ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) REPORT

for

UTILIZATION OF SPACES BETWEEN THE CENTRE PIVOTS TO GROW FRUITS IN ORCHARDS AT ETUNDA GREEN-SCHEME, OMUSATI REGION, NAMIBIA

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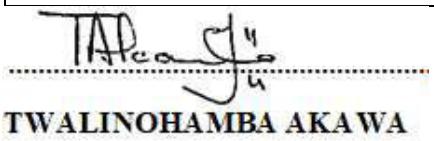

EAP Signature

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Proponent

September 2025

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1. INTRODUCTION

1.1 Introduction

The proponent for the proposed orchard development activities at Etunda Green-scheme is the **Ministry of Agriculture, Fisheries and Land Reform (MAFWLR)**. The MAFWLR is a key ministry in the Government Republic of Namibia (GRN) responsible for agricultural development.

More specifically, the MAFWLR's role encompasses a broad range of responsibilities aimed at ensuring food security, economic development, and sustainable resource management in Namibia, including:

- **Agricultural Development:** Promoting and supporting crop and livestock production, such as initiatives like the Green Schemes to enhance food security and agricultural productivity. This involves agricultural research, extension services, and infrastructure development (like irrigation systems).

The MAWLR is aware that there was no **Environmental Clearance Certificate (ECC)** issued when Etunda Irrigation-Scheme was established because the Environmental Management Plan (No. 7 of 2007) was not enacted. The MAWLR, also considered that since Etunda Irrigation-Scheme is already an existing establishment, there is no need for undergoing the Environmental and Social Impact Assessment (ESIA) process.

In light of the above, the MAFWLR committed to early involve an Environmentalist in the proposed orchards design of permanent crops layout design. This is to ensure that all (if any) potentially negative environmental impacts are identified and mitigated:

- Firstly; based on the permanent crops layout design plans, there were no significant negative environmental impacts of the proposed development of orchards at Etunda Green-scheme.
- Secondly; for the negative environmental impact that were identified, these could be mitigated and the MAFWLR has compiled an Environmental and Social Management Plan (ESMP) detailing how these will be mitigated.

This ESMP report is prepared based on the environmental and social conditions observed during fieldwork at the Etunda Irrigation-Scheme on 19 May 2025, and suggests measures required to mitigate the potential negative impacts associated with the proposed development of orchards.

1.2 Problem statement

Among other Green-schemes, the MAFWLR operates Etunda Green-scheme. Green-schemes utilize the pivot irrigation systems. The problem associated with designs of the pivot irrigation systems at Etunda Irrigation-Scheme is such that the spaces between the pivot systems are not efficiently used. While the unutilised spaces between the pivots is a general problem associated with other Green-schemes, there are challenges specific to Etunda Green-scheme, including:

- Water supply constraint: lack of capacity to irrigate,
- The additional land to be cleared for the proposed development of orchards,
- Irrigation inefficiency: the current irrigation system suffers from clogging of pipes,
- Clogged pipes,
- High energy consumption,
- Vandalism and theft, and
- No prior ESIA was conducted prior to establishment of Etunda Green-scheme.

1.3 Need and desirability of the proposed orchard development

In order to maximize land use, the MAFWLR proposes establishing fruit orchards within the Etunda Green-scheme, specifically utilizing the spaces between the center pivot irrigation systems. Optimisation of spaces between the pivot is need and it is supported by many legislations in Namibia as described below.

1.4 Rationale and objectives of the ESMP report

The precautionary approach principle was applied to mitigate negative environmental and social impacts by developing this ESMP report.

The rationale and objectives of this ESMP report is to meet conditions that will be stipulated in the ECC as a legal document:

- Provide an implementation framework by turning mitigation measures into actionable plans with clear responsibilities, timelines, and monitoring and evaluation activities;
- Act as a dynamic document for ongoing management, monitoring, and adaptation throughout the proposed orchard development project;
- Allow for the handling of unforeseen impacts and ensuring effective mitigation.
- Clearly define roles for environmental and social performance, fostering accountability, and

- Facilitate adaptive management through regular reviews and enhance the project's resilience.

2. ENVIRONMENTAL LEGISLATIONS AND GOVERNANCE

2.1 Overview of relevant legislations

***National Agricultural Policy*:** While focused on agriculture, this policy contains provisions for sustainable natural resource management, recognizing the increasing scarcity of water and arable land.

***Green Scheme Policy*:** The Green Scheme emphasizes on *"sustainable growth of economy, maintaining & improving land capability, reduction of poverty and introducing commercial irrigation farming."*

***National Land Policy*:** This policy also includes provisions for *"Environmentally Sustainable Land Use"* and related boards and planning.

***Water Resources Management*:** The Department of Water Affairs (which under MAFWLR) has a clear mandate to *"promote, manage and utilize water resources sustainably and manage Namibia's water resources".*

***National Development Plans and Strategies*:** The MAFWLR's activities are aligned with broader national development frameworks like the Vision 2030 and National Development Plans (NDPs), which consistently embed principles of sustainable development and environmental protection across all sectors. Namibia's Long-Term Low-Emission Development Strategy, for example, specifically includes *"Sustainable Land Use, Forestry and Agriculture*" as a pillar.

2.2 Governance

The decision-tree below which was used to guide preparation of this ESMP was based on the Environmental Management Act (No. 7 of 2007). According to this decision tree, the MAFWLR assumed that the proposed development of orchards is a listed activity. For the design of orchards, the MAFWLR appointed AIJ Consulting Engineers & Infrastructure Managers on a condition that they involve an Environmental Specialist in the early stage of the designs who will support application for the ECC.

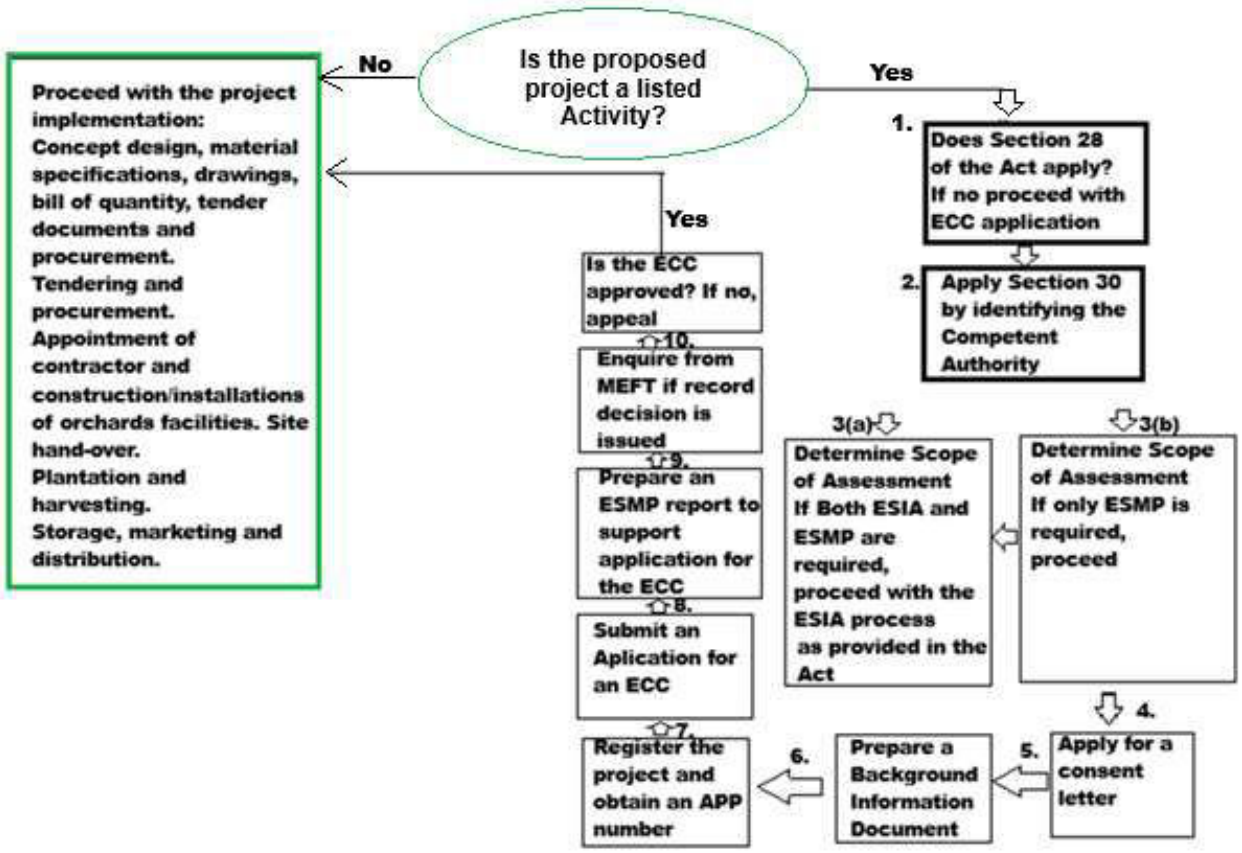

Figure 1*:* The decision tree.

