APP-005771

AGRICULTURAL RELATED ACTIVITIES AND THE ENVIRONMENTAL RELEASE OF GENETICALLY MODIFIED MAIZE ON THE FARM VENUS NO. 379, OTJOZONDJUPA REGION

ENVIRONMENTAL ASSESSMENT SCOPING REPORT

Assessed by:

Assessed for:

JN Malan

March 2025

Project:	**AGRICULTURAL RELATED ACTIVITIES AND THE ENVIRONMENTAL RELEASE OF GENETICALLY MODIFIED MAIZE ON THE FARM VENUS NO. 379, OTJOZONDJUPA REGION: ENVIRONMENTAL ASSESSMENT SCOPING REPORT**	
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Report Approval:	20250306 APP 00[illegible]71 ECC Appl[illegible] **Quzette Bosman** **Environmental & Social Practitioner**	

I Johannes N Malan acting as ~~representative of (JN Malan),~~ hereby confirm that the project description contained in this report is a true reflection of the information which the Proponent provided to Geo Pollution Technologies. All material information in the possession of the Proponent that reasonably has or may have the potential of influencing any decision or the objectivity of this assessment is fairly represented in this report and the report is hereby approved.

Signed at Windhoek on the 30 day of April 2025.

JN Malan

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ID Number

EXECUTIVE SUMMARY

Geo Pollution Technologies (Pty) Ltd was appointed by JN Malan (the Proponent) to undertake an environmental assessment for agriculture related activities and the cultivation of genetically modified maize on farm Venus FMB/00379/0000A, in the Otjozondjupa Region. The main existing activities on the farm are dry land crop cultivation and hospitality facilities. The Proponent currently utilises an area of approximately 160 ha for dry-land cultivation of maize, sorghum and sunflowers. In order to optimize cultivation of maize, the Proponent wish to apply for the necessary permits to cultivate genetically modified maize. The genetically modified maize events (strains) earmarked for cultivation are insect resistant, herbicide tolerant and a combination of insect resistant and herbicide tolerant maize.

All historically cleared areas for crop cultivation across the farm, including the existing and potential dryland areas amount to 160 ha.

The main operational activities related to agriculture include:

- land preparation,
- planting,
- fertilizer application and pest control,
- harvesting, and transporting activities specific to crops,
- bush clearing.

The environmental assessment determines all environmental, safety, health and socio-economic impacts associated with the continued and planned agricultural activities on the farms. Relevant environmental data was compiled by making use of primary, secondary data and from a reconnaissance site visit. Potential environmental impacts and associated social impacts were identified and are addressed in this report.

The project area is located amidst other farms. Due to the nature and location of the Proponent's agricultural and related activities, some impacts can be expected on the surrounding environment. Regular environmental performance monitoring is thus recommended to ensure regulatory compliance and the implementation of corrective measures when necessary, especially with regards to the cultivation of genetically modified maize. The Proponent's operations play a role in contributing to the Namibian agricultural sectors and provide valuable employment opportunities in the region.

The main concerns related to the operations are linked to the ecological impacts associated with cultivation of genetically modified maize. The addition of genetically modified maize on the farm, if not implemented responsibly, has the potential of aggravating existing impacts or causing additional impacts, while also being a contentious issue for some people. A safety, health, environment and quality policy coupled to and environmental management plan will contribute to effective management procedures, to prevent and mitigate impacts. All relevant legislation and regulations relating to agriculture, genetically modified organisms, labour and health and safety should be adhered to. Groundwater and soil pollution must be prevented at all times. Restrictions and prescriptions pertaining to the environmental release and handling of genetically modified maize should be strictly adhered to. This include, but is not limited to, planting of refuges, maintaining adequate buffer and/or isolation zones between genetically modified and traditional maize fields, correct pesticide application and vigilance and reporting of any signs of insect or weed resistance onset. All staff must be made aware of the importance of biodiversity and poaching or illegal harvesting of animal and plant products prohibited. Any waste produced must be removed from site and disposed of a designated burning site or re-used or recycled where possible. Hazardous waste must be disposed of at an approved hazardous waste disposal site. By appointing local employees and by implementing monitoring and training programs, the positive socio-economic impacts can be maximised while preventing or mitigating negative impacts.

The environmental management plan included in Section 9 of this document should be used as an on-site reference document, during all phases (planning, operations (including maintenance) and decommissioning) of the farms. All monitoring and records kept should be included in six monthly reports to ensure compliance with the environmental management plan and the Ministry of Environment, Forestry and Tourism's requirements. Parties responsible for transgression of the

environmental management plan should be held responsible for any rehabilitation that may need to be undertaken. A safety, health, environment and quality policy should be used in conjunction with the environmental management plan. Operators and responsible personnel must be taught the contents of these documents. Local or national regulations and guidelines must be adhered to and monitored regularly as outlined in the environmental management plan.

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LIST OF ABBREVIATIONS

AEZ	Agro-Ecological Zone
BE	Biological/Ecological
Bt	*Bacillus thuringiensis*
CHIRPS-2	Climate Hazards Group Infra-Red Precipitation with Station data
DWA	Department of Water Affairs
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EMA	Environmental Management Act No 7 of 2007
EMP	Environmental Management Plan
EMS	Environmental Management System
ES	Environmental Classification
GM	Genetically Modified
GMO	Genetically Modified Organism
IAPs	Interested and Affected Parties
IUCN	International Union for Conservation of Nature
mamsl	Meters Above Mean Sea Level
m/s	Metre per second
MEFT	Ministry of Environment, Forestry and Tourism
MAWLR	Ministry of Agriculture, Water and Land Reform
mm/a	Millimetres per annum
MSDS	Material Safety Data Sheet
NCRST	National Commission on Research, Science and Technology
NDP	National Development Plan
PC	Physical/Chemical
PPE	Personal Protective Equipment
SANS	South African National Standards
SHEQ	Safety, Health, Environment and Quality
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization
EPL	Exclusive Prospecting License
PEL	Petroleum Exploration License
RL	Reconnaissance Licences

GLOSSARY OF TERMS

Alternatives - A possible course of action, in place of another, that would meet the same purpose and need but which would avoid or minimize negative impacts or enhance project benefits. These can include alternative locations/sites, routes, layouts, processes, designs, schedules and/or inputs. The "no-go" alternative constitutes the 'without project' option and provides a benchmark against which to evaluate changes; development should result in net benefit to society and should avoid undesirable negative impacts.

Assessment - The process of collecting, organising, analysing, interpreting and communicating information relevant to decision making.

Competent Authority - means a body or person empowered under the local authorities act or Environmental Management Act to enforce the rule of law.

Construction - means the building, erection or modification of a facility, structure or infrastructure that is necessary for the undertaking of an activity, including the modification, alteration, upgrading or decommissioning of such facility, structure or infrastructure.

Cumulative Impacts - in relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

Environment - As defined in the Environmental Assessment Policy and Environmental Management Act - "land, water and air; all organic and inorganic matter and living organisms as well as biological diversity; the interacting natural systems that include components referred to in sub-paragraphs, the human environment insofar as it represents archaeological, aesthetic, cultural, historic, economic, palaeontological or social values".

Environmental Impact Assessment (EIA) - process of assessment of the effects of a development on the environment.

Environmental Management Plan (EMP) - A working document on environmental and socio-economic mitigation measures, which must be implemented by several responsible parties during all the phases of the proposed project.

Environmental Management System (EMS) - An Environment Management System, or EMS, is a comprehensive approach to managing environmental issues, integrating environment-oriented thinking into every aspect of business management. An EMS ensures environmental considerations are a priority, along with other concerns such as costs, product quality, investments, PR productivity and strategic planning. An EMS generally makes a positive impact on a company's bottom line. It increases efficiency and focuses on customer needs and marketplace conditions, improving both the company's financial and environmental performance. By using an EMS to convert environmental problems into commercial opportunities, companies usually become more competitive.

Evaluation –The process of ascertaining the relative importance or significance of information, the light of people's values, preference and judgements in order to make a decision.

Green Scheme - The Green Scheme is an initiative conducted by the Ministry of Agriculture, Water and Forestry to encourage the development of irrigation based agronomic production in Namibia with the aim of increasing the contribution of agriculture to the country's Gross Domestic Product. Its aim is also to simultaneously achieve the social development and upliftment of communities located within suitable irrigation areas and to also promote the human resources and skills development within the irrigation sub-sector. Such initiative could possibly enhance cross-border investment and facilitate the exchange of relevant and limited resources with neighbouring countries in this regard.

Hazard - Anything that has the potential to cause damage to life, property and/or the environment. The hazard of a particular material or installation is constant; that is, it would present the same hazard wherever it was present.

Interested and Affected Party (IAP) - any person, group of persons or organisation interested in, or affected by an activity; and any organ of state that may have jurisdiction over any aspect of the activity.

Mitigate - The implementation of practical measures to reduce adverse impacts.

Proponent (Applicant) - Any person who has submitted or intends to submit an application for an authorisation, as legislated by the Environmental Management Act no. 7 of 2007, to undertake an activity or activities identified as a listed activity or listed activities; or in any other notice published by the Minister or Ministry of Environment & Tourism.

Public - Citizens who have diverse cultural, educational, political and socio-economic characteristics. The public is not a homogeneous and unified group of people with a set of agreed common interests and aims. There is no single public. There are a number of publics, some of whom may emerge at any time during the process depending on their particular concerns and the issues involved.

Scoping Process - process of identifying: issues that will be relevant for consideration of the application; the potential environmental impacts of the proposed activity; and alternatives to the proposed activity that are feasible and reasonable.

Significant Effect/Impact - means an impact that by its magnitude, duration, intensity or probability of occurrence may have a notable effect on one or more aspects of the environment.

Stakeholder Engagement - The process of engagement between stakeholders (the proponent, authorities and IAPs) during the planning, assessment, implementation and/or management of proposals or activities. The level of stakeholder engagement varies depending on the nature of the proposal or activity as well as the level of commitment by stakeholders to the process. Stakeholder engagement can therefore be described by a spectrum or continuum of increasing levels of engagement in the decision-making process. The term is considered to be more appropriate than the term "public participation".

Stakeholders - A sub-group of the public whose interests may be positively or negatively affected by a proposal or activity and/or who are concerned with a proposal or activity and its consequences. The term therefore includes the proponent, authorities (both the lead authority and other authorities) and all interested and affected parties (IAPs). The principle that environmental consultants and stakeholder engagement practitioners should be independent and unbiased excludes these groups from being considered stakeholders.

Sustainable Development - "Development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs and aspirations" – the definition of the World Commission on Environment and Development (1987). "Improving the quality of human life while living within the carrying capacity of supporting ecosystems" – the definition given in a publication called "Caring for the Earth: A Strategy for Sustainable Living" by the International Union for Conservation of Nature (IUCN), the United Nations Environment Programme and the World Wide Fund for Nature (1991).

1 BACKGROUND AND INTRODUCTION

Geo Pollution Technologies (Pty) Ltd was appointed by JN Malan (the Proponent) to undertake an environmental assessment for the existing hospitality-, agricultural activities and the proposed environmental release of genetically modified (GM) maize on the farm Venus FMB/00379/0000A in the Otjozondjupa Region (Figure 1-1). The main commercial activities of the Proponent on the farm include crop cultivation, livestock farming and a hospitality facility. The Proponent currently utilizes an area of approximately 160 ha for dryland farming of mainly maize. In order to optimize cultivation of maize, the Proponent would like to apply for the necessary permits to cultivate genetically modified (GM) maize. The GM maize events (strains) earmarked for cultivation are insect resistant, herbicide tolerant and a combination of insect resistant and herbicide tolerant maize.

The main operational activities include:

- land preparation,
- planting (including proposed planting of GM maize),
- fertilizer application and pest control,
- harvesting,
- packaging and transporting activities specific to each crop,
- management of a self-catering accommodation facility.

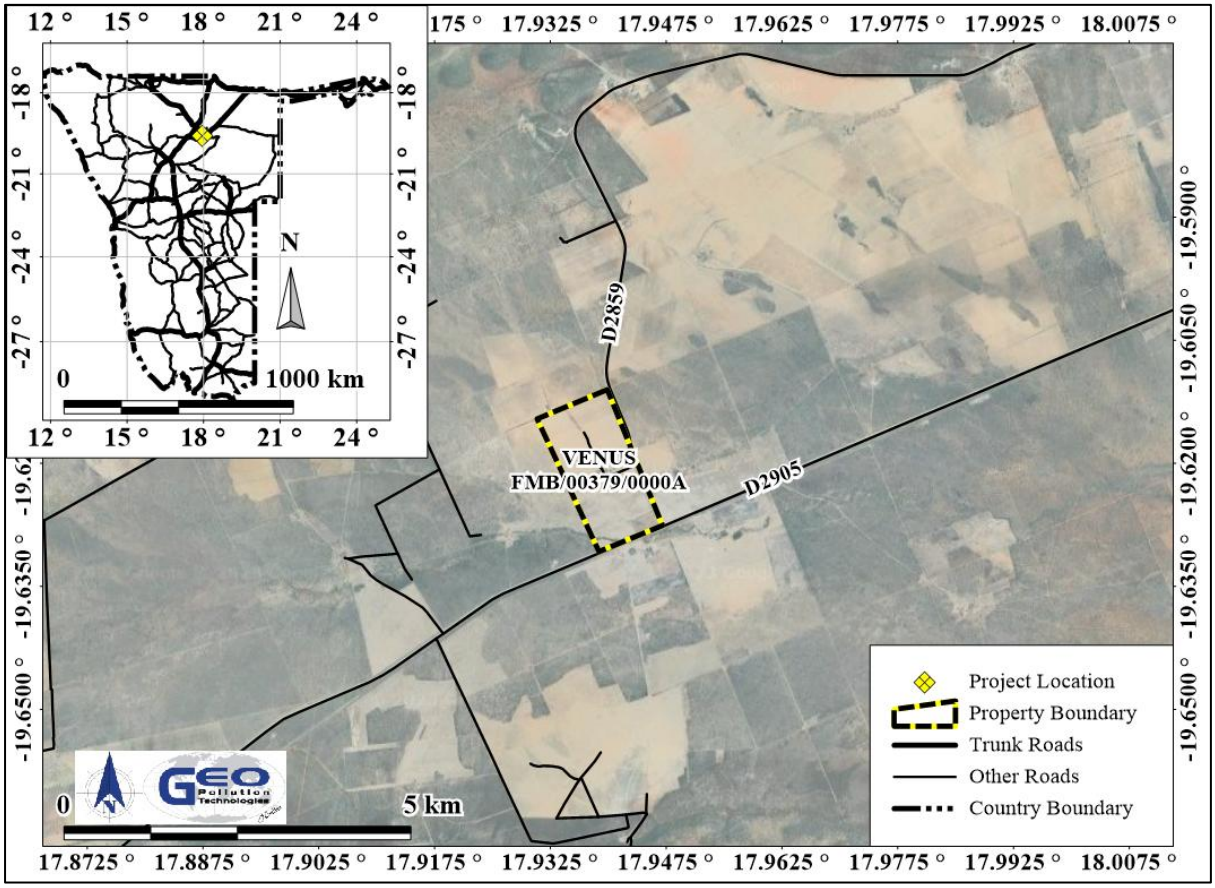


Figure 1-1 Project location

A detailed project description is provided in Section 4. The potential impacts of the project on the environment, resulting from various operational, maintenance and construction, and possible decommissioning activities, were determined through the risk assessment as presented in this report.

The environment, being defined in the Environmental Management Act as “land, water and air; all organic and inorganic matter and living organisms as well as biological diversity; the interacting natural systems that include components referred to in sub-paragraphs, the human environment insofar as it represents archaeological, aesthetic, cultural, historic, economic, paleontological or social values”. The

environmental assessment was conducted to apply for an environmental clearance certificate in compliance with Namibia's Environmental Management Act (Act No 7 of 2007) (EMA).

Project Justification – Traditionally, farms in the region were used for cattle ranching and dryland crop cultivation. These activities are undertaken by the Proponent, as well as the management of an accommodation facility. It is now the Proponent's intention to further diversify farming activities by cultivating GM maize. This addition is proposed in an effort to increase resilience in food production for Namibia. Namibia aims to increase sustainable food production and ensure food security in the country. In addition, agriculture is an important employment sector for Namibia, adding to roughly a third of the workforce. Existing and planned agricultural activities require employment, which is required to be maintained for continued operations. Increased prdin maize crops, through the cultivation of GM maize, will improve the overall economic resilience of the farm.

Benefits of the agricultural activities conducted by the Proponent include.

- Food production and enhanced food security.
- Employment and supporting of livelihoods of both unskilled and skilled labourers.
- Technological development and investment in agricultural practices.
- Generation of income that contributes to the national treasury and a positive trade balance through the export of produce to international markets.
- Support for economic resilience in the area through diversified business activities and opportunities.

2 SCOPE

The scope of this report is to, in compliance with the requirements of EMA:

1. Present a detailed project and environmental description related to the Proponent's activities.
2. Determine the potential environmental impacts emanating from the Proponent's activities and potential future decommissioning of such activities.
3. Identify a range of management actions to mitigate the potential adverse impacts to acceptable levels.
4. Provide sufficient information to the relevant competent authority and the Ministry of Environment, Forestry and Tourism (MEFT) and related authorities to make an informed decision regarding the project and the issuing of an environmental clearance certificate.

3 METHODOLOGY

Methods employed to investigate and report on potential impacts of the Proponent's activities on the social and natural environment include:

- Detailed infrastructure and operational procedures received from the client are presented in this report.
- Baseline information about the site and its surroundings were obtained from primary information, existing secondary information as well as from a reconnaissance site visit.
- A specialist report related to the benefits, impacts and concerns of environmental release of GM crops was compiled and the findings of this report was considered in the environmental assessment.
- As part of the scoping process to determine potential environmental impacts, interested and affected parties (IAPs) were consulted about their views, comments and opinions, all of which are presented in this report.
- As per the findings of this environmental assessment, a scoping report with an environmental management plan (EMP) were prepared and this will be submitted to the MEFT.

4 OPERATIONS AND RELATED ACTIVITIES

Agriculture activities have been conducted on the farm for the past 48 years with the Proponent continuing and gradually expanding agricultural activities for the past 22 years. Currently, maize,

sorghum and sunflowers are cultivated on a rotation basis on dryland fields. In an attempt to increase the resilience and potential yields of maize, the Proponent would like to, in the future, cultivate genetically modified maize. Additionally, there is a hospitality component on the farm known as the Meteorite Rest Camp. This include camping sites, self-catering chalets and rooms within a guest-house. Existing and planned operations are reliant on support infrastructure and resources, all of which are described below.

4.1 LAND CLEARING

Initial land clearing was conducted to accommodate dryland cropping. Land clearing for crop cultivation include removal of vegetation and boulders across the area, and was already completed many years ago. Bush clearing is also conducted around crop fields to allow for vehicles and implements to manoeuvre and to reduce competition for groundwater. Since almost the entire farm was cleared, no additional rangeland management is required. However, the fields and grasslands which are left fallow, do require continued aftercare. Approximately 160 ha across the farm was cleared and is used for crop cultivation. Bush was also cleared next to fences, and is maintained so, to act as firebreaks and to accommodate firefighting teams during a fire.

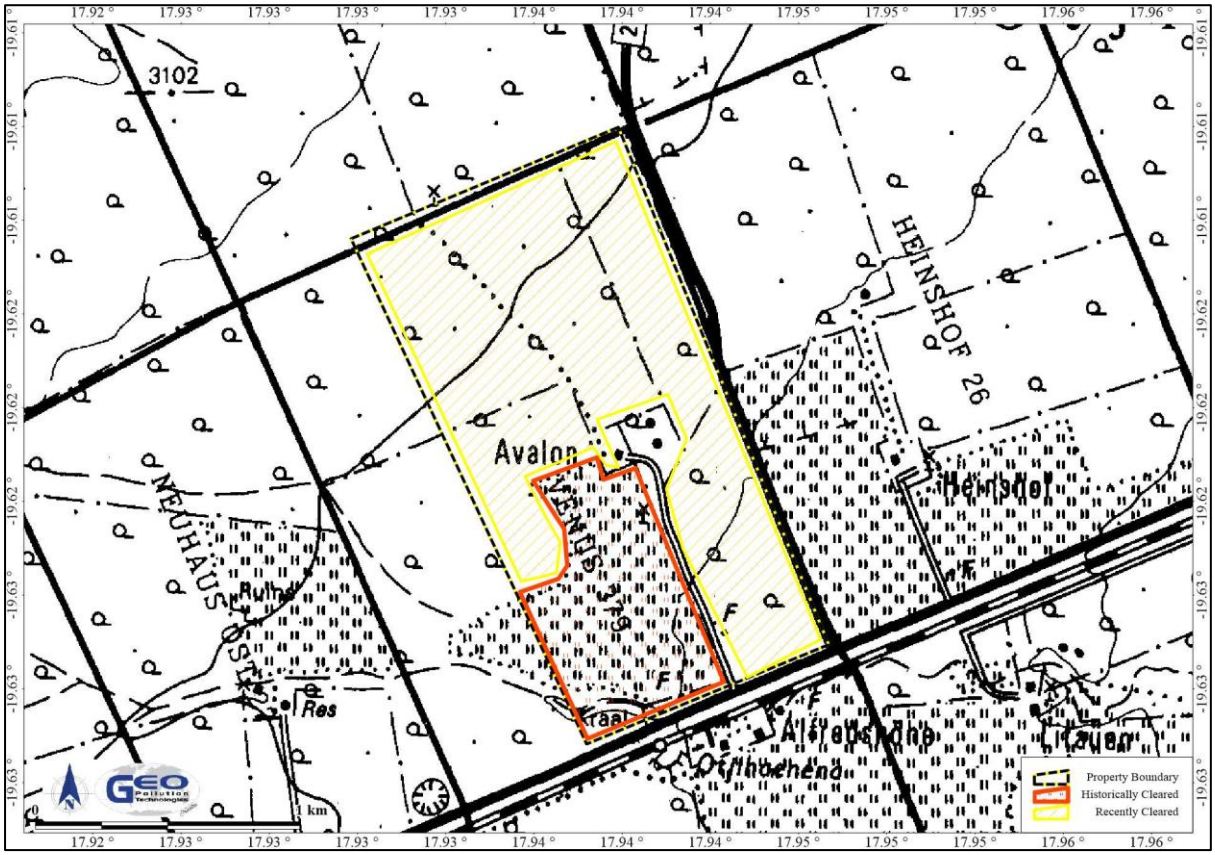


Figure 4-1 Cleared areas in relation to the 1975 topographical map

Photo 4-1 Cleared fields

Photo 4-2 Re-established small bush which requires after care management

4.2 ARABLE FARMING

Maize, sorghum and sunflowers are planted on a rotational basis across the farming unit. Figure 4-1 depicts the cultivated fields in relation to cleared areas. A small, 2 ha irrigated pecan nut orchard is maintained as part of operations. The orchard is drip-irrigated from boreholes on the property. However the main economic activity of farm still relates to dryland crop cultivation.

