Republic of Kenya

KENYA FISHERIES SERVICE

KMFRI Kenya Marine and Fisheries Research Institute

HDI ONE HEALTH & DEVELOPMENT INITIATIVE

NATIONAL MANUAL

STANDARD OPERATING PROCEDURE

(MSOP)

FOR FISH WELFARE IN AQUACULTURE

KENYA

Developed by:

MINISTRY OF MINING, BLUE ECONOMY AND MARITIME AFFAIRS

STATE DEPARTMENT FOR THE BLUE ECONOMY AND FISHERIES

NATIONAL

Manual Standard Operating Procedure (MSOP) for Fish Welfare in Aquaculture KENYA

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With Support Supported by One Health and Development Initiative (OHDI)

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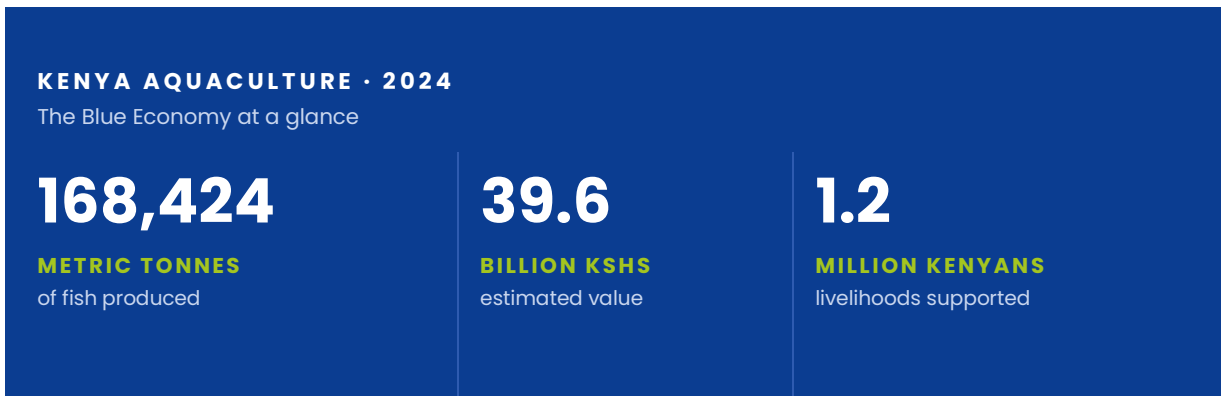
FOREWORD

Kenya's fisheries and aquaculture subsectors remain a strategic pillar of our nation's Blue Economy, contributing to food and nutrition security, employment, income generation, and trade. In 2024, the subsector produced 168,424 metric tonnes of fish valued at approximately KShs 39.6 billion, while supporting the livelihoods of approximately 1.2 million Kenyans directly and indirectly. This performance affirms the growing importance of fisheries and aquaculture in our national development agenda. It underscores the need to strengthen governance systems that promote responsible resource use, sustainability, and productivity.



As aquaculture continues to grow in Kenya, it is imperative that it is guided by clear, science-based, and nationally harmonised standards. This National Manual Standard Operating Procedure for Fish Welfare in Aquaculture (FW-MSOP) marks an important milestone in that journey. It provides a practical framework for safeguarding fish welfare and ethical production across the aquaculture value chain while also advancing food safety, environmental stewardship, and market confidence. In doing so, the Manual aligns with Kenya's broader legal and policy framework, including the Constitution of Kenya 2010 and the Fisheries Management and Development Act (Cap. 378), as well as relevant regional and international good practices.

This FW-MSOP reflects our national commitment to competitive and sustainable aquaculture systems that align with global best practices and recognise fish welfare as integral to quality production and resilient aquatic food systems. It is also a demonstration of Kenya's resolve to position itself as a leader in responsible fisheries and aquaculture management within the region and beyond. I commend all institutions, experts, and stakeholders who contributed to the development of this Manual, and I call upon regulators, county governments, producers, private sector actors, research institutions, and development partners to support its effective implementation.

This manual will serve not only as a regulatory and technical reference but also as a catalyst for continuous improvement, innovation, and shared accountability in the aquaculture subsector. By embracing fish welfare as a core principle of responsible and sustainable production, we will strengthen livelihoods, protect aquatic ecosystems, improve the quality and safety of fish products, and contribute meaningfully to national prosperity.

Hon. Hassan Ali Joho, EGH
CABINET SECRETARY
MINISTRY OF MINING, BLUE ECONOMY, AND MARITIME AFFAIRS

PREFACE

The development of this National Manual Standard Operating Procedure (MSOP) for Fish Welfare in Aquaculture is a significant step in strengthening the governance and sustainability of aquaculture in Kenya. As the subsector continues to grow and play an increasingly important role in food and nutrition security, employment creation, and income generation, there is a need for clear and practical standards to guide responsible aquaculture practices. This Manual has therefore been developed to provide a harmonised framework for promoting fish welfare across the aquaculture value chain.

The Manual outlines standards for key areas of aquaculture production, including fish health, feeding, water quality management, handling, transportation, harvesting, slaughter, and record-keeping. It is intended to guide inspectors, extension officers, producers, researchers, and other stakeholders in applying welfare-based practices that improve fish health, reduce losses, and enhance the quality and safety of aquaculture products.

This Manual is anchored on recognised fish welfare principles and is aligned with Kenya's legal and policy framework for fisheries and aquaculture development. Its implementation will strengthen compliance, support extension services, and promote continuous improvement in the management of aquaculture systems nationwide.

The successful adoption of this FW-MSOP will depend on the collaboration of all actors in the subsector, including the State Department for the Blue Economy and Fisheries, the Kenya Fisheries Service, Kenya Marine and Fisheries Research Institute, County Governments, research and academic institutions, other relevant agencies, producers, private sector actors, and development partners.

I urge all stakeholders to embrace this Manual as an important instrument for advancing a productive, sustainable, and welfare-responsive aquaculture subsector in Kenya.

Betsy M. Njagi, CBS
PRINCIPAL SECRETARY
STATE DEPARTMENT FOR THE BLUE ECONOMY AND FISHERIES

EXECUTIVE SUMMARY

The National Manual Standard Operating Procedure (MSOP) for Fish Welfare in Aquaculture establishes Kenya's first comprehensive national framework to guide fish welfare management across the aquaculture value chain in support of sustainable aquaculture growth, food security, and blue economy development. The Manual addresses existing regulatory and operational gaps where current fisheries laws and aquaculture regulations largely emphasise production, food safety, and environmental sustainability and provides specific guidance on fish welfare during on-farm production, handling, transport, and slaughter.

The Manual introduces harmonised, evidence-based standards applicable across hatcheries, pond systems, cage culture, tank-based systems, recirculating aquaculture systems (RAS), and integrated production models, covering the entire value chain from broodstock management and seed production to grow-out, harvesting, transport, processing, and marketing.

The Manual applies to freshwater and marine aquaculture species cultivated in Kenya - including tilapia, African catfish, common carp, rainbow trout, milkfish, mullet, prawns, and mud crabs, as well as emerging aquaculture species - and establishes core welfare principles that ensure the well-being of farmed fish adequate nutrition, optimal environmental conditions, disease prevention, expression of natural behaviour, and minimisation of stress across production systems. These principles are operationalised through clear standards on stocking density management, water quality monitoring, feeding and nutrition, fish handling and grading, live fish transport, harvesting procedures, slaughter practices, and biosecurity and health management, supported by measurable indicators and risk-based monitoring to promote continuous improvement.

The Manual adopts a One Health approach, recognising the interdependence between fish welfare, environmental sustainability, food safety, and public health, where improved welfare reduces disease risks, enhances production efficiency, strengthens biosecurity, improves product quality, and enhances market competitiveness. Implementation responsibilities are coordinated by the Kenya Fisheries Service (KeFS) in collaboration with county governments, Kenya Marine and Fisheries Research Institute (KMFRI), Directorate of Veterinary Services (DVS) National Environment Management Authority (NEMA), and other relevant institutions.

The Manual aligns with national legal frameworks, including the Fisheries Management and Development Act Cap. 378, Aquaculture Regulations 2024, National Aquaculture Policy, and Blue Economy Strategy, while also aligning with international frameworks including the World Organisation for Aquatic Animal Health (WOAH) Code, FAO Guidelines for Sustainable Aquaculture (GSA), and African Union (AU) Animal Welfare Strategy for Africa (AWSA) to ensure animal well-being and enhance Kenya's competitiveness in regional and global markets.

Adoption of this manual is expected to improve fish health, well-being and survival, reduce production losses, strengthen environmental management, enhance food safety, build consumer confidence, and expand market access, while supporting capacity development, innovation, and responsible aquaculture practices. The Kenya Fisheries Service, therefore, calls upon all stakeholders — including producers, county governments, research institutions, development partners, and private sector actors — to adopt and implement these standards to ensure sustainable aquaculture development and position Kenya as a regional leader in fish welfare governance and responsible aquaculture.

Daisy Muriuki 'ndc' (K),
AG. DIRECTOR GENERAL
KENYA FISHERIES SERVICE

ACKNOWLEDGEMENTS

The State Department for the Blue Economy and Fisheries (SDBEF) and the Kenya Fisheries Service (KeFS) gratefully acknowledge the dedication, expertise, and collaborative effort of all individuals and institutions that contributed to the development of this National Manual Standard Operating Procedure for Fish Welfare in Aquaculture (FW-MSOP).

The Technical Working Group (TWG), whose members represent a broad range of government agencies, research institutions, and technical disciplines, provided invaluable scientific guidance, critical review, and practical insight throughout the development process. Their commitment to advancing responsible and welfare-responsive aquaculture in Kenya is deeply appreciated.

Sincere appreciation is extended to the national and county government agencies, research and academic institutions, regulatory bodies, and private sector stakeholders who participated in technical reviews, public consultations, and validation workshops. Their contributions substantially strengthened the relevance, accuracy, and operational applicability of this Manual in Kenya.

The State Department for the Blue Economy and Fisheries gratefully acknowledges the support of the **One Health and Development Initiative (OHDI)** through the **Africa Fish and Aquaculture Welfare (AFIWEL) Program, supported by Coefficient Giving and Effective Altruism (EA) Funds**. Their technical, financial, and programmatic assistance was instrumental in facilitating multi-sectoral stakeholder engagement, establishing the evidence-based framework for the FW-MSOP, supporting the technical development of the MSOP, refining the content of this Manual to completion, and facilitating its official publication and launch for the Government of Kenya. This support has made a significant contribution to advancing fish welfare governance and strengthening sustainable aquaculture development in Kenya.

Finally, appreciation is extended to all individuals and organisations whose contributions, whether through direct participation, institutional support, or technical input, have helped shape this manual into a practical, nationally owned instrument for improving fish welfare across Kenya's aquaculture sector.

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ABBREVIATIONS AND ACRONYMS

AFIWEL	Africa Fish and Aquaculture Welfare Program
AMR	Antimicrobial Resistance
AU-IBAR	African Union – InterAfrican Bureau for Animal Resources
CA	Competent Authority
Cap.	Chapter (of legislation)
DO	Dissolved Oxygen
EAC	East African Community
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
FAO	Food and Agriculture Organization of the United Nations
FW-MSOP	Fish Welfare Manual Standard Operating Procedures
GAqP	Good Aquaculture Practices
HDPE	High-Density Polyethylene
IMTA	Integrated Multi-Trophic Aquaculture

KES / KFS	Kenya Forest Service
KeFS	Kenya Fisheries Service
KEBS	Kenya Bureau of Standards
KMFRI	Kenya Marine and Fisheries Research Institute
KVB	Kenya Veterinary Board
MSOP	Manual Standard Operating Procedure
NEMA	National Environment Management Authority
OHDI	One Health and Development Initiative
RAS	Recirculating Aquaculture Systems
SDBEF	State Department for the Blue Economy and Fisheries
SOP	Standard Operating Procedure
TWG	Technical Working Group
WOAH	World Organisation for Animal Health (formerly OIE)
WRA	Water Resources Authority

DEFINITIONS OF KEY TERMS

The following terms are defined as used in this Manual. Definitions are presented in alphabetical order.

Aquaculture : - The farming of aquatic organisms - including fish, molluscs, crustaceans, and aquatic plants - under controlled or semi-controlled conditions. It encompasses all stages of aquatic organisms' rearing from egg or juvenile through to harvest.

Biosecurity: - A set of management practices designed to prevent the introduction and spread of pathogens, invasive species, and other biological hazards within and between aquaculture facilities.

Broodstock: - Mature fish maintained and managed for reproductive purposes to produce eggs, sperm, or offspring for aquaculture production.

Competent Authority (CA): - The government ministry, department, or agency officially designated by the State as responsible for regulating and overseeing fish welfare standards, aquaculture governance, and related compliance within Kenya.

Cumulative Stress: - The combined physiological and behavioural burden placed on fish through multiple sequential stressors such as handling, transport, grading, and poor water quality, often exceeding the impact of any single stressor.

Environmental Enrichment: - The provision of physical, sensory, or social stimuli within the production environment that support the expression of natural behaviour, reduce chronic stress, and promote positive welfare states in fish.

Fish Welfare: - The physical and mental state of a fish in relation to the conditions in which it lives and dies. Good welfare implies the absence of unnecessary pain, fear, and distress, alongside the provision of conditions that allow fish to express natural behaviour and maintain good health.

Five Domains Model: - A contemporary animal welfare framework that evaluates fish welfare across four functional domains—nutrition, environment, health, and behaviour—and their collective influence on the animal's mental or affective state.

Five Freedoms: - A foundational animal welfare framework identifying: freedom from hunger, thirst, and malnutrition; freedom from physical and environmental discomfort; freedom from pain, injury, and disease; freedom to express normal behaviour; and freedom from fear and chronic stress.

Grow-out System: - An aquaculture production system in which juvenile fish (fingerlings or post-larvae) are reared to market size or harvest weight.

Hatchery: - A facility or operational unit in which fish eggs are incubated and hatched, and early life stages (larvae, fry, and fingerlings) are reared under controlled conditions for subsequent stocking or sale.

Humane Slaughter: - The killing of fish using methods that render the animal irreversibly unconscious before death, thereby preventing the experience of pain and suffering. Effective stunning followed immediately by killing is considered the standard for humane slaughter.

One Health: - An integrated approach that recognises the interdependence of human health, animal health, and ecosystem integrity, promoting coordinated action across sectors to prevent disease risks and ensure sustainable food systems.

Recirculating Aquaculture System (RAS): - A closed or semi-closed aquaculture production system in which water is continuously filtered, treated, and recirculated within the facility, enabling high-density production with minimal water exchange.