2.2.1. Applicability of Section 28

Although the MAWLR could qualify for exemption under Section 28 of Namibia's Environmental Management Act (No. 7 of 2007), the MAWLR opted not to seek for exemption from obtaining the ECC.

2.2.2. Competent authority

The proponent happened to be **a** competent authority at the same time. While the MAFWLR is mandated to manage the Etunda Green-scheme, the MAFWLR simultaneously plays the role of promoting crop production in Namibia.

2.2.3. *Screening*

A determination was made to decide the scope of the assessment by uploading the background information document (BID) on the MEFT's portal for EIAs. The Screening notice was issued and required the following documents to be uploaded:

- EIA.
- Confirmation of screening notice received (through email) in terms of assessment procedures (Section 35 (1)(a)(b) of the Environmental Management Act, No 7 of 2007).

- Preliminary Site Map (Project boundaries) with coordinates (decimal degrees) and a Legend.
- CV of Environmental Assessment Practitioner (EAP).
- Declaration for the Submission of Assessment Reports, and
- Consent letter for the MAFWLR.

2.3.1. Application for consent letter

The MAFWLR should prepare a consent letter informing the MEFT of this proposed project.

2.3.2. Background information document

This background information document (BID), to inform key stakeholders of the intention by the MAFWLR to undertake the proposed project.

2.3.3. Project registration

The project will be registered on the MEFT's portal for EIAs.

2.3.4. Application for ECC

Application for ECC will be launched as guided by the relevant Sections in the Act.

3. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The MAWLR has committed to protecting the environment during its proposed development of orchards through implementation of an **Environmental and Social Management Plan (ESMP)**. The main advantage is that the MAFWLR already has a Green-scheme Policy. It will even more efficient is this ESMP is integrated into the MAFWLR's Green-scheme Policy.

The ESMP serves as a detailed guide for environmental monitoring, outlining which indicators to track and the standard operating procedures (SOPs) to use for each. These indicators will be used to measure the state of the environment, including the quality of surface water, groundwater, and soil, both before and after the orchard development. The indicators are divided into two main categories: physical/chemical and biological. Within each category, specific parameters will be measured using various instruments.

4. ENVIRONMENTAL CERTIFICATIONS AND DOCUMENTATIONS

Environmental certifications will include permits and certificates needed to authorize performance of orchard development as required by other GRN entities. Documentations will be communicable materials that will be required to describe, explain or instruct and communicate information regarding the installations of infrastructures, site preparation and planting, operation, cultivating, harvesting, and marketing.

Before commencement of the proposed orchard development activities, the following environmental certifications and documentations shall be required:

Table 1: Permits and authorization.

Certification and documentation	**GRN entity/competent authority**	**Contact person/details**
Environmental Clearance Certificate (ECC)	Ministry of Environment, Forestry and Tourism	Environmental Commissioner
Water abstraction permit	Ministry of Agriculture, Fisheries, Water and Land Reform	Department of Water Affairs
Environmental and Social Management (ESMP) report	Ministry of Agriculture, Fisheries, Water and Land Reform	Agriculture Engineering Services
Inception report	Ministry of Agriculture, Fisheries, Water and Land Reform	Agriculture Engineering Services
Approved orchards development engineering design plans	Ministry of Agriculture, Fisheries, Water and Land Reform	Agriculture Engineering Services

4.1 Constitution of the Environmental Clearance Certificate (ECC)

Contents and conditions of ECC will be provided in the ECC. Amongst others, the following conditions might be included:

Regular environmental monitoring and evaluations on environmental performance should be conducted at the site and targets for improvements established and monitored throughout the orchard development activities.

The ECC should be valid for a period of 3 (three) years, from the date of issue.

- On expiry of the ECC, the MAFWLR will be required to submit within a period not exceeding one month, and in the prescribed form and manner an application to the Office of the Environmental Commissioner (OEC) for the renewal of the ECC.

- All other applicable and required permits or authorizations from relevant competent authorities must be obtained prior to commencement of the proposed activities.

- Granting of ECC constitutes an approval for the implementation of mitigation measures proposed in the approved ESMP, hence making the ESMP a legally binding document.

- The proponent shall appoint a suitably qualified Environmental Control Officer (ECO), before commencement of listed activities to ensure compliance and implementation of the approved ESMP.

- The proponent is required from date of commencing implementation of the orchards development activities, to compile and submit environmental monitoring reports (on the project progress and the management profile) on bi-annual basis to the OEC.

- Any changes to, or deviations from the scope of project activities approved in respect to the assessment received and reviewed for the purpose of or granting the ECC will be subject to an amendment application and approval by the OEC prior to adopting/implementing any such changes/deviations.

4.2 Constitution of other permits or licenses

Conditions and contents in other permits such as water abstraction permit will be determined by the competent GRN authorizing entities.

5. BASELINE ENVIRONMENTAL MONITORING INDICATORS

5.1 Physical/chemical environmental indicators

Some or all of the following parameters will be measured to indicate water quality:

- Free Carbon Dioxide;
- Water temperature;
- Dissolved oxygen (DO);
- Turbidity;
- Total suspended and dissolved solids;
- Nutrients (nitrates, nitrites, total phosphate, free chlorine, etc);
- pH, conductivity/salinity metre;
- Pathogens (bacteria, virus, etc), and
- Trace metals.
- Soil types.
- Soil moisture content.

6. TECHNOLOGY AND EQUIPMENT REQUIREMENTS

Equipment and technologies required for ESMP implementation and baseline environmental monitoring are provided below. These equipment and technology are available from various institutions in Namibia such as NCRST (National Council on Research, Science and Technology), NUST (Namibia University of Science and Technology), UNAM (University of Science and Technology), NAMWATER (Namibia Water Corporation), MAFWLR (Ministry of Agriculture, Fisheries, Water and Land Reform) and commercial laboratories.

With regard to technologies and equipment requirements, the local capacity for baseline environmental monitoring exist in Namibia. Therefore, it will not be necessary for the proponent to purchase these technologies and equipment. Rather it will be advisable for the proponent to collaborate with local institutions in order to invest in the local capacity for environmental baseline monitoring activities. These activities which will involve hiring of environmental consultants; training of students and in-service staffs in conducting baseline surveys; sample collection; sample processing and analysis and reporting.

Table 2: Technology and equipment requirements.

Parameter	**Equipment/method**
Free Carbon Dioxide (CO_2)	-Measure CO_2 directly using beverage carbonation metre. The recommended **OxyGuard portable CO_2 meter** is a reliable and easy-to-use instrument that measures dissolved CO_2) in water. The meter consists of a probe and a battery-powered transmitter. The meter displays CO_2 concentration and an analog signal as output. -The titration method can also be used, though not recommended.
Water temperature	-Measure using a **thermometer**. -The **Hach HQ30D** also measures temperature. -Currently there are online weather databases that provide daily water temperature data.
Dissolved oxygen	-The recommended ***Hach HQ30D*** **portable multi-parameter** gives maximum measurement flexibility and ease of operation with interchangeable probes and automatic parameter recognition.

	-The **Winkler's titration** method will be used for comparison.
Turbidity	-The recommended **HACH 2100Q turbidometer** is accurate and reliable in measuring turbidity. It is portable and battery powered; so measurements could be taken and recorded while in the field. -The **HACH HQ30D** also measures TDS (total dissolved solids) and could be ideal in case the **HACH 2100Q turbidometer** is not available. TDS could be used to indicate turbidity.
Total suspended and volatile solids	TSS and TVS could be measured either using the HACH DR 2700, DR 2800 or DR 900. The recommend **HACH DR 900** is portable, LED-sourced colorimeter and it measures at wavelengths of 420, 520, 560 nd 610 nm. Measurements could be taken and recorded while in the field; eliminating the need for sample transportation.
Nutrients (nitrates, nitrites, total phosphate, free chlorine, etc)	
pH, conductivity/salinity meter	The **Hach HQ30D** multi-parameter is recommended.
Pathogens	Pathological samples shall be taken for analysis of total coliforms and *Streptococcus sp*. Other indicators may be selected according to the ECO's discretion and factors inherent at site.
Trace metals	It is recommended that analysis for trace metals are performed by a commercial laboratory. The proponent or the ECO should collect samples, preserve and send them to a commercial laboratory (e.g. Analytical laboratory or NAMWATER).
Soil size analysis	Part of the soil will be used to study grain size using the **Sieving Assemblage-Wilson** instrument.

7. ENVIRONMENTAL MANAGEMENT COMMITTEE

There shall be established an environmental management committee (EMC). There will be no need for the proponent to recruit new employees as the committee will only meet on quarterly basis. For specialized environmental services, the proponent may hire an Environmental Control Officer (ECO) as well as a Soil Scientist on contract basis.

Below are proposed members of the EMC as well as required competency and responsibilities.

Table 3: Composition of environmental management committee.