The Proponent conducts conservation agriculture for all dryland crop cultivation, therefore no tillage is conducted during land preparation. After good rains complete germination of the planned planted sections are treated with herbicides to prevent weeds from overwhelming the future seedlings. Once the maize plants have broken the soil surface, herbicides such as round-up can no longer be used. Various other combinations of chemicals and herbicides are then employed to try and stem weed growth among the maize. The farming unit faces severe challenges with weeds such as Itch-grass / tarentaalgras (*Rottboellia cochinchinensis*). Apart from weed control, pesticides are also employed to protect the crop field from insects such as the fall-army worm. Pesticides are administered as per the specified application procedures for the corresponding pest by means of tractor spraying. To ensure correct and safe application of pesticides, a pesticide plan is implemented and regularly updated. The Proponent requires a minimum amount of pesticides as compared to conventional agricultural production though the implementation of hand clearing of weeds. Once maize has reached a certain height, manual removal of weeds is conducted. Larger mammals, such as warthog, porcupine and antelope, can cause damage to maize fields, fortunately the Proponent have not experienced extensive damages to crop fields due to wildlife.

Fertilizers are also applied as required and according to the specifications for application. Organic fertilisers are mainly utilized on the farm. Conventional harvesting of maize is conducted with the maize being sieved before being stored. The maize is stored in a maize dam and covered until collection for transportation to the mill.

Photo 4-3 Fallow land

Photo 4-4 Maize filed

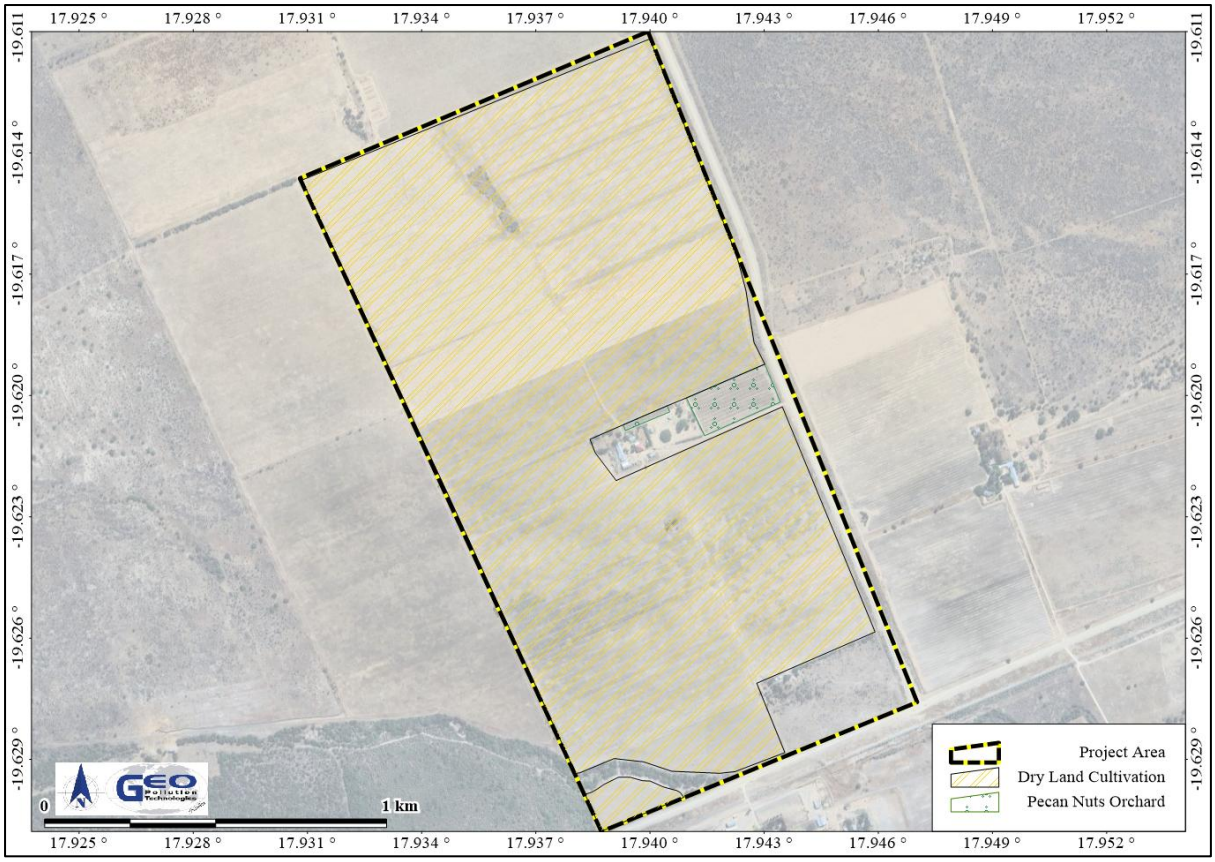


Figure 4-2 Cultivated Areas

4.3 CULTIVATION OF GENETICALLY MODIFIED MAIZE

The Proponent plans to cultivate GM maize. Applications for the environmental release of GM maize for cultivation, based on existing procedures, policies and plans, will be submitted to the National Commission on Research Science and Technology (NCRST) under the Ministry of Higher Education, Technology and Innovation for approval. Such applications must be accompanied by a completed application form, this environmental assessment and its accompanying EMP, the ECC, and emergency response plans for its cultivation and transport. The GM maize events earmarked for cultivation are listed in Table 4-1. Each type of maize is referred to as an "event".

Table 4-1 GM maize events earmarked for cultivation by the Proponent

Event	Commonly Referred/Trade Name	Trait
MON 810	Bt Maize/ YieldGard™	Resistant to lepidopteran* larvae like African maize stalk borer and fall armyworm
MON 89034	Bt Maize/ YieldGard™ VT Pro™	Resistant to lepidopteran larvae African maize stalk borer and fall armyworm
NK 603	Roundup Ready™ 2 Maize	Resistant (tolerant) to glyphosate herbicide (RoundUp™)
MON 89034 × NK 603	Roundup Ready® Maize 2	Resistant (tolerant) to glyphosate herbicide (RoundUp™) and resistant to lepidopteran larvae like like African maize stalk borer and fall armyworm
NK 603 × MON 810	YieldGard™ CB + RR	Resistant (tolerant) to glyphosate herbicide (RoundUp™) and resistant to lepidopteran larvae like like African maize stalk borer and fall armyworm

*Lepidopterans are the order Lepidoptera comprising moths and butterflies

The insect resistant events are protected during an outbreak of pests like the African maize stalk borer and fall armyworm. These are the larvae (caterpillar) of moths. Due to a specific protein the plant produce as a result of the genetic modification, the larvae of the moths die when eating the maize plants, thus minimizing crop loss without the need for applying pesticides. Herbicide resistant events have been modified to be tolerant to RoundUp™ which is a broad spectrum herbicide with the active ingredient glyphosate. Post-emergent Roundup Ready™ maize can thus be sprayed with RoundUp™ to kill weeds without harming the maize plant itself. This eliminates the need for pre-planting weed control regimes and manual weed removal post-emergence.

Applications for the environmental release of GM maize for cultivation, based on existing procedures, policies and plans, will be submitted to the NCRST under the Ministry of Higher Education, Technology and Innovation for approval. Such applications must be accompanied by a completed application form, this environmental assessment and its accompanying EMP, the ECC, and emergency response plans for its cultivation and transport.

The specialist report in Appendix B provides a detailed description and assessment of GMOs in general, and then specifically also the GM maize events to be planted by the Proponent. The report addresses myths, truths and concerns regarding GMOs and provide prevention and mitigation measures required for GM maize cultivation. The cultivation of GM maize has received conditional approval by MEFT for its cultivation in Namibia. This approval was based on a strategic environmental assessment conducted in 2019/2020 (Faul et al. 2020). The conditional approval requires that individual assessments must be undertaken for each farm, as is being done in this report.

In the interim, until GM maize cultivation is approved, conventional maize cultivation continues. Once GM maize is cultivated, harvested GM and conventional maize will be kept separate, should both be planted on the farm. If not kept separate, all maize will be considered as GM maize.

4.4 LIVESTOCK

Livestock is kept on the farm. However, after harvesting of certain crops, cattle from adjacent properties, are allowed to feed from the harvested fields. At times fields are left fallow to rest, or are used for grass production. Cattle may then again be let onto the farm in feeding of these resources.

4.5 HOSPITALITY AND ACCOMMODATION

In considering the proximity of the farm to the Hoba Meteorite, the Proponent has an established accommodation facility, comprising camping sites, self-catering chalets and guest rooms. A swimming pool and related facilities are available on site. The hospitality component was designed to accommodate local and international tourists who may be visiting the greater area. Therefore, the establishment has no other recreational or entertainment components. This component of the farming operations is active throughout the year and has a combined capacity of 45 persons (including the camping accommodation).

Photo 4-5 Self-catering chalet

Photo 4-6 Camping terrain

Photo 4-7 Swimming pool

Photo 4-8 Camping ablution facilities

4.6 SUPPORT INFRASTRUCTURE

Operations as outlined above, require support infrastructure or resources. All of the operations are provided with electricity from Cenored and augmented by means of a 3 kVA solar system with related storage capacity. The Proponent also has a back-up generator in the event of the solar and power failure. Employee houses are serviced with electricity. Fuel for farming operations are stored in two 2,200 l aboveground tanks. However, due to the high prevalence of diesel theft, smaller volumes may be kept in a mobile unit during operations when required.

Photo 4-9 Censored transformer

Photo 4-10 Fuel storage tank on site

Photo 4-11 Maize dam

Photo 4-12 Tractor and implement shed

Water is pumped from various boreholes mainly for domestic use, but also, at times, for livestock watering when cattle on the farm. Storage of water is determined by its use. While stock watering rely on water troughs, water designated for domestic use are stored in raised water tanks. All offices and employees' houses, as well as the hospitality facility, are provided with septic tank and french drain systems to accommodate waste water. **Waste disposal** mainly comprise an excavated pit where waste is regularly burned. Due to a lack of any recyclers in the area, recycling of certain wastes are not possible. However, where possible, certain waste items are not discarded, but rather re-used for alternative purposes. This includes the re-use of old oil when not collected by oil recycling companies. Any and all spoiled produce are made available as animal feed in the game camp and for livestock. Any hazardous waste is stored in suitable bunded areas.

Photo 4-13 Raised water tanks

Photo 4-14 Septic tank and soak away on site

The main **storage and maintenance areas** are located close to the main farm house and comprise of sheds and storerooms where implements and other maintenance material are stored under roof and on impermeable surfaces. Any maintenance and or minor repairs are conducted on site and within these areas. Unused equipment and related materials are stored in an access controlled area. Offices and employee houses are all located on the farm as well. All pesticides and herbicides are stored in a dedicated **chemical store**. The chemical store is access controlled. Fertiliser are stored in an open area, separate from all other chemicals or materials, on an impermeable layer. All areas have firefighting equipment and safety signs where required. A summary of the support infrastructure components are presented in Table 4 2.

Photo 4-15 Fertiliser storage

Photo 4-16 Chemical storage

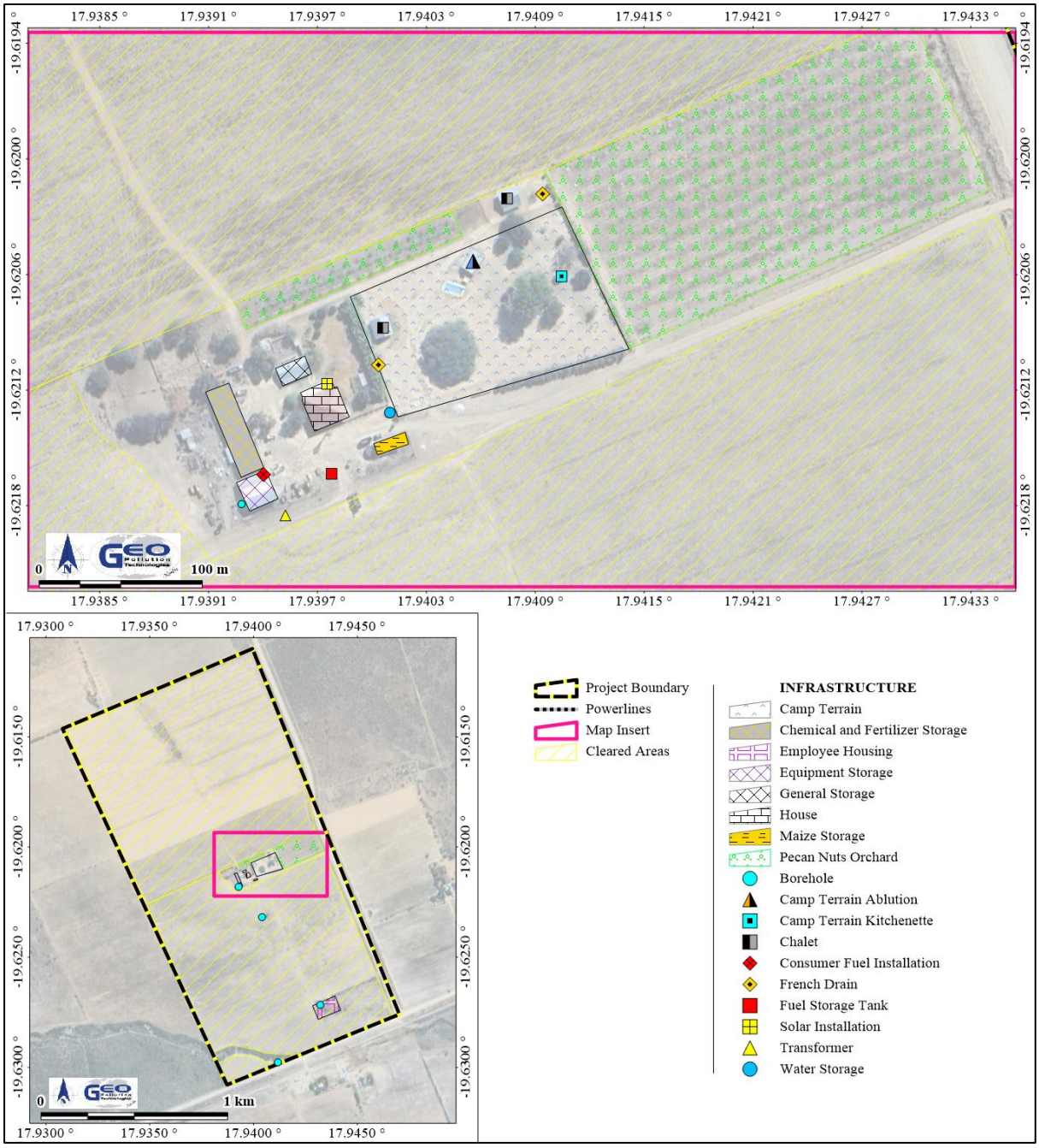


Figure 4-3 Map with infrastructure components

Table 4-2 Summary of infrastructure components related to agricultural operations

Project Component	Current Provision	Future Provision
Electricity Provision	Estimated 11 kVA mainly sourced from Cenored	No significant increase
Photovoltaic Solar System	3 kW Photovoltaic system including standby generator	No significant increase planned within the foreseeable future
Water Provision	Groundwater abstraction from various boreholes	Na additional boreholes or water abstraction planned for the foreseeable future
Water Storage	Raised reservoirs, water tanks and cement reservoir	Na additional water storage or water abstraction planned for the foreseeable future

Project Component	Current Provision	Future Provision
General Storage	One existing general and cool storage complex	No additional general and cool storage complex proposed
Sanitation and Liquid Waste Disposal	Current septic tank and french drain systems catering for existing staff compliment, camping and guest rooms	No additional disposal systems are planned for the foreseeable future
Fuel Storage	One 4,500 *l* and two 2,200 *l* above ground tanks located in a bund wall (unused). One 1,100 *l* mobile unit used	No additional tanks are proposed
Workshops and Maintenance Yards	One workshop and maintenance yard	No additional workshop and maintenance yard planned
Chemical Storage Area	One chemical storage unit	No additional chemical storage unit planned

4.7 EMPLOYMENT

All operations on the farm are reliant on labour. Operations currently require 6 permanent employees and about 10 seasonal employees (or contracting employees). All permanent employees are provided with brick houses, running warm water and electricity. There are dedicated permanent housing units. All employees are further provided with personal protective equipment when appropriate, while support is provided in terms of education, etc. Limited contractors are used as the Proponent's focus is to provide employment and to build and equip their own workforce with knowledge and skills related to the various components of operations.

Photo 4-17 Permanent employee house

Photo 4-18 Fenced employee garden

5 ALTERNATIVES

The Proponent has incorporated various possible revenue generating activities on the property to ensure a robust and sustainable operational unit. A combination of agriculture, hospitality, and related value addition activities are implemented, thereby significantly reducing possible feasible alternatives. Alternatives considered and described below, relate mostly to the implementation of the various project components, but also include:

- Location alternatives;
- Project implementation and design alternatives;
- No-go alternative.

5.1 LOCATION ALTERNATIVES

The location of the cultivated areas is well suited for crop production due to the favourable climate and suitability of soils. Land clearing and field establishment have already been completed for existing operations many years ago It should also be noted that the part of the area used for cultivation has been indicated as crop fields in topographic maps, as far back as 1975. Therefore, the area is a known crop producing unit for almost 50 years. In addition, the hospitality and accommodation facility is well located, being one of only a few in the area, to accommodate local and international tourists. No location alternatives are therefore considered feasible, since the Proponent owns the property on which operations are conducted and proposed.

5.2 PROJECT IMPLEMENTATION AND DESIGN ALTERNATIVES

Various alternatives are continually considered to optimise crop production and hospitality operations. The most noteworthy of these relating to soil preparation and crop selection, in particular whether to use GM seeds as opposed to non-GM seeds for crops.

5.2.1 Soil Preparation

Traditionally, soil is prepared for planting by tilling and ploughing. These processes break the top layer of soil at varying depths and mix residual plant material into the soil. It also uproots weeds and provide for loose soil. There is nowadays however, a shift in the approach to soil preparation that has some advantageous over traditional tilling. Conservation tillage practises aim at less disturbance of the soil and have advantages of less erosion, less evaporation and save on time and costs of traditional tilling. Conservation tillage can either be just partial tillage as is the case with strip-tilling or no tilling at all. With strip-tillage, only narrow strips are tilled in the area where planting will take place. The areas between planted rows are left untilled and with residual plant material from the previous harvest. With no-tillage, seeds are planted on the field with no soil preparation at all. The Proponent employs a zero-tillage approach related to soil preparation.

Table 5-1 Advantages and disadvantages of land preparation systems (adapted from https://cropwatch.unl.edu/tillage/advdisadv)

System	Major advantages	Major disadvantages
Plough	Suited for poorly drained soils. Excellent incorporation (mixing of soil for easy combination with chemical and organic elements). Well-tilled seedbed.	Major soil erosion. High soil moisture loss. Timeliness considerations. Highest fuel and labour costs. Reducing soil organic matter (micro flora and fauna), reduced soil structural stability. Increased surface runoff and water or wind erosion.
Disk	Less erosion with more residue. Well adapted for well-drained soils. Good incorporation.	Little erosion control with more operations. High soil moisture loss. Destroys soil structure. Compacts wet soil.
Strip-till	Tilled residue-free strip warms quickly. Injection of nutrients into row area. Well suited for poorly drained soils. Less wear on machinery, less use of fuel or animal power, less time devoted to soil preparation by the farmer thus a possible overall improvement in gross returns for the farm. Heavy rain, is more likely to concentrate in the seeder slots and thereby penetrate directly to the crop's root zone. Improve general water use efficiency by the crop.	Cost of preplant operation. Strips may dry too much, crust, or erode without residue. Not suited for drilled crops (mechanised seeding). Timeliness in wet falls. It also disturbs the soil but limits that disturbance to rows or slots in which the crop seeds and fertilizer are placed.
No-till	Excellent erosion control. Soil moisture conservation. Minimum fuel and labour costs. Builds soil structure and health.	No incorporation. Increased dependence on herbicides. Slow soil warming on poorly drained soils. Problems of disease and residue handling. Herbicides have long-term impacts on the environment. Some weeds have developed resistance to some herbicides, leading to a need to rotate both crops and herbicide groups in order to keep crops weed-free, or to plant GMO crops.

5.2.2 Crop Selection (Maize)

The main challenges faced by the Proponent in maize cultivation relates to the removal of weeds and extermination of pests such as Itch-grass (*Rottboellia cochinchinensis*), and the fall armyworm. The use of pesticides to control weeds and insect pests has its limitations.

Herbicides can be broad spectrum, i.e. effective against all plants, or selective, i.e. targeting only selected plants based on morphological, physiological, or biochemical characteristics. A common form of selectivity is between herbicides targeting broad-leaved flowering plants (*dicotyledons*) and those targeting grasses and grass-like flowering plants (*monocotyledons*). Thus, maize can for example be sprayed post-emergent with a broad-leaved herbicide. This will however not target and kill grasses. Ideally, one would like to spray a broad spectrum herbicide, like a glyphosate, that kills both broad-leaved and grass-like plants.

Insect control with insecticides also has its limitations and disadvantages. Insecticides are mostly non-selective and will kill both beneficial and pest species. Insecticides can also not be sprayed on food crops that are near harvesting, as the insecticide may remain in the produce and thus pose human health risks. Furthermore, insecticides applied by spraying, does not always reach and kill the insects that burrows into the fruit, or as is the case with maize, the maize ear.

To overcome the above challenges, GM maize can be considered. To date, conventional crop cultivation in Namibia excludes GM maize. Major advantages and disadvantages of traditional non-GM maize and various strains of GM maize are presented in Table 5 2.