Sentience: - The capacity of an animal to have subjective experiences, including the ability to feel pain, pleasure, fear, and other affective states. Fish are recognised as sentient vertebrates under this Manual.

Stocking Density: - The number or biomass of fish per unit volume or surface area within a production system. Appropriate stocking density is species-specific, life-stage-dependent, and system-dependent.

Stunning: - The application of a physical, electrical, or chemical method to render a fish rapidly and effectively unconscious before killing to prevent pain and distress during slaughter.

Technical Working Group (TWG): - A multi-disciplinary and multi-institutional body established to provide technical guidance, coordination, and oversight for the implementation, review, and revision of the of the FW-MSOP in Kenya.

SECTION

01.

INTRODUCTION & CONTEXT

Purpose, scope, alignment and the core principles that anchor the Manual.

IN THIS SECTION

SECTION 1 — INTRODUCTION AND CONTEXT

1.1 Purpose of the National Manual Standard Operating Procedure for Fish Welfare in Aquaculture

The National Manual Standard Operating Procedure (MSOP) for Fish Welfare in Aquaculture has been developed to provide a harmonised, evidence-based, and practical framework for improving fish welfare across aquaculture value chains in Kenya. The MSOP responds to the growing recognition that fish welfare is inseparably linked to fish health and well-being, food safety, public health, environmental sustainability, productivity, livelihoods, and ethical food systems.

This FW-MSOP addresses persistent gaps in fish welfare governance in Kenya, including inadequate knowledge of fish welfare, the absence of a comprehensive capacity development framework, fragmented guidelines, limited operational standards, weak enforcement capacity, and inconsistent interpretation of good welfare practices across the value chain. Kenya has several fisheries and aquaculture regulations, including fish safety and quality regulations, aquaculture regulations, and a Manual Standard Operating Procedure for fish inspection and quality assurance - all anchored under the Fisheries Management and Development Act, Cap. 378.

The Fisheries Management and Development Act, Cap. 378, does not explicitly recognise 'fish welfare' as a standalone legal concept. Its regulatory language is primarily framed around conservation, sustainable management, and the development of fisheries and aquatic resources. Nevertheless, welfare considerations are implicitly embedded within several core provisions of the Act. Provisions relating to water quality management, stocking densities, biosecurity, and disease control function as de facto welfare safeguards, though their primary intent is to ensure the safe production of fish as food.

The Act does not contain explicit provisions on humane handling, transport, or slaughter of fish, unlike international frameworks such as the WOAH Aquatic Animal Health Code. This absence creates a regulatory gap between broad sustainability principles and enforceable welfare obligations. The Fisheries Management and Development (Aquaculture) Regulations, 2024, do reference fish welfare, though in a broad, policy-level manner.

Kenya is developing a National Aquaculture Policy, supported by the Fisheries Management and Development Act, Cap. 378, and the Fisheries Management and Development (Aquaculture) Regulations (Legal Notice No. 126 of 2024). These policy, legal, and regulatory frameworks provide a solid foundation that now necessitates the development of comprehensive Fish Welfare Manual Standard Operating Procedures (FW-MSOPs) to operationalise, harmonise, and give practical effect to these policy and regulatory commitments.

The Fisheries Management and Development (Aquaculture) Regulations, 2024, Part II, Section 6(a) and (c), provide that the Director General of the Kenya Fisheries Service, in consultation with the Director of Veterinary Services, shall implement a national aquaculture animal health and welfare monitoring plan. This provision formally establishes animal welfare as a recognised component of aquaculture governance in Kenya.

1.1.1 Purpose and Intended Outcomes

The primary purpose of the FW-MSOP is to:

- Establish minimum, evidence-based fish welfare standards applicable across diverse aquaculture systems and socio-economic contexts.
- Translate fish welfare principles into clear operational procedures that can be consistently applied, monitored, and verified.
- Develop, adopt, and strengthen national FW-MSOPs aligned with regional and global best practices.
- Promote a risk-based, continuous-improvement approach to fish welfare rather than a purely punitive or compliance-only regulatory model.
- Strengthen alignment between fish welfare, food safety, environmental stewardship, and responsible aquaculture development.
- Develop knowledge and enhance skills on fish welfare across various stakeholders in the aquaculture value chain.

The FW-MSOP is designed not only to improve welfare outcomes for fish but also to enhance farm productivity, reduce avoidable losses, improve disease prevention, strengthen market trust, and support sustainable livelihoods within the aquaculture sector.

1.1.2 Core Objectives of the FW-MSOP

01	**Regulatory Alignment** Establish evidence-based, minimum fish welfare standards applicable across diverse aquaculture systems and harmonised with international frameworks.
02	**Operational Guidance** Translate welfare principles into clear, practical procedures that can be consistently applied, monitored and verified.
03	**Training & Capacity** Serve as a reference and training instrument for inspectors, extension officers and producers.
04	**Risk-Based Improvement** Promote a risk-based, adaptive and continuous-improvement approach to fish welfare.
05	**Integrated Governance** Strengthen alignment between fish welfare, food safety, environmental stewardship and responsible development.

The core objectives of the FW-MSOP include:

- **Regulatory Alignment:** Establish evidence-based, minimum fish welfare standards applicable across diverse aquaculture systems and socio-economic contexts, providing a standardised national framework for the enforcement of aquaculture laws and regulations. The MSOP further seeks to harmonise national practices with relevant international and regional standards, including those of WOAH, FAO, and AU-IBAR.
- **Operational Guidance:** Translate fish welfare principles into clear, practical, and enforceable operational procedures that can be consistently applied, monitored, and verified at national and sub-national levels. The MSOP standardises welfare inspection protocols across hatcheries, grow-out farms, transport systems, and slaughter facilities, and provides scoring tools, checklists, and measurable indicators to ensure objectivity, consistency, and accountability.
- **Training and Capacity Development:** Serve as a reference and training instrument for inspectors, extension officers, and aquaculture producers, while promoting continuous professional development through structured training modules, certification pathways, and refresher programmes to enhance knowledge, technical competencies, and professional skills on fish welfare across all stakeholders.
- **Risk-Based Continuous Improvement:** Promote a risk-based, adaptive, and continuous improvement approach to fish welfare, moving beyond a purely punitive or compliance-only regulatory model.
- **Integrated Governance and Sustainability:** Strengthen alignment between fish welfare, food safety, environmental stewardship, and responsible aquaculture development.

1.1.3 Intended Users and Application

This MSOP is intended for use by the following stakeholders:

- Government inspectors and regulatory authorities use the FW-MSOP as a reference framework to guide inspections, assessments, enforcement actions, compliance verification, and regulatory oversight related to fish welfare.
- Extension officers and advisory services use the FW-MSOP as a practical tool to support farmer education, on-farm improvements, and the translation of regulatory requirements into implementable farm-level management practices.
- Producers, transporters, processors, consumers, and market sector players use the FW-MSOP as a compliance and operational guide to meet national welfare requirements, improve production, handling and slaughter practices, and enable access to high-value and welfare-aligned domestic and international markets.

- Policy makers and standards developers use the FW-MSOP as a foundational document to complement national regulatory instruments, standards frameworks, and policy reform processes.
- Research, training institutions, and development partners use the FW-MSOP, as a basis for research, capacity building, curriculum development, professional training, and programme implementation in fish health and welfare.
- Private sector actors, including input suppliers, insurance providers, and financial institutions, use the FW-MSOP to serve as a reference for responsible business practices and welfare and sustainability-aligned investment.
- Non-governmental organisations use the FW-MSOP as a framework for supporting community-based initiatives and welfare-integrated aquaculture projects.

1.1.4 Situation Analysis and Rationale

In many African aquaculture systems, fish welfare challenges arise from complex interactions among structural, technical, and institutional constraints. These include limited access to welfare-specific research, training, and extension services; inadequate water quality management; poor handling, grading, and transport practices; inappropriate stocking densities; use of low-quality feeds; inappropriate feeding regimes; weak fish health and biosecurity management systems; and limited guidance on humane handling, transport, stunning, and slaughter methods. These challenges are further exacerbated by climate-related stressors, increasing environmental variability, resource constraints, and the prevalence of informal and semi-formal aquaculture production systems, which often operate outside structured regulatory and technical support frameworks.

Kenya currently implements the Manual of Standard Operating Procedures for Fish Inspection and Quality Assurance 2015, which provides guidance on sanitary requirements and Good Aquaculture Practices (GAqP) within aquaculture systems. While this framework is essential for food safety and quality assurance, it provides limited, non-systematic guidance on fish welfare management on farms across the production cycle and the entire value chain. These identified gaps provide a clear and compelling rationale for developing this FW-MSOP, which complements the existing MSOP, establishes structured welfare standards, and provides a coherent, science-based, and operational framework for fish welfare management in Kenya.

1.2 Scope of Application

The Fish Welfare Manual Standard Operating Procedures for Aquaculture (FW-MSOP) apply to **fish welfare management across the entire aquaculture value chain**, covering priority farmed species, diverse production systems, and all categories of actors involved in the breeding, rearing, handling, husbandry, transport, stunning, and slaughter of fish.

THE AQUACULTURE VALUE CHAIN

Welfare applies at every stage, from broodstock to market

1.2.1 Species Covered

The FW-MSOP applies primarily to commonly farmed freshwater finfish species (Table 1) and mariculture species (Table 2) in Kenyan aquaculture systems.

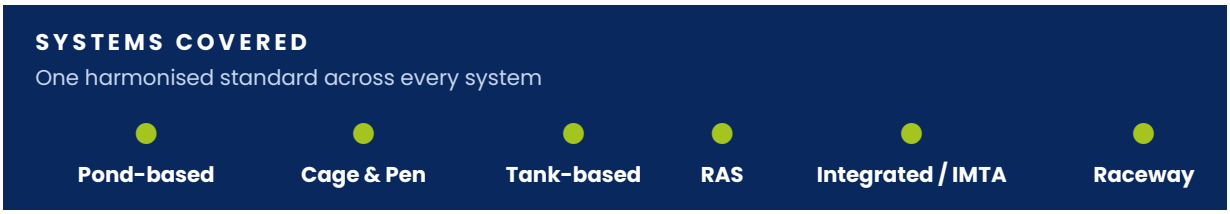
Table 1. Freshwater cultured species and operational scale in Kenya.

Common Name	Scientific Name	Operational Scale
Nile tilapia	*Oreochromis niloticus*	Commercial
Tilapia variabilis	*Oreochromis variabilis*	Pilot
Tilapia esculentus	*Oreochromis esculentus*	Pilot
Mozambique tilapia	*Oreochromis mossambicus*	Pilot
African catfish	*Clarias gariepinus*	Commercial
Common carp	*Cyprinus carpio*	Commercial
Rainbow trout	*Oncorhynchus mykiss*	Commercial
Brown trout	*Salmo trutta*	Pilot
Koi carp	*Cyprinus carpio (ornamental)*	Commercial
Goldfish	*Carassius auratus*	Commercial (ornamental)
African carp/Labeo	*Labeo victorianus*	Pilot/Commercial
Jipe tilapia	*Oreochromis jipe*	Subsistence

Table 2. Maricultured species and operational scale in Kenya.

Common Name	Scientific Name	Operational Scale
Milkfish	*Chanos chanos*	Commercial
Mullet	*Mugil cephalus*	Commercial
Seaweed (Cottonii)	*Kappaphycus alvarezii*	Commercial
Seaweed (Spinosum)	*Eucheuma denticulatum*	Commercial
Mud crabs	*Scylla serrata*	Commercial
Giant tiger prawn	*Penaeus monodon*	Subsistence
Indian white prawn	*Penaeus indicus*	Subsistence
Brine shrimp	*Artemia franciscana*	Pilot
Rock oyster	*Saccostrea cucullata*	Pilot
Ornate spiny lobster	*Panulirus ornatus*	Commercial

1.2.2 Production Systems Covered



The FW-MSOP applies to all major aquaculture production systems, including:

- Pond-based systems (earthen, raised, lined, or concrete)
- Pen and cage-based systems in inland or coastal waters
- Tank-based systems, including flow-through, aquaria, and static systems
- Recirculating Aquaculture Systems (RAS)
- Integrated and hybrid systems (e.g., Integrated Multi-Trophic Aquaculture (IMTA), aquaponics, and biofloc systems)
- Raceway systems

The standards and procedures described in this FW-MSOP are intended to apply to both small-scale and commercial operations without compromising minimum welfare outcomes.

1.2.3 Value Chain Actors and Activities Covered

The FW-MSOP applies to all individuals, institutions, and entities whose activities directly or indirectly influence fish health, welfare, biosecurity, handling, slaughter and overall management across the aquaculture value chain. This includes, but is not limited to:

- Hatchery operators and early life stage operators, including broodstock managers, egg and fry producers, and nursery facility operators.
- Grow-out production systems, comprising farm owners, managers, technicians, and on-farm personnel involved in daily husbandry, handling, grading, harvesting, slaughter, and system maintenance.
- Feed and input suppliers, feed manufacturers, distributors, veterinary input and service providers, and on-farm technical service providers whose products or services affect fish nutrition, health, and welfare outcomes.
- Live fish transport and handling services, including personnel involved in capturing, holding, grading, conditioning, intra-farm transfers, inter-farm movements, and off-farm transportation of live and harvested fish.
- Fish slaughter and processing facilities, including all establishments where fish are temporarily held, handled, stunned, slaughtered, or processed for food, research, or commercial purposes.

The MSOP also provides technical guidance, professional standards, and operational benchmarks relevant to supporting and oversight agencies, including advisory, regulatory, and research personnel, as well as input suppliers and specialised service providers.

1.2.4 Exclusions and Interface with Other Regulations

This FW-MSOP focuses specifically on fish welfare matters and sound operational practices. It does not replace or override national laws and regulations relating to:

- Environmental protection
- Food safety and public health
- Biosecurity and disease control
- Occupational health and safety

Rather, it is intended to complement and strengthen existing regulatory frameworks by providing practical, welfare-focused, and evidence-based operational guidance that can be integrated into national regulations, policies, inspection protocols, and enforcement systems.