Personnel	Competence	Responsibilities
Environmental Management Representative (EMR)	Should be in employment of the proponent. Should be a senior staff member with a management position in the MAFWLR (e.g. Senior Agricultural Engineer) or a Farmer Manager at Etunda Green-scheme.	• Represent management on environmental safety and occupational issues related to underwater hull cleaning operations. • Provide support and avail resources needed to endorse and implement the company's environmental policy. • Upon advice from the Soil Scientist or ECO, the EMR may suspend farming activities at the orchards if it is suspected that the activities constitute danger to human life or comprises safety risk to equipment and the environment.
Environmental Safety and Occupational Representative (ESOR)	Should be in employment of the MAFWLR. A minimum of grade 12, sufficient knowledge of environment, safety and ethics at the farm. Preferably, a Farm Manager.	• Represent employees' environmental safety and occupational concerns related to orchard development activities. • Ensure other employees comply to conditions as required in the environmental clearance certificates or permits. • Where untoward situation arises that may constitute a hazard to human life or environment and the equipment or other assets.
Soil Scientist	BSc. degree in soil science, agricultural engineering or related field.	• **Site Suitability and Pre-Planting Assessment:** The Soil Scientist shall conduct detailed soil surveys to classify soil types, assess drainage, analyse topography for erosion risk and irrigation planning, and investigate past land use for potential disease or pest issues. S/he shall also consider climate interactions with soil properties. • **Pre-Planting Soil Preparation and Amendment:** The Soil Scientist shall undertake a comprehensive soil testing for nutrient levels,

		pH, organic matter, CEC, and salinity. Based on these results, s/he shall recommend specific mitigation measures like lime, organic matter, deep ripping, fertilizers, and drainage solutions to optimize soil conditions before planting. • **Ongoing Soil Management and Sustainability:** The Soil Scientist's role shall extend to developing long-term mitigation plans for fertigation and nutrient management, regularly monitoring soil health, advising on efficient water management and irrigation, recommending orchard floor management practices (mulching, cover cropping), designing erosion control measures, and preventing/remediating soil compaction. Finally, s/he shall diagnose soil-related problems in established orchards and conduct research to enhance sustainable soil management.
Environmental Control Officer (ECO)	Master's degree or MSc. in the field of environmental or natural resources management, or water science. Knowledge of environmental impact assessment, experience in developing ESMP and the implementation of ESMP. Experience in undertaking baseline environmental monitoring is compulsory. More than 10 years of field survey co-ordination and laboratory analytical skills will be an added advantage.	• The overall responsibility of the ECO shall be to assist the MAFWLR in implementation of the ESMP and baseline environmental plan; ensure environmental compliance and certification with GRN policies and legislations. • Provide advice on environmental project management of the orchard development activities and obtain the ECC for the project. • Development of the ESMP for the orchard development activities. • ECO will advise the committee in domestication of the ESMP, scientific interpretation of results from baseline environmental surveys as well as reporting.

8. MITIGATION ACTIONS

Mitigation actions that are required to reduce or minimize negative impacts are described in ***table 4***.

8.1 Impacts preparedness and response plan

A **risk** is an uncertain event, whereas an **impact** is the definite outcome should that event happen. Since risks can profoundly affect workers, the environment, and property, it is crucial to always be prepared to respond, regardless of their likelihood. All response actions should be geared toward the following priorities in the order below:

- ***Safety*** of people (always First);
- ***Protection*** of the Environment, and
- ***Protection*** of Assets.

Emergency preparedness and response management follows a 5-step cycle:

- **Prevention:** Taking actions to stop an incident from occurring.
- **Mitigation:** Implementing measures to lessen the likelihood or severity of an emergency's damaging effects.
- **Preparedness:** Enhancing readiness to respond, through activities like developing procedures (e.g., method statements, exit plans), conducting training and awareness programs, and performing drills.
- **Response:** Immediate actions taken before, during, and after a hazard's impact to save lives, reduce losses, and alleviate suffering. This includes activating emergency centers, evacuations, providing care, rescue, and firefighting.
- **Recovery:** Actions aimed at returning to normal conditions, involving restoration of services, repair of damages (environmental, social, economic), debris cleanup, financial aid, and rebuilding infrastructure.

9. GRIEVANCE MECHANISM

The procedure the management will apply to deal with the employees' grievances will be enforced as follows:

9.1 Timely Action

The first and foremost requisite in grievance handling shall be immediate settlement as they arise. The sooner a grievance is settled, the lesser it will affect employees' performance. This requires the first line supervisors to be trained in recognizing and handling a grievance properly and promptly.

9.2 Accepting the Grievance

The supervisor shall recognize and accept the employees' grievances as and when it shall be expressed. Acceptance shall not necessarily mean agreeing with the grievance; it rather shows the supervisor's willingness to look into the complaint objectively and dispassionately.

9.3 Identifying the Problem
The grievance expressed by the employee shall be at times simply emotional, over-toned, imaginary or vague. The supervisor, therefore, shall be required to identify or diagnose the problem stated by the employee.

9.4 Collecting the Facts
Once the problem is identified as a real problem; the supervisor should, then, collect all the relevant facts and proofs relating to the grievance. The facts so collected shall be separated from the opinions and feelings to avoid distortions of the facts.

9.5 Analyzing the cause of the Grievance
Having collected all the facts and figures relating to the grievance, the next step involved in the grievance procedure shall be to establish and analyse the cause that led to grievance. The analysis of the cause shall involve studying various aspects of the grievance such as the employee's past history, frequency of the occurrence, management practices, union practices, etc. Identification of the cause of the grievance helps the management to take corrective measures to settle the grievance and also to prevent its recurrence.

9.6 Decision making
In order to take the best decision to handle the grievance, alternative courses of actions shall be worked out. These are, then, evaluated in view of their consequences on the aggrieved employee, the union and the management. Finally, a decision taken should best suite a given situation. Such decision should serve as a precedent both within the department and the company.

9.7 Implementing the Decision
The decision shall be immediately communicated to the employee and also implemented by the competent authority.

In case, it is not resolved, the supervisor once again needs to go back to the whole procedure step by step to find out an appropriate decision or solution to resolve the grievance.

10. EXTERNAL COMMUNICATIONS

10.1 Centralized Control and Official Spokespersons

Designated Authority:

- Typically, the MAFWLR will have designated individuals or departments responsible for external communications. This often includes a Public Relations Officer (PRO) or a communications unit.

Official Spokesperson:

- Only authorized individuals (e.g., the Minister, Executive Director, or a designated PRO) shall be permitted to speak to the media or make public statements on behalf of the MAFWLR. This ensures consistent messaging and adherence to official positions.
- The Agricultural Engineer shall make an internal communication to the authorized individuals who will disseminate information to the media or make public statements on behalf of the MAFWLR.

10.2 Key Objectives of External Communication

Information Dissemination:

- Proactively communicating MAFWLR's programs, policies, and activities to the public.

Transparency and Accountability:

- Providing permissible access to MAFWLR's information to the public, fostering two-way communication to enhance transparency.

Public Image Management:

- Identifying and managing factors that negatively impact the MAFWLR's image and implementing restorative measures.

Stakeholder Engagement:

- Engaging with various external stakeholders, including the public, farmers, private sector, international organizations, and other government bodies.

Promoting Mandate:

- Communicating the MAFWLR's vision, mission, and objectives (e.g., MAFWLR's focus on sustainable agriculture, water, and land resource management, and initiatives like the Green Schemes).

10.3 Communication Channels and Tools

Media Relations:

- Issuing news releases for significant reports or issues.

- Responding to media inquiries.
- Monitoring media coverage.
- Utilizing traditional media (print, broadcast) and online platforms.

Digital Communication:

- MAFWLR's website (MAWLR - MAFWLR - Portal Ariel): A central hub for information, reports, and updates.
- Social Media: Engaging with citizens, partners, and stakeholders, allowing for two-way communication. Policies typically exist for responsible social media use by government personnel.
- Email: For official correspondence, newsletters, and updates to specific mailing lists.

Publications and Reports:

- Producing official reports (e.g., environmental management plans, policy documents).
- Newsletters and brochures.

Public Engagements:

- Participating in trade fairs, exhibitions, and public events to disseminate information and engage with the public.
- Organizing or participating in workshops and consultations with stakeholders.

Speeches and Presentations:

- Ministers and other authorized personnel deliver speeches and presentations at various forums.

9.4 Strategic Approach

Communication Plans:

- The MAFWLR's Division of Agricultural Engineering shall develop a communication plan that outline objectives, target audiences, key messages, and chosen channels.

Audience Segmentation:

- Messages shall be tailored to different audience segments (e.g., farmers, investors, general public) to ensure relevance and impact.

Consistency:

- A strong emphasis shall be placed on maintaining a consistent voice, brand, and messaging across all external communications.

Monitoring and Evaluation:

- Assessing the effectiveness of communication efforts through media monitoring and public feedback.

11. RECOMMENDATIONS

It is recommended that:

- The proponent strictly adheres to ESMP and undertake baseline environmental monitoring;
- Data from baseline environmental monitoring should be kept and availed to GRN authorities when requested, and
- The technology and equipment may be hired.