Table 5-2 Alternative comparison of maize types for cultivation

Alternative	Advantages	Disadvantages	Preferred Option
Maize Type			
Traditional non-GM maize	♦ Long established crops of which the positive and negative properties are well known. ♦ Cheaper seeds. ♦ Seeds easily available. ♦ Can keep some harvested maize seed for next planting season.	♦ Highly susceptible to crop damage by insects. ♦ Reduced crop yields when significant pest outbreaks occur. ♦ Maize is only broad leaf herbicide tolerant. ♦ More labour intensive. ♦ More spraying result in more fuel use and thus greenhouse gasses. ♦ Increased water use due to need for dilution of insecticides.	♦ Cultivation of GM maize with traditional maize as refuges. Planting a combination of GM maize events, or varying GM maize events between planting seasons, will contribute to delaying the onset of insect resistance.
MON 810	♦ Resistant to main pests like fall armyworm. ♦ Increased actual yields. ♦ Reduced insecticide use. ♦ Less labour intensive ♦ Less greenhouse gas emissions due to reduced fuel use for spraying. ♦ Reduced water use due to less need for dilution of insecticides.	♦ Only one BT toxin can potentially lead to more rapid insect resistance to *Bacillus thuringiensis.* ♦ Seed is more expensive ♦ Seed is less easily obtainable. ♦ Requires special knowledge and proper management to prevent potential negative impacts.	
MON 89034	♦ Resistant to main pests like fall armyworm. ♦ Two *Bacillus thuringiensis* toxins has high efficiency and delay insect resistance. ♦ Increased actual yields.	♦ Seed is more expensive. ♦ Seed is less easily obtainable. ♦ Requires special knowledge and proper management to prevent potential negative impacts.	

Alternative	Advantages	Disadvantages	Preferred Option
	♦ Reduced insecticide use. ♦ Less labour intensive. ♦ Less greenhouse gas emissions due to reduced fuel use for spraying. ♦ Reduced water use due to less need for dilution of insecticides.		
NK 603	♦ Easier weed control. ♦ Increased actual yields.	♦ Weeds can become resistant to glyphosate. ♦ Requires special knowledge and proper management to prevent potential negative impacts.	
Stacked events: MON 89034 × NK 603; NK 603 × Mon 810	♦ Both insect resistance and easier weed control. ♦ Increased actual yields. ♦ Reduced insecticide use. ♦ Less labour intensive. ♦ Less greenhouse gas emissions due to reduced fuel use for spraying. ♦ Reduced water use due to less need for dilution of insecticides.	♦ Pests and weeds can become resistant to Bt proteins and glyphosate. ♦ Requires special knowledge and proper management to prevent potential negative impacts.	

5.3 NO GO ALTERNATIVE

Agriculture has been a core activity in the region for decades. Maize is supplied to Namibian mills and the stover used for fodder. Currently, within the restriction of pesticides available in Namibia and the significant infestation of invader grass species, the production of maize is almost not feasible. If maize is for example harvested along with the grass seeds, the entire harvest is downgraded, becoming not economically feasible when considering input costs. This could be disastrous to Namibia who already is a nett importer of maize.

Should the project not receive an environmental clearance certificate, there would be a loss in capital investment and a loss in employment. This will lead to a decrease in the spending power of the local community. Finally, less revenue will be generated for Namibia and more money will be required for importing of feed and food. However, the most important aspect of the no go alternatives will be the lack of staple food production for the local market.

6 ADMINISTRATIVE, LEGAL AND POLICY REQUIREMENTS

All projects, plans, programmes and policies with potential adverse impacts on the environment require an environmental assessment, as per the Namibian legislation. This promotes protection of the environment as well as sustainable development. The legislation and standards provided in Table 6-1 to Table 6-3 govern the environmental assessment process in Namibia, and are relevant to the assessed development.

Table 6-1 Namibian law applicable to the development

Law	Key Aspects
The Namibian Constitution	♦ Promotes the welfare of people ♦ Incorporates a high level of environmental protection ♦ Incorporates international agreements as part of Namibian law
Environmental Management Act Act No. 7 of 2007, Government Notice No. 232 of 2007	♦ Defines the environment ♦ Promotes sustainable management of the environment and the use of natural resources ♦ Provides a process of assessment and control of activities with possible significant effects on the environment
Environmental Management Act Regulations Government Notice No. 28-30 of 2012	♦ Commencement of the Environmental Management Act ♦ List activities that requires an environmental clearance certificate ♦ Provides Environmental Impact Assessment Regulations
Namibia Tourism Board Act Act No. 21 of 2000, Government Notice 261 of 200, 2000	♦ Provides for the registration and grading of accommodation establishments ♦ Provides for the declaration of any sector of the tourism industry as a regulated sector and for the registration of business falling within a regulated sector. ♦ Providing regulations and minimum requirements pertaining to o Levies payable o Registration of regulated business ♦ Registration of accommodation establishment
Accommodation Establishment and Tourism Ordinance 20 of 1973	♦ Consolidates and amend the laws relating to accommodation establishments and tourism and to provide for the establishment of tourist recreation areas and incidental matters ♦ Provides for regulations of tourism establishments ♦ Numerous amendments and repeals
Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act Act No. 36 of 1947; Government Notice No. 1239 of 1947	♦ Governs the registration, importation, sale and use of fertilizers, farm feeds, agricultural remedies and stock remedies ♦ Various amendments and regulations
Seed and Seed Varieties Act 23 of 2018 Act No. 23 of 2018, Government Notice No. 368 of 2018	♦ Provides for restrictions on the importation of seed ♦ Not in force yet

Law	Key Aspects
Water Resources Management Act Act No. 11 of 2013 Government Notice No. 268 of 2023	♦ Provides for management, protection, development, use and conservation of water resources ♦ Prevention of water pollution and assignment of liability
Forest Act Act No. 12 of 2001, Government Notice No. 248 of 2001	♦ Makes provision for the protection of the environment and the control and management of forest fires ♦ Provides for the licencing and permit conditions for the removal of woody and other vegetation as well as the disturbance and removal of soil from forested areas
Forest Regulations: Forest Act, 2001 Government Notice No. 170 of 2015	♦ Declares protected trees or plants ♦ Issuing of permits to remove protected tree and plant species ♦ Issuing of permits for harvesting of trees for wood and charcoal production and transport
Soil Conservation Act Act No. 76 of 1969, Government Notice No. 494 of 1970	♦ Laws relating to the combating and prevention of soil erosion, the conservation, improvement and manner of use of the soil and vegetation and the protection of the water sources in Namibia
Biosafety Act Act No. 7 of 2006, Government Notice No. 210 of 2016	♦ Regulates activities involving the research, development, production, marketing, transport, application and other uses of genetically modified organisms and specified products derived from genetically modified organisms ♦ Prohibits planting of genetically modified organisms without registration
Petroleum Products and Energy Act Act No. 13 of 1990, Government Notice No. 45 of 1990	♦ Regulates petroleum industry ♦ Makes provision for impact assessment ♦ Petroleum Products Regulations (Government Notice No. 155 of 2000) ♦ Prescribes South African National Standards (SANS) or equivalents for construction, operation and decommissioning of petroleum facilities (refer to Government Notice No. 21 of 2002)
Local Authorities Act Act No. 23 of 1992, Government Notice No. 116 of 1992	♦ Defines the powers, duties and functions of local authority councils
Public and Environmental Health Act Act No. 1 of 2015, Government Notice No. 86 of 2015	♦ Provides a framework for a structured more uniform public and environmental health system, and for incidental matters ♦ Deals with Integrated Waste Management including waste collection disposal and recycling, waste generation and storage, and sanitation
Labour Act Act No 11 of 2007, Government Notice No. 236 of 2007	♦ Provides for Labour Law and the protection and safety of employees ♦ Labour Act, 1992: Regulations relating to the health and safety of employees at work (Government Notice No. 156 of 1997)
Hazardous Substances Ordinance Ordinance No. 14 of 1974	♦ Applies to the manufacture, sale, use, disposal and dumping of hazardous substances as well as their import and export ♦ Aims to prevent hazardous substances from causing injury, ill-health or the death of human beings

Law	Key Aspects
Pollution Control and Waste Management Bill (draft document)	♦ Not in force yet ♦ Provides for prevention and control of pollution and waste ♦ Provides for procedures to be followed for licence applications

Table 6-2 Guiding documents, directives and standards

Standard or Code	Key Aspects
South African National Standards (SANS)	♦ The Petroleum Products and Energy Act prescribes SANS standards for the construction, operations and demolition of petroleum facilities ♦ SANS 10089-3:2010 is specifically aimed at storage and distribution of petroleum products at fuel retail facilities and consumer installations ♦ SANS 10131 (2004) is aimed at above-ground storage tanks for petroleum products ♦ Provide requirements for spill control infrastructure

Table 6-3 Relevant multilateral environmental agreements

Agreement	Key Aspects
Charter of the Regional Tourism Organisation of Southern Africa (RETOSA), 1997	♦ Development of tourism through effective marketing of the Region in collaboration with the public and private sector ♦ To facilitate, encourage and assist in the development of legal and ethical tourism throughout the Southern African Region taking due consideration of the overall development of the people, the Region and the Region's natural and cultural resources
Stockholm Declaration on the Human Environment, Stockholm 1972	♦ Recognizes the need for a common outlook and common principles to inspire and guide the people of the world in the preservation and enhancement of the human environment
United Nations Framework Convention on Climate Change (UNFCCC)	♦ The Convention recognises that developing countries should be accorded appropriate assistance to enable them to fulfil the terms of the Convention
Convention on Biological Diversity, Rio de Janeiro, 1992	♦ Under article 14 of The Convention, EIAs must be conducted for projects that may negatively affect biological diversity
International Treaty on Plant Genetic Resources for Food and Agriculture, 2001	♦ Promotes conservation, exploration, collection, characterization, evaluation and documentation of plant genetic resources for food and agriculture ♦ Promote the sustainable use of plant genetic resources for food and agriculture

Listed activities, which require an ECC application (Government Regulation No 29 of 2012) related to this project, include the following:

Section 2 of Government Notice No 29 of 2012: Waste Management, Treatment, Handling, and Disposal Activities

♦ 2.1 The construction of facilities for waste site, treatment, and disposal of waste. The Proponent has septic tanks and soak-away systems to collect and dispose of sewage and waste water.

Section 4 of Government Notice No 29 of 2012: Forestry Activities

- 4 The clearance of forest areas, deforestation, afforestation, timber harvesting or any other related activity that requires authorisation in terms of the Forest Act, 2001 (Act No 12 of 2001) or any other law: The farm has previously been cleared (spanning a timeframe of 54 years).

Section 6 of Government Notice No. 29 of 2012: Tourism Development Activities

- 6. The construction of resorts, lodges, hotels or other tourism and hospitality facilities. The camping and related hospitality facility was constructed and is currently in operation and maintained accordingly.

Section 7 of Government Notice No 29 of 2012: Agriculture and Aquaculture Activities

- 7.4 The import, processing and transit of genetically modified organisms: The Proponent plans to plant GM maize.
- 7.5 Pest control: The Proponent uses conventional pest control products as approved by the Namibian government. These may include herbicides and pesticides and will vary according to season and pests encountered during a year.

Section 8 of Government Notice No. 29 of 2012: Water Resource Developments

- 8.1. The abstraction of ground or surface water for industrial or commercial purposes: Groundwater is abstracted for current and proposed commercial operations (cattle and small scale irrigation as well as the accommodation facility).
- 8.6 Construction of industrial and domestic wastewater treatment plants and related pipeline systems: The Proponent has installed wastewater treatment facilities in the form of septic tanks and french drains to manage mainly black and grey water from worker residential units, guest rooms, kitchen and the wastewater from the camping terrain.

Section 9 of Government Notice No. 29 of 2012: Hazardous Substance Treatment, Handling and Storage

- 9.1 The manufacturing, storage, handling or processing of a hazardous substance defined in the Hazardous Substances Ordinance, 1974. Fuel is stored on site for daily operations.
- 9.2 Any process or activity which requires a permit, licence or other form of authorisation, or the modification of or changes to existing facilities for any process or activity which requires an amendment of an existing permit, licence or authorisation or which requires a new permit, licence or authorisation in terms of a law governing the generation or release of emissions, pollution, effluent or waste: The Proponent has the infrastructure to store more than 4,000 *l* in aboveground storage tanks.
- 9.5 Construction of filling stations or any other facility for the underground and aboveground storage of dangerous goods, including petrol, diesel, liquid petroleum gas or paraffin: Fuel is stored on site, in aboveground storage tanks for daily operations.

Additional national planning legislation considered include:

- National Development Plan (NDPs).
- Ministry of Agriculture, Water & Forestry Strategic Plan 2017/18-2021/22.
- National Sustainable Tourism Growth & Development Strategy 2016-2026.
- Namibia's Draft Tourism Sector Recovery Plan 2022-2024.
- Namibia's Climate Change Adaptation.

The rationale behind the NDPs is to introduce an element of flexibility within the Ministry planning system by fast tracking development in areas where progress is insufficient. It also incorporates new development opportunities and aims to address challenges that have emerged after the formulation of various NDPs. In the Strategic Plan, the increase in yields of sorghum, pearl millet and maize harvested per hectare, is a key performance indicator for the Plan's Second Pillar's strategic objective, which are aimed to:

"increase productivity during the strategic period through the implementation of appropriate technologies e.g. Comprehensive Conservation Agriculture (CCA) and mechanization in order to ensure food security at both household and national level."

The above ties in with NDPs which purposes to set out a roadmap for achieving envisioned rapid industrialization while adhering to the four integrated pillars of sustainable development as identified in the plan. Conservation agriculture further contribute primary to the "Economic Progression" pillar by aiming to increase the volumes of locally produced goods. One of the focus areas of the economic progression pillar of NDPs is agriculture and food security. The NDPs aims to decrease the amount of food insecure individuals, increase food production and increase the share of value addition in crop and livestock farming. Operational activities on the farm are in line with all of these strategies as identified in the NDPs as well as for the Strategic Plan.

Namibia's Climate Change Adaptation Communication to the United Nations Framework Convention on Climate Change, identifies adaptation actions (amongst others) for the agriculture and water sectors. The following actions have specifically been considered by the Proponent:

- Develop improved crop varieties that adapt to climate change (Climate-Resilient Agriculture);
- Promote the diversification of crops to hedge against erratic rainfall and shorter seasons (Climate-Smart Agriculture); and
- Improve water demand management, particularly at the local level and in the agricultural, industrial, mining and tourism sectors.

It is mentioned in the National Sustainable Tourism Growth & Development Strategy 2016-2026, that for every 13 tourists arriving in Namibia, one job is created. Therefore, the strategy was developed to increase tourist arrivals to generate more employment for Namibians. An objective was stated to grow the tourism industry to become the second most important contributor to the Namibian economy, both in terms of contributions to GDP as well as earnings in foreign revenue. The strategy was based on the fourth National Development Plan (NDP-4) which saw tourism as one of the key pillars of Namibian economic policy. A vital strategy identified in the National Sustainable Tourism Growth & Development Strategy 2016-2024, was to, amongst others, create and maintain a well-trained tourism workforce. Although the strategy's focus is on public-private partnerships, it recognises the importance of maintaining a well-trained tourism workforce.

The global Covid19 pandemic and related travel restrictions have severely affected the Namibian Tourism industry. In response to the effects of the pandemic, the Namibian Government drafted the Tourism Sector Recovery Plan 2022 – 2024. Although the plan is focussed on strategies and actions to be taken by various governing agencies, it also indicates how the tourism sector may be involved in rebuilding the industry. It provides guidelines for growth and new tourism products, which includes mining, agritourism, sports tourism, aqua tourism, astronomy, etc. It should however be noted that, since lifting of the Covid19 restrictions, tourism has recovered to above pre-covid19 levels.

7 ENVIRONMENTAL CHARACTERISTICS

This section lists pertinent environmental characteristics of the study area and provides a statement on the potential environmental impacts on each.

7.1 LOCALITY AND SURROUNDING LAND USE

The project is located in the Grootfontein Constituency centred on (19.621686 °S and 17.940026 °E.), approximately 18 km west of Grootfontein and 3 km south of the Hoba Meteorite National Heritage Site. Farm Venus FMB/00379/0000A is situated on the corner of the D2860 and D2859 and located in the Grootfontein Townlands. Presently, there is one exclusive prospecting license (EPL) active across the northern parts of the farm. EPL8548 is registered for base and rare metals, dimension stone, industrial minerals, nuclear fuel minerals, precious metals and semi-precious stones. On the southern parts of farm there is an EPL application submitted for base and rare metals, industrials minerals, and precious metals. No active petroleum exploration licenses (PEL) are registered over farm.

Surrounding properties are all similar in nature and used for crop cultivation and livestock rearing (commercial farming). However, not all adjacent properties would like to cultivate GM maize. No national or proclaimed conservation areas, protected areas or communal conservancies, are located close to the farm. The adjacent properties are listed in the table below and their locations are depicted in Figure 7 1.

Table 7-1 Adjacent properties

Number on Map	Farm Name and/or Number	Number on Map	Farm Name and/or Number
1	Hanssenia FMB/00019	3	Litauen FMB/00032
2	Heinshof FMB/00026	4	Leyboldshohe FMB/00377

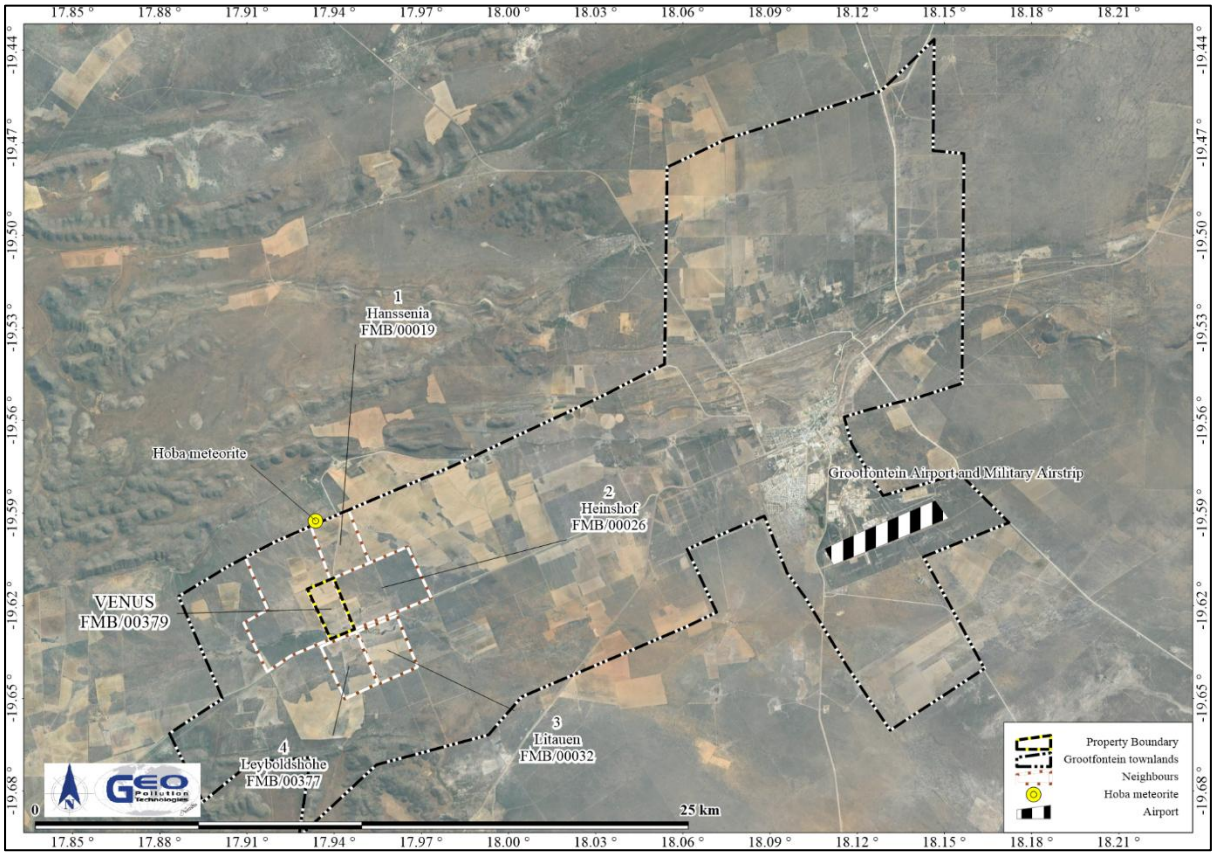


Figure 7-1 Properties adjacent to the project area

Implications and Impacts

The location is well suited for the agricultural activities. It is already zoned for agricultural use and is located in an area suitable for dry land farming. All buffer zones, as required for the cultivation of GM maize should be maintained between the Proponent and neighbours cultivating traditional maize. Consideration should be provided toward prospecting activities proposed across portions of the farm.

7.2 CLIMATE

According to the Köppen-Geiger Climate Classification system the project is located in a hot semi-arid climate (BSh) (http://koeppen-geiger.vu-wien.ac.at/present.htm) (Kottek et al., 2006). This means that the area receives precipitation below potential evapotranspiration, but not as low as a desert climate and has a mean annual temperature of at least 18°C.

There is a general lack of weather stations and data in Namibia, especially in the rural areas. The Atlas of Namibia of 2022 does provide relatively crude averages for various climatic conditions

(Atlas of Namibia Team, 2022). Averages are however for very large areas and does not reflect more localised conditions which are influenced by factors such as for example topography.

7.2.1 Precipitation

As a work around to obtain precipitation data, long term precipitation data can be obtained for the project area from the Climate Hazards Group Infra-Red Precipitation with Station data version 2 (CHIRPS-2) database (Funk et al., 2015) or, where available, from in-situ observations made by landowners in the project area. Both methods have their limitations. The CHIRPS-2 data is averages over 25 km^2 areas as determined by remote sensing and in-situ data, while landowners do not necessarily have the necessary equipment and installations for very accurate measurements. The CHIRPS-2 dataset consists of long term precipitation data (1981 to near-present) obtained from satellite imagery and, where available, in-situ station data. The data is averaged over an area of roughly 5 km by 5 km. This averaging effect should be kept in mind during data analyses as high precipitation from single thunderstorm cells would be averaged out, thereby providing a reduced daily maximum precipitation value.