1.2.5 Applicability Across Contexts

This FW-MSOP is applicable across the following contexts:

- **Regulatory and Legal Context:** This FW-MSOP provides minimum enforceable standard operating procedures under the Fisheries Management and Development Act, Cap: 378 and the Aquaculture Regulations (2024). Gazetted inspectors have a standard checklist for welfare compliance, thereby strengthening Kenya's ability to meet national, regional, and international standards.
- **Production and Farm Management:** The Manual guides farmers on humane and ethical handling, harvesting, stocking densities, feeding, propagation, and water quality management. The expected results are reduced fish stress and disease outbreaks, thereby improving productivity. Training modules for extension officers will support farmers with practical welfare practices.
- **Trade and Market Access:** The FW-MSOP aligns with Codex Alimentarius and EU import requirements, where fish welfare in the aquaculture sector is increasingly scrutinised. It also builds consumer trust by embedding welfare into quality assurance systems.
- **Education, Research, and Technology:** The FW-MSOP is a reference framework for universities, vocational training, and research institutions, supporting curriculum development and execution for aquaculture training programmes. It also encourages innovation in welfare-friendly technologies.
- **Community and Equity Safeguards:** The FW-MSOP has set minimum standards that are practical and affordable, ensuring that smallholder farmers are not excluded, and promoting equity in enforcement so that welfare obligations apply equally to export farms and local production.
- **International Benchmarking:** The FW-MSOP is a clear demonstration of Kenya's commitment to global best practices, harmonising with the WOAH Aquatic Animal Health Code, FAO guidelines, and AU-IBAR frameworks. It also provides a platform for

regional leadership in East Africa, where harmonised welfare standards can support cross-border trade.

1.3 Synergies and Alignment of the MSOP

1.3.1 Legal and Institutional Framework in Kenya

The FW-MSOP is designed to operate within and alongside existing national legal, policy, and institutional frameworks governing fisheries, aquaculture, animal health, food safety, and environmental management. It does not seek to replace national laws or regulatory mandates, but rather to provide practical, welfare-focused operational guidance that strengthens their implementation.

Alignment with National Laws and Regulations

This FW-MSOP is aligned with the following national laws and regulations:

- Constitution of Kenya 2010: Articles 42 and 69, relating to the right to a clean, healthy environment, protection of genetic resources and biological diversity, and the sustainable utilisation of natural resources for present and future generations.
- Fisheries and aquaculture laws and regulations: Fisheries Management and Development Act (Cap. 378), Fisheries Management and Development (Aquaculture) Regulations 2024, Fish Safety and Quality Regulations 2024, and Monitoring, Control, and Surveillance Regulations (under development).
- Animal health and animal welfare legislation: Animal Diseases Act (Cap. 364), Veterinary Surgeons and Veterinary Para-professionals Act (Cap. 366), Public Health Act (Cap. 242), Prevention of Cruelty to Animals Act (Cap. 360), Wildlife Conservation and Management Act 2013, and the Fisheries Management and Development Act (Cap. 378).
- Food safety and public health laws: Constitution of Kenya Articles 43 and 46, Food, Drugs and Chemical Substances Act (Cap. 254), Public Health Act (Cap. 242), Meat Control Act (Cap. 356), Fisheries Management and Development Act, Cap. 378, and Safety and Quality Regulations (Legal Notice 120 of 2024).
- Environmental protection and water management regulations: Environmental Management and Coordination Act (EMCA) Cap. 387 and its subsidiary regulations, including the Environmental (Impact Assessment and Audit) Regulations 2003 (as amended in 2019), the Environmental Management and Coordination (Water Quality) Regulations 2006, the Environmental Management and Coordination (Waste Management) Regulations 2006, the Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations 2009, and the Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing)

Regulations 2006; the Water Act (Cap. 372); and the Sustainable Waste Management Act 2022 and associated regulations.

- Biosecurity, disease control, and veterinary public health frameworks: Animal Diseases Act (Cap. 364), Veterinary Surgeons and Veterinary Para-professionals Act (Cap. 366), Public Health Act (Cap. 242), Biosafety Act (Cap. 320), and the Fisheries Management and Development Act (Cap. 378).

Institutional Mandates and Roles

The effective implementation of fish welfare standards in Kenya requires coordinated action among multiple public institutions with complementary statutory mandates. These are outlined below:

Fisheries and Aquaculture Authorities

- **State Department for the Blue Economy and Fisheries (SDBEF):** Provides strategic direction for aquaculture development; coordinates inter-ministerial and inter-agency collaboration; and ensures alignment with national laws, policies, and international treaties, conventions, and protocols.
- **Kenya Fisheries Service (KeFS):** Issues licences for aquaculture establishments and fish trade; develops and enforces aquaculture policies, standards, and guidelines; maintains a register of aquaculture establishments; monitors and regulates live fish movements; and oversees fish disease surveillance and welfare compliance.
- **Kenya Bureau of Standards (KEBS):** Sets product and safety standards for fish and aquaculture products; and certifies compliance for domestic and export markets.
- **County Governments:** Develop County Aquaculture Development Plans; issue local permits for aquaculture operations; monitor compliance with welfare, biosecurity, and environmental standards; and collaborate with KeFS on inspections and enforcement.
- **Kenya Marine and Fisheries Research Institute (KMFRI):** Conducts applied and collaborative research on the implementation, performance, and impacts of the FW-MSOP in aquaculture systems; generates scientific evidence to inform regulatory frameworks and best practices; and develops innovation in welfare-friendly technologies.

Veterinary and Animal Health Authorities

- **State Department for Livestock:** Oversees veterinary policy and animal health legislation; provides national coordination and oversight of animal disease surveillance and control programmes, including movement of live aquatic species across borders.
- **Kenya Veterinary Board (KVB):** Regulates veterinary surgeons and para-professionals; and ensures only qualified personnel handle aquatic animal health interventions.

Environmental and Water Resource Agencies

- **National Environment Management Authority (NEMA):** Is the principal agency for environmental management, involving regulation, monitoring, and providing guidelines for aquaculture to prevent environmental degradation. Key aspects include Environmental Impact Assessment (EIA) approvals for aquaculture projects, pollution control, licensing and compliance monitoring, and protection of aquatic habitats.

- **Water Resources Authority (WRA):** Is the national regulator responsible for the management, use, protection, and conservation of water resources; issues permits for water abstraction and use; monitors and enforces compliance relating to water resource quality and quantity for domestic, agricultural, industrial, and aquaculture use; and undertakes catchment-level water resources management through Basin Water Resources Committees and Water Resource Users Associations (WRUAs). Following the devolution of water service provision to county governments under the Water Act 2016, the regulation of water service delivery is undertaken by the Water Services Regulatory Board (WASREB) through licensed Water Service Providers, while the WRA retains the national mandate for the regulation of water resources.

- **Kenya Forest Service (KFS):** Ensures the protection of water towers, mitigates climate change provides, and supports the provision of ecosystem services.

1.3.2 Alignment with Regional and Global Frameworks

The FW-MSOP is grounded in, and aligned with, recognised regional and global frameworks that promote responsible aquaculture, aquatic animal health, and integrated food system governance.

Alignment with the WOAH Aquatic Animal Health Code

The FW-MSOP aligns with the principles and relevant provisions of the WOAH Aquatic Animal Health Code, particularly those related to aquatic animal health management, biosecurity and disease prevention, transport of live aquatic animals, and humane handling and killing of farmed fish. The FW-MSOP builds on this foundation by translating health-oriented standards into practical, welfare-focused operational procedures, recognising that good health is a prerequisite for good welfare but does not, alone, guarantee positive welfare outcomes.

Alignment with FAO Aquaculture Pathways and Responsible Aquaculture Guidance

The FW-MSOP aligns with FAO's frameworks for responsible aquaculture development, including guidance on sustainable intensification of aquaculture, environmental stewardship, farm management, productivity and resilience, and capacity development and extension systems. By embedding fish welfare within broader sustainability and productivity objectives, the MSOP reinforces FAO's emphasis on socially acceptable, environmentally responsible, and economically viable aquaculture systems.

Alignment with AU-IBAR Animal Welfare Strategy

At the continental level, the FW-MSOP aligns with the AU-IBAR Animal Welfare Strategy of Africa (AWSA), which promotes integrating animal welfare into livestock development, food systems, and trade across Africa. The MSOP contributes to this strategy by extending animal welfare considerations explicitly to aquaculture and fish production, providing harmonised minimum standards that can support regional coherence, and strengthening institutional capacity for welfare governance and enforcement.

Alignment with EAC Animal Health Measures for Aquatic Animals

At the regional level, the FW-MSOP aligns with the EAC Animal Health Measures for Aquatic Animals, which aim to contain and eradicate aquatic animal diseases to protect and develop the EAC fisheries industry and sustain ongoing trade. The FW-MSOP provides operational guidance on disease prevention and early detection, aquatic animal welfare, hygiene and sanitation practices, responsible use of veterinary medicines and biologicals, movement controls and quarantine measures, transportation of live aquatic animals, and aquatic animal food safety.

Integration within One Health Frameworks

The FW-MSOP is explicitly informed by One Health frameworks, recognising the interconnections between fish health and welfare, human health, and environmental sustainability. Poor fish welfare practices can increase disease risks, antimicrobial misuse, food safety hazards, and environmental degradation, with direct implications for public health and ecosystem integrity. By adopting a One Health lens, the FW-MSOP encourages preventive and system-based approaches to health and welfare management, supports responsible use of antimicrobials and improved biosecurity, reinforces linkages between fish welfare, food safety, and environmental protection, and promotes cross-sectoral collaboration between fisheries, veterinary, public health, and environmental authorities.

1.3.3 Alignment with Voluntary Verification, Improvement, and Certification Schemes

The FW-MSOP is designed to function as a complementary technical reference that defines minimum operational requirements for fish welfare across aquaculture systems in Kenya. It is intentionally structured to be compatible with voluntary verification, improvement, certification, and farmer capacity-building schemes that promote responsible, welfare-aligned, and sustainable aquaculture practices.

The FW-MSOP establishes baseline fish welfare principles, risk controls, and minimum compliance expectations that may serve as a reference point for voluntary schemes seeking to assess, verify, certify, or support progressive improvement in farm practices. Use of the FW-MSOP within voluntary verification, improvement, or certification schemes does not alter its role as a minimum welfare standard. Participation in any voluntary scheme

remains optional and independent of regulatory compliance, and adoption of the FW-MSOP does not require engagement with any specific verification or certification system.

1.4 Core Fish Welfare Principles

The FW-MSOP is grounded in contemporary scientific understanding of fish biology, behaviour, and sentience, as well as internationally recognised welfare frameworks adapted to aquatic species. Fish are sentient vertebrates capable of experiencing pain, stress, and negative affective states, and their welfare must therefore be actively protected throughout all stages of production, handling, transport, and slaughter. This FW-MSOP adopts a principles-based approach to fish welfare, ensuring that operational standards are guided not only by inputs and procedures, but also by welfare outcomes that matter to the fish.

1.4.1 The Five Freedoms and Five Domains Applied to Fish Welfare

THE FIVE FREEDOMS

Foundations of fish welfare

01	**Freedom from Hunger, Thirst & Malnutrition** Nutritionally appropriate feed and adequate water quality.
02	**Freedom from Physical & Environmental Discomfort** Suitable water quality, density, temperature and habitat.
03	**Freedom from Pain, Injury & Disease** Preventive health management, biosecurity and timely care.
04	**Freedom to Express Normal Behaviour** Conditions allowing species-specific behaviour and movement.
05	**Freedom from Fear & Chronic Stress** Minimising avoidable stressors in handling and transport.

Historically, the Five Freedoms framework has provided a foundational reference for animal welfare. While still relevant, this FW-MSOP recognises that welfare science has evolved, and that fish welfare is best addressed using a combination of the Five Freedoms and the more contemporary Five Domains model, adapted to the specific biological and environmental needs of fish. Under this FW-MSOP, the following core welfare principles apply:

- **Freedom from Hunger, Thirst, and Malnutrition:** Fish must have access to nutritionally appropriate feed provided at suitable frequencies and quantities, and to water of adequate quality to support normal physiological function.
- **Freedom from Physical and Environmental Discomfort:** Fish must be reared in environments that provide appropriate water quality, stocking densities, temperature, oxygen levels, and habitat conditions suited to the species and life stage.
- **Freedom from Pain, Injury, and Disease:** Preventive health management, biosecurity, and timely treatment must be prioritised to minimise injury, disease, and unnecessary

suffering. Handling and operational procedures must be designed to reduce the risk of physical harm.

- **Freedom to Express Normal Behaviour:** Fish must be kept under conditions that allow species-specific behaviours, including appropriate social interactions, movement, and feeding behaviour, within the constraints of farmed systems.
- **Freedom from Fear and Chronic Stress:** Management practices must minimise avoidable stressors, including poor handling, excessive noise, overcrowding, and inappropriate transport or slaughter methods.

The Five Domains model complements these freedoms by explicitly recognising the role of mental and affective states in welfare. Under this model, fish welfare is influenced by four physical and functional domains — nutrition, environment, health, and behaviour — which together shape the fifth domain: the fish's mental state. The FW-MSOP uses this model to guide assessment of welfare outcomes, particularly where indicators of stress, injury, or behavioural disturbance are observed.

1.4.2 Outcome-Based and Risk-Oriented Welfare Standards

The FW-MSOP emphasises outcome-based welfare assessment, recognising that compliance with procedures alone does not guarantee good welfare. Observable indicators such as behaviour, injury rates, mortality, growth performance, and physiological stress responses are essential for evaluating whether welfare standards are being met. At the same time, the FW-MSOP adopts a risk-based approach, prioritising prevention of welfare harms through improved aquaculture system design, management practices, and early intervention. This approach supports continuous improvement rather than one-time compliance.

1.4.3 Fish Welfare within a One Health Perspective

Fish welfare is inseparably linked to One Health, recognising the interconnectedness of animal and human health, welfare, and environmental integrity. Poor fish welfare can increase disease susceptibility, drive inappropriate antimicrobial use, compromise food safety, and contribute to environmental degradation. Conversely, good fish welfare supports healthier aquaculture ecosystems, safer food, and more resilient livelihoods. The FW-MSOP therefore positions fish welfare not as an isolated ethical concern, but as a core component of sustainable, safe, and responsible aquaculture food systems.

Fish Health & Welfare	Human Health	Environment & Ecosystems

SECTION

02

GENERAL WELFARE REQUIREMENTS

Cross-cutting standards that apply to every farm, system and scale of operation.

IN THIS SECTION

SECTION 2 — GENERAL WELFARE REQUIREMENTS (CROSS-CUTTING)

The requirements set out in this section apply to all farms, production systems, and scales of operation.

2.1 Stocking Density Standards

Stocking density is a foundational determinant of fish welfare and a key management factor influencing health, behaviour, water quality, growth performance, and mortality. Inappropriate stocking densities — particularly overcrowding — are a major driver of chronic stress, injury, disease transmission, and environmental degradation in aquaculture systems.

The FW-MSOP establishes minimum stocking density standards based on species, life stage, and production system, and requires that stocking density be actively managed as a dynamic welfare risk rather than a fixed input.