12. REPORTING

Baseline monitoring and environmental monitoring should be reported to MEFT and other GRN authorities when requested. This should be done either by submitting quarterly or annual reports.

Table 4: Impacts mitigation and response plan.

RECEIVING ENVIRONMENTAL RECEPTORS	IMPACTS	MITIGATION ACTIONS	RESPONSIBLE PERSONS OR ENTITY
PHYSICAL ENVIRONMENTAL RECEPTORS			
Air quality	Orchards development activities are **low-impact activities** that generally have a **minimal direct effect on air quality**—especially when compared to highly industrialised activities. However, some negative impacts include: **Dust Emissions:** • **Land Preparation:** Activities like clearing land, tilling, and creating planting mounds can generate significant amounts of dust, especially in dry, arid or semi-arid regions like Namibia. • **Farm Traffic:** Vehicles moving on unpaved roads within the orchard and during transport of materials can kick up dust. • **Harvesting:** Certain harvesting methods, particularly for some fruit types, can also stir up dust. **Emissions from Machinery and Equipment:** • **Combustion Engines:** Tractors, irrigation pumps, sprayers, and other machinery used in planting, cultivation,	**Dust Control** • **Minimize Soil Disturbance:** During land preparation, planting, and cultivation, aim to minimize tilling and soil movement, especially during dry and windy conditions. • **Cover Crops/Mulching:** Plant cover crops between orchard rows or use mulching materials to keep soil covered, reducing wind erosion and dust generation. • **Watering Unpaved Roads:** If there are unpaved access roads within or around the orchards, regular watering can suppress dust. • **Windbreaks:** Establish tree lines or other windbreaks around the orchard to reduce wind speed over exposed soil, thereby reducing dust. **Machinery Emissions** • **Regular Maintenance of Equipment:** Ensure all tractors, pumps, generators, and other machinery are regularly serviced and well-maintained to operate efficiently and minimize exhaust emissions (particulates, NOx, SOx). • **Fuel Efficiency:** Promote fuel-efficient practices and consider upgrading to newer, more efficient machinery with lower emission standards. • **Electric or Hybrid Equipment:** Where feasible, explore the use of electric or hybrid machinery for	**Environmental Manager Representative** (EMR) **Environmental Safety and Occupational Representative** (ESOR) **Soil Scientist** **Environmental Control officer** (ECO)

	harvesting, and pest control run on fossil fuels (diesel, petrol), releasing exhaust fumes containing: o Particulate Matter (PM2.5, PM10) o Nitrogen Oxides (NOx) o Volatile Organic Compounds (VOCs) o Carbon Monoxide (CO) o Sulphur Dioxide (SO2) (though less common with cleaner fuels) **Pesticide and Fertilizer Application:** • **Sprays and Drifts:** The application of pesticides, herbicides, and some liquid fertilizers can lead to airborne drift, where fine droplets or particles are carried by wind beyond the target area. This can impact surrounding air quality and non-target organisms. • **Volatilization:** Some chemical compounds in pesticides or fertilizers can volatilize (evaporate) into the atmosphere, contributing to air pollution. • **Ammonia Emissions:** The application of nitrogen-based fertilizers can lead to the emission of ammonia (NH3) gas, which can contribute to particulate matter formation in the atmosphere.	tasks that allow it, significantly reducing local air pollution. • **Optimize Operations:** Plan fieldwork to minimize idle time for machinery. **Pesticide and Fertilizer Application (VOCs, Aerosols):** • **Integrated Pest Management (IPM):** Implement IPM strategies to reduce the overall reliance on synthetic pesticides. This involves using biological controls, resistant varieties, and monitoring to only apply chemicals when necessary. • **Targeted Application:** Use precision application techniques (e.g., direct injection, shielded sprayers) to ensure pesticides and fertilizers are applied only where needed, minimizing drift and aerosol formation. • **Low-Volatile Formulations:** Choose pesticide formulations with lower volatility to reduce the amount of VOCs released into the atmosphere. • **Optimal Weather Conditions for Spraying:** Spray pesticides during calm conditions (low wind speed) and appropriate temperatures to minimize off-target drift. Avoid spraying during inversions, which can trap chemicals close to the ground. • **Buffer Zones:** Maintain adequate buffer zones around sensitive areas (e.g., residential areas, water bodies) to prevent chemical drift. • **Proper Storage and Disposal:** Store chemicals in sealed containers in well-ventilated areas and dispose of empty containers and leftover chemicals according to regulations to prevent accidental release. **Biomass Burning (if applicable):**	

	Biomass Burning (Orchard Debris): • **Pruning Waste:** Pruned branches, old trees, and other orchard debris are sometimes burned as a method of disposal or disease control. This burning releases smoke, particulate matter, carbon monoxide, and other harmful pollutants into the atmosphere. This is often a significant concern for air quality, especially in areas near urban centers. **Odors:** • **Fertilizer Application:** Certain organic fertilizers (e.g., manure) or synthetic fertilizers can release strong odors, particularly when freshly applied. • **Pesticide Odors:** Some pesticides may have distinct odors.	• **Avoid Open Burning:** Strongly discourage or prohibit the open burning of agricultural waste (pruning, dead trees). • **Alternative Disposal:** Promote alternative methods for biomass disposal, such as chipping for mulch, composting, or anaerobic digestion. **Monitoring and Awareness:** • **Regular Monitoring:** Implement a system to monitor air quality parameters if there are concerns about specific pollutants. • **Farmer Training:** Educate farmers and workers on best practices for air quality management, safe handling of chemicals, and proper equipment operation.	
Noise generation	Orchard development, despite being less industrial, contributes to noise pollution through several sources: primarily **heavy machinery** like tractors, sprayers, irrigation pumps, harvesting equipment, chippers, and generators. **Vehicular traffic**, including heavy trucks and farm vehicles, also adds to the noise.	**Select Quieter Equipment:** • Prioritize modern machinery that is designed for lower noise emission. • Ensure all equipment is well-maintained to prevent excessive noise from worn parts.	**ECO**

	Operational sounds like power pruning tools and particularly loud, intermittent bird-scaring devices are significant contributors. The initial **construction and development phase** with its associated heavy equipment also generates substantial noise. These noise sources lead to various **negative impacts**, including disturbance to wildlife (affecting breeding and feeding), annoyance and stress for nearby residents, a general reduction in quality of life, and potential health effects for workers due to long-term exposure.	**Limit Operating Hours:** • Restrict noisy activities to specific daytime hours, avoiding early mornings, late evenings, weekends, and public holidays, especially if residential areas are nearby. **Noise Barriers/Buffers:** • Utilize existing natural topography or vegetation as noise buffers between the development site and sensitive receptors (e.g., residential areas, wildlife habitats). • Consider temporary noise barriers or fencing during particularly noisy operations if close to sensitive areas. **Site Planning:** • Position noisy activities (e.g., equipment staging areas, material stockpiles) as far as possible from sensitive receptors. **Efficient Work Planning:** • Plan work efficiently to minimize the duration of noisy activities. Consolidate noisy tasks where possible.	

		Worker Training: • Train workers on best practices for noise reduction, such as turning off idling equipment. **During the Operational Phase (Orchard Maintenance, Harvesting, Irrigation):** **Maintain Equipment Regularly:** • Ensure all farm machinery (tractors, sprayers, harvesters) and irrigation pumps are regularly serviced to keep them running efficiently and quietly. Worn parts often increase noise. **Optimize Operation Schedules:** • Schedule the use of particularly noisy equipment (e.g., large tractors for spraying or mowing) during times that minimize disturbance to nearby communities, if applicable. **Vegetation Buffers:** • Establish and maintain dense tree lines or other vegetation belts around the perimeter of the orchard, especially on sides facing sensitive areas. These can	

		significantly absorb and diffuse sound. **Enclose Stationary Noise Sources:** • If any permanent noisy installations are required (e.g., irrigation pump houses, power generators), enclose them in sound-attenuating structures. **Use Quieter Alternatives:** • Where possible, opt for quieter agricultural methods or technologies. For example, some irrigation systems are inherently quieter than others. **Community Engagement (If Applicable):** • If there are nearby communities, engage with them regarding planned noisy activities and establish channels for feedback to address concerns promptly.	