The Atlas of Namibia indicates the average rainfall for the area as 500 to 550 mm/a, with a variation in annual rainfall of 30 to 40% (Atlas of Namibia, 2022). Based on the CHIRPS-2 dataset, the rainfall for the project area is 500.87 mm/a, with a smaller coefficient of variance of 28.46% (Table 7-2). Both datasets indicate monthly rainfall peaking in January to February. CHIRPS-2 also indicates heavier precipitation (single day events) occurring between December to April, with a single day 25 km² maximum of 61.31 mm in March, being the highest. Maximum precipitation received over a 3-day period is 104.16 mm. This indicates that very heavy rainfall over long periods is not a common occurrence, although 104 mm in three days is higher than typical rainfall for most of Namibia south and southwest of the project area is presented in. Seasonal (July to June) total precipitation, centred on the average rainfall for the last 43 years, is presented with the daily total precipitation and the seasonal cumulative precipitation in Table 7-2. From the figure it is clear that the average rainfall for seven out of the last 10 seasons were all below average.

The potential evapotranspiration for the project area is between 2,400 and 2,500 mm/a. By dividing the mean annual potential evapotranspiration into the mean annual precipitation, an aridity index value for the area was computed as 0.22. This indicates the area to just fall into the semi-arid category which is larger than 0.2 but smaller than 0.5.

Table 7-2 Rainfall statistics (Funk et al., 2015)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum (mm/m)	18.03	24.10	35.82	6.28	0.00	0.00	0.00	0.00	0.00	0.00	8.59	17.93
Maximum (mm/m)	324.24	227.74	207.04	124.69	6.98	0.52	0.05	0.04	8.41	46.52	107.89	177.59
Average (mm/m)	120.72	112.79	89.26	35.25	0.76	0.03	0.00	0.00	0.94	18.61	41.41	77.15
Variability (%)	58.02	47.56	38.96	86.31	240.00	357.54	380.67	655.74	226.72	67.40	50.74	51.15
Daily Maximum (mm)	55.16	47.62	61.31	56.19	5.06	0.33	0.05	0.02	7.01	28.01	32.42	44.82
Average Rain Days	12.93	11.05	7.70	3.33	0.28	0.26	0.16	0.05	0.53	4.00	8.00	10.86
Season July - June average 500.87					Season coefficient of variation: 28.46					3 Day return period: 104.16		
Date range:			1981-Jan-01	to	2024-Jun-30			Lat: 19.622°S			Long: 17.940°E	

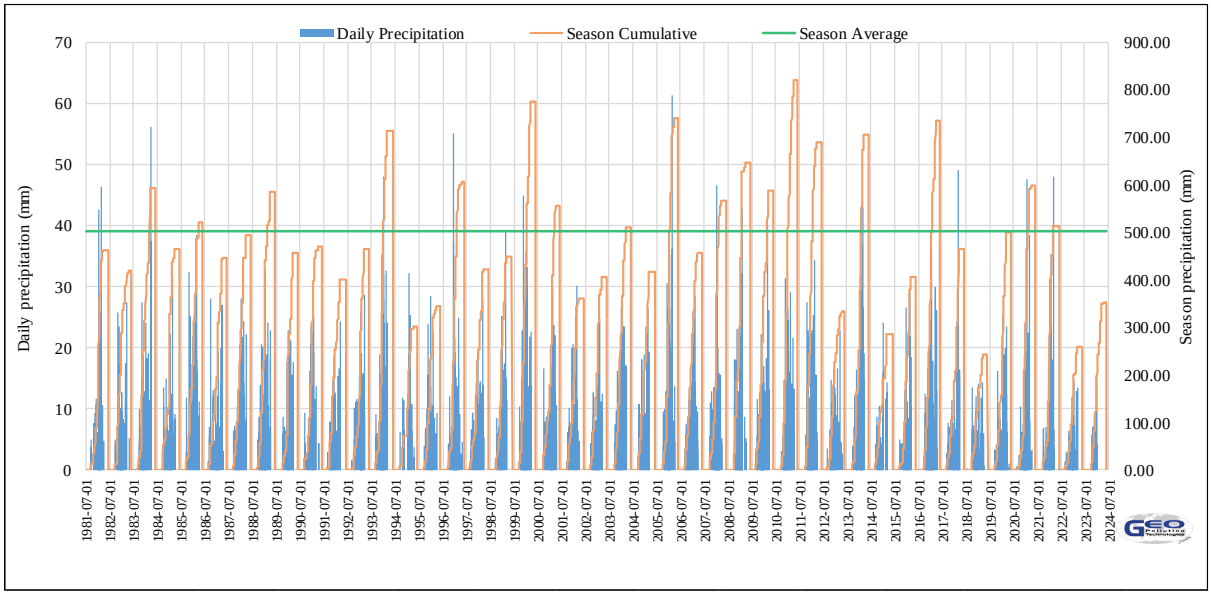


Figure 7-2 Daily and seasonal rainfall (Funk et al., 2015)

Similar to precipitation data, temperature data is also lacking for the project area, with the Atlas of Namibia presenting only crude, large scale averages. To have an idea of temperatures in the area, monthly temperature data was retrieved from the Modern-Era Retrospective analysis for Research and Applications version 2 (MERRA-2) data set for a height of 2 m above surface (Ronald Gelaro, et al., 2017). This data set is a NASA atmospheric reanalysis, incorporating satellite data integration and aims at historical climate analyses at 0.5° x 0.625° spatial resolution. This translates to roughly 3,640 km², which still is a large area, but is somewhat less crude than the Atlas data.

Table 7-3 presents statistics of daily data abstracted from the MERRA-2 data set for the last 41 years. The lowest temperature of -1.5°C was recorded in June. The average annual minimum temperature is 4.8°C. A maximum temperature of 40.3°C was measured in November, while the average annual maximum temperature is 36.6°C. The average annual temperature range is 21.5°C while the average diurnal temperature (difference between daily minimum and maximum temperature) for this area is around 23°C. Direct normal solar irradiance for the area is 7.135 kWh/m²/day.

Table 7-3 Temperature statistics based on Merra-2 data

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum (°C)	8.94	9.30	7.83	4.54	1.51	-1.50	-1.44	1.58	4.35	6.24	6.32	9.45
Maximum (°C)	40.13	39.26	38.44	36.08	33.35	29.84	30.08	33.90	37.43	40.24	40.31	40.13
Average (°C)	25.51	24.15	23.07	20.60	18.18	15.44	15.12	18.26	21.85	24.76	25.92	25.70
Diurnal (°C)	20.72	19.33	20.03	21.60	23.41	24.71	25.49	27.07	27.19	25.18	24.15	22.07
Season July - June				Seasonal average Temperature: 21.55								
Date range:		1980-Jan-01	to	2021-Sep-30		Lat: 19.622°S				Long: 17.940°E		

Table 7-3 indicates wind data as measured for the Grootfontein airport. Prevailing winds are generally from the east. Localised conditions on the farm may see wind patterns being slightly altered by localised topography.

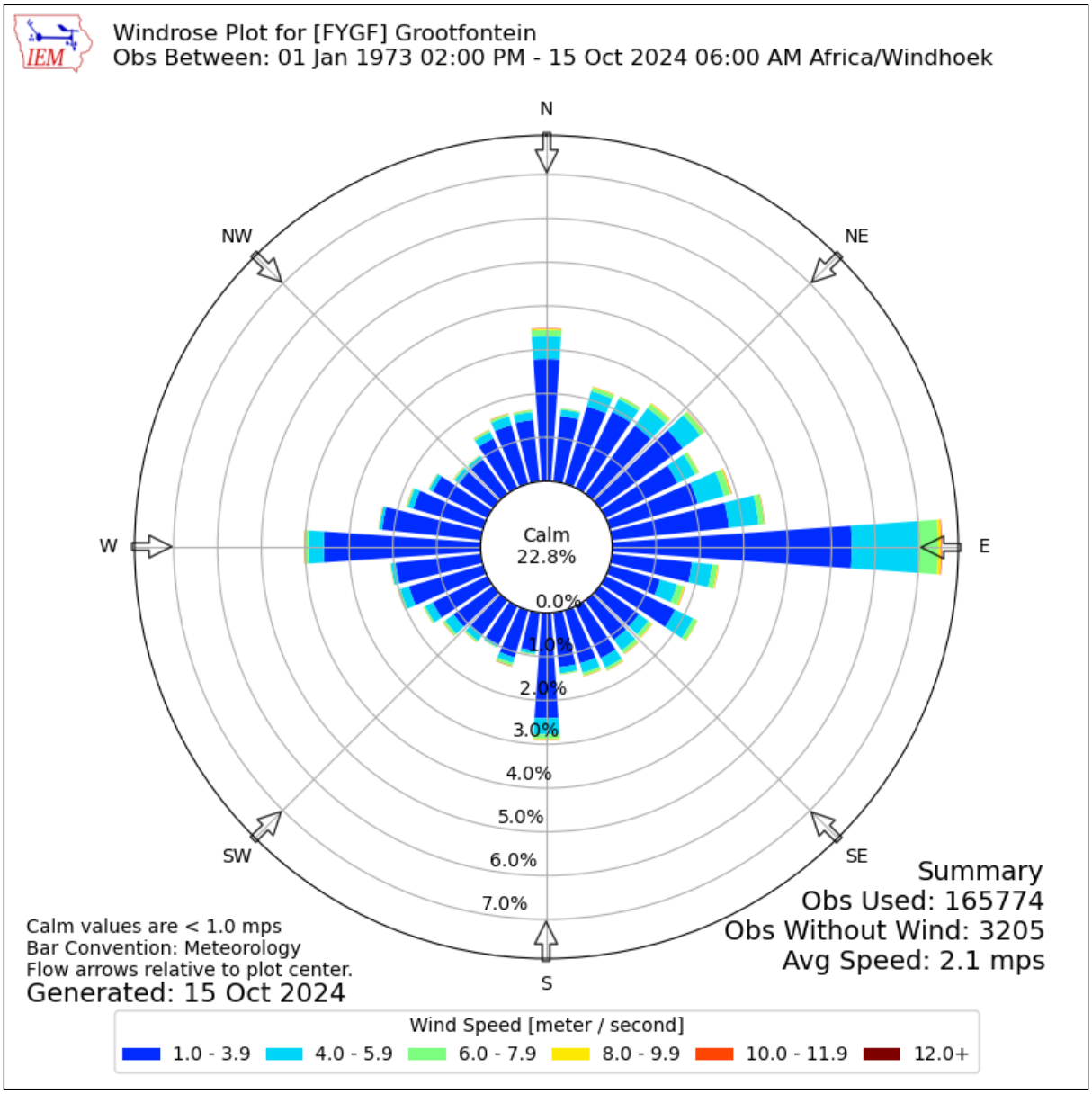


Figure 7-3 Wind rose for the Grootfontein area (https://mesonet.agron.iastate.edu)

Implications and Impacts

Rainfall events are often thunderstorms with heavy rainfall that can occur in short periods of time ("cloud bursts"). Rainfall in the area is above the Namibian average, but varies significantly year on year. Heavy rainfall can lead to soil erosion when improper agricultural practises are employed. Recurring drought conditions may impact on groundwater availability due to reduced aquifer recharge.

Hot dry winds increase the risk of crop damages as well as fire risks and related severity. General winds may carry chemicals and pollen of crops in mainly a western direction while the solar radiation values are high enough to reliably support future construction of photovoltaic solar panels. Climate change contributors are largely related to the mechanised systems and synthetic fertilisers used as part of operations. Effects of climate change to consider during the proposed operations over the next 30 years include increased frequency of droughts (changing rainfall patterns) and higher temperatures (World Bank, 2021).

7.3 TOPOGRAPHY, DRAINAGE

The farm is located in an open valley system surrounded by the Otavi mountain outcrops. It is part of the Kalahari Sandveld Landscape (Medelson, 2022), a flat basin of sedimentation, much of which is characterized by aeolian landforms, including linear dunes and pans. The landscape formed through the accumulation of sand from river flow in a wetter climate during post Gondwana breakup. These sediments were reworked during a subsequent drier period. Today relict dunes remain at places from this former drier climate period.

The general description of little to no run-off relates to the fact that rain rapidly infiltrates the sands while the many small pans scattered across the landscape, only collect and hold water for short periods following thunderstorm deluges. Therefore, watercourses in the landscape area are normally dry. The topography can be described as flat to slightly undulating. Ground surface elevation across the farm vary between 1,508 mamsl in the north-western corner and 1,490 mamsl in the south-eastern corner (Figure 7-5). There is a general north-west to south-east dip across the farm. The differences in elevation necessitated the erection of soil and rock berms around some of the crops fields, as form of erosion control. A cross-section from the highest to the lowest point on the farm indicated an average slope gradient of 1.4%.

Photo 7-1 South-western view from the farm

Photo 7-2 North-western view from the site

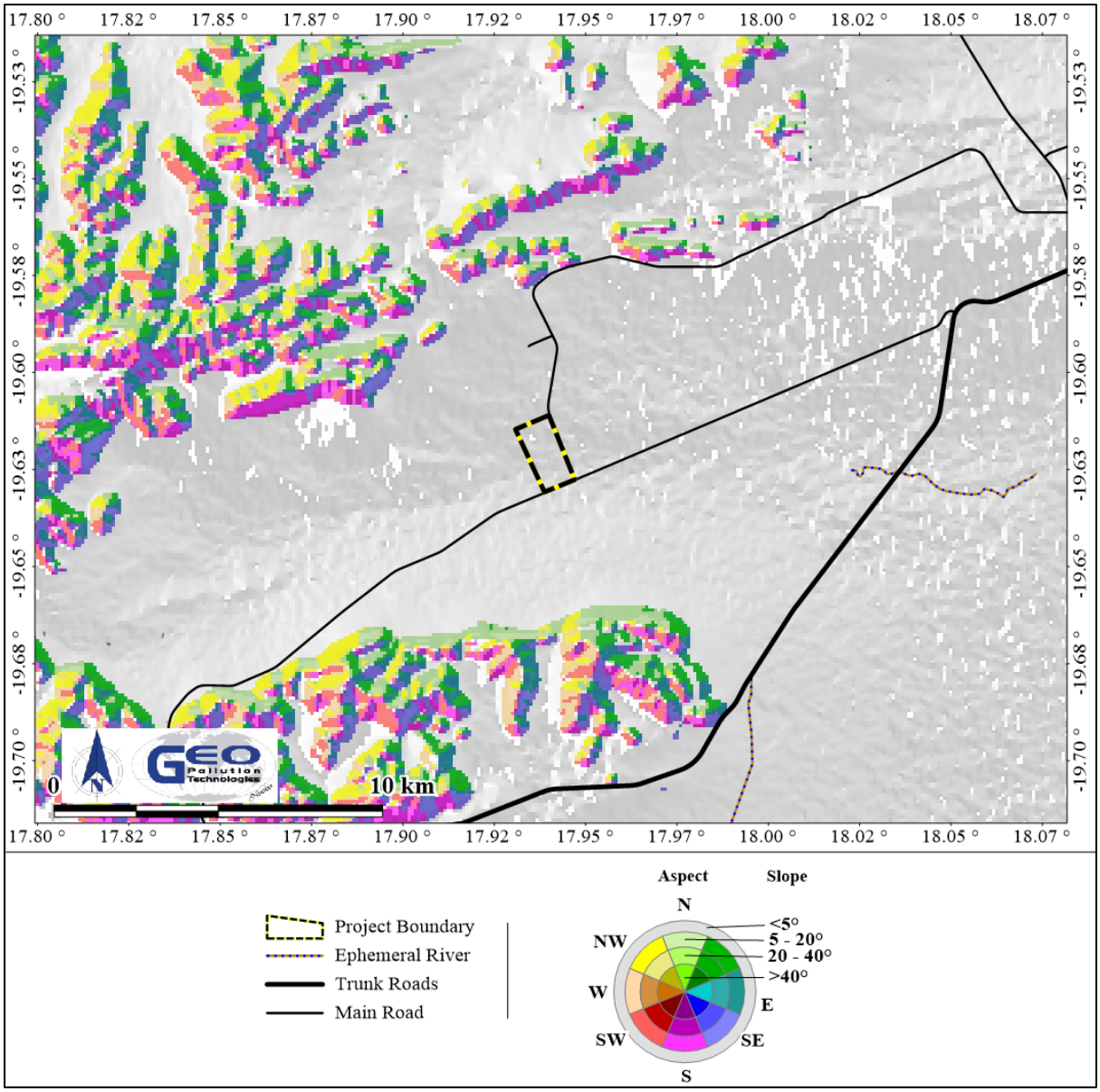


Figure 7-4 Slope Aspect

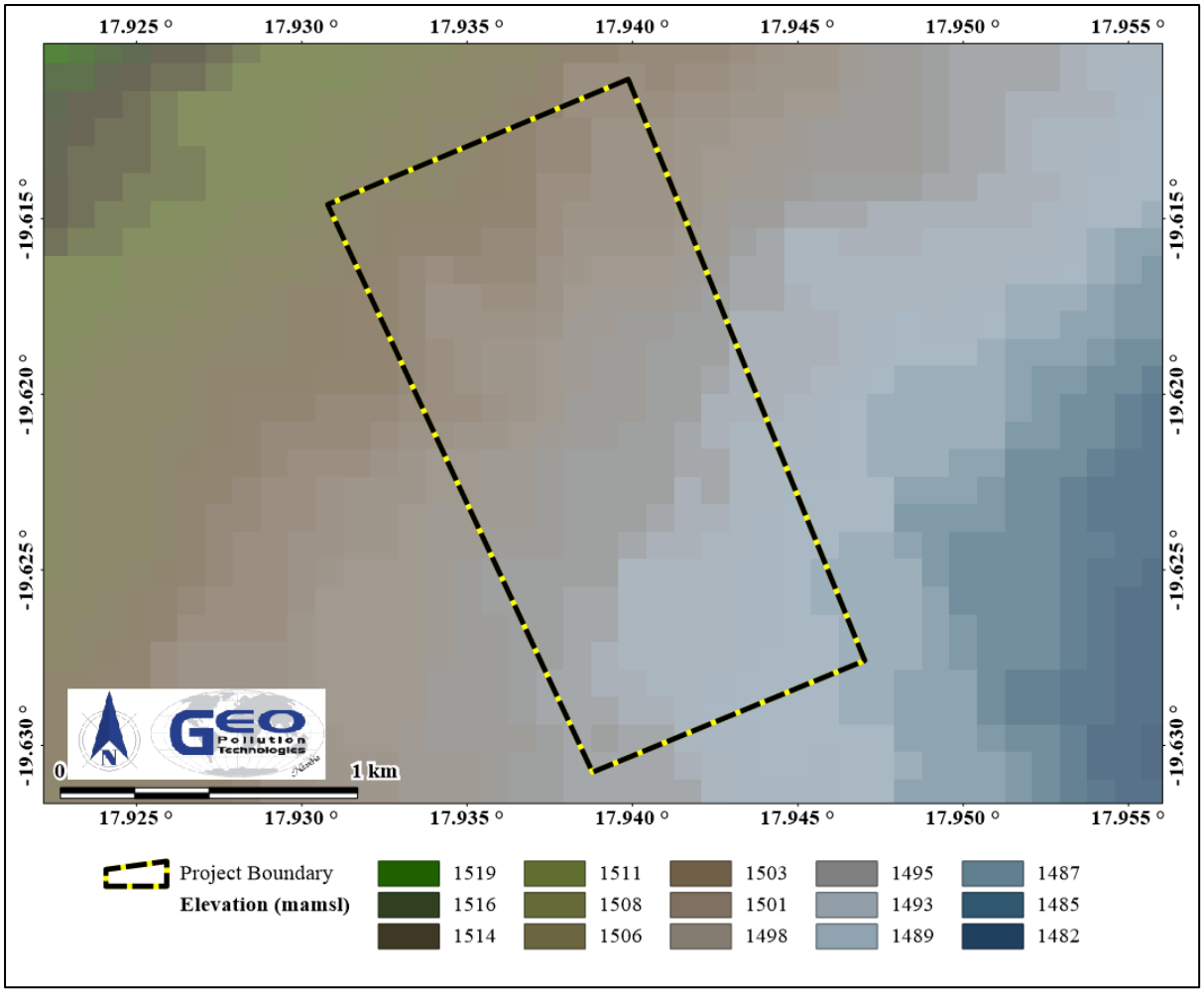


Figure 7-5 Elevation across the farm

Implications and Impacts

The project area is generally flat and well suited for crop cultivation. Drainage across the site has been influenced by surrounding land use as well as the topography. Soil berms have been established at points along the natural drainage lines, while rock berms and cut-off tranches direct runoff around cultivated areas.

7.4 SOIL AND AGRO-ECOLOGICAL ZONES

The Dominant soil type for this area is Eutric Chromic Leptic Cambisol. Eutric Chromic Leptic Cambisol refers to a young soil group that shows the first signs of differentiating into distinct horizons. These soils typically form in newly exposed or deposited colluvial, alluvial and aelion materials, or where aridity has slowed down soil formation.

The composition of soil in this particular area is roughly 65-70% sand, 10-15% silt and 15-20% clay which gives it the characteristics and texture of loam soil. Bulk density was computed to be 1,450-1,500 mg/cm^3 which means that the soil will affect root growth of various plants, but not necessarily restrict it. Soils in this area typically reach depths of >190 cm, have a pH of 5.5-6 and a cation exchange capacity of 7-10 cmol/kg (Atlas of Namibia, 2022).

The farm is situated within the Kalk-2 Agro-Ecological Zone (AEZ) with an average growing period of 105 days. The Kalk-2 AEZ is ranked 2nd in Namibia in terms of agricultural potential and is deemed most suitable for short-maturing crops and large stock grazing. The Kalk-2 area is generally not regarded as suitable for cropping, as is most of Namibia, and this is true for some

parts of the farm. The areas under cultivation around Grootfontein are however located in patches where sufficiently deep, quality soil is present for crop cultivation.

Soil berms can be found at the entrance of the farm, and along some of the roads where running water could cause erosion. This is to prevent the soil from being eroded when heavier precipitation occurs across and upstream of the project location. These soil berms can be seen in Photo 7-3 and Photo 7-4.