2.1.1 Principles Governing Stocking Density

Stocking density decisions under this MSOP must be guided by the following principles:

- Stocking densities shall not compromise the physical health, behavioural needs, or physiological functioning of fish.
- Densities shall be adjusted to reflect species-specific biology, growth stage, and environmental conditions.
- Stocking density must be compatible with the system's capacity to maintain acceptable water quality and oxygen levels.
- Stocking density must be reviewed and adjusted throughout the production cycle, particularly following grading, growth spurts, disease events, or environmental stressors.
- Economic viability shall be considered in balancing fish health and production profitability.

2.1.2 Species-Specific Guidance

Different fish species vary in their tolerance to crowding, social behaviour, oxygen demand, and stress response. Accordingly:

- Stocking densities shall be species-specific, taking into account behavioural patterns, growth rates, and metabolic requirements.
- Life stage considerations — including fry, fingerlings, juveniles, and market-size fish — must be reflected in density decisions.

- Mixed-species stocking, when practised, must be managed carefully to avoid aggression, competition, or welfare compromise.

Species-specific density ranges and thresholds are provided in Annex I, informed by scientific evidence and local production conditions.

2.1.3 System-Specific Thresholds

Stocking density limits must also reflect the characteristics and carrying capacity of the production system. System-specific considerations include:

- **Pond Systems:** Stocking densities must account for pond size, depth, water exchange, aeration capacity, and natural productivity. Overstocking in ponds often leads to rapid deterioration of water quality and increased welfare risk.
- **Cage Culture Systems:** Cage stocking densities must be determined based on water flow, current speed, dissolved oxygen availability, and waste dispersal. Seasonal changes and site-specific environmental conditions must be factored into density management.
- **Tank-Based and Flow-Through Systems:** Stocking densities must align with system design, water turnover rates, filtration capacity, and oxygenation. Overstocking in tanks increases the risk of injury and rapid declines in water quality.
- **Recirculating Aquaculture Systems (RAS):** Stocking densities must be compatible with biofiltration capacity, solids removal efficiency, and system redundancy. Higher densities may be possible in RAS, but only where system performance and monitoring capacity are robust.
- **Hatcheries and Nursery Systems:** Early life stages require particular attention to density, as overcrowding can impair growth, increase deformities, and elevate mortality. Densities must be progressively adjusted as fish grow.
- **Integrated and Hybrid Systems:** Including Integrated Multi-Trophic Aquaculture (IMTA), aquaponics, and biofloc systems, stocking densities must be assessed in relation to the overall biological and hydraulic carrying capacity of the integrated system.

2.1.4 Monitoring and Adjustment of Stocking Density

Operators are required to:

- Maintain records of stocking densities and biomass over time, with appropriate reporting systems.
- Monitor fish behaviour, growth, and health as indicators of density-related stress.
- Adjust densities through grading, thinning, or system modification as needed.
- Implement corrective actions when welfare indicators suggest non-compliance.

Inspectors, aquaculture specialists, and extension officers should assess stocking density not only against nominal thresholds, but also in relation to observed welfare outcomes and system performance.

MINIMUM STANDARD REQUIREMENT

Under the FW-MSOP, stocking density shall be considered non-compliant where it results in:

- Persistent poor water quality
- Elevated injury or mortality
- Suppression of normal behaviour
- Increased disease occurrence attributable to crowding

Stocking density management is therefore a core welfare obligation and a key entry point for welfare improvement across all aquaculture systems.

2.2 Water Quality Management

Water quality management is a non-negotiable foundation of fish welfare. Because fish live entirely within their environment, any deterioration in water quality has immediate and direct consequences for their health, behaviour, stress levels, and survival. Poor water quality is one of the most common and preventable causes of welfare compromise in aquaculture systems.

Under the FW-MSOP, operators are required to proactively manage water quality to ensure conditions consistently support good welfare outcomes across all life stages and production systems.

2.2.1 Key Water Quality Parameters

The following parameters are recognised as critical to fish welfare and must be routinely monitored and managed:

- **Dissolved Oxygen (DO):** Adequate oxygen levels are essential for respiration, metabolism, and normal behaviour. Low dissolved oxygen leads to stress, reduced feeding, impaired growth, and can rapidly result in mortality.
- **Temperature:** Water temperature influences metabolism, immune function, oxygen demand, and feeding behaviour. Temperatures outside species-specific tolerance ranges cause physiological stress and increase disease susceptibility.
- **pH:** Extreme or fluctuating pH levels can damage gills, disrupt metabolic processes, and reduce tolerance to other stressors. Stable pH within acceptable ranges is essential for welfare and system stability.
- **Ammonia and Nitrogenous Wastes:** Accumulation of ammonia and other nitrogenous compounds is toxic to fish and a common indicator of system overload or poor management. Elevated levels cause gill damage, stress, and increased mortality.

- **Turbidity and Suspended Solids:** Excessive turbidity can impair gill function, reduce feeding efficiency, and indicate poor waste management or erosion. Clear and well-managed water supports better welfare outcomes.

Additional parameters, such as nitrite, nitrate, salinity, alkalinity, and heavy metals, may be relevant depending on species and system type and should be included in national adaptations where appropriate.

> ◆ **WATCH THESE FIVE PARAMETERS**
>
> Dissolved oxygen, temperature, pH, ammonia and nitrite are the day-to-day drivers of fish welfare. Monitor them on a routine schedule and act before thresholds are breached.

Table 3. Recommended water quality ranges for freshwater cultured fish.

Parameter	Cold-Water Fish	Warm-Water Fish
Temperature (°C)	14–17	22–32
Salinity (ppt)	0–5	0–5
Alkalinity/hardness as $CaCO_3$ (mg/l)	40–70	40–70
pH	6.5–8.5	6.5–8.5
Dissolved oxygen (mg/l)	≥ 5	≥ 3
Phosphate (mg/l)	10–100	10–100
Unionised ammonia (NH_3) (mg/l)	< 0.5	< 0.5
Ionised ammonia (NH_4^+) (mg/l)	< 1.5	< 1.5
Plankton turbidity (Secchi depth, cm)	30–45	30–45
Suspended solids >1 µm (mg/l)	2–10	2–10
Suspended solids <1 µm (mg/l)	2–3	2–3
Nitrite (NO_2^-) (mg/l)	< 1	< 1
Nitrate (NO_3^-) (mg/l)	< 10	< 10
Chlorine (Cl_2) (mg/l)	< 0.8	< 0.8

Table 4. Recommended water quality parameters for hatcheries.

Hatchery Type	pH	Temp. (°C)	DO (mg/l)	NO_2^- (mg/l)	NO_3^- (mg/l)	Salinity (ppt)
Freshwater prawns	7.0–8.5	28–30	> 5.0	< 0.1	< 2.0	0–10
Marine shrimps	7.0	28	> 5.0	0.1–0.2	< 0.1	35
Freshwater finfish	6.5–8.5	28–30	> 4.0	0.2–0.5	< 0.1	3–5

2.2.2 Monitoring Frequency

Water quality must be monitored at a frequency appropriate to the system's, species', and stocking density's risk profiles. As a minimum:

- Key parameters should be checked daily or at regular intervals in intensive systems, hatcheries, and RAS.
- Monitoring frequency should increase during high-risk periods, including high temperatures, rapid growth or high biomass, disease outbreaks, and after handling, grading, or system changes.
- Continuous or automated monitoring is encouraged where feasible, particularly for dissolved oxygen and temperature.

Monitoring responsibilities should be clearly assigned, and staff conducting measurements must be adequately trained and competent.

Table 5. Water quality monitoring frequency in aquaculture.

Water Quality Parameter	Recommended Monitoring Frequency	Significance for Fish Welfare
Water Temperature (°C)	Daily (morning and afternoon)	Controls metabolism, feeding, growth, and oxygen demand
Dissolved Oxygen (mg/l)	Daily (early morning and late afternoon)	Low DO causes stress, poor growth, and mortality
pH	Daily	Affects fish health and ammonia toxicity
Ammonia (NH_3/NH_4^+)	Weekly (daily in intensive systems)	Toxic to fish, especially unionised NH_3
Nitrite (NO_2^-)	Weekly	Causes methaemoglobinaemia ('brown blood disease')
Nitrate (NO_3^-)	Monthly	Indicator of long-term waste accumulation
Alkalinity (mg/l $CaCO_3$)	Monthly	Buffers pH stability
Hardness (mg/l $CaCO_3$)	Monthly	Affects osmoregulation and toxicity
Turbidity / Water Clarity	Weekly	Affects feeding efficiency and photosynthesis
Total Suspended Solids (TSS)	Monthly (or as needed)	Impacts gill function and biofilter performance
Carbon Dioxide (CO_2)	Weekly	High CO_2 reduces oxygen uptake
Hydrogen Sulphide (H_2S)	As needed / when odour is present	Highly toxic even at low concentrations
Salinity / Conductivity	Monthly	Indicator of dissolved ions
Heavy metals	Annually or after any episodic event	Risk of bioaccumulation

Water Quality Parameter	Recommended Monitoring Frequency	Significance for Fish Welfare
Pesticides	Annually or after any episodic event	Risk of bioaccumulation
Microbiological (fungi, bacteria, parasites)	Monthly or after any episodic event	Disease risk monitoring

2.2.3 Acceptable Ranges and Thresholds

Acceptable water quality ranges must be species-specific, life-stage-appropriate, and system-dependent. This MSOP defines acceptable operating ranges for each key parameter, alert thresholds that trigger corrective action, and critical limits beyond which immediate intervention is required. These ranges are based on scientific evidence, national guidelines, and local production realities.

2.2.4 Corrective Actions and Welfare Protection

Where water quality parameters fall outside acceptable ranges, operators must:

- Take immediate corrective actions to restore suitable conditions.
- Reduce stocking density, feeding rates, or biomass where necessary.
- Increase aeration, water exchange, or filtration.
- Document incidents, actions taken, and outcomes.
- Establish early warning mechanisms and farm networks for sharing outcomes and best practices.

> **MINIMUM STANDARD REQUIREMENT**
>
> Under the FW-MSOP, water quality management shall be considered non-compliant where:
>
> - Monitoring is lacking, infrequent, or undocumented.
> - Fish are exposed to prolonged or repeated poor water quality.
> - Corrective actions are delayed or ineffective.
> - Welfare indicators show stress, injury, or mortality attributable to water quality failures.
> - Relevant Kenyan water standards and East African Standards are not being met.

2.3 Feeding and Nutrition

Appropriate feeding and nutrition are essential to fish welfare, health, growth, and overall system performance. Poor feeding practices — whether due to inadequate nutrition, inappropriate feeding methods, or poor feed handling — can lead to stress, impaired

growth, increased disease susceptibility, deterioration of water quality, and increased mortality. Under the FW-MSOP, feeding and nutrition must be managed in a manner that supports species-specific physiological needs, minimises welfare risks, and protects environmental and food safety outcomes.

2.3.1 Feed Quality Requirements

Feed provided to fish must be:

- Nutritionally appropriate for the species, life stage, and production objectives.
- Formulated to meet essential protein, energy, vitamin, and mineral requirements.
- Free from contaminants, spoilage, and harmful substances.
- Sourced from reputable manufacturers or suppliers.
- Economically viable to support sustainable production.

The use of poor-quality, expired, or contaminated feed constitutes a serious welfare risk and is not acceptable under this MSOP. Where medicated feeds are used, they must be applied responsibly and in accordance with veterinary or regulatory guidance.

Table 6. Requirements for tilapia fingerling/grower commercial complete feed (KS 2289-1:2011).

Feed Parameter	Starter (Fingerlings)	Grower	Finisher	Brooder
Weight (g)	1–49	50–200	200 – market size	≥ 50 (♀), ≥ 80 (♂)
Feeding rate (% body weight)	6–8	3	2–4	4–6
Crude protein % (min.)	35	30	24	32
Energy ME (kcal/kg)	2,500	2,750	2,900	2,800
Lysine (g/kg, min.)	1.2	1.2	1.2	1.2
Methionine (g/kg, min.)	0.5	0.5	0.5	0.5
Crude fibre % (max.)	4	6	6	6
Crude fat % (max.)	8	10	10	10
Pellet size (mm)	2 (max.)	2–5	4–6	2–5
Float time (minutes)	2	2	2	2
Moisture content % (max.)	10	10	10	10
Calcium %	0.4–0.6	0.4–0.6	0.4–0.6	0.45–0.65
Phosphorus %	0.5–0.7	0.5–0.7	0.5–0.7	0.6–0.7

Table 7. Requirements for tilapia fingerling/grower commercial supplementary feed (KS 2289-2:2011).

Feed Parameter	Starter (Fingerlings)	Grower	Finisher	Brooder
Weight (g)	1–49	50–200	200 – market size	≥ 50 (♀), ≥ 80 (♂)

Feed Parameter	Starter (Fingerlings)	Grower	Finisher	Brooder
Feeding rate (% body weight)	6	3	3	4
Crude protein % (min.)	26	23	18	24
Energy ME (kcal/kg)	2,500	2,750	2,900	2,800
Lysine % (min.)	0.9	0.9	0.9	0.9
Methionine % (min.)	0.38	0.38	0.38	0.38
Crude fibre % (max.)	4	4	6	6
Crude fat % (max.)	8	10	10	10
Pellet size (mm)	2 (max.)	2–5	4–6	2–5
Float time (minutes)	2	2	2	2
Moisture content % (max.)	12	12	12	12
Calcium %	0.4–0.6	0.4–0.6	0.4–0.6	0.45–0.65
Phosphorus %	0.5–0.7	0.5–0.7	0.5–0.7	0.6–0.7

Table 8. Requirements for catfish fingerling/grower commercial complete feed (KS 2451-1:2013).

Feed Parameter	Starter (Fingerlings)	Grower	Finisher	Brooder
Weight (g)	1–49	50–250	250 – market size	≥ 50 (♀), ≥ 80 (♂)
Feeding rate (% body weight)	6–8	3	2–4	4–6
Crude protein % (min.)	45	35	30	30
Energy DE (kcal/kg, min.)	3,000	3,000	3,000	3,000
Lysine (g/kg, min.)	1.4	1.4	1.4	1.4
Methionine (g/kg, min.)	0.6	0.6	0.6	0.6
Crude fibre % (max.)	4	6	6	6
Crude fat %	4–6	4–6	4–6	4–6
Pellet size (mm)	2 (max.)	2–5	4–6	2–5
Moisture content % (max.)	10	10	10	10
Calcium % (max.)	0.5	0.5	0.5	0.5
Phosphorus %	0.5	0.5	0.5	0.5

Table 9. Requirements for catfish fingerling/grower commercial supplementary feed (KS 2451-2:2013).