Land and soil resources	**Soil Erosion:** • **Initial Land Clearing:** Removal of native vegetation exposes bare soil, making it highly susceptible to wind and water erosion, especially on slopes or in windy regions. • **Tillage and Cultivation:** Repeated tilling (ploughing, harrowing) breaks down soil structure, reduces organic matter, and leaves the soil surface vulnerable to erosion by rain and wind. • **Inter-row Management:** If inter-rows are kept bare (e.g., through herbicide use or constant cultivation), there's no protective cover, leading to soil particle detachment and transport. • **Irrigation Runoff:** Poorly managed irrigation (e.g., excessive water application, uneven distribution) can lead to surface runoff, carrying away topsoil and nutrients. • **Compacted Traffic Areas:** Vehicle tracks create compacted pathways that shed water rather than allowing it to infiltrate, increasing runoff and erosion in other areas. **Soil Compaction:** • **Heavy Machinery:** Repeated passes of tractors, sprayers, harvesters, and other heavy	**Comprehensive Site Assessment and Planning** ○ **Detailed Soil Surveys:** Before development, conduct thorough soil surveys to understand inherent properties (texture, structure, depth), identify problem areas (e.g., hardpans, sodic soils), and determine suitability for specific fruit crops. ○ **Topographic Analysis:** Analyze slopes and drainage patterns to design orchard layouts that minimize water runoff and erosion. ○ **Pre-Planting Remediation:** Implement soil amendments (lime for pH adjustment, gypsum for sodic soils) and deep ripping/chiseling to break up compacted layers and improve drainage *before* trees are planted. This is far more effective and less disruptive than trying to correct issues later. **Erosion Control** ○ **Contour Planting:** Plant trees along the contours of the land, especially on slopes, to slow down water flow and reduce soil erosion. ○ **Terracing:** On steeper slopes, construct terraces to create flatter planting areas, intercept runoff, and prevent soil loss. ○ **Cover Cropping/Inter-row Vegetation:** ▪ Establish permanent grass or legume cover crops in the inter-rows (between tree rows). This shields the soil from raindrop impact, binds soil particles with roots, increases organic matter,	**Soil Scientist** **MAFWLR (Agricultural Engineer)** **MAFWLR (Farm Manager)**

	equipment over the same areas (especially when soil is wet) compact the soil. • **Foot Traffic:** Frequent walking in specific areas (e.g., around trees) can also contribute to compaction. • **Impacts:** Compaction reduces soil pore space, hindering water infiltration and drainage, decreasing aeration (oxygen availability for roots), impeding root growth and penetration, and making the soil less hospitable for beneficial microorganisms. This leads to reduced nutrient uptake and overall tree health. **Loss of Soil Organic Matter (SOM):** • **Tillage:** Frequent tillage accelerates the decomposition of SOM, releasing carbon dioxide into the atmosphere and reducing the soil's capacity to hold water and nutrients. • **Removal of Biomass:** If pruning waste or other organic residues are removed from the orchard rather than being reincorporated, the natural replenishment of SOM is reduced. • **Bare Soil:** Maintaining bare ground in inter-rows or around trees means no new organic matter from plant roots or residues is being added.	improves infiltration, and suppresses weeds. ▪ Choose drought-tolerant and low-competition species suitable for arid conditions. ▪ Manage cover crops by mowing (not tilling) to prevent competition with trees for water and nutrients, and to return organic matter to the soil. ○ **Mulching:** Apply organic mulches (e.g., wood chips, straw, pruning waste) around the base of trees. Mulch protects the soil surface from erosion, conserves moisture, moderates soil temperature, suppresses weeds, and gradually adds organic matter. ○ **Vegetated Waterways/Buffer Strips:** Create vegetated strips along drainage paths and waterways to slow runoff, filter sediments, and prevent soil from entering water bodies. **Preventing and Mitigating Soil Compaction** ○ **Controlled Traffic Farming:** Designate permanent traffic lanes for machinery to minimize compaction across the entire orchard floor. This requires careful planning of row spacing and equipment pathways. ○ **Avoid Wet Soil Operations:** Prohibit heavy machinery use when the soil is wet, as wet soils are highly susceptible to compaction. ○ **Appropriate Machinery and Tires:** Use tractors with larger tires, dual tires, or low-pressure tires to better distribute weight and reduce ground pressure.	

	Nutrient Imbalances and Depletion/Leaching: • **Intensive Fertilization:** While necessary, improper or excessive application of synthetic fertilizers can lead to nutrient imbalances. Some nutrients (like nitrogen) can leach below the root zone, contaminating groundwater. • **Crop Removal:** As fruit is harvested and removed from the system, it takes nutrients with it, which must be replenished. Without careful management, this can lead to the depletion of specific nutrients over time. • **Acidification:** Long-term use of certain nitrogen fertilizers can lead to soil acidification, which affects nutrient availability and can be detrimental to tree health if not managed. **Salinization:** • **Irrigation with Saline Water:** In arid or semi-arid regions (like parts of Namibia), prolonged irrigation with water containing elevated salt levels (brackish groundwater or treated wastewater) can lead to the accumulation of salts in the topsoil, hindering plant growth and water uptake. • **Poor Drainage:** If there's inadequate drainage, salts	○ **Reduced/No-Till Practices:** Minimize or eliminate tillage in the inter-rows to preserve soil structure, build organic matter, and reduce the risk of compaction. ○ **Biological De-compaction:** Utilize deep-rooting cover crops (e.g., certain legumes or brassicas) that can naturally break up compacted layers over time. **Nutrient Management and Soil Health** ○ **Regular Soil and Leaf Tissue Analysis:** Conduct frequent soil testing and leaf analyses to determine the precise nutrient needs of the orchard. This prevents over-application (which can lead to nutrient leaching and pollution) and under-application (which affects tree health and yield). ○ **Nutrient Management Plans (NMPs):** Develop and adhere to site-specific NMPs that detail the type, amount, timing, and method of fertilizer application. ○ **Fertigation:** Apply nutrients through the irrigation system (fertigation) for precise, efficient delivery directly to the root zone, minimizing waste and runoff. ○ **Organic Matter Enhancement:** Continuously add organic matter through compost, manure, green manures, and the decomposition of cover crops and mulches. Organic matter improves soil structure, water retention, nutrient cycling, and microbial activity – crucial for arid soils. ○ **Crop Rotation (if applicable in early stages/inter-rows):** While orchards are perennial, considering rotation with soil-	

	cannot be leached away from the root zone and build up, causing salinization. **Pesticide and Herbicide Accumulation/Contamination:** • **Residues in Soil:** Repeated application of pesticides and herbicides can lead to their accumulation in the soil, potentially impacting soil microorganisms, invertebrates, and even the health of the trees themselves. • **Leaching to Groundwater:** Some chemicals can leach through the soil profile into groundwater, contaminating water sources. • **Runoff to Surface Water:** Pesticides can be carried by surface runoff into streams, rivers, and dams, harming aquatic ecosystems. • **Impact on Soil Biota:** Certain pesticides can negatively affect beneficial soil organisms (bacteria, fungi, earthworms) that are crucial for nutrient cycling and maintaining soil structure. **Soil Structure Degradation (Crusting, Hardsetting):** • **Raindrop Impact:** Bare soil is vulnerable to the impact of raindrops, which can break	improving crops in future inter-row management can be beneficial. **Efficient Irrigation Systems** ○ **Drip/Micro-sprinkler Irrigation:** Implement precision irrigation systems that deliver water directly to the tree roots, minimizing evaporation, runoff, and deep percolation. This is crucial at Etunda where water efficiency is paramount. ○ **Irrigation Scheduling:** Use soil moisture sensors, weather data, and plant physiological monitoring to schedule irrigation accurately, providing only the water needed to avoid over-irrigation which leads to waterlogging and potential salinization. ○ **Water Quality Monitoring:** Regularly test irrigation water for salinity and adjust management practices if high salt levels are detected. **Drainage Management** ○ **Subsurface Drainage:** Install subsurface drainage systems (e.g., tile drains) in areas prone to waterlogging or where there are impermeable layers, to remove excess water from the root zone. ○ **Raised Beds:** For certain fruit crops or in areas with persistent drainage issues, planting trees on raised beds can improve root aeration and prevent waterlogging. ○ **Leaching:** Periodically apply excess water (beyond plant needs) with good drainage to leach accumulated salts from	

	down soil aggregates and lead to surface crusting, reducing water infiltration and increasing runoff. • **Hardsetting:** In some soil types, a dense, hard surface layer can form when dry, making it difficult for roots to penetrate and for water to enter the soil.	the root zone, especially important in arid irrigated areas. This must be carefully managed to prevent water waste and nutrient leaching.	
Water quality	**Pesticide and Herbicide Runoff:** • Orchards, especially in their establishment and early growth phases, often require significant use of pesticides (insecticides, fungicides) and herbicides to control pests, diseases, and weeds. • When these chemicals are applied, they can be washed off by irrigation water or rainfall and enter surface water bodies (canals, rivers, ephemeral streams) or leach into groundwater. • **Impact:** Many pesticides are toxic to aquatic life, even at low concentrations. They can directly kill fish and other organisms, disrupt aquatic food webs, and accumulate in the environment. Herbicides can eliminate aquatic vegetation,	Mitigating the negative impacts of orchard development activities on water quality at Etunda Green Scheme is crucial for the long-term sustainability of the project and the health of surrounding ecosystems: **Water Resource Management & Efficiency:** • **Precision Irrigation (Drip Irrigation):** Transitioning from flood irrigation to highly efficient methods like drip irrigation is paramount. As indicated in research related to Namibia's Green Schemes, drip irrigation significantly improves Water Use Efficiency (WUE) and reduces water runoff, minimizing the potential for pollutant transport. • **Optimized Irrigation Scheduling:** Utilizing soil moisture sensors, weather data, and crop specific water requirements to irrigate precisely when and how much water is needed. This prevents over-irrigation, which can lead to leaching of nutrients and pesticides into groundwater or surface water. • **Rainwater Harvesting and Storage:** Implementing systems to capture and store rainwater (e.g., in reservoirs or tanks) can reduce	**Soil Scientist** **MAFWLR (Agricultural Engineer)** **MAFWLR (Farm Manager)** **ECO**