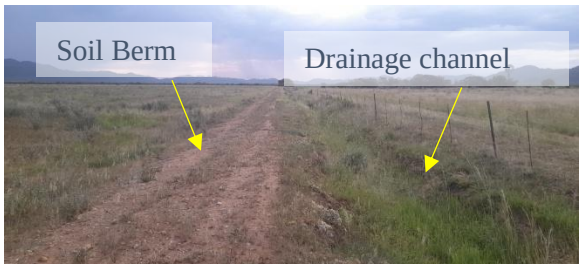


Photo 7-3 Soil berm and a drainage channel along the border fence

Photo 7-4 Soil berm at the project entrance

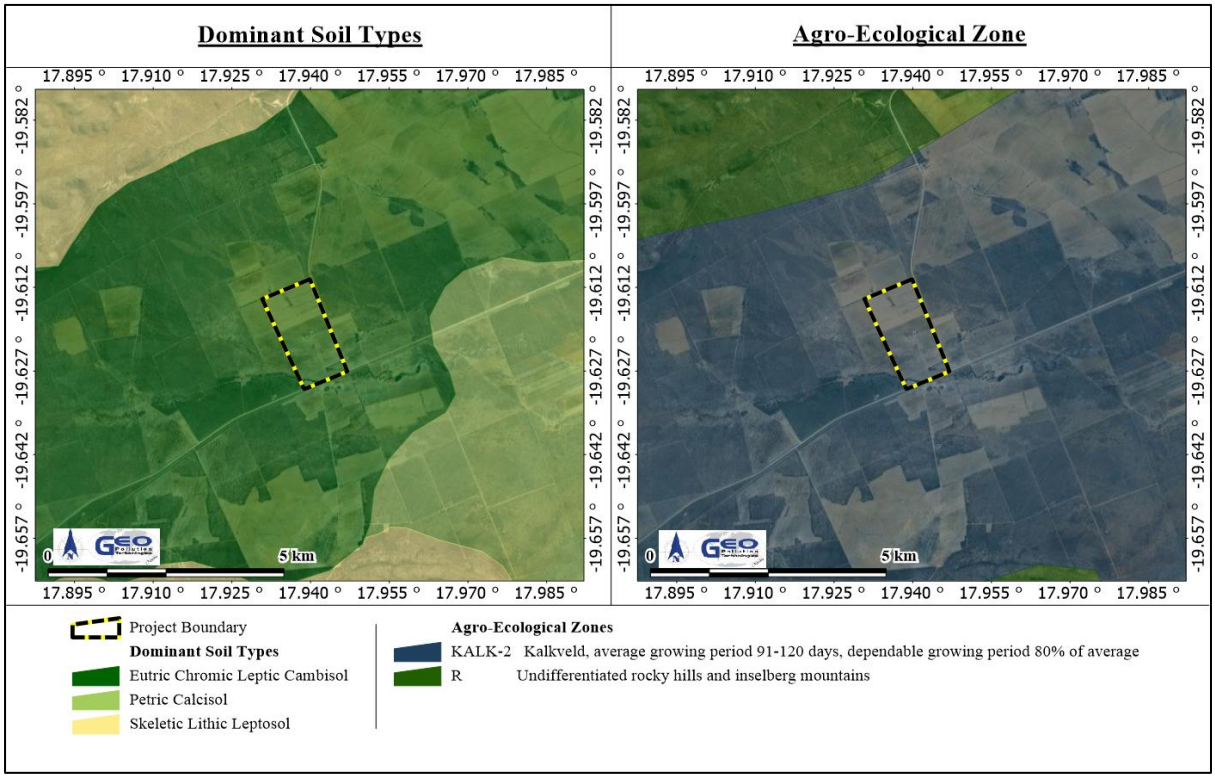


Figure 7-6 Dominant soil type map

Implications and Impacts

Soil contamination by hazardous chemicals and/or the excessive use of fertilizers and pesticides may negatively impact soil and the local ecology. Conservation agricultural techniques aim at maintaining and even increasing soil organic content and thereby improving soil. Conservation agriculture should be conducted where possible. Erosion berms reduce the risk of soil erosion across the farm.

7.5 GEOLOGY AND HYDROGEOLOGY

The geology underlying the project area formed during the Namibian, Quaternary and Tertiary Age. Locally, the geology from the Quaternary and Tertiary Age comprises of the Kalahari Group deposits which consists of sand, calcrete and gravel (Figure 7-7). The Kalahari Group sediments originate mainly from fluvial deposition with some reworking through aeolian processes.

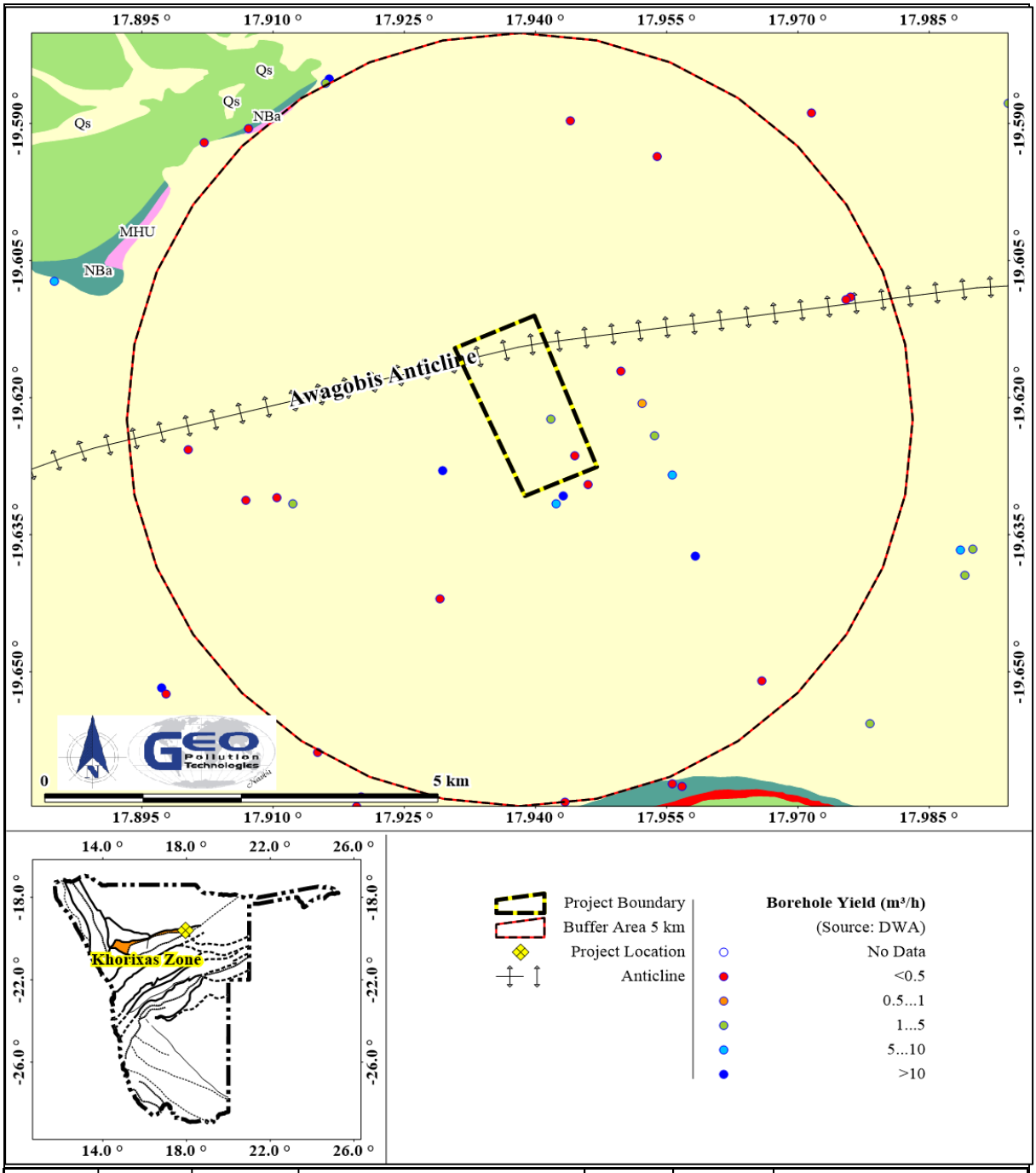
Kalahari sediments at the project location form only a surface cover. The Kalahari Group sediments commonly overlie pre-Kalahari rocks of the Damara Sequence (Namibian Age). At the project location the underlying Damara Sequence consists of dolostones, limestone and shales of the Abenab Subgroups. These subgroups belongs to the Otavi Group (Schneider, 2008) which in turn belongs to the Khorixas Zone of the Damara Sequence.

Moderate folding of the strata occurred during the Pan African Orogeny (680-450 Ma) and resulted in the formation of synclines and anticlines, generally trending east - west. The development of joints and fractures in the rocks are associated with the folding, which have an impact on the hydrogeological characterization of the area. To the north of the project area is the Grootfontein Syncline, with the Awagobis Anticline running staring through the project area.

Various northeast striking magnetic dykes (subsurface) are known to be present in the area surrounding the project location, as inferred from aeromagnetic data. These dykes seems to be related to the Paresis intrusion which are situated just south of Otjiwarongo, with dykes radiating from this intrusion. Geophysical-interpreted dykes can also occur in the area and strike towards the northeast. The nature of these dykes tend to be mineralised faults with high hydraulic conductivity values. Both the Tsumeb (further to the west) and Remnant dykes represented a major exploration target for the NamWater exploration water supply programme to Windhoek. The dykes are thought to have shattered the host rocks during its formation (Nigel, 1993). Where dolomite is the host rock, it forms a zone favourable for the development of karst features and groundwater accumulation.

Several known karst features are present in the region. These include the mineralised karst chimneys of both the Tsumeb and Abenab Mines (Bäumle, 2003), as well as several lakes (e.g. Otjikoto and Guinas) and caves (e.g. Ghaub). Although no caves or lakes are known to be in close proximity (<10 km radius) to the project area.

A number of springs are present in the Otavi Mountain land and most of these springs are related to the contact zones between relatively impermeable formations of the Grootfontein Metamorphic Complex and more permeable formations of the Damara Sequence. According to survey data a number of these springs are close (4 km) to the southern border of the project area, but none of them are located on the farm.



Age	Lith Code	Supergroup	Group	Subgroup	Formation	Description
Quaternary	Qs		Kalahari			Sand, gravel, and calcrete
Namibian	NGa	Damara	Otavi	Abenab	Gauss	Dolostone (massive)
	NBadd				Berg Aukas	Dolostone (laminated dark)
	NBa					Dolostone (laminated light/dark)
Mokolian	MHU		Grootfontein Metamorphic Complex		Haub	Paragneiss, Orthogneiss

Figure 7-7 1:250,000 Geological map

The project area is situated in the Omatako Groundwater Basin. Localised groundwater flow may take place along preferred flow paths in different directions, but the larger scale groundwater flow is expected to be in a northern to eastern direction (Figure 7-8). Local flow patterns may vary due to groundwater abstraction. Groundwater flow is expected to take place through primary porosity in the surface cover, while it is expected to flow along fractures, faults, dykes/mineralised faults or along contact zones (secondary porosity) and other geological structures present within the underlying formations (hard rock formations). Contact zones in the

area occur between permeable and impermeable formations and create favourable conditions to promote groundwater flow.

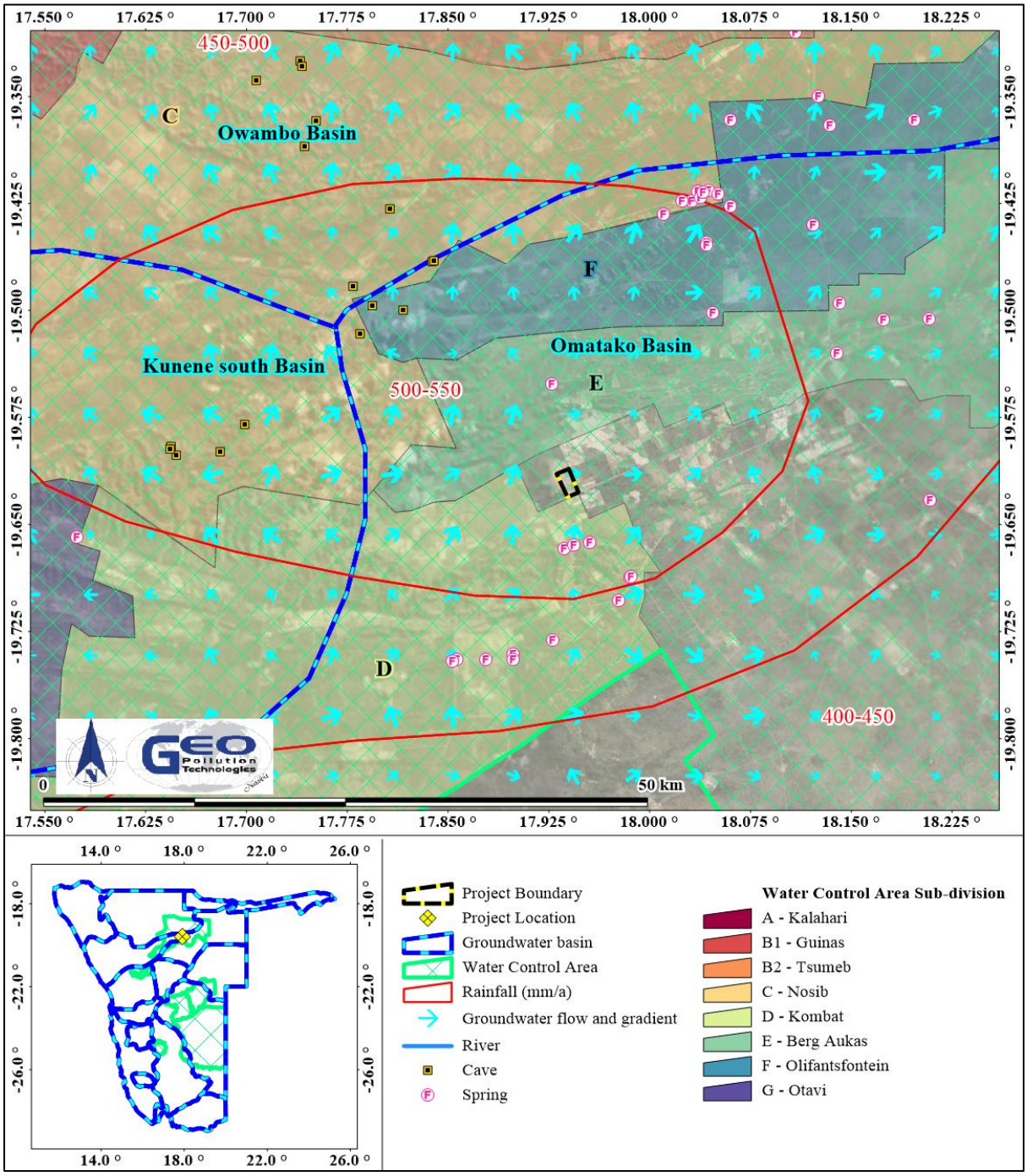


Figure 7-8 Groundwater catchments and water control areas

Table 7-4 presents groundwater statistics for 30 boreholes in a 5 km radius around the project area. The groundwater information was obtained from Department of Water Affairs (DWA) borehole database. This database is generally outdated, and more boreholes might be present. The average depth of 11 of the 30 boreholes are 61.09 m below surface and the yield of 11 of the 30 boreholes ranges between 0.6 and 73 m³/h. The average groundwater level of 21 of the 30 known boreholes is 17.03 m below surface, ranging between 7 and 50 m below surface.

Table 7-4 Groundwater statistics

	Depth (m)	Yield m³/h)	Water level (m)	Water Strike (m)	TDS (ppm)	SO4 (ppm)	NO3 (ppm)	F (ppm)
Data Points	11	11	21	5	10	10	9	10
Minimum	36	0.6	7	18	402	4	2.6	0.5
Average	61.1	14.6	17.0	28.2	643	15	14	1
Maximum	87	73	50	57	1239	84	40	0.9
Group A	*0-50*	*>10*	*0-10*	*0-10*	*0-1000*	*0-200*	*0-10*	*0-1.5*
%	36%	36%	33%	0%	90%	100%	44%	100%
Group B	*50-100*	*5-10*	*10-50*	*10-50*	*1000-1500*	*200-600*	*10-20*	*1.5-2.0*
%	64%	9%	67%	80%	10%	0%	44%	0%
Group C	*100-200*	*0.5-5*	*50-100*	*50-100*	*1500-2000*	*600-1200*	*20-40*	*2.0-3.0*
%	0%	55%	0%	20%	0%	0%	11%	0%
Group D	*>200*	*0-0.5*	*>100*	*>100*	*>2000*	*>1200*	*>40*	*>3*
%	0%	0%	0%	0%	0%	0%	0%	0%
30 boreholes in a 5 km radius from				**-19.621686**		**17.940026**		

Statistical grouping of parameters is for ease of interpretation, except for the grouping used for sulphate, nitrate and fluoride, which follow the Namibian guidelines for the evaluation of drinking-water quality for human consumption, with regard to chemical, physical and bacteriological quality. In this case the groupings has the following meaning:

Group A: Water with an excellent quality

Group B: Water with acceptable quality

Group C: Water with low health risk

Group D: Water with a high health risk, or water unsuitable for human consumption.

Implications and Impacts

Due to the geological characteristics of the area, the groundwater would be vulnerable to contamination should it occur in the area. The groundwater users would be negatively influenced if the groundwater were to be contaminated. There is little risk of over abstraction by the Proponent due to water only being abstracted for stock watering and domestic use. Although the french drain systems for the lodging and staff housing could potentially pose as a point source of contamination. This would happen if the french drain system were to fail or if it was not properly constructed.

7.6 PUBLIC WATER SUPPLY

The Proponent and surrounding farming communities are completely reliant on groundwater as a source of potable water supply. In the potable water on the farm was obtained through an open pit. However, this structure has collapsed and is no longer in use. The actives boreholes on the farm tap into the Omatako Basin and are located within the Tsumeb-Otavi-Grootfontein Subterranean Water Control Area (Government Notice 1969 of 13 November 1970 and Proclamation 278 of 31 December 1976 (Extension)). The closest water pipeline is the NamWater Karstland Bulk Pipeline, located approximately 4 km south of the operations. The Namwater Scheme utilises supply boreholes, the closest being WW21522.

Photo 7-5 Unused water pit on site

Photo 7-6 Unused borehole on site

Implications and Impacts

Groundwater is a valuable resource in the farming area and is controlled by the Ministry of Agriculture, Water and Land Reform. Groundwater contamination may negatively impact surrounding boreholes. No alternative water supply options exist if extensive contamination or deterioration of groundwater occur.

7.7 ECOLOGY

This region is located in the Acacia sub-biome of the Tree-and-Shrub Savanna Biome. This biome is dominated by Acacias that grow in its arid environment along with short shrubs and grasses that grow in the shallow soils of the area's hills. The Karstveld vegetation type, comprising mixed woodland species with an average tree height of 3 to 4.5 m is documented for this area. Typically, 30 to 35% of this vegetation type is covered by woody plants. Plant diversity for this area may range between 400 to 500 species, the second highest diversity category for Namibia. Trees such as *Acacia flecki, Acacia kirkii, Boscia albitrunca, Carissa edulis, Searsia lancea* and a variety of other trees are characteristic of this Karstveld vegetation type. According to the Tree Atlas of Namibia (Curtis & Mannheimer, 2005), 111 different tree species occur in the quarter degree square 1917DB, in which the farming operations are located. A summary of the trees protected by legislation in Namibia, is presented in Table 7-5, while a complete list of trees, which may occur in the area, is attached in Appendix E. Rangeland management conducted on the farm has ensured the removal of some smaller trees while cultivation areas required the complete removal of all vegetation on such areas.

Table 7-5 Trees with conservation concerns in quarter degree squares 1917DB (Curtis & Mannheimer, 2005)

Name	Common Name	Notes (from the Tree Atlas of Namibia)
Acacia erioloba	Camel-thorn	Protected by forestry legislation.
Albizia anthelmintica	Worm-cure Albizia; Aru	The low numbers of young trees recorded is a concern, as is the number of dead trees in some areas. It is Protected by forestry legislation.
Aloe littoralis	Windhoek Aloe	Potentially threatened by pachycaul trade. Protected by the Nature Conservation. Ordinance and listed in CITES Appendix II.
Berchemia discolor	Bird Plum	This species is protected by forestry legislation, as well as by traditional Owambo cultures for its fruit and shade. The population does not appear to be in any real danger at the moment, but communities could be encouraged to plant this species.
Boscia albitrunca	Shepherd's Tree	Although widespread and hardy, it is heavily utilised by people and animals. The difficulty that young plants have in becoming established is a concern, but

Name	Common Name	Notes (from the Tree Atlas of Namibia)
		fortunately there appears to be a health and widespread population of young plants. Protected by forestry legislation.
Combretum imberbe	Leadwood	Although heavily utilized by people, regrowth is good and growth of young trees is vigorous. Because of its religious importance and many uses, it is protected locally. Old specimens warrant protection as monuments. Protected by forestry legislation.
Erythrina decora	Namib Coral-tree	Endemic to Namibia and very uncommon throughout its range. Worthy of protection with very few young trees. Protected by forestry legislation.
Euphorbia avasmontana	Slender Candelabra-euphorbia	Listed in CITES Appendix II.
Euphorbia guerichiana	Paper-bark Euphorbia	Listed in CITES Appendix II.
Ficus sycomorus	Sycamore Fig	Affected in areas with excessive underground water abstraction causing springs to dry up. Lack of young trees. Local communities protect the trees for their fruit and shade. Protected by forestry legislation.
Hyphaene petersiana	Makalani Palm	Should be monitored due to extensive harvesting. Protected by forestry legislation.
Lannea discolor	Live-long	Protected by forestry legislation.
Maerua schinzii	Ringwood Tree	Increasingly impacted by humans and giraffes. Protected by forestry legislation.
Searsia lancea	Willow Rhus	May be affected by a disease. Protected by forestry legislation. Previously *Rhus lancea.*
Schinziophyton rautanenii	Manketti	Increase use for carving might be a concern. Great food value. Greatly damaged by veld fires. Protected by forestry legislation.
Sclerocarya birrea	Marula	Protected locally by communities that use them. Protected by forestry legislation.
Spirostachys africana	Tamboti	Protected by forestry legislation.
Ziziphus mucronata	Buffalo-thorn	Protected by forestry legislation.

Different from the vegetation structure, in which plants share ecological requirements and growth forms, floristic groups are identified by plants being endemic to it. The majority of the farm forms part of the Highland (1500 m) Domain Floristic Group and hosts up to 323 species of flora (Atlas of Namibia Team, 2022).

The Otavi Mountainlands north-west and south-west of the farm, present suitable habitats for a number of bat species which have been documented to range across the project area. These bats include the following species: Dent's Horseshoe Bat (*Rhinolophus denti*), Striped Leaf-nosed Bat (*Macronycteris vittatus*) and the Greater Long-fingered Bat (*Miniopterus inflatus)*. The farm further falls within the habitat for a number of additional species of concern which may occur within the area. Some of the IUCN Red List of threatened species which are more likely to occur on site are listed in Table 7-6.