Feed Parameter	Starter (Fingerlings)	Grower	Finisher	Brooder
Weight (g)	1–49	50–250	250 – market size	≥ 50 (♀), ≥ 80 (♂)
Feeding rate (% body weight)	6	3	3	4
Crude protein % (min.)	26	23	18	24
Energy DE (kcal/kg, min.)	2,500	2,750	2,900	2,800
Lysine (g/kg, min.)	0.9	0.9	0.9	0.9
Methionine (g/kg, min.)	0.38	0.38	0.38	0.38
Crude fibre % (max.)	4	4	6	6
Crude fat %	8	10	10	10
Pellet size (mm)	2 (max.)	2–5	4–6	2–5
Moisture content % (max.)	12	12	12	12
Calcium %	0.4–0.6	0.4–0.6	0.4–0.6	0.40–0.65
Phosphorus %	0.5–0.7	0.5–0.7	0.5–0.7	0.5–0.7

2.3.2 Feeding Frequency and Methods

Feeding frequency and methods must be adapted to species biology, life stage, and environmental conditions. Operators are required to:

- Establish feeding schedules appropriate to fish size, metabolism, and water temperature.
- Adjust feeding rates during periods of stress, disease, or poor water quality.
- Use feeding methods that promote equitable feed access and minimise competition.
- Avoid feeding practices that induce unnecessary stress or aggressive behaviour.

2.3.3 Avoidance of Overfeeding and Underfeeding

Both overfeeding and underfeeding present significant welfare risks. Underfeeding can result in hunger, aggression, poor growth, increased size variation, and weakened immune function. Overfeeding leads to feed waste, deterioration of water quality, increased ammonia levels, and secondary welfare impacts. Operators must:

- Monitor feeding responses and adjust rations accordingly.
- Observe fish behaviour during feeding as an indicator of welfare and appetite.
- Modify feeding practices in response to environmental changes or system performance.
- Record feeding quantities and adjustments where required

.

2.3.4 Feed Storage and Handling

Operators are required to:

- Store feed in clean, dry, well-ventilated areas protected from moisture, pests, and direct sunlight.
- Use feed on a first-in, first-out basis to prevent spoilage and expiry.
- Clearly label feed batches and maintain basic inventory records.
- Avoid cross-contamination with chemicals, fuels, or veterinary products.

MINIMUM STANDARD REQUIREMENT

Under this FW-MSOP, feeding and nutrition practices shall be considered non-compliant where:

- Feed quality is demonstrably inadequate or compromised.
- Feeding practices result in chronic hunger, excessive competition, or stress.
- Overfeeding leads to persistent deterioration in water quality.
- Feed storage and handling pose risks to fish welfare or food safety, including risks associated with feed expiry.

2.4 Handling and Grading

Handling and grading are among the highest-welfare-risk activities in aquaculture operations. When poorly planned or executed, these activities can cause acute stress, physical injury, scale loss, immunosuppression, and mortality. Under the FW-MSOP, handling and grading must therefore be minimised, planned, and conducted in a welfare-conscious manner at all times. Handling and grading practices must prioritise the prevention of unnecessary pain, injury, and distress, and must be justified by clear management needs such as size sorting, health assessment, transfer, or harvest preparation.

2.4.1 Principles for Handling and Grading

- Handling shall be limited to what is strictly necessary.
- Activities shall be planned in advance to reduce duration and stress.
- Fish shall be handled gently and efficiently, using appropriate equipment.
- Exposure to air shall be minimised to less than 15 seconds per fish and must never exceed 30 seconds.
- The temperature difference between holding water and culture water must be 2°C or less.
- Handling shall be avoided during periods of extreme temperature, low dissolved oxygen, or disease outbreaks, unless required for welfare or emergency reasons.

2.4.2 Handling Methods and Equipment

Operators must use handling methods and equipment that minimise injury and stress, including:

- Using nets, scoops, pumps, or grading equipment designed for fish handling.
- Avoid using rough, abrasive, or damaged equipment.
- Ensuring equipment is clean and free from contaminants, with cleaning records maintained.
- Preventing overcrowding during capture or confinement.
- Applying species-specific handling techniques.

Manual handling of fish should be avoided wherever possible. Where unavoidable, it must be brief, gentle, and conducted by trained personnel.

2.4.3 Grading Practices

Grading is often necessary to manage growth variation, reduce competition, and improve feeding efficiency. Under this MSOP:

- Grading frequency shall be kept to the minimum necessary.
- Fish shall be graded using methods appropriate to species, size, sexual maturity, and system.
- Appropriate grader mesh sizes shall be used to prevent injury and excessive compression.
- Grading activities shall be conducted during periods of optimal water quality and environmental conditions.
- Grading shall be conducted during the early morning or late afternoon when temperatures and stress are lower.
- Fish showing signs of stress, injury, or illness shall be handled with additional care or excluded from grading where appropriate.

Post-grading monitoring is required to identify delayed stress responses, injury, or mortality.

2.4.4 Use of Sedation or Anaesthesia

Where permitted under national safety and quality regulations, the use of approved sedatives or anaesthetics may be considered to reduce stress during handling or grading. Any such use must:

- Comply with national veterinary and food safety regulations.
- It should be applied by trained personnel.
- Be appropriately documented.
- Respect withdrawal periods where applicable.

MINIMUM STANDARD REQUIREMENT

Under this FW-MSOP, handling and grading practices shall be considered non-compliant where they:

- Cause avoidable injury, stress, or mortality.
- It involves prolonged or repeated exposure to air.
- They are conducted using inappropriate or poorly maintained equipment.
- They are carried out by untrained personnel.
- Fail to include post-activity monitoring and response.
- Fail to record occurrences.

2.5 Transport of Live Fish (Internal and External)

The transport of live fish — whether within a farm (internal transport) or between facilities (external transport) — poses significant welfare risks due to handling, confinement, changes in water quality, and exposure to stressors. Poorly managed transport can result in injury, physiological stress, disease transmission, and mortality. Under this FW-MSOP, live fish transport must be carefully planned, appropriately equipped, and competently executed to minimise stress and protect fish welfare throughout the transport process.

2.5.1 Pre-Transport Planning and Preparation

Before transport, operators must:

- Confirm that transport is necessary and cannot be avoided.
- Ensure fish are fit for transport and free from disease or injury.
- Withdraw feed for 12–48 hours for fingerlings and 24–48 hours for broodstock (depending on species) prior to transport, where appropriate, to reduce waste and water quality deterioration.
- Prepare transport containers, equipment, and water in advance.
- Plan routes, duration, and contingency measures.

Transport must not be undertaken during extreme environmental conditions or when water quality cannot be maintained within acceptable ranges.

2.5.2 Transport Conditions and Welfare Protection

During transport, the following welfare requirements must be met:

- **Water Quality and Oxygenation:** Adequate dissolved oxygen must be maintained throughout transport using appropriate aeration or oxygenation systems. Transport

water must be clean, oxygen-saturated, and at culture temperature. Water temperature and quality must be monitored and managed to prevent stress or shock.

- **Stocking Density during Transport:** Fish must not be overcrowded in transport containers. Transport stocking densities must be lower than or appropriate to holding densities to account for reduced water volume and increased stress.
- **Handling and Confinement:** Handling during loading and unloading must follow the welfare principles outlined in Section 2.4. Confinement time must be minimised, and fish must not be exposed to air for prolonged periods.
- **Size Grading:** Fish of similar size should be transported together to reduce aggression and injury.
- **Duration and Monitoring:** Transport duration must be kept as short as reasonably practicable. Fish must be monitored during transport for signs of stress, hypoxia, or injury, and corrective actions taken where necessary.

Table 10. Recommended maximum transport durations for fingerlings in oxygenated bags.

Species	Average Fingerling Size	Transport Method	Max. Duration
Tilapia (Oreochromis spp.)	5–20 g	Plastic bag with pure oxygen or oxygen-saturated water	6–12 hours
African catfish (Clarias gariepinus)	5–20 g	Oxygenated bag	8–12 hours
Rainbow trout (Oncorhynchus mykiss)	5–20 g	Oxygenated bag	4–6 hours

Table 11. Recommended maximum transport durations for broodstock.

Species	Average Size	Transport Method	Recommended Max. Duration
Tilapia / African catfish broodstock	0.5–3 kg	Oxygenated bags or tanks with pure O_2	1–3 hours in bags; up to 12–24 hours in well-oxygenated tanks with water exchange
Rainbow trout broodstock	0.5–2 kg	Oxygenated bags / insulated tanks	< 1–2 hours in bags; up to 6–8 hours in tanks with oxygen

2.5.3 External Transport Requirements

For external transport between farms, hatcheries, nurseries, processing facilities, or markets, operators and transporters must additionally ensure:

- Vehicles and containers are fit for purpose, clean, and disinfected.
- Transport water and equipment do not introduce pathogens or contaminants.
- Compliance with national transport, biosecurity, and animal health regulations.
- Appropriate documentation accompanies the consignment, where required.
- Transportation of fish adheres to national legislation on species ecological zoning.
- Adherence to traceability systems, including documentation of specific batch numbers.
- Live fish transport containers and oxygenated bags shall be branded and labelled to facilitate traceability and strengthen compliance monitoring along the value chain, indicating, at a minimum, the source facility, species, batch or consignment number, date of dispatch, and intended destination.

2.5.4 Post-Transport Care and Monitoring

Upon arrival, operators must:

- Gradually acclimatise fish to new water conditions.
- Minimise handling during unloading.
- Monitor fish closely for signs of stress, injury, or mortality.
- Record transport outcomes, including any welfare incidents.
- Ensure proper biosecurity and compliance measures.

MINIMUM STANDARD REQUIREMENT

Under the FW-MSOP, live fish transport shall be considered non-compliant where:

- Transport is conducted without adequate planning or equipment.
- Fish experience avoidable stress, injury, or mortality.
- Water quality and oxygenation are not adequately maintained.
- Transport personnel lack appropriate training.
- Post-transport monitoring and documentation are absent.

2.6 Harvesting and Pre-Slaughter Holding

Harvesting and pre-slaughter holding are among the most welfare-critical phases in aquaculture production. During this stage, fish are often exposed to high levels of stress from crowding, handling, confinement, water-quality fluctuations, and logistical delays. Poorly managed harvesting and holding practices can result in acute suffering, injury, immunosuppression, increased mortality, and compromised product quality.

2.6.1 Core Welfare Principles for Harvesting

- Stress, fear, and physical injury must be minimised.
- Crowding intensity and duration must be strictly controlled.
- Water quality and dissolved oxygen levels must be maintained at all times.
- The time between harvest and slaughter must be kept as short as reasonably practicable (preferably within 2–6 hours, depending on species).
- Fish must remain fit, conscious, and minimally stressed until stunning occurs.
- Fish must never be subjected to prolonged holding under deteriorating conditions.

2.6.2 Harvest Planning and Preparation

Before harvesting, operators must:

- Develop a documented harvest plan that includes timing, methods, staffing, and equipment.
- Plan harvesting during early morning or late evening, where possible.
- Ensure availability of trained personnel and adequate oxygenation systems and holding units.
- Confirm the readiness of slaughter facilities to receive fish.
- Avoid harvesting during extreme temperatures or adverse environmental conditions unless unavoidable.
- Withdraw or before harvest where appropriate, to protect water quality.
- Avoid applying fertilisers one to two weeks prior to harvesting.
- Make marketing arrangements well in advance of the harvest date.

2.6.3 Harvesting Methods

Harvesting methods must be species- and system-appropriate and designed to minimise injury and stress. Key requirements include:

- Gradual crowding rather than sudden or forceful aggregation.
- Avoidance of excessive compression, crushing, or prolonged confinement.
- Use of nets, pumps, or harvesting devices designed for fish welfare.
- Partial drainage of ponds during the early morning on the day of harvest.
- Minimisation of air exposure during lifting and transfer.
- Continuous monitoring of fish behaviour and condition during harvesting.
- Humane and lawful disposal of mortalities.

2.6.4 Pre-Slaughter Holding Conditions

Where fish are held prior to slaughter, holding conditions must:

- Maintain water quality within acceptable species-specific ranges.
- Ensure adequate dissolved oxygen at all times.

- Avoid excessive holding densities.
- Prevent mixing of fish batches to avoid increased aggression or stress.
- Avoid exposure to extreme temperatures, noise, and disturbance.

MINIMUM STANDARD REQUIREMENT

Under the FW-MSOP, harvesting and pre-slaughter holding practices shall be considered non-compliant where:

- Fish are subjected to excessive crowding or prolonged holding.
- Water quality parameters are not maintained.
- Harvesting causes avoidable injury or mortality.
- Fish experience unnecessary delay before stunning and slaughter.
- Operations proceed despite a clear welfare compromise.

2.7 Slaughter and Killing of Fish

The slaughter and killing of fish is a critical welfare stage that must be carried out in a humane manner that minimises pain, fear, and distress. Humane slaughter is not only an ethical obligation but also a key determinant of meat quality, food safety, and market acceptance. Fish are sentient vertebrates, and failure to apply humane slaughter practices constitutes a serious welfare breach, regardless of production scale or system.

Under the FW-MSOP, all fish destined for human consumption must be effectively stunned before killing, except where national regulations explicitly provide otherwise. Slaughter practices must be planned, controlled, and performed by trained personnel using approved methods.

2.7.1 Core Welfare Principles for Slaughter

- Fish must be rendered unconscious rapidly and effectively before death.
- Loss of consciousness must be maintained until death occurs.
- Pain, fear, and distress must be prevented.
- Handling before slaughter must be minimised and welfare-conscious.
- Equipment and methods must be appropriate to species and size, and hygienic.

Slaughter must not be conducted on conscious fish using methods that cause prolonged suffering. Stressed fish suffer more and produce poorer flesh quality.

2.7.2 Acceptable Stunning and Killing Methods

Acceptable stunning and killing methods must be species-appropriate, effective, and humane. These may include, where permitted and properly applied:

- Percussive stunning, followed immediately by killing — preferred for large fish.

- Stunning followed by immediate icing.
- Electrical stunning, where equipment is properly calibrated and maintained, isis preferred for batch slaughter.
- Use of approved anaesthetics.
- Brain spiking (ike-jime) after stunning.
- Other scientifically validated methods recognised by competent authorities.

The effectiveness of stunning must be verified by observing indicators such as loss of posture, absence of rhythmic opercular movement, and lack of response to stimuli.

> ⚠ **UNACCEPTABLE PRACTICES**
>
> The following practices are considered unacceptable under the FW-MSOP due to the high likelihood of causing prolonged suffering:
>
> ✕ Killing fish without prior stunning.
>
> ✕ Allowing fish to suffocate in air or on ice while conscious.
>
> ✕ Disembowelling, bleeding, or gutting conscious fish.
>
> ✕ Use of unapproved or improvised methods that do not reliably induce unconsciousness.