	affecting habitat and oxygen levels. **Nutrient Loading (Eutrophication):** • Orchards require fertilizers (nitrogen, phosphorus, potassium) for optimal growth and fruit production. • Excessive or improperly timed application of fertilizers, or poor irrigation practices, can lead to nutrient runoff into water bodies. • **Impact:** This influx of nutrients can cause **eutrophication**, leading to rapid algal blooms. When these algae die and decompose, they consume large amounts of dissolved oxygen in the water, creating anoxic or hypoxic (low oxygen) conditions. This oxygen depletion is highly detrimental to fish and other aquatic organisms, often leading to fish kills. It can also produce unpleasant odors and tastes in water. **Sedimentation and Erosion:** • Land preparation for orchards, especially if it involves clearing natural vegetation or significant earthworks, can expose soil to erosion by wind and water. • Runoff from these disturbed areas can carry sediment into irrigation channels and natural water bodies.	reliance on external water sources, especially during dry periods, thus lessening the overall water abstraction pressure. • **Water Quality Monitoring:** Regular and systematic monitoring of water quality in irrigation canals, groundwater, and nearby natural water bodies is essential. This allows for early detection of contamination and helps in identifying the sources of pollution, enabling timely corrective actions. **Nutrient Management:** • **Soil Testing and Nutrient Analysis:** Before planting and periodically thereafter, conduct comprehensive soil tests to determine existing nutrient levels. This informs fertilizer application rates, preventing excessive use. • **Precision Fertilization:** Apply fertilizers based on actual crop needs and soil test results, using methods that deliver nutrients directly to the plant roots (e.g., fertigation through drip systems). This reduces the amount of excess fertilizer that can leach into water. • **Slow-Release Fertilizers:** Utilize slow-release or controlled-release fertilizers, which release nutrients gradually over time, reducing the risk of sudden, large releases into water bodies. • **Organic Fertilizers and Composting:** Incorporate organic matter (e.g., compost, manure) into the soil. This improves soil structure, water retention, and nutrient availability, reducing the need for synthetic fertilizers and enhancing natural filtration. • **Cover Cropping:** Plant non-cash crops (cover crops) between orchard rows or during fallow periods. Cover crops reduce soil erosion, improve soil health, suppress weeds (reducing herbicide	

	• **Impact:** Increased sedimentation can:
	  ○ **Reduce water clarity (turbidity):** Impairing light penetration for aquatic plants and making it difficult for fish to find food.
	  ○ **Smother aquatic habitats:** Covering spawning grounds, suffocating fish eggs, and burying benthic (bottom-dwelling) organisms.
	  ○ **Clog irrigation infrastructure:** Increasing maintenance costs.
	  ○ **Transport other pollutants:** Many chemicals, like phosphorus and some pesticides, bind to soil particles and are transported with sediment.
	
	Salinization:
	
	• Irrigation in arid and semi-arid regions like Etunda, over time, can lead to the accumulation of salts in the soil and, subsequently, in return flows to water bodies. This is a common issue in many irrigation schemes.
		needs), and can tie up excess nutrients, preventing their leaching.
		
		Pest and Disease Management:
		
		• **Integrated Pest Management (IPM):** Implement an IPM strategy that prioritizes non-chemical methods before resorting to pesticides. This includes:
		  ○ **Biological Control:** Using natural predators or parasites to control pests.
		  ○ **Cultural Practices:** Employing practices like crop rotation (though less applicable to orchards, good for surrounding areas), proper sanitation, and resistant varieties.
		  ○ **Physical Barriers:** Using netting or other physical methods to deter pests.
		  ○ **Targeted Pesticide Application:** If pesticides are necessary, choose those with low toxicity to non-target organisms, apply them precisely (e.g., spot treatments), and only when pest thresholds are met.
		• **Responsible Pesticide Handling:** Ensure proper storage, mixing, and application of pesticides to prevent spills and runoff. Train workers on safe handling procedures and provide appropriate protective equipment.
		• **Buffer Zones:** Establish vegetated buffer zones (strips of natural vegetation) around water bodies. These buffers act as filters, trapping sediments and absorbing excess nutrients and pesticides before they reach the water.
		
		Soil Management and Erosion Control:
		
		• **Minimizing Soil Disturbance (Conservation Agriculture):** Practices like no-till or reduced tillage in the inter-row spaces of orchards can	

	• Even with efficient irrigation, some salts are introduced with the irrigation water itself, and as water evaporates from the soil, salts concentrate. • **Impact:** Increased salinity in water bodies can make the water unsuitable for certain aquatic species, reduce biodiversity, and render water unusable for downstream agricultural or domestic purposes. **Altered pH Levels:** • The use of certain fertilizers or soil amendments can alter the pH of the soil, and subsequently, the runoff water. • **Impact:** Significant changes in water pH can be stressful or lethal to aquatic organisms, which are often adapted to a specific pH range.	minimize soil erosion, improve soil structure, and enhance water infiltration. • **Mulching:** Applying organic mulch around trees helps conserve soil moisture, suppress weeds, and reduce soil erosion, especially during heavy rainfall. • **Contour Planting and Terracing:** On sloping land, planting orchards along contours or using terracing can significantly reduce water runoff and soil erosion. • **Sediment Traps and Basins:** Constructing small sediment traps or retention basins at strategic points can capture eroded soil particles before they enter water bodies. **Regulatory and Capacity Building Measures:** • **Environmental Impact Assessment (EIA):** Conduct comprehensive EIAs before any significant orchard expansion to identify potential water quality impacts and develop specific mitigation plans. The EIA process should involve stakeholder consultation. (Note: A recent EIA for a feedlot at Etunda is underway, suggesting existing environmental assessment frameworks). • **Adherence to National Regulations:** Ensure strict compliance with Namibia's Water Resources Management Act, Environmental Management Act, and any relevant agricultural policies. • **Farmer Training and Education:** Provide ongoing training for farmers at Etunda on sustainable agricultural practices, including water conservation, integrated nutrient management, IPM, and responsible chemical handling. • **Monitoring and Evaluation:** Establish a robust monitoring program for water quality (physical, chemical, and biological parameters) that allows for adaptive management. Regular evaluation of	

		mitigation measures is crucial to ensure their effectiveness.	
FLORA DIVERSITY			

Habitat Loss and Fragmentation	The primary impact is the conversion of existing natural or semi-natural vegetation into cultivated land. Even if these spaces are currently disturbed, they likely support some level of local flora adapted to the conditions. Introducing orchards means clearing this existing vegetation, leading to a direct loss of habitat for native plant species. This fragmentation of natural areas can isolate remaining patches, making it harder for plant populations to thrive and spread.		**Proponent** **ECO**
Introduction of Non-Native Species	Orchards typically consist of non-native fruit trees. While these provide a food source, they don't contribute to the natural flora diversity of the region. They may also require specific management practices (pesticides, fertilizers) that can harm surrounding native plants.		
Changes in Soil Composition and Hydrology	Agricultural practices associated with orchards, even with pivot irrigation, can alter soil structure, nutrient content, and water drainage patterns. This can make the environment unsuitable for native plants that are adapted to the original soil and water conditions.		
Reduced Resilience	A diverse ecosystem is generally more resilient to environmental changes, pests, and diseases. Replacing diverse native flora with a monoculture (or a limited number of orchard species) reduces the overall ecological resilience of the area. To ensure optimal growth of the orchard trees, weed control measures are often implemented. These can involve		

Weed Control **Impact on Associated Fauna**	herbicides, which can unintentionally affect non-target native plant species in the vicinity, further reducing biodiversity. The loss of specific native flora can have a cascading effect on local fauna that depend on those plants for food, shelter, or breeding. This includes insects, birds, and small mammals.		
FAUNA DIVERSITY			

