

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

9.2 HUMAN RIGHTS

Human Rights: These are rights inherent to all human beings, independent of nationality, place of residence, sex, national or ethnic origin, race, religion, language, or any other status. All human beings are equally entitled to human rights without discrimination. These include the right to life, equality before the law, the right to work, social security, education, and the right to development. These rights are all interrelated, interdependent and indivisible(Access the comprehensive text here 30 articles on the 30 Articles of the Universal Declaration of Human Rights | OHCHR

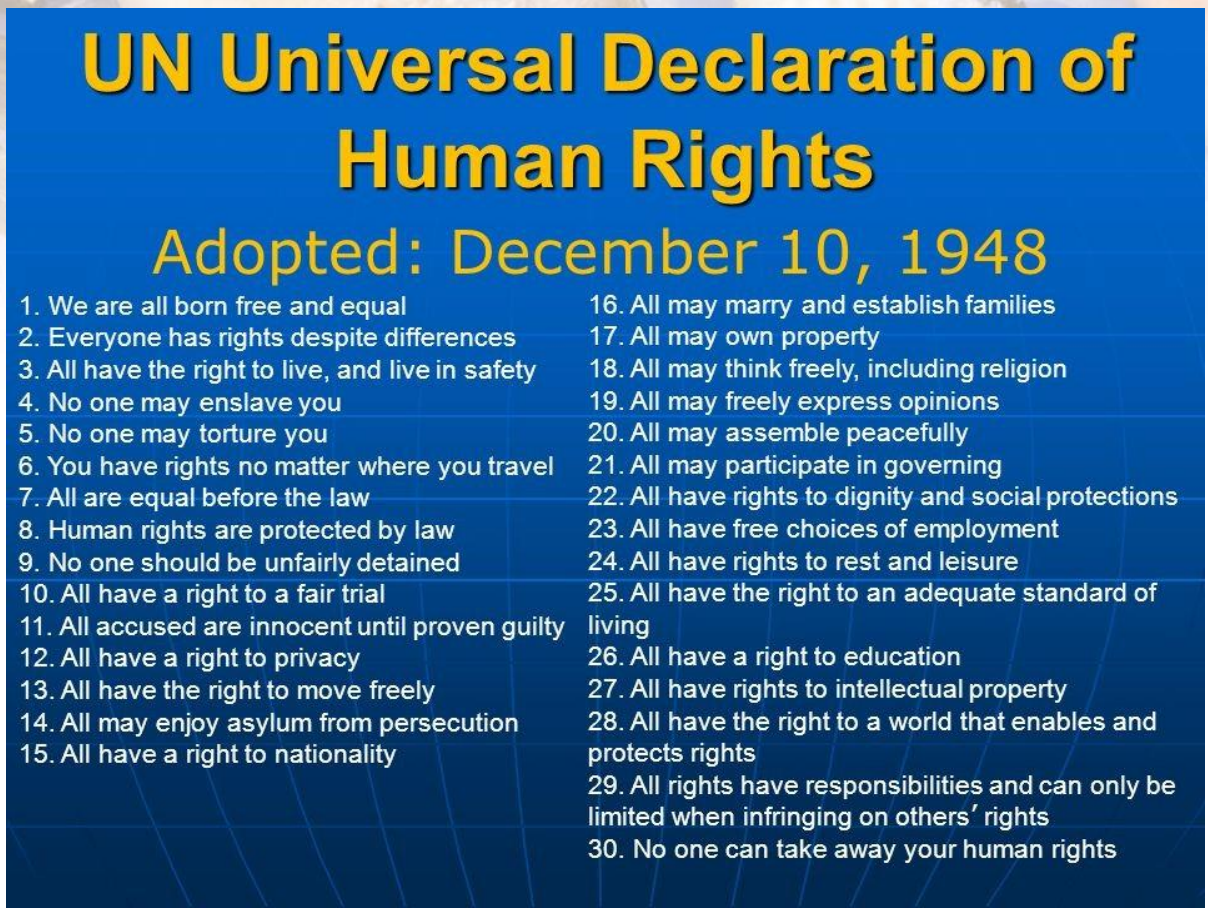

Figure 4: 30 articles of Huma rights https://rvalibrary.org/shelf-respect/law-library/national-human-rights-month/ Accessed on 14/11/2024

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

convention-rights-child-text-child-friendly-version.pdf accessed on 13/11/2024.

Access the full text here file

A human rights-based approach (HRBA): This is a conceptual framework based on international human rights standards and directed towards promoting and protecting human rights. HRBA seeks to analyze the inequalities which lie at the heart of development problems and redress discriminatory practices and unjust distributions of power that impede development progress.