Where traditional or informal practices exist, operators are encouraged to transition to humane alternatives through training and capacity-building.

> ■ **MINIMUM STANDARD REQUIREMENT**
>
> Under the FW-MSOP, slaughter and killing practices shall be considered non-compliant where:
>
> — Fish are not effectively stunned before killing.
>
> — Unacceptable or inhumane methods are used.
>
> — Staff lack appropriate training or competence.
>
> — Monitoring and corrective actions are absent.
>
> — Practices result in avoidable pain, distress, or prolonged death.

2.8 Health Management and Biosecurity

Effective health management and biosecurity are essential to prevent disease transmission, protect fish welfare, ensure food safety, and safeguard the surrounding environment. Under the FW-MSOP, health management and biosecurity must be preventive, risk-based, and

welfare-oriented, with a strong emphasis on reducing disease occurrence rather than reacting to outbreaks.

2.8.1 Disease Prevention

Disease prevention is the primary objective of health management under this MSOP. Key preventive practices include:

- Maintaining appropriate stocking densities and water quality.
- Implementing good feeding and nutrition practices.
- Minimising handling and other stress-inducing activities.
- Applying effective hygiene and sanitation measures.
- Use disease-resistant or healthy seed from reputable sources.
- Quarantining new or returning stock where applicable.

2.8.2 Biosecurity Measures

Biosecurity measures must be applied at farm, facility, and system levels. Operators are required to:

- Control the movement of fish, equipment, vehicles, and personnel.
- Clean and disinfect equipment between uses and sites.
- Manage water sources to reduce contamination risks.
- Implement pest and predator control measures.
- Establish protocols for visitor access and staff hygiene.
- Restrict access to holding and slaughter areas.
- Establish proper disposal mechanisms for fish wastes.

2.8.3 Use of Therapeutics and Antimicrobial Stewardship

The use of veterinary medicines and other therapeutics must be responsible, justified, and welfare-focused. Under this MSOP:

- Therapeutics shall only be used when there is a clear health or welfare need.
- Use must comply with national veterinary, food safety, and regulatory requirements.
- Treatments must be administered by trained personnel or under professional guidance.
- Correct dosing, duration, and withdrawal periods must be respected.
- Antimicrobials shall not be used for routine prevention or growth promotion.
- Use must be based on clinical need and, where possible, informed by diagnosis.
- Records of antimicrobial use must be complete, accurate, and available for review.

MINIMUM STANDARD REQUIREMENT

Under the FW-MSOP, health management and biosecurity shall be considered non-compliant where:

- Preventive measures are absent or ineffective.
- Disease outbreaks are recurrent due to poor management.
- Therapeutics are misused or undocumented.
- Antimicrobials are use d routinely or irresponsibly.
- Biosecurity failures result in avoidable welfare harm.

2.9 Environmental Enrichment

Environmental enrichment refers to the provision of conditions or stimuli that enhance fish's ability to express natural behaviours, cope with their environment, and maintain positive welfare. Under the FW-MSOP, environmental enrichment is recognised as a supportive welfare measure that complements core requirements such as water quality, stocking density, feeding, and health management.

2.9.1 Types of Environmental Enrichment

- **Structural enrichment:** Use of shelters, substrates, or structural features that provide refuge, visual barriers, or spatial complexity, where compatible with system design and hygiene requirements.
- **Behavioural and feeding-related enrichment:** Feeding strategies or devices that stimulate natural foraging behaviour, reduce competition, or distribute feed more evenly.
- **Environmental variability:** Controlled variation in water flow, lighting, or habitat features to reflect natural conditions, where feasible and safe.

The use of enrichment must never compromise water quality, stocking density, hygiene, or fish health.

MINIMUM STANDARD REQUIREMENT

- Environmental enrichment is encouraged but is not mandatory as a minimum requirement.
- Absence of enrichment alone does not constitute non-compliance.
- However, where enrichment is used, it must not compromise fish welfare, health, or environmental quality.

2.10 Emergency and Contingency Welfare Standard Operating Procedures

Emergency and contingency welfare SOPs establish clear actions and responsibilities to protect fish welfare, human safety, and the environment during unexpected events. Under the FW-MSOP, all aquaculture operations are required to prepare for, respond to, and recover from emergency events in a manner that prioritises fish welfare, minimises suffering, and limits avoidable losses.

2.10.1 Scope of Emergencies Covered

This SOP applies to, but is not limited to, the following emergency scenarios:

- Sudden drops in dissolved oxygen or hypoxia events.
- Power failure or equipment malfunction (e.g., aeration, pumping, filtration).
- Extreme temperature events (heat waves, cold shocks).
- Disease outbreaks or mass mortality events.
- Flooding, drought, or severe weather events.
- Chemical or heavy-metal contamination, or water pollution incidents.
- Structural failures affecting containment or water supply.
- Accidental injuries to fish or personnel.

2.10.2 Preparedness and Risk Planning

Operators must establish and maintain emergency preparedness plans appropriate to their system and risk profile. At a minimum, this includes:

- Identification of key welfare risks and failure points.
- Availability of essential emergency equipment (e.g., backup aeration, oxygen supply).
- Clear assignment of staff roles and responsibilities during emergencies.
- Communication pathways for rapid internal and external notification.
- Integration of emergency welfare response into routine training and drills.
- Documentation and recording of all emergencies with preventive measures introduced.

2.10.3 Immediate Welfare Response

Upon detection of an emergency, operators must take immediate action to protect fish welfare. Priority actions include:

- Rapid restoration of oxygen and water quality.
- Reduction of stocking density or biomass where feasible.
- Suspension of feeding and handling activities.
- Isolation of affected units or systems.
- Removal and humane killing of severely compromised fish where recovery is unlikely.

2.10.4 Emergency Killing and Depopulation

In situations where fish cannot be recovered without prolonged suffering, humane emergency killing must be carried out. Emergency killing must:

- Use humane, approved methods consistent with Section 2.7.
- It should be conducted by trained personnel.
- Minimise duration and distress.
- Be documented and reviewed.

Mass depopulation must only be undertaken where necessary and as a last resort to prevent severe welfare compromise.

2.10.5 Post-Emergency Assessment and Recovery

Following an emergency event, operators must:

- Assess welfare outcomes, mortality, and system damage.
- Identify root causes and contributing factors.
- Implement corrective and preventive measures.
- Review and update emergency plans and SOPs.
- Provide additional staff training to address identified gaps.

SECTION

03

SYSTEM-SPECIFIC PROCEDURES

Tailored welfare SOPs for hatcheries, grow-out systems and emergency response.

IN THIS SECTION

SECTION 3 — SYSTEM-SPECIFIC STANDARD OPERATING PROCEDURES

3.1 Hatchery Welfare SOPs

Hatcheries play a decisive role in determining fish welfare outcomes throughout the production cycle. Poor welfare conditions at broodstock, egg, larval, fry, or fingerling stages can result in chronic health problems, deformities, stunted growth, high mortality, and long-term performance losses. Under the FW-MSOP, hatchery operations are therefore subject to heightened welfare safeguards and must apply strict management controls across all early life stages. These SOPs apply to all hatchery and nursery operations in Kenya, regardless of scale or production system.

Hatchery managers and technical personnel shall be competent and appropriately certified to operate the hatchery systems under their charge, including demonstrable knowledge of recirculating aquaculture systems (RAS) where such systems are in use. Competence requirements are intended to ensure professional management, proper handling of fish across all early life stages, and consistent application of the welfare standards set out in this Section.

3.1.1 Broodstock Management

Broodstock welfare is fundamental to reproductive success and offspring quality. Broodstock must be managed to minimise stress, injury, disease, and other adverse conditions that compromise reproductive behaviour and physiology. Minimum welfare requirements for broodstock include:

- Maintenance of appropriate stocking densities and sex ratios.
- Provision of optimal water quality, quantity, and environmental conditions.
- Adequate nutrition tailored to reproductive needs.
- Gentle and minimal handling, particularly during spawning periods.
- Regular health monitoring and prompt response to disease or injury, following a prescribed monitoring programme with records maintained at all times.
- Maintenance of suitable, clean culture systems that preclude cross-contamination.
- Provision of adequate production units, resting units, and quarantine facilities.

Broodstock shall be sourced from clearly identified, certified, and approved sources to ensure traceability, genetic quality, and freedom from disease, in line with national aquaculture standards and regulatory requirements. To guide farmers and hatchery operators toward certified and reliable sources, the Kenya Fisheries Service (KeFS) shall

maintain and publish, on an annual basis through its official website, a list of certified broodstock and quality seed providers.

Broodstock acquisition and management shall be supported by a broodstock assessment checklist maintained and applied by the Kenya Fisheries Service for administrative inspection purposes. The checklist shall, at a minimum, address broodstock age, reproductive cycle and maturity, health and disease status, and quarantine arrangements, and shall be used during hatchery assessments to verify compliance with the minimum welfare requirements set out above.

The use of approved hormones must comply with national fisheries regulations and other applicable laws on animal welfare. It must be carried out by trained and skilled aquaculture personnel using approved substances and methods. Repeated or unnecessary hormonal manipulation that compromises fish welfare is prohibited.

3.1.2 Egg Handling

Egg handling is a highly sensitive stage with significant welfare and viability implications. Poor handling can result in damage, infection, and high embryonic mortality. Under this FW-MSOP:

- Egg collection and transfer must be conducted gently and efficiently.
- Eggs must be protected from temperature shock, desiccation, and contamination.
- Eggs must be graded to the appropriate life stage and incubated separately.
- Water quality parameters must be maintained within species-appropriate ranges.
- Disinfection procedures, when applied, must use approved methods and concentrations as prescribed in Good Aquaculture Practices (GAqP) and manufacturer's instructions.
- Overcrowding in incubation systems must be avoided.
- Incubation systems should be monitored regularly to remove dead eggs.

Egg mortality and abnormal development rates should be monitored and recorded as indicators of welfare and management performance. Specific standards for egg handling and transport, including egg stocking densities, mode and duration of transportation, and container specifications, shall be defined through research and published as supplementary guidance.

3.1.3 Larval Rearing

Larval stages are particularly vulnerable to welfare compromise due to underdeveloped physiological systems and high sensitivity to environmental conditions. Minimum welfare requirements for larval rearing include:

- Provision of adequate water of correct quality and quantity.
- Timely and correct first feeding using recommended live or formulated feeds.
- Feeding frequencies aligned with larval metabolic needs.

- Maintenance of correct larval densities to prevent overcrowding.
- Continuous grading to minimise size variation and cannibalism.
- Minimisation of disturbance, over-handling, and abrupt environmental changes.

High or sudden larval mortality must be noted, recorded, and must trigger immediate investigation and corrective action.

3.1.4 Fish Seed Management and Transport

Fish seed handling and transport represent a critical transition point with elevated welfare risks. Fish seed must be managed carefully to prevent stress, injury, and delayed mortality. Under this FW-MSOP:

- Fish seed must be graded only when necessary, using appropriate equipment.
- Stocking densities during holding and transport must be conservative.
- Water quality and oxygenation must be strictly maintained within recommended levels.
- Transport duration must be minimised and undertaken when temperatures are low.
- Fish seed must be acclimatised gradually to new environments upon arrival, in holding units prepared in advance.
- Seed transportation must use containers recommended for the specific fish species and size.
- Fish to be transported must be in well-labelled containers that minimise harm and facilitate traceability.
- Count verification of fingerlings sold must be ensured to inform feeding regimes and water quality management.
- Fish seed transport outcomes, including mortality and post-transport performance, must be monitored and recorded.

Monitoring, Records, and Continuous Improvement

Hatchery operators are required to maintain records covering:

- Broodstock management and spawning events.
- Egg survival and hatch rates.
- Larval survival and growth.
- Fry/fingerling handling and transport outcomes.
- Water quality parameters.
- Health management and treatment records.
- Mortalities, stocking dates, and densities.

A standardised record-keeping instrument aligned with this FW-MSOP — such as a log book — shall be developed and distributed to hatchery operators at both national and county government levels. Inspectors and hatchery managers should use these records, along with direct observation, to assess welfare performance and identify areas for improvement.

To enhance transparency, preparedness, and compliance among hatchery operators, inspection and assessment checklists shall be shared with hatcheries in advance of scheduled assessments. This enables operators to prepare the required records, address any gaps, and align their practices with the applicable welfare standards prior to inspection.

MINIMUM STANDARD REQUIREMENT

Under the FW-MSOP, hatchery operations shall be considered non-compliant where:

- Broodstock are subjected to chronic stress, injury, or poor health management.
- Egg, larval, or fry/fingerling mortality remains persistently above acceptable levels due to poor management.
- Handling and transport practices cause avoidable welfare harm.
- Monitoring and record-keeping are absent or inadequate.

3.2 Grow-Out Systems

Grow-out systems represent the longest and most welfare-critical phase of aquaculture production. During this stage, fish are exposed to environmental, management, and social conditions for extended periods that directly influence their health, behaviour, stress levels, and survival. Poor welfare practices at the grow-out stage are a major cause of chronic suffering, disease outbreaks, economic losses, fish mortalities, and environmental degradation.

Under the FW-MSOP, all fish grow-out systems must comply with the general welfare requirements outlined in Section 2, in addition to the system-specific SOPs described below.

GROW-OUT SYSTEMS

The longest, most welfare-critical production phase

01	**Pond-Based Systems** Maintain species-specific stocking densities, manage dissolved oxygen and feeding, and observe fish at dawn when oxygen is lowest.
02	**Cage Culture Systems** Site cages for adequate water flow, use UV-treated nets, prevent injuries and escapes, and plan for mass-mortality events.
03	**Tank-Based & RAS** Match density to biofiltration capacity, install backup power and aeration, and maintain alarms with mandatory contingency planning.

3.2.1 Pond-Based Grow-Out Systems

Pond systems are widely used in Kenya and vary considerably in size, intensity, and management capacity. Fish welfare risks in pond systems commonly arise from overstocking, poor water quality, feeding mismanagement, and inconsistent monitoring. Minimum welfare requirements for pond-based systems include:

- Maintenance of species-specific stocking densities appropriate to pond size, depth, and productivity.
- Regular monitoring and management of water quality parameters, particularly dissolved oxygen and temperature.
- Use aeration or water exchange, as needed, to prevent hypoxia.
- Proper pond preparation, drying, and sanitation between production cycles.
- Feeding practices that minimise waste accumulation and water quality deterioration.
- Control of predators and invasive species that may cause stress or injury.
- Regular disinfection of nets in culture facilities to prevent cross-contamination, using a documented protocol specifying frequency and method.