Avi-fauna	**Habitat Loss and Simplification:** • **Conversion of natural/semi-natural habitats:** The spaces between pivot irrigation systems, even if currently used for other crops, likely contain some level of natural or semi-natural vegetation, fallow lands, or less intensively managed areas. Converting these to orchards means replacing existing vegetation with a monoculture or a less diverse range of plant species. This directly leads to a loss of habitat for a variety of bird species that rely on the original vegetation for foraging, nesting, and refuge. • **Reduced habitat heterogeneity:** Traditional agricultural landscapes, especially in dryland areas like Namibia, often provide a mosaic of different habitats. Intensive orchard development tends to create more homogeneous landscapes, reducing the variety of niches available for different bird species. Studies show that bird diversity is higher in heterogeneous parcels and in areas with diverse land cover. **Increased Agricultural Intensification:** • **Pesticide and herbicide use:** Orchards, especially intensive ones, often involve significant	∟ **Habitat Preservation and Creation:** • **Retain and Enhance Natural Vegetation:** Avoid clearing all natural vegetation, especially along watercourses (riparian zones) and field edges. These areas provide crucial nesting sites, foraging grounds, and cover for birds. Plant indigenous trees and shrubs that offer food sources (berries, nectar, insects) and nesting opportunities. • **Establish Buffer Zones:** Create buffer zones of native vegetation between orchards and natural habitats. These buffers act as corridors for movement and provide additional habitat. • **Incorporate Hedgerows and Windbreaks:** Plant diverse hedgerows and windbreaks using native species around orchard perimeters. These not only serve as windbreaks for the crops but also offer nesting, roosting, and foraging habitat for birds. • **Provide Artificial Nesting Structures:** Where natural nesting sites are scarce, consider installing bird boxes or platforms for cavity-nesting species or raptors (e.g., owls, kestrels) which can also help with pest control. ∟ **Minimizing Chemical Impacts:** • **Integrated Pest Management (IPM):** Implement IPM strategies to reduce reliance on broad-spectrum pesticides. This includes using biological controls (e.g., encouraging natural predators of orchard pests), pest-resistant varieties, and targeted pesticide application only when necessary. • **Bird-Friendly Pesticides:** If pesticides are essential, choose those with low toxicity to birds and other non-target organisms.	**Proponent** **ECO**

	use of pesticides and herbicides to control pests and weeds. These chemicals can directly poison birds (e.g., through contaminated food sources) or indirectly affect them by reducing their insect prey base. This is a major factor in bird declines in agricultural areas globally. • **Reduced food sources:** While orchards might offer some food (fruits), they often lack the diverse insect populations that many bird species rely on, especially insectivorous birds. The use of pesticides further depletes these food sources. • **Changes in vegetation structure:** Orchard trees might not provide the same structural complexity or nesting opportunities as native vegetation or even other agricultural crops. For example, some bird species prefer open grasslands or specific types of shrubs that would be removed for orchard development. **Water Management Changes** • **Impact of irrigation:** While pivot irrigation is already in place, the development of orchards might alter water distribution patterns or intensify water use in these specific areas. Changes in water availability can impact local	• **Timing of Application:** Apply pesticides during times when birds are less active (e.g., late evening or early morning) or when specific migratory or breeding birds are not present. • **Fertilizer Management:** Implement precise fertilizer application to minimize runoff into water bodies, which can lead to eutrophication and negatively impact aquatic insect populations that many birds feed on. ∟ **Water Management:** • **Efficient Irrigation:** Employ water-efficient irrigation methods (e.g., drip irrigation) to minimize water abstraction from natural sources, thus maintaining water levels in wetlands and rivers important for waterbirds and their food sources. • **Maintain Water Features:** If possible, preserve or create small ponds, wetlands, or seasonal water features within or adjacent to the scheme. These can attract a diversity of birds, especially waterbirds. ∟ **Minimizing Disturbance:** • **Controlled Access:** Limit human and vehicle access to sensitive bird nesting or roosting areas, especially during breeding seasons. • **Noise Reduction:** Where possible, minimize excessive noise from machinery during critical bird breeding periods. ∟ **Monitoring and Research:** • **Baseline Surveys:** Conduct baseline surveys of bird diversity and abundance before orchard development to understand the existing avi-fauna.	

	ecosystems and the species dependent on them. Irrigation generally leads to declines in farmland birds, with only a small fraction increasing after the onset of irrigation. This is likely due to the loss of nesting and foraging habitat arising from shifts in crops and/or loss of fallow lands associated with irrigation. **Fragmentation and Isolation:** • **Habitat fragmentation:** Even if some natural areas remain, the development of orchards can fragment existing habitats, making it harder for birds to move between suitable patches. This can isolate populations and reduce their long-term viability. **Species-Specific Impacts:** • **Decline of specialist species:** Specialist birds that depend on specific habitats or food sources are particularly vulnerable to habitat changes. Generalist species, on the other hand, might adapt better or even benefit from some aspects of agricultural landscapes (e.g., increased food in some cases), but this often comes at the cost of overall biodiversity. Studies have shown that increased irrigated orchards can lead to a	• **Long-term Monitoring:** Implement long-term monitoring programs to assess the impacts of orchard development on bird populations and adjust management practices as needed. • **Research and Collaboration:** Support research into bird-friendly orchard management practices specific to the Namibian context and collaborate with ornithologists and conservation organizations. ∟ **Education and Awareness:** • **Farmer Training:** Educate farmers and workers at the Etunda Green Scheme about the importance of bird conservation and best practices for minimizing negative impacts. • **Community Engagement:** Involve local communities in conservation efforts, fostering a sense of shared responsibility for biodiversity.	

	replacement of specialist by generalist species. • **Impact on ground-nesting birds:** Intensive agricultural practices, including orchard development, often disturb ground-nesting birds or remove suitable nesting sites.		
Fish diversity	**Changes in Water Quality and Quantity** • **Pesticide and Fertilizer Runoff:** Orchards typically require the use of pesticides and fertilizers. If not properly managed, runoff from these chemicals into nearby water bodies (rivers, canals, or wetlands) can introduce pollutants. These pollutants can be directly toxic to fish, disrupt aquatic food webs, or cause eutrophication (excessive nutrient enrichment), leading to oxygen depletion and harm to fish. • **Increased Water Abstraction:** While pivot irrigation is generally efficient, expanding irrigated areas with orchards could lead to increased overall water abstraction from rivers or groundwater sources. Reduced water levels in natural water bodies can directly impact fish habitats, especially for species that rely on specific depths or	∟ **Integrated Pest Management (IPM):** Reduce the reliance on broad-spectrum pesticides. ∟ **Precision Fertilization:** Apply fertilizers efficiently to minimize runoff into water bodies. ∟ **Water-Efficient Irrigation:** Utilize techniques like drip irrigation to reduce overall water usage and prevent excessive abstraction from natural sources. ∟ **Maintaining Riparian Buffers:** Protect and restore natural vegetation along water bodies, as these buffers are crucial for shading, bank stability, and providing organic matter to aquatic ecosystems. ∟ **Environmental Impact Assessments (EIAs):** Conduct thorough assessments before any development to identify potential negative impacts on biodiversity and plan appropriate mitigation strategies. ∟ **Monitoring and Adaptive Management:** Continuously monitor water quality and fish populations to detect any adverse effects and adjust management practices as needed.	**MAFWLR** **ECO**

	flow rates for spawning, feeding, or shelter. • **Altered Hydrology:** Irrigation systems can alter natural water flow patterns, potentially affecting floodplains or seasonal wetlands that are crucial for certain fish species as breeding grounds or refugia during dry periods. **Habitat Alteration and Fragmentation** • **Direct Habitat Loss:** The development of orchards, even in "spaces between" pivots, might involve clearing natural vegetation or altering land contours, which could indirectly impact adjacent aquatic habitats by increasing erosion and sedimentation. Sedimentation can smother fish eggs, reduce water clarity, and clog gills. • **Reduced Riparian Buffers:** If natural vegetation along water bodies (riparian zones) is removed or disturbed to accommodate orchards, it can reduce the shading, bank stability, and organic matter input that are vital for healthy aquatic ecosystems and fish habitats. **Introduction of Invasive Species:** • While not a direct consequence of orchards themselves,		

	increased human activity and agricultural development can sometimes facilitate the introduction of non-native fish species or pathogens into local water systems, which can outcompete or prey on native fish, disrupting the ecosystem.		
SOCIO-ECONOMIC SETTING AND GOVERNANCE			
Resources efficiency and management	**Lack of capacity to irrigate additional areas to be cleared for orchards development at Etunda Green-scheme:** • The Etunda Green-scheme faces challenges with outdated equipment, low water pressure, and the need to optimize production to enhance food security. • Expanding orchard development requires careful planning to mitigate the existing lack of irrigation capacity.	**Optimize Existing Water Resources and Infrastructure** • **Repair and Upgrade Infrastructure:** A significant challenge at Etunda is broken and outdated equipment, including irrigation systems and pumps. Prioritizing repairs and replacing old infrastructure with modern, more efficient systems is crucial. This has already shown positive results in increasing maize yields. • **Improve Water Conveyance Efficiency:** The Etunda scheme relies on the Calueque-Olushandja Canal. Reducing water loss through leaks, evaporation, and inefficient distribution within the existing canal and pipeline network is vital. Lining canals or converting open canals to closed pipe systems can significantly reduce water loss. • **Implement Smart Irrigation Technologies:** ○ **Drip Irrigation:** This is highly recommended for orchards as it delivers water directly to the plant roots, minimizing evaporation and runoff. Studies in Namibia have shown drip irrigation can significantly increase water	**MAFWLR**

		use efficiency (over 80% compared to rainfed agriculture) and improve yields. ○ **Precision Irrigation:** Using sensors (e.g., soil moisture sensors, weather stations, even nuclear-based techniques like cosmic ray neutron sensors) to monitor real-time water needs of crops. This allows for precise application of water, preventing over-irrigation and saving significant volumes. ○ **Automated Systems:** Integrating automated irrigation systems with sensors can ensure water is applied only when and where it's needed, optimizing water use and reducing labor costs. • **Deficit Irrigation Strategies:** While ensuring adequate water for high-value crops like orchards, research into controlled deficit irrigation for certain growth stages can save water without significantly impacting yield. This involves intentionally applying less water than the crop's full evapotranspiration needs at specific times. • **Crop Selection:** While the goal is orchard development, carefully selecting drought-tolerant or water-efficient fruit tree varieties suitable for Namibia's arid conditions can reduce overall water demand. **Enhance Water Supply** • **Assess and Diversify Water Sources:** ○ **Groundwater Exploration:** Conduct thorough hydrogeological surveys to assess the potential for sustainable groundwater abstraction without depleting aquifers or impacting other water users. This needs careful management to prevent over-extraction.	