HRBA is concerned with empowering people to know and claim their rights and increasing the ability and accountability of individuals and institutions who are responsible for respecting, protecting, and fulfilling rights. The HRBA approach aims to eliminate or at least diminish the impediments of existing exclusion and discrimination within the implementation of any programme or project. HRBA gives equal attention to both achieving development goals and to the processes that are chosen to achieve these goals. So, within HRBA, the processes that enable the participation and inclusion of all stakeholders are important.

9.2.1 ABOUT HRBA AND PANT PRINCIPLES

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

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

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

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

It has four elements:

Participation: Do all stakeholders engage actively, in a way which allows rights-holders to contribute meaningfully and influence processes and outcomes?

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

Guiding questions are:

- Are fair and effective platforms for public-private dialogue in place, and do they give space to representatives of women and men with less power and status?

- Are measures taken to include and enhance the capacity of those with less knowledge and power so that they can participate meaningfully in the consultative processes? For example, do all stakeholders have sufficient and accessible information on the issues being addressed? Are they invited to truly participatory processes? Are barriers removed, e.g., no expensive travelling, not during busy seasons, not inaccessible for women or persons with disabilities?
- Are stakeholders actively engaged at all stages of the programming process?
- Do initiatives make space for vulnerable people to take actions of their own choosing to manage perceived risks? This is especially important in 'transformative' efforts that encourage profound changes in livelihood systems in response to climate change or market upheavals.

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

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

i. Minimize corruption.
ii. Have positive effects on conflict management.
iii. Be a key step towards alleviating tensions in society and consolidating peace in post-conflict societies.

Guiding questions are:

- Are the duty bearers and other actors with power identified?
- Does the initiative contribute to ensuring that public and private sector actors have systems in place to monitor and disclose social and environmental impacts according to national and international standards?
- Do monitoring and evaluation arrangements involve civil society organisations representing the concerned population?
- Are there consequences (legal, financial, or moral) for non-compliance with human rights objectives and principles?
- Has the contribution established accessible and effective mechanisms for redress and complaints?

- Does the contribution facilitate access to networks, organisations and other sources of information that may assist duty bearers to enhance their accountability and rights holders to claim their rights?

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

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

Key questions are:

- Are vulnerable groups specifically identified and targeted?
- Is there a proper analysis of the consequences of the contribution for these women, men, girls, and boys?
- Is there a plan for their inclusion and benefit including disaggregated data and indicators?
- Are tariffs and fees also adjusted to accommodate poor and marginalized groups?
- Are land and property rights addressed to ensure that women, minorities, and poor people are protected or compensated?
- Are the livelihoods supported resilient to risks related to climate and market volatility and uncertainty, and therefore relevant for vulnerable populations that cannot afford to shoulder uncertain risks?

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

Transparency all people have the right to obtain information in an accessible and timely manner, e.g., about pollution levels, water quality, environmental health risks, exploitation plans, land use plans and disaster preparedness plans. Granting sufficient and accessible information to affected women and men in planning and policy making processes is of key importance to their ability to influence and monitor developments. It is also important to consider local traditions, survival strategies and indigenous people's dependence on natural resources, and ensuring that separate views are documented. It is also essential to consider access to natural resources for people living in poverty and that a long-term sustainable development can be promoted, to avoid future opposition and conflicts.

Guiding questions are:

- Are the plans and goals of the contribution made public and explicit in an accessible manner to all stakeholders concerned, including the most marginalized groups so that they understand benefits and risks?
- Will affected women, men, girls, and boys receive sufficient, timely and accessible information, including separate views on the plans, and will they be able to take meaningful part in and influence the process?
- Will access to information regarding the local risk situation be improved and will early warning systems be developed so that the ability of vulnerable groups to protect themselves and quickly recover after disasters is strengthened?
- Does the initiative contribute to capacities and commitments for greater transparency in policies and practice affecting land and natural resource tenure, particularly in new forms of land acquisitions and concessions?