Table 7-6 IUNC Red listed species which may occur in the area

Species Name	Common Name	IUCN Red List Status
Sagittarius serpentarius	Secretary bird	Threatened
Torgos tracheliotos	Lappet-faced Vulture	Endangered
Falco vespertinus	Red-footed Falcon	Vulnerable
Neophron percnopterus	Egyptian Vulture	Endangered (Breeding area)
Aquila nipalensis	Steppe Eagle	Endangered
Acinonyx jubatus	Cheetah	Vulnerable
Trigonoceps occipitalis	White-headed Vulture	Critically Endangered
Smutsia temminckii	Temminck's Pangolin	Vulnerable
Parahyaena brunnea	Brown Hyaena	Near Threatened
Numenius arquata	Eurasian Curlew	Near Threatened

Species Name	Common Name	IUCN Red List Status
Calidris ferruginea	Curlew Sandpiper	Near Threatened
Glareola nordmanni	Black-winged Pratincole	Near Threatened
Macronycteris vittatus	Striped Leaf-nosed Bat	Near Threatened
Ardeotis kori	Kori Bustard	Near Threatened

The probability of some of the species in Table 7-6 occurring on site is low, due to the majority of the farm, as well as the surrounding areas, being used for cultivation. However, planted crops are known to attract animals who feed of them, mostly duiker and porcupine. However, during drought periods, such as in the recent season, crops are also attacked by termites. The damage to crops can be extensive with the complete destruction of crops in particular areas. Crop damage or loss occur throughout the year. Few snakes have been observed on site.

Implications and Impacts

Pollution of the soil and groundwater by hazardous chemicals and/or the excessive use of fertilizers and pesticides may negatively impact the local ecology. Irresponsible use of pesticides to kill vermin such as jackal may further impact on already threatened vulture populations as well as other scavengers. Pesticides may also magnify (biomagnification) in higher trophic levels, especially top predators. This may lead to reproductive and other physiological defects and ultimately declining populations.

Planting of GM maize without implementing the necessary refuges, and not implementing monitoring programmes and preventative and mitigation measures when needed, may result in insect and weed resistance development. This may potentially impact the local ecosystem structure. Concerns related to the killing of non-target insects as a result of planting insect resistant maize are addressed in the specialist report (Appendix B).

7.8 LOCAL ECONOMY

The Otjozondjupa Region's economy is a diverse representation of various sectors and industries within the region. These include (but are not limited to) mining, tourism and agriculture; all of which have shown potential to be developed. Portions of the constituency which are closer to the urban areas, have more economic diversity. However, the agricultural sector is a large economic contributor, if not the largest in the constituency. Not only does it create jobs, but it has also been one of the driving forces of infrastructure development and related capital expenditure, which are on-going in planning considerations. Continued employment increases individuals' economic resilience and provides for increased social security benefits.

Water quality, essential to livestock rearing, will have an effect on the productivity of operations, therefore the economic benefits of ensuring that the water quality and quantity of the groundwater reserve remains at its best, is an essential component of the agricultural process. If water treatment is required, then the cost of production will increase, resulting in a decrease in revenue and feasibility. The same can be said for the quality of the soil, as lowered quality soil will be less economically productive and contaminated soil, such as found in some areas within the constituency, not usable at all. Water and soil are paramount for the continued functioning of the agricultural project and therefore provide a vital ecosystem service to the Proponent.

Regionally, skilled agriculture and fisheries provide the most employment (31%). The data presented in Table 7-7 was obtained from the Namibia Statistics Agency as per the census in 2011. Updated data related to the different industries' employment statistics has not yet been released as part of 2023 census data. It should be noted that although fisheries falls within the agriculture sector, it does not contribute to employment in the Otjozondjupa Region. The economy of the area relies largely on commercial livestock farming supplemented with crop production and charcoal manufacturing. Livelihoods in the constituency are varied, engaging sectors such as construction, wholesale and retail, administrative (public and defence) and manufacturing.

Table 7-7 Main industry of employed population aged 15 years and above for the Grootfontein Constituency and Otjozondjupa Region (Namibia Statistics Agency, 2011)

Main Industry	Grootfontein Constituency	Otjozondjupa Region
Total	8,463	40,477
Agriculture Forestry and Fishing	2,464	12,526
Mining and Quarrying	216	1,879
Manufacturing	355	2,547
Electricity Gas Steam and Air Conditioning Supply	37	92
Water Supply Sewerage Waste Management and Remediation Activities	23	208
Construction	323	2,147
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	454	2,872
Transportation and Storage	223	1,398
Accommodation and Food Service Activities	133	1,114
Information and Communication	23	221
Financial Insurance Activities	119	695
Real Estate Activities	0	8
Professional Scientific and Technical Activities	71	366
Administrative and Support Service Activities	789	3,339
Public Administration and Defence; Compulsory Social Security	2,114	4,927
Education	265	1,800
Human Health and Social Work Activities	221	974
Arts Entertainment and Recreation	19	156
Other Services Activities	266	835
Activities of Private Households	307	2,206
Activities of Extraterritorial Organisation and Bodies	1	12

Implications and Impacts

Operations on the farm sustain valuable full time employment opportunities in a constituency which relies on the agricultural sector. The project contributes to the local and national agricultural sector. Employment and remuneration of the workforce within the area contributes to economic stability.

The addition of GM maize cultivation, will increase the knowledge of a part of the workforce in terms of the specific requirements linked to GMOs. On a national level, the potential increased yields of GM maize will increase food security during, for example, the outbreak of fall armyworm outbreaks. In considering Round-Up Ready maize, the cultivation thereof can lead to a reduced use of chemicals and tillage, contributing to preserving soil health. However, concerns have been raised about the impact GMO maize may have on on-GMO farmers as well as the export beef industry. These and additional concerns related to GM maize, are discussed in detail in a specialist report (Appendix B).

7.9 DEMOGRAPHIC PROFILE

The project area is located in the Grootfontein Constituency of the Otjozondjupa Region. Goods and services are mainly sourced from Grootfontein. For demographic information of the 2023 population and housing census, refer to Table 7-8 (Namibia Statistics Agency, 2023) which includes the details for the Grootfontein Constituency in relation to the National and regional averages, compared to the census data of 2011.

Although the project falls within the Grootfontein Constituency, the nature of the area is rural. Unemployment in the Grootfontein Constituency is lower at 34.9%, compared to the national and regional averages, while the literacy rate is also lower.

Table 7-8 Demographic characteristics of the Grootfontein Constituency, the Otjozondjupa Region (Namibia Statistics Agency, 2011; 2023)

	2011		2023	
	Grootfontein Constituency	**Otjozondjupa Region**	**Grootfontein Constituency**	**Otjozondjupa Region**
Population (Males)	12,748	73,902	18,705	113,280
Population (Females)	12,130	70,001	18246	107,531
Population (Total)	24,878	143,903	36,951	220,811
Population density (people/km^2)	2.2	1.4	3.3	2.1
Unemployment (15+ years)	30,8%*	37%*	Tbd	Tbd
Literacy (15+ years)	80.5%	83%	Tbd	Tbd

* Calculated as per the economically active segment of the population

Implications and Impacts

Operations on the farm sustain valuable full time employment opportunities in a constituency which relies on the agricultural sector. The project contributes to the local and national agricultural sector and specifically in terms of the diversified operations. Employment and remuneration of the workforce within the area stimulates additional economic growth.

The addition of GM maize cultivation, will increase the knowledge of a part of the workforce in terms of the specific requirements linked to GMOs. On a national level, the potential increased yields of GM maize will increase food security during, for example, the outbreak of fall armyworm. In considering Round-Up Ready maize, the cultivation thereof can lead to a reduced need for chemicals and tillage, contributing to preserving soil health. However, concerns have been raised about the impact GMO maize may have on non-GMO farmers as well as the export beef industry. These and additional concerns related to GM maize, are discussed in detail in a specialist report (Appendix B).

7.10 CULTURAL, HERITAGE AND ARCHAEOLOGICAL ASPECTS

There are no cultural or heritage aspects known to be present on the farm. The proximity of the farm to Grootfontein, allows for easy integration to cultural and related services for employees. There are no cultural or heritage aspects known to be present on the farm. The Hoba Meteorite is located about approximately 3 km north-east of the farm.

Archaeological and paleontological aspects may occur around the mountains, however, no such resources have been discovered. The greater area (north of the farm) has been cited to contain a number of caves and dolocine cavities which have been studied for not only the unique habitats they present, but also the geological evidence related to climate.

Implications and Impacts

Existing areas of operations are not close to any caves or related features. However should any archaeological resources be found, such resources should be reported for investigation.

8 PUBLIC CONSULTATION

Consultation with the public forms an integral component of an environmental assessment investigation and enables interested and affected parties (IAPs) e.g. neighbouring landowners, local authorities, environmental groups, civic associations and communities, to comment on the potential environmental impacts associated with projects and to identify additional issues that they feel should be addressed in the environmental assessment.

Public participation notices were advertised, twice in two weeks, in two national papers: The notices appeared in the Republikein and the Namibian Sun on 22 and 29 February 2024. A site notice was placed on site and notification letters were hand-delivered or e-mailed to neighbours as well as the

relevant ministries and authorities. See Appendix E for proof of the public participation processes and registered IAPs.

During the notification period, discussions held with neighbouring parties centred around providing information about the environmental assessment process and the cultivation of GM produce. It became apparent, through these conversations, that none of the neighbours had concerns related to the cultivation itself, however, they were concerned about cross-pollination and or contamination of non-GM produce. Generally neighbours wanted to know how cross-pollination or contamination can be prevented, to ensure that their non-GM products remain GM free. The environmental assessment and related management plan, lies at the heart of the mitigation measure. Adherence to it, as well as the requirements of the GM seed suppliers, specifically provide measures related to the size of buffer and/or isolation zones and the various contingency plans. These plans are required to be drafted and submitted prior to any cultivation. These plans are also required to be submitted to the NCRST for approval.

9 ASSESSMENT AND MANAGEMENT OF IMPACTS

The purpose of this section is to assess and identify the most pertinent environmental impacts that are expected from the operational, construction, care and maintenance, and potential decommissioning activities of the farm. An EMP based on these identified impacts is presented in this section.

For each impact, an environmental classification was determined based on an adapted version of the Rapid Impact Assessment Method (Pastakia, 1998). Assessment of impacts is based on the following categories: importance of condition (A1); magnitude of change (A2); permanence (B1); reversibility (B2); and cumulative nature (B3) (Table 9-1).

The environmental classification is calculated as follows:

Environmental classification = A1 x A2 x (B1 + B2 + B3).

The environmental classifications of impacts and the respective classes are provided in Table 9-2.

The probability ranking refers to the probability that a specific impact will happen following a risk event. These can be improbable (low likelihood); probable (distinct possibility); highly probable (most likely); and definite (impact will occur regardless of prevention measures).

Table 9-1 Assessment criteria

Criteria	Score
Importance of condition (A1) – assessed against the spatial boundaries of human interest it will affect	
Importance to national/international interest	4
Important to regional/national interest	3
Important to areas immediately outside the local condition	2
Important only to the local condition	1
No importance	0
Magnitude of change/effect (A2) – measure of scale in terms of benefit/disbenefit of an impact or condition	
Major positive benefit	3
Significant improvement in status quo	2
Improvement in status quo	1
No change in status quo	0
Negative change in status quo	-1
Significant negative disbenefit or change	-2
Major disbenefit or change	-3
Permanence (B1) – defines whether the condition is permanent or temporary	
No change/Not applicable	1

Temporary	2
Permanent	3
Reversibility (B2) – defines whether the condition can be changed and is a measure of the control over the condition	
No change/Not applicable	1
Reversible	2
Irreversible	3
Cumulative (B3) – reflects whether the effect will be a single direct impact or will include cumulative impacts over time, or synergistic effect with other conditions. It is a means of judging the sustainability of the condition – not to be confused with the permanence criterion.	
Light or No Cumulative Character/Not applicable	1
Moderate Cumulative Character	2
Strong Cumulative Character	3

Table 9-2 Environmental classification (Pastakia 1998)

Environmental Classification	Class Value	Description of Class
72 to 108	5	Extremely positive impact
36 to 71	4	Significantly positive impact
19 to 35	3	Moderately positive impact
10 to 18	2	Less positive impact
1 to 9	1	Reduced positive impact
0	-0	No alteration
-1 to -9	-1	Reduced negative impact
-10 to -18	-2	Less negative impact
-19 to -35	-3	Moderately negative impact
-36 to -71	-4	Significantly negative impact
-72 to -108	-5	Extremely Negative Impact

9.1 RISK ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN

The EMP provides management options to ensure impacts of the agricultural and related activities on the farm are minimised. An EMP is a tool used to take pro-active action by addressing potential problems before they occur. This should limit corrective measures needed, although additional mitigation measures might be included if necessary. The environmental management measures are provided in the tables and descriptions below. For the GMO specific management plan please refer to Appendix B. These management measures should be adhered to during the execution of various activities on the farm. This section of the report is also presented as a stand-alone document for easy reference. All personnel taking part in the operations of the farm should be made aware of the contents of this section, so as to plan the operations accordingly and in an environmentally sound manner.

The objectives of the EMP are:

- to include all components related to operational and possible construction activities of the farm;
- to prescribe the best practicable control methods to lessen the environmental impacts associated with the farm;
- to monitor and audit the performance of operational personnel in applying such controls; and
- to ensure that appropriate environmental training is provided to responsible operational personnel.

Various potential and definite impacts will emanate from the operations, maintenance/construction and decommissioning phases. The majority of these impacts can be

mitigated or prevented. The impacts, risk rating of impacts, as well as prevention and mitigation measures are listed below.

As depicted in the tables below, impacts related to the operational phase are expected to mostly be of medium to low significance and can typically be mitigated to have a low significance. The extent of impacts are largely site specific to local and are not of a permanent nature. Due to the nature of the surrounding areas, cumulative impacts are possible and the most important of these are potential groundwater and biodiversity/ecological impacts.

9.1.1 Planning

During the phases of planning for the operations, maintenance/construction and decommissioning of the farm, it is the responsibility of the Proponent to ensure they are and remain compliant with all legal requirements. The Proponent must also ensure that all required management measures are in place prior to, and during all phases, to ensure potential impacts and risks are minimised. The following actions are recommended for the planning phase and should continue during all other phases of the project:

- Ensure that all the necessary permits from the various ministries, local authorities and any other bodies that governs the operations, maintenance/construction and decommissioning activities on the farm remain valid. These include the water abstraction license, consumer installation certificate and a permit for environmental release of GM maize .
- Ensure all appointed contractors and employees enter into an agreement, which includes the EMP. Ensure that contractors, sub-contractors, employees and all personnel present on site understand the contents of the EMP.
- Make provisions to have a Health, Safety and Environmental (HSE) Coordinator to implement the EMP and oversee occupational health and safety as well as general environmental related compliance.
- Make provision for a community liaison officer to deal with complaints.
- Have the following emergency plans, equipment and personnel on site, where reasonable, to deal with all potential emergencies:
    - EMP, risk management plan, emergency response plan and HSE manuals;
    - Adequate protection and indemnity insurance cover for incidents;
    - Procedures, equipment and materials required for emergencies (e.g. firefighting, first aid, etc.).
- Establish and maintain a fund for future ecological restoration, specifically for instances of environmental damage caused during operations including pollution remediation where required. Should project activities cease completely, and future land-use will not involve agriculture, the funds should be utilised to remove all redundant infrastructure and waste.
- Establish and/or maintain a reporting system to report on aspects of operations, maintenance/construction, and decommissioning as outlined in the EMP. Keep monitoring reports on file for bi-annual submission to MEFT in support of environmental clearance certificate renewal applications. This is a requirement by MEFT.
- Appoint a specialist environmental consultant to update the environmental assessment and EMP and apply for renewal of the environmental clearance certificate prior to expiry.

9.1.2 Revenue Generation in the Professional Sector

Consulting and professional services are engaged with for assistance in applications for new permits and renewal of existing permits such as borehole registrations, fuel storage and environmental clearance certificates. Such services may further be extended to pest control for operations, and accounting and legal services for administrative processes. All of these services are paid for and therefore the agricultural project contributes to revenue generation in the local and national sectors. In addition, during many of these processes, such as per the renewal of water licenses, information is generated which informs and facilitates planning of the Proponent as well as affected parties and governmental agencies.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Planning	Employment and contribution to local and national economy	3	2	3	3	2	54	4	Definite
Daily Operations	Contracted services and contribution to local and national economy	2	1	3	3	1	14	2	Definite
Indirect Impacts	Increased economic resilience in the professional sector	3	1	3	1	1	15	2	Highly Probable

Desired Outcome: Contribution to national treasury and increased economic resilience in the local and national professional sector.

Actions

Enhancement:

- Contract local Namibians where possible.
- Adhering to permit conditions on reporting.
- Deviations from this practice must be justified.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Service providers' contracts or agreements or records be kept.
- All reporting, monitoring and information sharing records kept on file.

9.1.3 National Development Goals: Agriculture and Land Use Planning

The agricultural project pins down key development goals and challenges which were identified as part of the Namibian development goals. It may be considered as an agricultural project which aims at generating income from foreign sectors by providing the most value per resource (soil and labour). In addition, the project is located in line with the regional planning initiatives which identified the location as an area for agricultural development. The project will further contribute to the national climate change combatting initiatives through crop diversification and proposed resilient crop cultivation. Developing of the agricultural sector was identified as one of the core plans within the NDPs for Namibia. The agricultural project therefore is considered to be a positive contributor to achieving national development goals.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Planning	Project implementation in line with the NDP and regional land use planning	4	1	2	1	1	16	2	Highly Probable
Daily Operations	Expansion of the agricultural sector in the Region. Project implementation in line with the regional land use planning	3	2	2	2	2	36	4	Highly Probable
Indirect Impacts	Contributing to achieving the goals set out in Vision 2030 for Namibia	3	1	3	3	3	36	4	Highly Probable

Desired Outcome: Continued contribution to the development of the Region as well as implementation of project activities in line with NDPs and Vision 2030.

Actions

Enhancement:

- Liaison with regional and national governmental agencies through appropriate financial and social responsibility reporting.
- Increase recycling initiatives and incorporate additional greenhouse gas reduction activities such as conservation tillage and climate smart agriculture.
- Infrastructure maintenance and development such as, road servitude, water- and sanitation system developments (provision to employees) and node development. Where possible, public and private partnership regarding projects should be considered.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- All project contributions towards regional development, inclusive of communications held with relevant authorities, to be kept on file.

9.1.4 Skills and Development

Training is essential to all aspects of the operations. Relative to responsibility, every employee requires the skillset to conduct tasks which form part of the operation. General skills in cattle handling, for example, may be acquired through on the job training and guidance from skilled workers. Progressive training in terms of, for example, safe pesticide application or specialised equipment handling (such as tractor operator) may require additional resources to aid in the training such as demonstrations, manuals and explanations. The skills and training of employees allow them to conduct certain tasks safely and or according to the required standard for continued operations.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction	Employment and transfer of skills, technological advancements	2	1	2	3	1	12	2	Probable
Daily Operations	Employment and transfer of skills	2	1	2	3	2	14	2	Definite
Indirect Impacts	Employment and transfer of skills in Namibia's agricultural sector	2	1	2	3	3	16	2	Definite

Desired Outcome: To see an increase in skills of local Namibians, as well as development and technological advancements in the agricultural industry.

Actions

Enhancement:

- Sourcing of employees and contractors must first be at local level and if not locally available, regional or national options should be considered. Deviations from this practice must be justified.
- Inform employees about parameters and requirements for references upon employment.
- Provide managerial references for unofficial training or skills transfer when conducted.
- Relative to their responsibilities, provide on-farm training for all staff involved in pesticide application / agrochemical , including but not limited to:
  - The safe transport, handling and storage of pesticides
  - Warning and advice pictograms commonly used on pesticide labels
  - Disposal of leftover pesticide and or pesticide containers
- Ensure first-aid and fire-fighting training for a portion of the workforce.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- Keep records of all training provided to employees.
- Ensure that all training is certified or managerial references provided (proof provided to the employees) inclusive of training attendance, completion and implementation.
- Include all information in a bi-annual report.

9.1.5 Revenue Generation and Employment

Skilled and unskilled labour are required for the operations and maintenance/construction activities associated with the farm. Importantly, employment provided is permanent and long term and in some instances, generational. The use of GMO maize is expected to increase the success rate and nett economic benefit of operations. However, due to the variability of GMO seed prices, input costs etc, the nett benefit will vary year on year. It is nonetheless foreseen, based on historic cultivation of GMO in other developing countries, that the overall revenue generation capacity will be increased, contributing to the sustainability of operations and related employment. Livelihoods are thus sustained and the spending power of the local community increased. Through continued long term employment, economic resilience is enhanced of individual employees. In addition revenue is generated through the provision of hospitality and tourism services. Increased travel within Namibia and specifically to this region may increase the demand for accommodation and related services.

Through employment, the Proponent also contributes to the Social Security while significant contributions are also made to the Namibian Revenue Services. Revenue is generated through the sale of products on national and international markets.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction	Employment and contribution to local and national economy	2	1	2	2	2	12	2	Definite
Daily Operations	Employment contribution to local and national economy	2	1	3	3	1	14	2	Definite
Indirect Impacts	Decrease in unemployment, contribution to local economy	3	1	3	3	3	27	3	Definite

Desired Outcome: Contribution to national treasury and provision of employment to local Namibians.

Actions

Enhancement:

- The Proponent must employ local Namibians where possible.
- If the skills exist locally, employees must first be sourced from the area, then the region and then nationally.
- Deviations from this practice must be justified.
- Opportunities for additional income generating activities to be investigated in order to sustain employment.
- Where feasible, employment of the same seasonal and/or temporary workforce year on year.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Bi-annual summary report based on employee records.

9.1.6 Ideals and Aspirations

There are various controversies and viewpoints related to GMO cultivation and consumption. Therefore, care was taken during the public notification of the project, to clearly stipulate the intension of the Proponent to cultivate GMO maize. Some of these issues were raised, by a lesser percentage of IAPs contacted, verbally, during notification discussions. Both concerns have the potential to significantly affect the ideals and aspirations of those concerned.