Operators must routinely observe fish for abnormal behaviour and conditions, particularly during early morning hours when oxygen levels may be lowest.

3.2.2 Cage Culture Systems

Cage culture systems pose distinct welfare challenges related to confinement, water-flow dependency, and exposure to environmental fluctuations. Fish welfare in cages is highly influenced by site selection and environmental management. Under this MSOP, cage culture operations must:

- Site cages in locations with adequate water flow and oxygen availability, in line with the Fisheries Management and Development (Aquaculture) Regulations 2024.
- Avoid excessive stocking densities that restrict movement or degrade welfare.
- Monitor water quality and environmental conditions regularly, including routine observation of fish for abnormalities.
- Use recommended cage and netting materials; nets should be UV-treated and sourced from certified cage input suppliers.
- Maintain cages and nets to prevent injuries, entanglements, or escapes.
- Implement appropriate fallowing or rotation practices where applicable.
- Use recommended fish feed types, sizes, qualities, and quantities, and manage feeding to ensure even distribution and minimise competition.
- Maintain a platform or means for routine cage inspection.
- Establish a documented fish harvesting protocol and mechanisms for the handling and disposal of dead fish in cases of mass mortalities, in line with the Protocol for Handling and Disposal of Mass Fish Mortalities set out in Annex III.

Seasonal and temporal changes, algal blooms, invasive aquatic weeds, and water quality fluctuations must be anticipated and managed to prevent acute welfare events. The use of HDPE cages is encouraged over metal cage structures.

3.2.3 Tank-Based and Recirculating Aquaculture Systems (RAS)

Tank-based and RAS systems allow greater environmental control but also pose high welfare risks if system failures occur. The risks arise from overcrowding at high densities, technology failure, and power interruptions. Welfare outcomes in these systems depend heavily on system design, monitoring, and staff competence. Minimum welfare requirements include:

- Stocking densities aligned with the system carrying capacity and biofiltration performance.
- Continuous or frequent monitoring of key water quality parameters.
- Backup systems for critical infrastructure, such as aeration, filtration, and power supply, including stand-by generators, solar power, and sufficient oxygen reserves.
- Regular maintenance and calibration of equipment.
- Prompt response protocols for system alarms or failures.
- Adequate training and skills enhancement of staff in system management and emergency response.
- Maintenance of optimum feeding levels to support effective waste removal from the system.
- Provision of basic quarantine facilities and mechanisms for disposal of mortalities.

In RAS systems, rapid deterioration of water quality can occur if the system fails; therefore, contingency planning is mandatory.

Monitoring and Welfare Assessment

Across all grow-out systems, operators must:

- Conduct routine welfare observations based on fish behaviour, health, and performance.
- Monitor mortality trends and investigate abnormal fish mortalities.
- Maintain accurate records of stocking, feeding, treatment, harvest, water quality, and other critical fish husbandry practices.
- Adjust management practices promptly in response to welfare indicators.

Inspectors and verifiers should assess grow-out welfare using a combination of animal-based, resource-based, and management-based indicators, as outlined in Section 4.3.2.

3.3 System-Specific Emergency Welfare Notes

These system-specific notes complement the Emergency and Contingency Welfare SOPs outlined in Section 2.10 by highlighting common failure points and priority welfare actions unique to different aquaculture systems. They do not replace the core emergency SOPs, but provide targeted guidance to support rapid and effective welfare protection.

EMERGENCY WELFARE NOTES

System-specific failure points & priority welfare actions

01	**Hatchery Systems** Risks: power loss, water-quality crashes, disease in early life stages. Actions: restore aeration, isolate batches, humanely euthanise compromised fry.
02	**Pond-Based Grow-Out** Risks: dawn oxygen crashes, flooding, drought, contamination. Actions: deploy aeration, reduce biomass, isolate affected ponds.
03	**Cage Culture** Risks: storms, algal blooms, net damage, low dissolved oxygen. Actions: assess cage integrity, redistribute biomass, suspend feeding and handling.
04	**Tank-Based & RAS** Risks: power outage, biofilter collapse, sensor or alarm failure. Actions: activate backup power, cut feeding, carry out emergency water exchange.

3.3.1 Hatchery Systems — Emergency Welfare Notes

Common Emergency Risks

- Power failure affecting aeration, temperature control, or water circulation.
- Sudden deterioration in water quality.
- Equipment failure in incubation or larval rearing units.
- Disease outbreaks with rapid spread among early life stages.
- Accidental introduction of non-target species.

Priority Welfare Actions

- Immediate restoration of aeration and temperature stability.
- Rapidly reduce stocking densities where feasible.
- Isolation of affected batches to limit the spread.
- Early humane euthanasia of severely compromised larvae or fry to prevent prolonged suffering.
- Close post-event monitoring of survival and deformities.
- Screening and sorting of affected batches.
- Maintenance of a fully equipped first aid kit on site.

3.3.2 Pond-Based Grow-Out Systems — Emergency Welfare Notes

Common Emergency Risks

- Dissolved oxygen crashes, especially during early morning hours.
- Flooding or embankment failure.
- Drought-related water shortages or temperature extremes.
- Chemical runoff or contamination from the surrounding land.
- Accidental introduction of non-target species.
- Predation events.

Priority Welfare Actions

- Immediate deployment of aeration or water exchange.
- Partial harvesting or biomass reduction where oxygen levels cannot be stabilised.
- Isolation of affected ponds to prevent the spread of contaminants or disease.
- Protection of fish from predators entering ponds.
- Emergency harvesting and humane slaughter where recovery is not feasible.

3.3.3 Cage Culture Systems — Emergency Welfare Notes

Common Emergency Risks

- Storms, strong currents, or wave action.
- Sudden drops in water quality due to algal blooms, invasive aquatic weeds, upwelling, or pollution.
- Net damage, escapes, or predator attacks.
- Low dissolved oxygen due to stratification or eutrophication.
- Abrupt water hyacinth infestation ('floating islands').

Priority Welfare Actions

- Rapid assessment of cage integrity and fish behaviour.
- Adjustment of stocking densities or redistribution of biomass.
- Emergency relocation of cages where feasible.
- Suspension of feeding and handling during acute stress events.
- Humane emergency killing where fish cannot be recovered without suffering.

3.3.4 Tank-Based and RAS Systems — Emergency Welfare Notes

Common Emergency Risks

- Power outages affect pumps, aeration, or biofiltration.
- Biofilter collapse leading to ammonia or nitrite spikes.
- Monitoring sensor or alarm failures.

- Rapid system-wide water quality deterioration.

Priority Welfare Actions

- Immediate activation of backup power and aeration systems.
- Reduction of biomass and feeding to stabilise water quality.
- Isolation of affected tanks or system components.
- Emergency water exchange, where feasible.

Rapid humane euthanasia of severely compromised fish to prevent prolonged suffering.

Operators must be familiar with the emergency risks specific to their system and integrate these notes into their site-level emergency preparedness plans. Inspectors and extension officers should use these notes to assess whether emergency responses are appropriate, timely, and welfare-focused in relation to system-specific risks.

SECTION

04

ROLES & GOVERNANCE

Institutional roles, the Technical Working Group, inspection and record-keeping.

IN THIS SECTION

SECTION 4 — ROLES, RESPONSIBILITIES AND GOVERNANCE

4.1 Institutional Roles

Effective implementation of fish welfare standards under this FW-MSOP will require establishing clear institutional roles, coordinating across relevant sectors, and ensuring accountability at all levels of the aquaculture value chain. The FW-MSOP recognises that fish welfare governance is inherently multi-institutional and multidisciplinary, cutting across fisheries management, animal health, food safety, environmental management, devolved local governance systems, and the private sector. All institutions and authorities with mandates in these sectors shall coordinate their actions and share responsibilities in accordance with the provisions of this FW-MSOP.

4.1.1 Competent Authority

The Competent Authority (CA) shall be the Ministry responsible for overall oversight and coordination of fisheries and aquaculture. Key responsibilities include:

- Providing policy and regulatory oversight for fish welfare.
- Endorsing or adopting the national FW-MSOP.
- Ensuring implementation and review of the FW-MSOP.
- Coordinating inter-ministerial and inter-agency collaboration.
- Integrating fish welfare into aquaculture development strategies.
- Ensuring alignment with national laws, policies, and international treaties, conventions, and protocols.

4.1.2 Research and Academic Institutions

Kenya Marine and Fisheries Research Institute (KMFRI) and other relevant academic institutions will play a leading role in strengthening the scientific foundation of fish welfare governance. Their responsibilities will include:

- Developing guidelines for humane handling, transport, and slaughter based on scientific evidence.
- Generating, synthesising, and disseminating evidence-based information on fish welfare, health, and production systems.
- Supporting species-specific and system-specific adaptations of the FW-MSOP across freshwater and marine aquaculture systems.
- Developing, testing, validating, and standardising fish welfare indicators, benchmarks, and operational thresholds.

- Providing technical and scientific input into the formulation, review, and revision of national policies and standards.
- Supporting capacity building through curriculum development, training programmes, and professional skills development.
- Promoting innovation, applied research, and technology transfer in fish welfare and production systems.

4.1.3 County Governments

Under the Kenyan legal framework, extension services are domiciled under County Government structures. County governments play a critical role by:

- Facilitating local awareness creation and education on fish welfare.
- Supporting data collection and reporting.
- Conducting extension services through county fisheries and aquaculture extension officers, including providing advisory support to farmers, hatchery operators, and processors.
- Supporting the implementation of welfare-friendly practices and identifying welfare risks.
- Facilitating hands-on training and capacity building for farmers and other aquaculture value chain actors.
- Acting as a feedback channel between producers and regulators.

4.1.4 Role of the Private Sector

Industry actors, including seed and feed suppliers, grow-out farms, processors, aquaculture infrastructure suppliers, and transporters, bear direct responsibility for implementing fish welfare standards in practice. Their roles include:

- Applying FW-MSOP operational procedures within their operations.
- Maintaining accurate records and documentation.
- Investing in welfare-friendly infrastructure and practices.
- Participating in training, awareness creation, and continuous improvement initiatives, including offering demonstration sites for skills development.
- Cooperating with inspections, audits, and verification processes.

4.2 Technical Working Group (TWG)

Kenya has established a Technical Working Group (TWG), with a secretariat, to support effective coordination, technical oversight, and continuous improvement of fish welfare standards. This mechanism serves as the primary technical and coordination platform for fish welfare governance and implementation.

TECHNICAL WORKING GROUP (TWG)

Kenya's primary platform for fish welfare coordination

01	**Composition** Multi-disciplinary, multi-institutional membership spanning fisheries, veterinary, food-safety, environment, research, industry and civil society.
02	**Roles & Responsibilities** Provides technical guidance, coordinates training and awareness, reviews welfare data and inspection findings, and recommends MSOP updates.
03	**Decision-Making** Evidence-based, consensus-driven decisions with clear escalation pathways to ministerial approval and recorded dissenting views.

4.2.1 Composition

The TWG should be multi-disciplinary and multi-institutional, reflecting the cross-cutting nature of fish welfare. Membership should include representatives from:

- The Competent Authority responsible for fisheries and aquaculture.
- County governments.
- Other co-opted government agencies.
- Veterinary or aquatic animal health authorities.
- Food safety and public health institutions.
- Environmental and water resource agencies.
- Research and academic institutions.
- Industry associations or producer organisations.
- Civil society or technical partners, where appropriate.

The composition of the TWG shall be governed by clear criteria for membership and defined terms of reference.

4.2.2 Roles and Responsibilities

The TWG is responsible for providing technical guidance and coordination for fish welfare implementation. Key roles include:

- Overseeing the adaptation and contextualisation of the FW-MSOP at the national level.
- Providing technical advisory input or observer support, particularly during initial establishment or pilot phases.
- Providing technical advice on fish welfare standards and procedures.

- Supporting alignment with national laws, policies, and strategies.
- Coordinating training, capacity building, and awareness creation initiatives.
- Reviewing fish welfare data, inspection findings, and implementation challenges.
- Recommending updates or revisions to the national FW-MSOP based on evidence and learning.
- Facilitating coordination between institutions and stakeholders.

4.2.3 Decision-Making Processes

Clear, transparent decision-making processes are essential to the TWG's credibility and effectiveness. The Competent Authority shall define:

- The scope of decisions that the TWG can make.
- Procedures for consensus-building and technical endorsement.
- Escalation pathways for policy or regulatory decisions requiring ministerial approval.
- Documentation and communication of decisions and recommendations.

Decisions shall be evidence-based, guided by the core fish welfare principles outlined in this FW-MSOP, and aligned with national priorities. Where consensus cannot be reached, mechanisms for recording dissenting views and seeking external technical input shall be established.

4.3 Inspectors and Extension Officers

Inspectors and extension officers play a central role in translating the FW-MSOP from policy and guidance into practice. Their actions directly influence compliance, learning, continuous improvement, and trust between regulators, producers, and other stakeholders.

4.3.1 Roles in Implementation

Inspectors are primarily responsible for regulatory oversight and compliance assessment. Their roles include:

- Conducting fish welfare inspections in accordance with national policies, institutional mandates, and guidelines.
- Assessing compliance with FW-MSOP requirements and applicable regulations.
- Identifying welfare risks, non-compliances, and priority corrective actions.
- Documenting inspection findings and recommendations.
- Issuing comprehensive inspection reports, including corrective actions to be taken.
- Referring serious or repeated non-compliance through appropriate regulatory channels.

Extension officers focus on advisory support and capacity strengthening. Their roles include:

- Supporting farmers and operators to understand and apply FW-MSOP requirements.
- Identifying welfare risks early and recommending preventive measures.
- Providing training, demonstrations, and technical support.

- Supporting record-keeping and good management practices.
- Acting as a link between operators, inspectors, researchers, other service providers, and input suppliers.

4.3.2 Ethical Obligations

Inspectors and extension officers must adhere to high ethical standards in the execution of their duties, including:

- Acting impartially, professionally, with integrity, and without conflict of interest.
- Applying standards consistently and transparently.
- Respecting the confidentiality of farm and operator information.
- Avoiding coercive, punitive, or discriminatory practices.
- Maintaining up-to-date knowledge of regulations and scientific developments.

4.3.3 Inspection Procedures

Inspection procedures under the FW-MSOP are designed to be risk-based, proportionate, and improvement-oriented, recognising the diversity of aquaculture systems and capacities. Inspections are conducted in accordance with the Fisheries Management and Development Act, Cap. 378.

Types of Inspections

- **Approval Inspections:** Conducted to assess compliance with regulations and inform the authorisation of aquaculture establishments.