9.3 SOCIAL INCLUSION

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

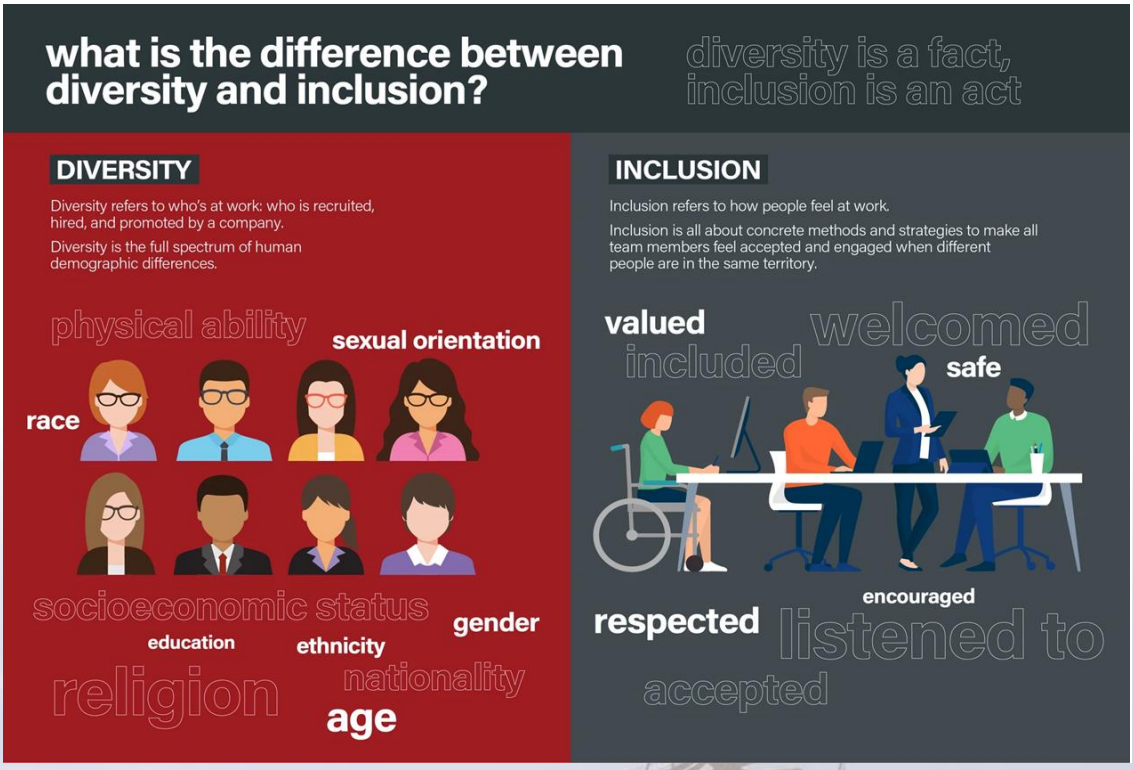

Figure 5 Diversity vs Inclusion DRP Group. (n.d.). What is the difference between diversity and

inclusion? DRP Group. Retrieved November 14, 2024, from https://www.drpgroup.com/en/blog/what-is-the-difference-between-diversity-and-inclusion.

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

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

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

9.3.1 Leave no one Behind

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

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

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

- Combine relevant national and UN development, human rights, conflict, inequalities, political, risk and humanitarian analysis for more joined up assessment of who is left behind and why – with a view to identifying the furthest behind.
- Triangulate the data from the above sources through a consultative analytical process to develop a mutual understanding across all interventions that consider the voices and experiences of communities together with other data sources.

STEP 2: Why? Prioritization and analysis

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

STEP 3: What? What should be done?

Identifying what should be done and by whom.

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

STEP 4: How? How to measure and monitor progress

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

STEP 5: Advancing accountability for LNOB.

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

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Annex 1. List of participants who validated this document

S/No	Name	Institution
1	Joseph Kairu	County Government of Siaya
2	Winston Motanya	County Government of Kisii
3	Nicholas Manyinsa	County Government of Kisii
4	Cecilia Mutuku	County Government of Machakos
5	Paul Busienei	County Government of Nakuru
6	David Kimera	Youth Agri-Preneur
7	Lawrence Swanya	County Government of Machakos
8	Kenneth Kagai	County Government of Trans-Nzoia
9	Benedict Khanyifu	County Government of Trans-Nzoia
10	Mwalimu Menza	Kenya Agricultural and Livestock Research Organization
11	George Kamami	County Government of Makueni
12	Moses Munialo	County Government of Bungoma
13	Agesa Eric	County Government of Kakamega
14	Benard Mainga	County Government of Kwale
15	Jane Kamamu	County Government of Kilifi
16	Teresia Ndungu	County Government of Nyandarua
17	Wilbur Mutai	County Government of Uasin-Gishu
18	Stephen Odipo	Kenya Agricultural and Livestock Research Organization
19	Solomon Mbivya	Papa Farmers Limited
20	William Mwangi	County Government of Makueni
21	Doreen Kinoti	Micro-Enterprises Support Programme Trust
22	Serah Nzau	Micro-Enterprises Support Programme Trust
23	Margaret Kikuvi	Micro-Enterprises Support Programme Trust

Micro-Enterprises Support Programme Trust
MESPT Plaza, 01 Tausi Rd
Westlands, between Westlands Rd & Muthithi Rd.
P.O Box 187-00606 Sarit Centre.
Email: info@mespt.org
Tel: 0722 207 905 | 0735 333 154

MESPT
MICRO ENTERPRISES SUPPORT PROGRAMME TRUST

MINISTRY OF FOREIGN AFFAIRS OF DENMARK
Danida