Of particular concern to some of the neighbours, is possible cross-pollination and the related effects thereof. In such instances, the future economic aspirations of the particular party may be affected since the current price of GM maize is lower than that of conventional maize. The different pricing schedule for conventional and GM maize stems from the pricing schedule adopted for South Africa. However, the Namibian non-GMO premium is much higher than in South Africa. The current difference in price for maize per ton is 8%. A complex factoring system was employed by the Namibian Grain Producers Association to reach this difference. It takes into account yields per hectare, national markets as well as allowances for drought conditions this in turn results in greater pressure on consumers to whom this cost is carried forward. This aspect therefore not only affect the different maize producers, but also the consumers. Whether for or against the cultivation of GM maize, ideals and aspirations of parties are affected. Some, such as adjacent land owners, more than others.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction	Information sharing about proposed expansion and related possible environmental constraints	2	2	2	2	3	28	3	Probable
Daily Operations	Information sharing related to cultivation of GM produce	2	1	2	2	2	12	2	Probable

Desired Outcome: Continued sharing of activity plans with IAPs and governing agencies. Maintaining an open door policy with neighbours and employees.

Actions

Mitigation:

- Information sharing about the project's progress should be made available to governmental agencies, interested and affected parties and the IAPs, The Proponent and affected parties should use the information generated during the environmental assessment to realistically plan for future growth. Open communication regarding future development should be maintained.
- Contractor's tenders to include best practise requirements for construction safety, security and environmental management. Pollution, poaching and unauthorised habitat destruction to carry contractual penalties.
- The Proponent must employ Namibians where possible. Deviations from this practise should be justified appropriately.
- A community liaison officer should be appointed during the construction phase especially to facilitate community grievances and concerns.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Records kept of all information shared with authorities, neighbours and employees.

9.1.7 Agricultural Produce

The project is in line with the objectives of Namibia's NDPs and contributes to the economy of, and food security in, Namibia. Locally produced crops decrease the amount of crops that needs importation. Cultivation of GMO maize is expected to increase annual crop yields due to decreased insect damage, especially during a heavy infestations or plagues, and less competition with weeds. Less weeds and especially problematic grasses, also provide a cleaner crop yield.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction and Daily Operations	Contribution to economy, contribution to food security in Namibia	1	2	3	3	2	16	2	Definite
Indirect Impacts	Reduced import needs, increase in trade balance, spread of knowledge and skills, increased crop productivity	1	2	3	3	3	18	2	Definite

Desired Outcome: Maximum contribution to the food security and economy of Namibia. Provide a positive contribution to the trade balance of Namibia by reducing the amount of imported produce and exporting higher value products.

Actions:

Enhancement:

- Teach employees on sustainable farming practices to enable the spread of knowledge and skills and thereby increase the productivity of small-scale farming as well.
- Diversification and continuous improvement to maximise sustainability of the farm.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Bi-annual reporting on educational programmes and training conducted.

9.1.8 Health, Safety and Security

Daily operational and intermittent maintenance and construction activities on the farm are reliant on human labour. Such activities have varying degrees of health and safety risks. Examples include the operation of vehicles and machinery with moving parts, such as harvesters, and the handling of hazardous chemicals with inherent health hazards, such as pesticides and fuel, when ingested, inhaled or physical contact occur. Encounters with wild animals, and especially venomous species like snakes, may pose risks to employees. Security risks relates to unauthorized entry on the farm, theft and sabotage.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction	Physical injuries, exposure to chemicals and criminal activities	1	-2	3	3	1	-14	-2	Probable
Daily Operations	Physical injuries, exposure to chemicals and criminal activities	1	-2	3	3	2	-16	-2	Probable

Desired Outcome: To prevent injury, health impacts and theft.

Actions

Prevention:

- Implement and maintain an integrated health and safety management system, to act as a monitoring and mitigating tool.
- Comply with all health and safety standards as specified in the Labour Act and related legislation.
- Clearly label dangerous and restricted areas as well as dangerous equipment and products such as agrochemicals.
- Lock away or store all equipment and goods on site in a manner suitable to discourage criminal activities (e.g. theft).
- Provide all employees with required and adequate personal protective equipment (PPE) where required.
- Ensure that all personnel receive adequate training on the operational procedures of equipment and machinery and the handling of hazardous substances.
- Train selected personnel in first aid and ensure first aid kits are available on site.
- The contact details of all emergency services must be readily available.
- Implement a maintenance register for all equipment whose malfunction can lead to injury or exposure to hazardous substances.
- Apply and adhere to all industry specific health and safety procedures and regulations applicable to the handling of food produce for markets.

Mitigation:

- Treat all minor work related injuries immediately and obtain professional medical treatment if required.
- Assess any safety problems and implement corrective action to prevent future occurrences.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- Record any incidents with the actions taken to prevent future occurrences.

- Compile a bi-annual report of all incidents reported. The report should contain dates when training was conducted and when safety equipment and structures were inspected and maintained.

9.1.9 Fire

Construction activities, failing electrical infrastructure, mechanical operations and fires outside of designated areas, may increase the risk of the occurrence of unplanned and / or uncontrolled fires, which may spread into the nearby fields and surrounding farms. Lightning may cause natural fires during the dry season. Farming operations do not present the same fire risk as operations which include charcoal production in the greater area. Uncontrolled fires which have generated in other areas will present a risk to existing and prosed operations.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction	Fire risk	1	-2	2	2	1	-10	-2	Probable
Daily Operations	Fire risk	1	-2	2	2	1	-10	-2	Probable

Desired Outcome: To prevent property damage, veld fires, possible injury and impacts caused by uncontrolled fires.

Actions:

Prevention:

- Prepare a holistic fire protection and prevention plan. This plan must include evacuation plans and signage, an emergency response plan and a firefighting plan.
- Ensure fire-fighting equipment are maintained in good working order at all times. Ensure such equipment is readily available / unobstructed access.
- Personnel training (safe operational procedures, firefighting, fire prevention and responsible housekeeping practices).
- Ensure all flammable chemicals are stored according to material safety data sheet (MSDS) and SANS instructions and all spills or leaks are cleaned immediately.
- Maintain regular site, mechanical and electrical inspections and maintenance.
- Maintain firefighting equipment and promote good housekeeping.
- Clean and maintain firebreaks at strategic locations on the properties, especially where vulnerable to external fire.
- Notify the farmers' association as well as all surrounding farmers if planned burns (e.g. to create firebreaks) are planned.
- Allow fires used for purposes such as cooking (by staff) in designated areas only.

Mitigation:

- Implement the fire protection and firefighting plan in the event of a fire.
- Quick response time by trained staff will limit the spread and impact of fire.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- Maintain a register of all incidents on a daily basis. Include measures taken to ensure that such incidents do not repeat themselves.
- Compile a bi-annual incidents report. The report should also contain dates when fire drills were conducted and when firefighting equipment were tested and training given.

9.1.10 Noise

Noise is generated by various operational and possible construction activities. Machinery like generators, machinery, vehicles and harvesters cause elevated noise levels that may result in hearing impairment after long term exposure. Activities are generally remote from receptors other than the Proponent, his employees and their families residing on the farm. The nature of the noise is related mainly to the ongoing operation (for maintenance records) and mechanical maintenance typically on a farm.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction	Excessive noise generated from construction activities – nuisance and hearing loss	1	-1	2	2	1	-10	-1	Probable
Daily Operations	Noise generated from the operational activities – nuisance and hearing loss	1	-1	2	2	1	-10	-1	Definite

Desired Outcome: To prevent any nuisance and hearing loss due to noise generated.

Actions

Prevention:

- Follow Health and Safety Regulations of the Labour Act and/or World Health Organization (WHO) guidelines on maximum noise levels (Guidelines for Community Noise, 1999) to prevent hearing impairment.
- Regularly service all machinery to ensure minimal noise production.

Mitigation:

- Hearing protectors as standard PPE for workers in situations with elevated noise levels.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- Health and Safety Regulations of the Labour Act and WHO Guidelines.
- Maintain a complaints register.
- Bi-annual report on complaints and actions taken to address complaints and prevent future occurrences.

9.1.11 Waste Production

Various waste streams result from the operational and possible construction and maintenance activities. Waste may include hazardous waste associated with hydrocarbon products and chemicals, as well as soil and water contaminated with such products. Construction waste may include building rubble and discarded equipment. Domestic waste will be generated by the residents and employees on the farm. Most of the farming related waste can be re-used and or recycled, however certain waste, such as empty pesticide containers are hazardous and should be disposed of according to hazardous waste requirements.

Waste presents a contamination risk and when not removed regularly may become a health and/or fire hazard and attract wild animals and scavengers. Sewage is a form of liquid biological waste that needs disposal.

Since no official waste disposal facilities, especially for hazardous waste, are available, all waste that cannot be re-used are burned at dedicated waste sites.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction	Excessive waste production, littering, illegal dumping, contaminated materials	1	-2	2	2	2	-12	-2	Definite
Daily Operations	Excessive waste production, littering, contaminated materials	1	-2	2	2	2	-12	-2	Definite

Desired Outcome: To reduce the amount of waste produced and prevent pollution and littering.

Actions

Prevention:

- Implement waste reduction measures. All waste that can be re-used/recycled must be kept separate.
- Ensure adequate temporary storage facilities for disposed waste are available.
- Prevent windblown waste from entering the environment.
- Prevent scavenging (human and non-human) of waste at the storage facilities.
- Educate employees on the importance of proper waste handling and disposal.

Mitigation:

- Waste should be disposed of regularly and at appropriately classified disposal facilities, this includes hazardous material (empty chemical containers and contaminated materials, soil and water).
- Discarded waste should be disposed of and burned regularly at a dedicated site to reduce health and pollution risks.
- Empty chemical containers that may present a contamination/health risk must be treated as hazardous waste. Workers should not be allowed to collect such containers for purposes of storing water or food. This can be achieved by puncturing or crushing such containers prior to disposal.
- Liaise with the applicable authorities regarding waste and handling of hazardous waste.
- Ensure all ablution facilities are designed to prevent groundwater contamination.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- Maintain a register of disposal of hazardous waste. This should include type of waste, volume as well as disposal method/facility.
- Record any complaints received regarding waste with notes on actions taken.
- All information to be included in a bi-annual report.

9.1.12 Ecosystem and Biodiversity Impact

Agriculture and related activities are ongoing on the farm. Possible expansion is planned on existing cleared areas and no further impacts on vegetation are thus expected from additional land clearing. Rangeland improvement is an ongoing endeavour as part of the aftercare program, while cattle numbers are continually evaluated to avoid the risk of overgrazing.

Irresponsible pesticide use, for example as method of vermin control, may impact on scavengers such as vultures and in the long run on top predators through biomagnification in higher trophic levels. Similarly, the use of insecticide on crop fields may also affect non-target species. It would therefore be advantageous to use GM maize which, for example in the case of BT Maize, target a certain problem species. Less insecticides can be applied to reduce the risk of harm to non-target species.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction	Impact on fauna and flora. Loss of biodiversity	2	-1	3	2	2	-14	-2	Probable
Daily Operations	Impact on fauna and flora. Loss of biodiversity – poaching, poisoning, etc.	2	-1	2	2	2	-12	-2	Probable

Desired Outcome: To avoid pollution of, and impacts on, the ecological environment.

Actions.

Prevention:

- Strictly adhere to pesticide application instructions and use pesticides only for the purposes for which it is registered and marketed. Importantly, pesticides should not be used to kill vermin unless specifically registered for that purpose, and even then alternative, environmentally friendly methods should be investigated and used.
- Restrict access to pesticides, insecticides and any other material which can be used by poachers.
- Prevent spray drift by applying pesticides during calm weather conditions.
- Ensure the employees applying pesticides are trained and / or skilled in the application thereof.
- Educate all contracted and permanent employees on the value of biodiversity and strict conditions prohibiting harvesting and poaching of fauna and flora must be part of employment contracts. Include prohibitions or regulations on the collection of firewood.
- Regular inspection of fences, game footpaths and other sites for snares, traps or any other illegal activities.
- Ensure all fuel, oil, hydraulic fluid and waste oil handling (e.g. servicing of vehicles or refuelling) is conducted on impermeable or bunded areas or make use of drip trays where such structures are not present.

Mitigation:

- For construction activities, if any, contain construction material to a designated laydown area and prevent unnecessary movement out of areas earmarked for clearing and construction.
- Report any extraordinary animal sightings to the MEFT
- Prevent scavenging of waste by fauna.
- Take disciplinary action against any employees failing to comply with contractual conditions related to poaching and the environment.

Responsible Body:

- Contractor
- Proponent

Data Sources and Monitoring:

- Report on all extraordinary animal or plant sightings or instances of poaching.
- Keep frequent records of borehole water levels and abstracted water volumes to identify any trends or consistent reduction in water levels.
- Compile a bi-annual report on all monitoring results.

9.1.13 GM Crops Becoming Invasive

Concerns have been raised regarding the possibility of GM crops establishing themselves outside of farmland with the potential of becoming invasive. After decades of planting traditional maize , no instances of this have been recorded and it is highly unlikely that the GM cultivars will be any different. Neither maize nor cotton has any closely related species occurring naturally within Namibia, thus further decreasing the possibility of them establishing and becoming invasive.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	GM crops becoming invasive	2	-1	2	2	2	-12	-2	Probable

Desired Outcome: To prevent the unintended proliferation of GM maize or cotton outside dedicated crop fields.

Actions

Prevention:

- Contain GM seeds and prevent spillages during transport.
- Spill clean-up plan where accidental spills occur during transport.
- Prevent theft of GM crop seeds.

Mitigation:

- Refer to GM cultivation contingency plans for the handling and transport of GM seeds.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Spill management plan.
- Record all spills and include maize strain, date, location and spill clean-up measures with photo records.
- Submit the spill report to the NCRST.

9.1.14 Pesticide Resistance

In GM crop fields, pesticide resistance has been reported in insects (against Bt proteins) and weeds (against glyphosate). This is however no different from pesticide resistance reported in non-GM crop fields. Over reliance on the use of glyphosate and the lack of crop and herbicide rotation by farmers, in some regions, contribute to the development of weed resistance. In order to address this problem, and maintain good levels of weed control, farmers have increasingly adopted more integrated weed management strategies incorporating a mix of herbicides, other herbicide tolerant crops and cultural weed control measures. These include, using other herbicides together with glyphosate rather than solely relying on glyphosate; using herbicide tolerant crops that are tolerant to other herbicides, such as glufosinate; and using cultural practices such as mulching. These add cost to the GM herbicide tolerant production systems compared to about 10-15 years ago, although relative to the current conventional alternative, the GM herbicide tolerant technology continues to offer important economic benefits.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	Development of pesticide resistance	2	-1	2	2	2	-12	-2	Probable

Desired Outcome: To delay, or ideally prevent, the onset of pesticide resistance in insects and weeds.

Actions

Prevention:

- Develop and implement an insect and weed resistance management plan in collaboration with the seed supplier.
- The plan should among others include.
  - All farmers must adhere to the refuge strategy as stipulated by the GM seed supplier.
  - As part of the insect resistance management plan, intermittently apply insecticides to kill any pest insects that may have developed Bt resistant traits.
  - Application of glyphosate herbicide as per the prescribed concentration (i.e. not lower or higher concentrations as this may be ineffective) and application procedures.
  - Weed control prior to planting which should include herbicides of alternative active ingredients to allow killing of weeds that may have developed resistance to glyphosate.
  - Weed control prior to its production of viable seeds.
  - Cleaning of farm implements to prevent distribution of potential resistant weeds.
  - Crop rotation.

Responsible Body:

- Proponent HSE Officer, seed supplier

Data Sources and Monitoring:

- Insect and weed resistance management plan kept on site.
- Regular inspection of all fields to ensure early detection of extraordinary damage to crops that would indicate Bt resistance.
- If Bt resistance is expected, implement the insect resistance management plan and notify the NCRST and seed supplier.
- Inspection of all fields after application of glyphosate to ensure early detection of surviving weeds that may indicate resistance.
- If glyphosate resistance is expected, implement the weed resistance management plan and notify the NCRST and seed supplier.

- Keep record all instances of suspected insect or weed resistance. Note at least the species, date, extent and measures taken.
- Keep record of all instances of insecticide and herbicide application as a measure to combat weeds or to prevent / delay resistance in insects and weeds. Note at least the date, insecticide and/or herbicide used, concentration of active ingredients as applied, and the reason for application.

9.1.15 Soil Disturbance and Contamination

Without good and suitable soil, existing and proposed farming operations will not be possible. All farming operations have an impact on the soil, some by a lesser degree and others more extensively. Cattle require drinking posts. At these sites there is usually an accumulation of manure which undergoes frequent trampling. Overgrazing may lead to soil degradation and erosion. However, crop cultivation has a much more significant impact on not only soil structure, but also composition. Land preparation techniques involve tillage of all areas while infrastructure establishment may necessitate earthworks. Once the dryland crop field have been established, the Proponent further employs no-till (conservation tillage) practises, limiting further soil disturbance. Irrigated fields, however, have higher occurrences of soil compaction which require conventional tillage. Soil is compacted by mechanical activities such as planting, crop spraying and harvesting as well as livestock being allowed on the field after harvesting.

Once crop fields have been established, the addition of agrochemicals may change the soil composition. Fertiliser is added for certain elements lacking in the existing soil while pesticides may remain in the soil until broken down. In some instances, the irrigation itself, which is often more than the natural rainfall, may further alter the soil composition as the water dissolves of reacts with elements of the soil.

Apart from the crop and cattle related activities, hydrocarbon spills and leaks from machinery, equipment or failing fuel storage infrastructure may also affect the soil composition. All of the processes has the potential to contaminate the soil rendering it less feasible for crop cultivation.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2)Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	Hazardous material, spillages, hydrocarbon leakages from vehicles and machinery.	2	-1	2	2	1	-10	-2	Improbable
Daily Operations	Over application of fertilizer, pesticides, herbicides, etc. Sewerage system malfunction.	2	-1	2	2	1	-10	-2	Improbable

Desired Outcome: To prevent the contamination, compaction, erosion, or structure disturbance of soil.

Actions

Prevention:

- Appoint reputable contractors.
- Vehicles may only be serviced on a suitable spill control structure.
- Regular inspections and maintenance of all vehicles to ensure no leaks are present.
- Ensure all waste oil handling is conducted on impermeable or bunded areas.
- Follow prescribed dosage of fertilizers and pesticides / herbicides and to avoid over application. Where possible application decision should be based on soil testing and plant analysis. Fertiliser application should consider soil temperature and moisture content and not be applied to severely compacted soils.
- All hazardous waste must be removed from the site and disposed of timeously at a recognised hazardous waste disposal facility, including any polluted soil or water.
- All hazardous chemicals and fuel should be stored in a sufficiently bunded area, as per MSDS requirements.

- Where possible, soil compaction from stock grazing and/or heavy machinery movement should be minimised.
- Restrict heavy machinery to designated areas.
- Retain appropriate indigenous vegetation buffers along soil berm and cut-off trenches.
- Increased crop residue left in the soil where possible.

Mitigation:
- All spills must be cleaned up immediately.
- Consult relevant MSDS information and a suitably qualified specialist where needed.

Responsible Body:
- Proponent
- Contractors

Data Sources and Monitoring:
- Maintain Material Safety Data Sheets for hazardous chemicals.
- Continued visual monitoring for soil compaction.
- Soil should be sampled and analysed annually to ensure the correct amounts of fertilizer is applied and soil and groundwater quality is maintained.
- Registers be kept by the Proponent on the type, quantities and frequency of application of fertiliser, pesticides and any other chemicals utilised in crop production.
- A register of all incidents must be maintained on a daily basis. This should include measures taken to ensure that such incidents do not repeat themselves.
- All spills or leaks must be reported on and cleaned up immediately.

9.1.16 Groundwater, Surface Water Contamination

Leakages and spillages of hazardous substances from vehicles, waste oil handling and accidental fuel, oil or hydraulic fluid spills during the operational phase may contaminate the environment. Increase of nutrient levels (from over application of fertilizers or pesticides) in the soil that can leach to the groundwater. Runoff from rainfall events may carry chemical components, such as fertilisers and or pesticides from the site. Groundwater might spread pollutants to neighbouring receptors and may create an impact on downstream water users. Pollution due to sewerage system overflow or leakage may further put the groundwater at risk.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2)Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	Contamination of the local aquifer	2	-2	2	2	2	-24	-3	Probable

Desired Outcome: To prevent the contamination of groundwater, surface water and soil.

Actions

Prevention:

- Appoint reputable contractors.
- Vehicles may only be serviced on a suitable spill control structure.
- Regular inspections and maintenance of all vehicles to ensure no leaks are present.
- All hazardous chemicals and fuel should be stored in a sufficiently bunded area, as per MSDS requirements.
- Ensure all waste oil handling is conducted on impermeable or bunded areas.
- Follow prescribed dosage of fertilizers and pesticides / herbicides and to avoid over application.
- Maintain sewerage systems and conduct regular monitoring.
- All hazardous waste must be removed from the site and disposed of timeously at a recognised hazardous waste disposal facility, including any polluted soil or water.
- Train and or guide persons involved with the sewerage systems, or any related effluent system, in terms of maintenance and operation to ensure the system is operated effectively.

Mitigation:

- All spills must be cleaned up immediately.
- Consult relevant MSDS information and a suitably qualified specialist where needed.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Maintain Material Safety Data Sheets for hazardous chemicals.
- Soil should be sampled and analysed annually to ensure the correct amounts of fertilizer is applied and soil and groundwater quality is maintained.
- Groundwater should be sampled and analysed to test for nitrate concentrations from the fertilizer and for traces of chemicals used in pesticides and herbicides.
- Registers be kept by the Proponent on the type, quantities and frequency of application of fertiliser, pesticides and any other chemicals utilised in crop production.
- A register of all incidents must be maintained on a daily basis. This should include measures taken to ensure that such incidents do not repeat themselves.
- All spills or leaks must be reported on and cleaned up immediately.

9.1.17 Visual Impact

Agricultural activities are, and will continued to be, conducted across farmland that have already been used for this purpose for years, or longer. Cultivated areas are demarcated on old topographic maps, indicating that the area has long since been recognised as an agricultural area. Satellite imagery of 1985 confirm these agricultural areas on the property which is surrounded by similar operations. Operations therefore add to the existing landscape character.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction	Aesthetic appearance and integrity of the site	1	1	2	2	2	6	1	Probable
Daily Operations	Aesthetic appearance and integrity of the site	1	1	2	2	2	6	1	Probable

Desired Outcome: To minimise aesthetic impacts associated with the farm.