		○ **Rainwater Harvesting:** Implement large-scale rainwater harvesting systems, especially during good rainy seasons, to supplement irrigation water. This could involve constructing larger storage dams or reservoirs. ○ **Recycled Wastewater:** Explore the feasibility of treating and reusing wastewater from nearby communities for irrigation, provided it meets quality standards for agricultural use and is economically viable. • **Inter-basin Transfers (if feasible and sustainable):** While complex and often controversial, if there are underutilized water sources in other basins with connectivity potential, this could be a long-term option, but requires extensive environmental and social impact assessments. **Improve Management and Capacity Building:** • **Strengthen Institutional Capacity:** Ensure that the Etunda Green Scheme management has the technical expertise and financial resources to implement and maintain advanced irrigation systems. This includes training staff in modern water management practices. • **Farmer Training and Extension Services:** Provide comprehensive training to farmers on efficient irrigation techniques, soil moisture monitoring, and orchard management best practices. Knowledge transfer is crucial for the successful adoption of new technologies. • **Data Collection and Monitoring:** Establish robust systems for monitoring water abstraction, water use efficiency, and crop water requirements. This data is essential for informed decision-making and adaptive management.	

		• **Financial Investment:** Securing adequate funding for infrastructure upgrades, technology adoption, and ongoing maintenance is paramount. This may involve government investment, private sector partnerships, or accessing climate finance mechanisms. • **Policy and Regulatory Frameworks:** Ensure that water abstraction permits and agricultural policies support efficient water use and discourage wasteful practices. **Consider the Broader Context:** • **Integrated Water Resource Management (IWRM):** Approach water management at Etunda within the broader regional water resource context. This means collaborating with NamWater, local communities, and other water users to ensure sustainable water allocation and management for all. • **Environmental Impact Assessment (EIA):** Before clearing additional areas for orchards, conduct a thorough EIA to assess the potential impact on water resources, biodiversity, and ecosystem services. This can help identify and mitigate risks proactively. • **Long-term Planning:** Develop a long-term water management plan for Etunda that accounts for climate change impacts (e.g., increased droughts, erratic rainfall) and projected future water demands.	
Theft and vandalism	Vandalism and theft pose significant challenges at Etunda Green Scheme. Before developing orchards at Etunda, it is crucial to implement a multi-faceted mitigation strategy that combines physical security, technological solutions,	**Comprehensive Physical Security Measures** • **Robust Fencing:** Install sturdy, well-maintained perimeter fencing around the entire orchard area. Consider electrified fences or fences with anti-	

	community engagement, and legal frameworks.	climb features. Regular inspections and immediate repairs are vital, as broken fences are a common point of entry for livestock and thieves.
		• **Access Control:**
		  ○ Implement controlled entry points with gates that are always locked when not in use.
		  ○ Consider security checkpoints for vehicles and personnel entering and exiting the orchard.
		  ○ Maintain a log of all visitors and their purpose.
		• **Lighting:** Install adequate lighting, especially in vulnerable areas like storage facilities, equipment sheds, and entry points. Motion-activated lights can deter intruders.
		• **Secure Storage:**
		  ○ All valuable equipment (tractors, irrigation pumps, tools, fertilizers, pesticides) should be stored in secure, locked buildings.
		  ○ Consider anchoring large machinery to the ground or walls to make them harder to move.
		  ○ Keep fuel tanks locked and, if possible, out of sight.
		• **Riparian Buffer Protection:** While developing orchards, ensure that natural vegetation along water bodies (riparian buffers) is preserved. This not only protects fish diversity but can also act as a natural barrier and reduce accessibility for some intruders.
		
		Technological Solutions:
		
		• **CCTV and Surveillance Systems:**
		  ○ Strategically place high-definition CCTV cameras with night vision capabilities to monitor the entire orchard, focusing on	

		vulnerable areas, entry points, and storage facilities. ○ Implement remote monitoring capabilities, allowing management to view footage from anywhere. ○ Consider AI-powered cameras that can differentiate between animals, workers, and intruders to reduce false alarms. ○ Dummy cameras can serve as a cost-effective deterrent in some areas. • **GPS Tracking and Geofencing:** Install GPS trackers on all valuable machinery and equipment. Use geofencing to set virtual boundaries and receive alerts if equipment moves outside designated areas. Some systems even offer remote immobilization capabilities for stolen vehicles. • **Intruder Detection Systems:** Utilize motion sensors, infrared beams, or LoRaWAN-based sensors to detect unauthorized entry into the orchard or specific sensitive areas. These systems can trigger alarms or send real-time alerts. • **Drone Surveillance:** Drones can provide aerial surveillance of large areas, identify trespassers, and monitor the overall security of the orchard. Autonomous drone patrols can offer constant coverage. • **Asset Marking and Registering:** Mark all equipment with unique identifiers (e.g., farm address, unique serial numbers) and maintain a comprehensive register of all assets with photographs. This makes stolen items harder to resell and easier to trace. **Community Engagement and Collaboration:** • **Local Community Involvement:** This is perhaps the most critical aspect in a Namibian context,	

		where rural communities are often the immediate neighbors of green schemes. ○ **Awareness Campaigns:** Educate the local community about the importance of the Etunda Green Scheme for local employment and food security. Emphasize that vandalism and theft directly undermine these benefits. ○ **Job Creation:** Prioritize local employment in the orchard operations. This fosters a sense of ownership and reduces the economic desperation that can sometimes drive petty crime. ○ **Community Liaison:** Establish clear channels of communication with local leaders and community members. ○ **Farm Watch/Rural Watch Groups:** Encourage the formation of local security groups where neighbors and farm workers can collaborate to share information about suspicious activities and collectively deter crime. ○ **Reward Systems:** Consider implementing a system that rewards community members for providing information that leads to the prevention of vandalism or recovery of stolen property. • **Police and Law Enforcement Collaboration:** ○ Establish a strong working relationship with local police and rural crime units. ○ Regularly share information about security concerns and incidents. ○ Encourage rapid response to reported incidents. ○ Support initiatives by farmer associations to advocate for stronger laws and more effective prosecution of rural crime, as seen in the Omaruru farmers' proposal in Namibia.	

		Management and Operational Practices: • **Regular Security Audits:** Conduct periodic assessments of security measures to identify vulnerabilities and implement improvements. • **Staff Training:** Train all staff on security protocols, how to identify suspicious activity, and reporting procedures. • **Visibility and Presence:** Maintain a visible presence on the farm, even during off-hours, through regular patrols (human or technological). • **Insurance:** Obtain comprehensive insurance coverage for crops, equipment, and infrastructure to mitigate financial losses from vandalism and theft. • **Clear Signage:** Display clear signage indicating security measures are in place (e.g., "CCTV in operation," "Private Property").	
Sustainability and governance issues	There is a lack of Environmental and Social Impact Assessment (ESIA) process prior to establishment of Etunda Green-scheme.	Develop an ESMP because the Etunda Green-scheme is already established it is already late to undertake a new ESIA.	ECO MAFWLR

MANDATE

Promoting, developing, managing, and utilizing Agriculture, Fisheries, Water, and Land Resources sustainably. This is the overarching mandate.

VISION STATEMENT

"Where the nation's Agricultural, Water and Forest resources are sustainably and equitably used for improved livelihood, wellbeing and wealth for all."

MISION STATEMENT

"To create an enabling environment and develop strategies, programmes and projects aimed at enhancing food and nutrition security in order to improve the livelihoods of all Namibians."

TARGET

The proposed activities to cultivate permanent crops such as mangoes, guavas, oranges and others, will contribute to food security, economic diversification, and job creation at the targeted Etunda Green-scheme.

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IMPACT

- Increase water supply by installing more infrastructure.
- Install more irrigation facilities and replace clogged pipes.
- Reduce high theft rates to below 10%.