- **Routine Inspections:** Planned assessments conducted at defined intervals (annually, quarterly, or monthly) based on national regulations or risk profiles. These inspections assess overall compliance with minimum welfare standards, review farm records, observe fish condition and behaviour, identify emerging welfare risks, and provide findings and recommendations.

- **Follow-Up / Verification Inspections:** Conducted after previous inspections identified non-compliances or required corrective actions, focusing on verifying implementation of corrective actions and confirming sustained compliance.

- **Spot-Check Inspections:** Random, risk-based inspections that may initiate a non-compliance incident. They are conducted to assess the level of compliance under normal operating conditions, deter non-compliance through their unpredictability, facilitate early detection of welfare risks, and help identify MSOP gaps for improvement.

- **Annual Audit/National Inspection:** Conducted by non-resident inspectors to monitor and evaluate the level of implementation and compliance with fish welfare requirements, following routine inspection procedures.

- **Emergency/Trigger-Based Inspections:** Conducted in response to specific events or concerns, such as unusual mortality or disease outbreaks, complaints or reports of poor welfare practices, or environmental contamination incidents.

4.3.4 Welfare Indicators and Assessment Tools

01	**Behavioural indicators** Swimming, feeding response, schooling and surface activity.
02	**Physical indicators** Body condition, fin and skin integrity, deformities and injuries.
03	**Physiological indicators** Stress responses, growth performance and signs of disease.
04	**Environmental indicators** Water-quality readings and stocking density relative to the system.
05	**Records & outcomes** Mortality, treatments and corrective actions tracked over time.

Effective welfare assessment shall be undertaken by applying clear, measurable, and context-appropriate indicators. Welfare assessment shall incorporate, in a complementary manner, the following categories of indicators:

Animal-Based Indicators

Animal-based indicators are direct measures derived from cultured fish, including physiological, behavioural, and morphological observations. They are recognised as the most reliable determinants of welfare outcomes and shall be applied as primary measures. These may include:

- Behavioural indicators (e.g., abnormal swimming, lethargy, surface gasping).
- Physical condition (e.g., injuries, lesions, fin damage).
- Health indicators (e.g., external parasites, abnormal colouration).
- Mortality and morbidity rates.
- Growth performance and size variation.
- Observed stress responses.

Resource-Based Indicators

Resource-based indicators relate to the environment, infrastructure, and management inputs provided to fish. These include:

- Water quality parameters (e.g., dissolved oxygen, temperature, pH, ammonia).
- Stocking density.
- System design and maintenance.
- Availability and quality of feed.
- Equipment used for handling and transport.
- Waste management.

Management-Based Indicators

Management-based indicators assess the policies, procedures, decision-making systems, and human practices implemented to safeguard fish welfare. These may include:

- Feeding protocols and schedules.
- Husbandry practices.
- Health management and biosecurity plans.
- Handling, grading, and transport procedures.
- Staff training and competency.
- Monitoring and record-keeping systems.
- Internal audits and reviews.
- Risk assessment and planning.
- Emergency and contingency planning.

The use of standardised assessment tools and checklists is encouraged to ensure uniformity and consistency in welfare evaluations, and shall be applied by inspectors, extension officers, and other designated personnel.

4.3.5 Documentation and Record-Keeping

Accurate and accessible documentation is essential for effective welfare management, monitoring, and accountability under this FW-MSOP. All operators subject to this FW-MSOP shall maintain complete, accurate, and up-to-date records that substantiate welfare assessments and demonstrate continuous improvement. Such records shall be made available for inspection upon request by competent authorities and shall constitute evidence of compliance with prescribed welfare standards.

RECORD-KEEPING ESSENTIALS

Three documentation domains every operator must maintain for inspection

Farm Records	Health & Mortality Records	Water Quality Records
✓ Stocking dates, sources & numbers	✓ Daily & periodic mortality	✓ Routine parameter monitoring
✓ Species & production system	✓ Disease signs & outbreak frequency	✓ Heavy-metal & contaminant sampling
✓ Feeding regimes, types & sources	✓ Treatments & veterinary medicines	✓ Dates, times & methods of measurement
✓ Harvesting, quantities & grading	✓ Biosecurity & preventive measures	✓ Equipment & calibration records
✓ Equipment (DO meters, thermometers)	✓ Mortality disposal methods	✓ Corrective actions & effluent treatment

Farm Records

Basic farm records should include:

- Stocking dates, stock sources, and numbers.
- Species and production system details.
- Feeding regimes, feed types, storage, and sources.
- Harvesting dates, quantities, and grading events.
- Equipment used (e.g., DO meters, thermometers).

Health and Mortality Records

Health-related records should document:

- Daily or periodic mortality.
- Disease signs and outbreak frequency.
- Treatments administered, including veterinary medicines.
- Preventive measures and biosecurity actions.
- Mortality disposal methods.

Water Quality Records

Water quality records should include:

- Routine monitoring results for key water quality parameters.
- Sampling records for heavy metals and contaminants for official control.
- Dates, times, and methods of measurement.
- Type of equipment used and calibration records.
- Corrective actions are taken when parameters fall outside acceptable ranges.
- Water and effluent treatment measures.

Where digital tools are available, electronic record-keeping is encouraged to improve accuracy, traceability, and analysis. Records should be retained for a period defined by national regulations and made available upon request to authorised personnel.

To promote accountability, data-driven management, and harmonisation across regulatory levels, the Competent Authority shall develop standardised record-keeping tools and logbooks aligned with the welfare inspection and assessment checklist. Consistent and verifiable record-keeping shall be linked to farm and facility certification and accreditation, such that the maintenance of complete and accurate records forms a basis for the issuance and retention of relevant approvals.

SECTION

05

REVIEW & UPDATE PROCESS

Keeping the Manual current, credible and continuously improving over time.

IN THIS SECTION

SECTION 5 — REVIEW AND UPDATE PROCESS OF THE MSOP

5.1 Review Cycle

The FW-MSOP shall undergo periodic technical review through an inclusive, multi-stakeholder process convened by the Competent Authority or its designated body. Farmers, inspectors, researchers, community representatives, extension officers, and other relevant stakeholders will be actively engaged to ensure the FW-MSOP remains relevant, scientifically sound, and effective in safeguarding fish welfare across diverse aquaculture systems and contexts.

A routine technical review of the FW-MSOP shall be conducted at defined intervals, recommended at no longer than every three years, or as determined by the Competent Authority. The purpose of periodic review is to incorporate advances in scientific knowledge, evolving best practices, and emerging welfare risks, while maintaining regulatory clarity and stability.

In addition to scheduled reviews, ad hoc or extraordinary reviews may be initiated where warranted. Such reviews may be triggered by, but are not limited to:

- Emergence of new or substantial scientific evidence affecting fish welfare, husbandry practices, or welfare assessment methods.
- Occurrence of major disease outbreaks, welfare incidents, or systemic failures revealing gaps or limitations in existing provisions.
- Introduction, revision, or harmonisation of national, regional, or international regulatory or policy frameworks relevant to aquaculture, animal welfare, biosecurity, or food safety.
- Identification of recurring implementation challenges or unintended welfare consequences arising from the application of the FW-MSOP.

All reviews shall aim to preserve the core purpose and minimum welfare intent of the FW-MSOP, ensuring that revisions strengthen, rather than dilute, protections for fish welfare. The outcomes of review processes, including adopted amendments, shall be documented and communicated to relevant stakeholders through appropriate official channels.

5.2 Amendment and Validation Procedures

Any amendment to the FW-MSOP shall be undertaken in accordance with a structured, transparent, and evidence-based process as prescribed by the Competent Authority. The amendment process shall safeguard the integrity, credibility, and regulatory usefulness of

the FW-MSOP, ensuring that all modifications are consistent with scientific knowledge, best practices, and applicable legal standards. No amendment shall take effect unless duly approved through the prescribed process.

5.2.1 Proposing Amendments

Amendments to the FW-MSOP may be proposed by:

- The Competent Authority responsible for fisheries and aquaculture.
- Bodies mandated to oversee the FW-MSOP.
- County government departments responsible for fisheries and aquaculture are implementing the FW-MSOP.
- Recognised research or regulatory institutions where new evidence has direct implications for fish welfare standards.
- Recognised fish farmer associations, private sector groups, or fish farmer cooperatives.

All proposed amendments must be supported by a clear justification, including scientific evidence, operational experience, or regulatory rationale demonstrating the need for change.

5.2.2 Technical Review and Consultation

All proposed amendments to the FW-MSOP shall be formally submitted to the Competent Authority and received for consideration. To improve coordination, communication, and efficiency in handling stakeholder inputs, the Competent Authority shall establish or designate a liaison office or unit responsible for receiving, logging, acknowledging, and managing proposed amendments, and for coordinating their processing through the Technical Working Group. Upon receipt, proposed amendments shall undergo technical review by the FW-MSOP Technical Working Group and by qualified experts in fish welfare, aquaculture systems, and related disciplines. The review process shall ensure that:

- Amendments are submitted and received in the prescribed format (see Annex II).
- Amendments are consistent with the core objectives and principles of the FW-MSOP.
- Changes do not weaken minimum welfare protections.
- Provisions remain adaptable to diverse national contexts.

5.2.3 Validation and Adoption

Following technical review, proposed amendments shall be subject to a formal validation process conducted by the Competent Authority. Validated amendments shall:

- Be clearly documented, including the rationale and scope of changes.
- Specify the effective date of adoption.
- Communications should be made through official channels to the relevant implementing authorities.

Amendments shall not take effect until formally validated and adopted in accordance with these procedures.

5.2.4 Record of Amendments

A consolidated record of amendments, including revision dates and summaries of changes, shall be maintained to ensure traceability, transparency, and consistency in application across jurisdictions.

5.3 Transition and Future Pathways

The FW-MSOP will form part of the national welfare standards in the aquaculture subsector.

5.3.1 Positioning as a National Fish Welfare Standard

To operationalise and implement fish welfare interventions, the FW-MSOP shall serve as a national standard for enforcing fish welfare matters from time to time, taking into account emerging issues and any future changes in the aquaculture subsector.

5.3.2 Building on the FW-MSOP

The FW-MSOP explicitly recognises that the following may build on it over time:

- Higher-level voluntary standards developed by industry or certification bodies.
- Additional technical guidance and supplementary documentation.
- Future certification frameworks aligned with market or regulatory requirements.

The FW-MSOP shall ensure that any such frameworks align with fish welfare obligations and that the development of higher-level standards does not reduce the minimum welfare protections established herein.

5.3.3 National Ownership and Alignment with Regional and International Development

National ownership and alignment of the FW-MSOP with regional and international development frameworks are critical to establishing a structured path for sustainable aquaculture in Kenya while accounting for emerging developments. Kenya will ensure that standards affecting the FW-MSOP are co-developed by local stakeholders to reflect domestic realities, through the following approach:

- The FW-MSOP shall be developed by the Competent Authority to ensure alignment with existing fisheries and aquaculture laws and regulations.
- In line with the Constitution of Kenya 2010, the development and review process of the FW-MSOP shall involve public consultations with aquaculture value chain actors to ensure procedures are practical and widely acceptable.
- By embedding fish welfare into national governance through the FW-MSOP, Kenya strengthens its Blue Economy framework, making fish welfare in aquaculture a core pillar of economic productivity rather than merely an ethical consideration.

ANNEXES

Reference tables, the amendment form, mortality protocol and bibliography.

IN THIS SECTION

ANNEX I — RECOMMENDED STOCKING DENSITIES

The following tables provide species-specific recommended stocking densities for the major commercially farmed fish species in Kenya. These densities serve as minimum guidance and may be refined over time through additional research and production experience.

Table 12. Recommended stocking densities for Tilapia (Oreochromis spp.).

Life Stage	Culture System	Recommended Stocking Density
Larvae / Hatchlings	Hatchery tanks / jars	2,000–5,000 larvae/m³
Early fry	Nursery tanks / hapas	500–1,000 fry/m² or 200–500 fry/m³
Advanced fry	Nursery ponds / hapas	20–50 fry/m²
Fingerlings	Nursery ponds	10–20 fish/m²
Juveniles	Grow-out ponds (semi-intensive)	3–5 fish/m²
Grow-out (table fish)	Concrete tanks / raceways	20–30 kg/m³
Grow-out (table fish)	Earthen ponds (semi-intensive)	2–3 fish/m²
Grow-out (intensive ponds)	Aerated ponds	5–8 fish/m²
Grow-out (cage culture)	Cages (Lake Victoria)	50–100 fish/m³
Broodstock	Breeding ponds / hapas	2–3 fish/m² (♀:♂ = 3:1)

Table 13. Recommended stocking densities for African catfish (Clarias spp.).

Life Stage	Culture System	Recommended Stocking Density
Larvae	Hatchery tanks / troughs	3,000–5,000 fish/m³
Early fry	Nursery tanks / hapas	1,000–2,000 fish/m³
Advanced fry	Nursery tanks / ponds	300–600 fish/m³
Fingerlings	Tanks / lined ponds	200–300 fish/m³
Juveniles	Grow-out tanks / ponds	80–120 fish/m³
Grow-out (table fish)	Earthen / static ponds	2–10 fish/m³
Grow-out (table fish)	Tanks / intensive ponds	80–120 fish/m³
Grow-out (intensive / RAS)	RAS / tanks	60–100 fish/m³
Very intensive (upper limit)	Tanks (high aeration)	100–200 fish/m³

Table 14. Recommended stocking densities for rainbow trout in Kenya.

Life Stage	Culture System	Recommended Stocking Density
Fry	Hatchery tanks / troughs	1,000–2,000 fish/m³
Early fingerlings	Tanks / raceways	400–600 fish/m³
Fingerlings	Tanks / raceways	200–300 fish/m³
Juveniles	Raceways / flow-through	80–120 fish/m³
Grow-out (table fish)	Raceways	120–200 fish/m³
Grow-out (large trout)	RAS / raceways	60–100 fish/m³

ANNEX II — PROPOSED AMENDMENT SUBMISSION FORM

All proposed amendments to this FW-MSOP must be submitted to the Competent Authority using the form below or an equivalent format prescribed by the Competent Authority. Please complete all fields and attach supporting documentation.

Table 15. Proposed Amendment Form.

No.	Section of FW-MSOP	Sub-Section of FW-MSOP	Issue(s) / Justification	Proposed Amendment
1				
2				
3				
4				
5				

NATIONAL MANUAL

STANDARD OPERATING PROCEDURE

(MSOP)

FOR FISH WELFARE IN AQUACULTURE

KENYA

> Promoting responsible aquaculture through improved fish welfare standards, sustainable production systems, and evidence-based management practices.

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