Actions

Mitigation:

- Regular waste disposal, good housekeeping and routine maintenance on infrastructure will ensure that the longevity of structures are maximised and maintain a low visual impact.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- Compile a bi-annual report of all complaints received and actions taken.

9.1.18 Cumulative Impact

Possible negative cumulative impacts (i.e. the build-up of minor impacts to become more significant) associated with the operational phase and any maintenance/construction activities are mainly linked to traffic, reduction in soil and groundwater quality and GMO resistance. The cumulative increase in employees in the area may put more pressure on biodiversity as a result of poaching or harvesting of plant and animal products. The cumulative positive impacts from farming in the Otjozondjupa Region relates to increased and sustained employment, revenue generation and overall improved living conditions and livelihoods as a result of increased spending power.

Project Activity/Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Construction and Operations (Negative)	Waste production, pollution, etc. The build-up of minor impacts to become more significant	2	-1	2	2	1	-10	-2	Probable
Daily Construction and Operations (Positive)	Employment, skills development, revenue generation	2	1	2	2	1	10	2	Definite

Desired Outcome: To minimise cumulative all impacts associated with the farm.

Actions

Mitigation:

- Addressing each of the individual impacts as discussed and recommended in the EMP would reduce the cumulative impact.
- Reviewing biannual reports for any new or re-occurring impacts or problems would aid in identifying cumulative impacts. Planning and improvement of the existing mitigation measures can then be implemented.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Reviewing monitoring results based on all other impacts will give an overall assessment of the impacts of the operational phase.

9.2 DECOMMISSIONING AND REHABILITATION

Closure and decommissioning of agricultural and related activities on the farm as a whole is not foreseen during the validity of the environmental clearance certificate or in the near future. However, it is more likely that certain components may be decommissioned. Decommissioning is therefore included for this purpose as well as the fact that construction activities may also include modification and decommissioning of infrastructure. Future land use after decommissioning should be assessed prior to decommissioning and rehabilitation initiated if the land would not be used for future purposes. Should decommissioning occur at any stage, rehabilitation of the area may be required. Decommissioning will entail the complete removal of all infrastructure including buildings and tourism infrastructure. Any pollution present on the site must be remediated. The impacts associated with this phase include noise and waste production as structures are dismantled. Noise must be kept within Health and Safety Regulations of the Labour Act and/or WHO standards. Waste should be contained and disposed of at a dedicated waste disposal site and not dumped in the surrounding areas. The EMP for the farm will have to be reviewed at the time of full decommissioning to cater for changes made to the site and to implement guidelines and mitigation measures.

9.3 ENVIRONMENTAL MANAGEMENT SYSTEM

The Proponent could implement an environmental management system (EMS) for their operations. An EMS is an internationally recognized and certified management system that will ensure ongoing incorporation of environmental constraints. At the heart of an EMS is the concept of continual improvement of environmental performance with resulting increases in operational efficiency, financial savings and reduction in environmental, health and safety risks. An effective EMS would need to include the following elements:

- A stated environmental policy which sets the desired level of environmental performance;
- An environmental legal register;
- An institutional structure which sets out the responsibility, authority, lines of communication and resources needed to implement the EMS;
- Identification of environmental, safety and health training needs;
- An environmental program(s) stipulating environmental objectives and targets to be met, and work instructions and controls to be applied in order to achieve compliance with the environmental policy;
- Periodic (internal and external) audits and reviews of environmental performance and the effectiveness of the EMS;
- The EMP.

10 CONCLUSION

Agricultural and related activities as performed on farm, by the Proponent, contributes positively to the economy of Namibia. Food is produced for national markets and the sale of livestock for meat production to both local and international markets. A number of employment opportunities are sustained and skills development within the local workforce occur. Revenue is generated that contributes to the Namibian economy.

Negative impacts associated with operational and intermittent maintenance and construction activities on the farm, as summarised in section 9, can successfully be mitigated. Implementing a HSE policy will contribute to effective management procedures to prevent and mitigate impacts. All regulations relating to the agricultural and related activities of the Proponent, including health and safety legislation, should be adhered to and implemented where applicable. Groundwater and soil pollution must be prevented at all times. Fire prevention should be key, fire response plans must be in place, and regular firefighting training provided to key employees. The GMO management plan as present in Appendix B must be implemented and strictly adhered to. All staff must be made aware of the importance of biodiversity and the poaching or illegal harvesting of animal and plant products prohibited. This includes the proper handling and correct application of pesticides. Any waste produced must be properly disposed, re-used, or recycled where possible.

The EMP (Section 9) should be used as an on-site reference document for the operations of the farm. Parties responsible for transgression of the EMP should be held responsible for any rehabilitation that may need to be undertaken. The Proponent could use an in-house Health, Safety, Security and Environmental Management System in conjunction with the EMP. All operational personnel must be taught the contents of these documents.

Should the Directorate of Environmental Affairs agree with the impacts and related mitigation measures, they may issue an environmental clearance certificate to the Proponent. The environmental clearance certificate will render this document legally binding on the Proponent. The assessment process's aim is not to stop the farming activities, or any of its components, but to rather determine its impact and guide sustainable and responsible development as per the spirit of the EMA.

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Appendix A Certificates

Certificate no.: 2801

Certificate of Registration for Accommodation Establishment

It is hereby certified that

Meteorite Rest Camp

having complied with the requirements relating to the registration of accommodation establishments in terms of the Namibia Tourism Board Act, 2000 (Act No. 21 of 2000), section 20 is registered as a:

Rest Camp

Registration Number:

RES01027

The registration is only valid with effect from:

05/02/2019

Digu //Naobeb
Chief Executive Officer
Namibia Tourism Board

05/02/2019
Date awarded

Namibia Tourism Board

This certificate is issued without alteration or erasure of any kind. It is an offence in terms of section 19 of the Namibian Tourism Board Act, 2000 (Act No 21 of 2000) to operate a regulated business without a valid registration certificate. This certificate remains property of the Namibia Tourism Board, and must be returned in accordance with the regulations relating to the registration regulations.

Appendix B: GM Maize in Namibia Specialist Report

ENVIRONMENTAL RELEASE OF GENETICALLY MODIFIED MAIZE AND COTTON FOR AGRICULTURAL PURPOSES IN NAMIBIA

Assessed by:

Assessed for:

Agricultural Industry

October 2024

Project:	**ENVIRONMENTAL RELEASE OF GENETICALLY MODIFIED MAIZE AND COTTON FOR AGRICULTURAL PURPOSES IN NAMIBIA: SPECIALIST ASSESSMENT**	
Report: **Version/Date:**	Final October 2024	
Lead Consultant	Geo Pollution Technologies (Pty) Ltd PO Box 11073 Windhoek Namibia	TEL.: (+264-61) 257411 FAX.: (+264) 88626368
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Cite this document as:	Faul A. 2024. Environmental Release of Genetically Modified Maize and Cotton for Agricultural Purposes in Namibia: Strategic Environmental Assessment Report	
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Report Approval	 **André Faul** **Environmental Scientist**	

EXECUTIVE SUMMARY

Introduction

Stakeholders in the agricultural sector intend to apply for the registration of genetically modified (GM) maize for environmental release in Namibia. Under the Biosafety Act and Environmental Management Act of Namibia, the environmental release of a GM organism requires an environmental risk assessment to be conducted. This document reports on an assessment conducted by Geo Pollution Technologies (Pty) Ltd for the environmental release of GM maize and cotton. The specific GM events for maize are MON 810, MON 89034, NK 603 and stacks (combinations) of these events, and for cotton MON 88913 and the stacked event MON 88913 × MON 15985.

These maize and cotton events have primarily been designed to provide insect and / or herbicide resistance. Insect resistance is targeted at the fall armyworm and African maize stalk borer in maize, and the African boll worm in cotton. These pests can cause significant crop losses within days of infestation in traditional non-GM maize and cotton fields. In insect resistant events, moth larvae are controlled by specific proteins that were introduced into the maize and cotton through genetic engineering. Herbicide resistant maize and cotton are resistant to the systemic, non-selective herbicide glyphosate. This enables farmers to manage all weeds in maize and cotton fields by applying glyphosate without harming the maize and cotton itself.

Scope and Methodology

A specialist assessment report was prepared by conducting an extensive literature review and interviewing experts in the field of agricultural economics, specifically in the Namibian environment. The report addresses both GM maize and GM cotton and can thus be used as literature source in environmental impact assessments for farmers' who wish to cultivate GM maize and/or GM Cotton.

Literature Review and Aspects of GM Maize and Cotton Cultivation

A vast amount of scientific and unscientific (popular) publications are available. To separate fact from myth requires in-depth consideration of various publications. A number of expert scientific reviews on the topic of genetically modified organisms (GMOs) are available. The most recent of these covering two decades worth of literature and data.

The main concerns related to the cultivation of GMOs in general are the potential health effects they may have on the consumers as a result of their changed genetic composition, and the potential impact on biodiversity as a result of their environmental release.

Based on the review of existing scientific literature, no concrete evidence could be found that substantiate the various claims of negative impacts caused by GMOs. What became evident is that many anti-GMO lobbyists portray GMOs in a negative light without critical examination of the existing scientific data. Some of these campaigns have been so successful that amidst a severe shortage of food, Zambia's government refused a consignment of food aid consisting of GM maize. Thus far, the only real argument that has some scientific credibility pertaining to negative impacts of GM crops, is that insect and weed resistance can develop in light of the designed GM traits. However, this is not more so than resistance development in conventional non-GM maize (and other crop) cultivation activities.

Conclusion

Economically, the cultivation of GM maize and cotton have been shown, more often than not, to be more profitable and higher yielding (especially for insect resistant crops), than its non-GM counterpart. This is evident in the complete adoption of GM cotton in South Africa with no traditional cotton being planted anymore. The profitability and yields also increase significantly during years of significant pest infestations. In a country like Namibia, with mostly marginal agronomic potential, and likely to be significantly affected by climate change, it makes sense to diversify agronomic practices by introduction GM crops into the system. This assessment report will guide the implementation process and provide a framework within which adopters of GM maize and cotton for cultivation must operate. It remains the responsibility of each farmer to perform the necessary calculations to establish feasibility of GM maize and cotton cultivation for his / her specific circumstances.

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LIST OF ABBREVIATIONS

ATF	Namibian Agricultural Trade Forum
Bt	*Bacillus thuringiensis*
Btk	*Bacillus thuringiensis krustak*i
DDT	Dichlorodiphenyltrichloroethane
DNA	Deoxyribonucleic acid
EIA	Environmental Impact Assessment
EMA	Environmental Management Act No 7 of 2007
EPSPS	Enolpyruvylshikimate-3-phosphate synthase
EU	European Union
FAO	Food and Agriculture Organization
GE	Genetically Engineered
GM	Genetically Modified
GMO	Genetically Modified Organism
HGT	Horizontal Gene Transfer
HIV	Human Immunodeficiency Virus
HT	Herbicide Tolerant
ISAAA	The International Service for the Acquisition of Agri-biotech Applications
ISPM	International Standards for Phytosanitary Measures
IUCN	International Union for the Conservation of Nature
LMO	Living Modified Organism
NASEM	National Academies of Sciences, Engineering, and Medicine
NAU	Namibia Agricultural Union
NBA	National Biosafety Authority
NCRST	National Commission on Research Science and Technology
NDP5	Fifth National Development Plan
SADC	Southern African Development Community
SPS	Sanitary and Phytosanitary
Subsp.	Subspecies
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
USA	United States of America
WHO	World Health Organization
WTO	World Trade Organization

GLOSSARY OF TERMS

Actual Yield – The real tonnage/ha harvested, which typically are less than potential yield because of reducing factors, limiting factors and less than perfect conditions.

Assessment - The process of collecting, organising, analysing, interpreting and communicating information relevant to decision making.

Competent Authority - means a body or person empowered under the local authorities act or Environmental Management Act to enforce the rule of law.

Cumulative Impacts - in relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

Environment - As defined in the Environmental Assessment Policy and Environmental Management Act - "land, water and air; all organic and inorganic matter and living organisms as well as biological diversity; the interacting natural systems that include components referred to in sub-paragraphs, the human environment insofar as it represents archaeological, aesthetic, cultural, historic, economic, palaeontological or social values".

Environmental Release – For purposes of this document this means the release of genetically modified crops for controlled agricultural purposes.

Genetic Modification / Genetic Engineering – the process of altering the genetic material of an organism to produce a genetically modified organism.

Genetically Modified Organism - organisms whose genetic material (genome) has been artificially altered, through genetic engineering, to express favourable physiological traits or produce desired biological products.

Herbicide Resistance – The ability of a plant, typically referring to weeds, to withstand the effects of a herbicide.

Horizontal Gene Transfer – The transfer of genetic material between single cell and / or multicellular organisms where offspring is not produced.

Insect Resistance – The ability of a plant to resist insect damage either through natural means or as a result of genetic modification.

Mitigate - The implementation of practical measures to reduce adverse impacts.

Potential Yield - The maximum tonnage/ha that a crop can produce given no reducing factors (weeds, pests, diseases, etc.), an abundance of water and nutrients, and optimum carbon dioxide levels, radiation, temperature, etc.

Significant Effect/Impact - means an impact that by its magnitude, duration, intensity or probability of occurrence may have a notable effect on one or more aspects of the environment.

Sustainable Development - "Development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs and aspirations" – the definition of the World Commission on Environment and Development (1987). "Improving the quality of human life while living within the carrying capacity of supporting ecosystems" – the definition given in a publication called "Caring for the Earth: A Strategy for Sustainable Living" by the International Union for Conservation of Nature (IUCN), the United Nations Environment Programme and the World Wide Fund for Nature (1991).

Tolerance – The ability of a plant or animal to tolerate a pesticide. Often used interchangeably with resistance.

1 BACKGROUND AND INTRODUCTION

Worldwide, vast expanses of land has been cleared to make way for crop farming to produce food and other agricultural products. With the human population exceeding eight billion, traditional methods of practising agriculture are struggling to meet the demand for food. This is further exacerbated by climate change impacts on rainfall and desertification. Therefore, the agricultural sector continuously investigates and apply increasingly intensive farming methods, to maximise yield and profitability per farming unit. Modern biotechnology has the potential to revolutionize the agricultural industry by developing genetically modified organisms (GMOs) that, due to specific engineered traits, can increase yields and profits while simultaneously simplifying crop cultivation.

Agriculture is one of the key economic sectors in Namibia and one of the major contributors to employment. To meet the growing demand for maize for food and feed production as well as cotton, it is the intention of some farmers to register genetically modified (GM) maize and cotton for environmental release in Namibia. To achieve this, such farmers must apply for permission from the Biosafety Council, of the National Commission on Research, Science and Technology (NCRST), to cultivate GM maize in Namibia. To allow for the registration of GMOs in Namibia, an environmental impact assessment, and an associated management plan, is required as per the Environmental Management Act (EMA) of Namibia (Act No. 7 of 2007). The GM maize earmarked for registration expresses three different genetically engineered (GE) traits, being 1) insect resistance (Mon 810 and Mon 89034), 2) glyphosate resistance (NK 603), and 3) both insect and glyphosate resistance (Mon 810 × NK 603 and Mon 89034 × NK 603). The GM cotton earmarked for registration is 1) glyphosate resistance (MON 8913) and 2) glyphosate and insect resistance (MON 88913 × MON 15985).

2 OBJECTIVES

The main objective of this study is to provide sufficient information to feed into environmental impact assessments for individual farmers who wish to cultivate GM maize and cotton. This will be achieved by:

1. Providing a brief explanation of what constitutes a GMO.
2. Presenting a literature review on GM maize and cotton, the potential benefits, impacts and main concerns related to GM maize and cotton and GMOs in general.
3. Providing a summary of the legal and regulatory framework related to GMOs in Namibia.
4. Evaluating the potential environmental impacts that may result from the cultivation of the selected GM maize and cotton strains in Namibia.
5. Identifying a range of management actions to mitigate the potential adverse impacts to acceptable levels.

3 NEED AND DESIRABILITY

The Fifth National Development Plan of Namibia (NDP5) recognises the importance of the agricultural sector in Namibia. Currently agriculture supports approximately 70% of Namibians and provide employment to roughly a third of the workforce. The NDP5's desired outcome is to see a reduction in food insecurity through an increase in food production [agriculture]. A reduction in agricultural potential (yield) is however expected in light of climate change and desertification. In addition, the occurrence of periodic drought cycles drastically reduce agricultural productivity in Namibia. Therefore, technological advancements are required should Namibia wish to increase food production by means of agriculture.

Maize is one of the staple foods in Namibia and a key ingredient in many animal feed products. Due to the lack of rainfall, the commercial cultivation of maize is only feasible in selected areas, and on relatively small scale. As a result, Namibia is a net importer of maize. Local maize production volumes are dependent on rainfall (dryland cropping), sufficient volumes of stored water (groundwater and dams) and suitable soils. Cotton is an ideal small-scale cash crop in drier climates, due to its resilience under lower rainfall conditions. Yields of both maize and cotton are affected by the outbreak of pests like the fall armyworm and boll worm that can rapidly damage vast stands of maize and cotton

respectively. (See Appendix A for examples of newspaper articles making headlines on pests affecting the agriculture sector.).

Genetically modified crops have the ability to resist or withstand some of the obstacles in crop cultivation. This may result in various direct and indirect benefits and ultimately contribute to food and feedstuff security. Benefits of cultivating pest and herbicide resistant GM crops include:

- Increased actual yields leading to enhanced food and feedstuff security for local and international markets.
- Resilience in the agricultural sector.
- Increased income and thus spending power.
- Increased revenue paid to government.
- Decreased insecticide use.
- More convenient and potentially safer pest control.
- More time for additional income generating activities which can in turn lead to more employment.

4 LITERATURE REVIEW

In the first part of the literature review, a short explanation of the basics of GMOs is provided.

4.1 GENETICALLY MODIFIED ORGANISMS

The World Health Organisation (WHO) defines and explains GMOs as follows:

"Organisms (i.e. plants, animals or microorganisms) in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating and/or natural recombination. The technology is often called "modern biotechnology" or "gene technology", sometimes also "recombinant DNA [deoxyribonucleic acid] *technology" or "genetic engineering". It allows selected individual genes to be transferred from one organism into another, also between nonrelated species. Foods produced from or using GM organisms are often referred to as GM foods"* (WHO 2014).

Genetically modified organisms are thus organisms whose genetic material (genome) has been artificially altered, through genetic engineering, to express favourable physiological traits or produce desired biological products. Genetic modification is not a new concept, the method however has changed significantly in the last four to five decades.

4.1.1 Selective Breeding

As far back as 30,000 years ago, people selectively bred wolves that shared similar favourable phenotypic traits. The result of this selective breeding is that the offspring is more likely to have the genes responsible for that specific trait. In turn, by selecting the offspring with the trait, and again breeding with them, increases the chances of the offspring containing those genes. As this process is repeated, a wolf with a different genotype and phenotype is eventually produced. This is exactly how the numerous dog breeds in existence today, originated (e.g. doberman, labrador, beagle, etc.). Their original ancestors were wolves, but their genotype, and thus phenotype, are now completely different. So much so that dogs are regarded as an entirely new species.

Maize and cotton are no exceptions when it comes to selective breeding. Originally, maize was a wild grass, teosinte, with tiny ears and very few kernels (Photo 4-1). Through selective breeding, dating back as far as 9,800 years, maize now produce large ears with many kernels (Photo 4-2). Cotton was also bred to have more and longer fibres than their wild relatives (Photo 4-3) (https://faculty.sites.iastate.edu).

Selective breeding is thus a slow process of changing the genome of an organism, in order to develop traits favourable to man. Other examples include the numerous colours in budgies, canaries and some parrots, seedless watermelons, larger fruits and vegetables, cattle better suited for specific environments, cows producing more milk, etc.

Photo 4-1 Teosinte ear

Photo 4-2 Maize ear

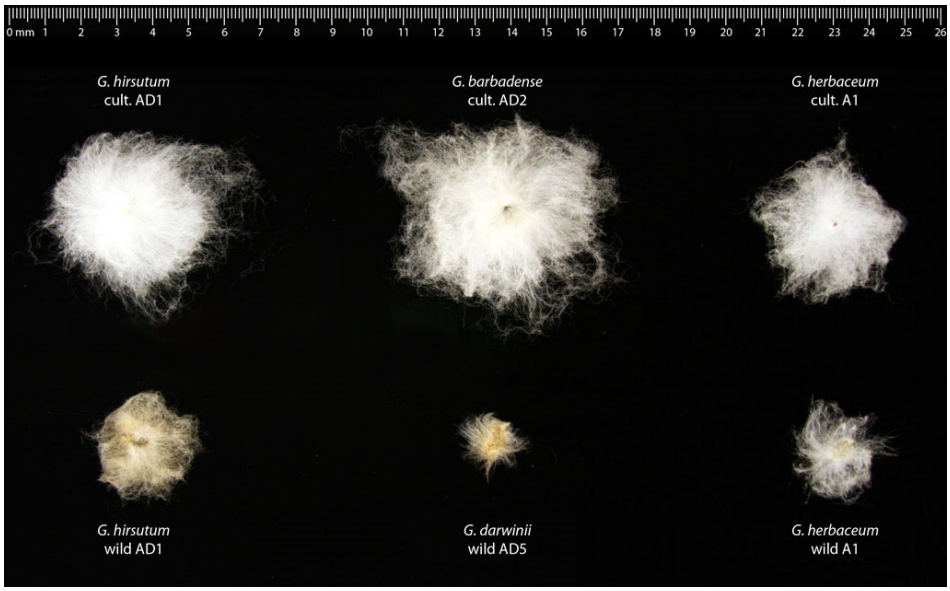

Photo 4-3 Comparison of three species of wild and domesticated cotton (from https://faculty.sites.iastate.edu)

4.1.2 Brief History of Genetically Modified Organisms

Although selective breeding also results in organisms that are genetically different (modified), "GMO" typically refers to the modern techniques of genetic engineering.

In 1973, the first GM bacteria was engineered (Cohen et. al. 1973) when scientists succeeded in "cutting" a gene from one strain of bacteria and "pasting" it into the genome of another bacterium. By 1974, the first GM mammal, a mouse, was engineered (Jaenisch and Mintz 1974). Eight years later, in 1982, the first medication produced by a GMO was approved for human use (Ladisch and Kohlmann 1992). In the latter case, bacteria was engineered to

synthesize insulin in large enough amounts to allow its purification and subsequent administration to patients. The insulin had the exact same structure as that produced in humans. By the early 1990's, the first commercially available GM tomato was placed on the market as food (Bruening and Lyons 2000). In 2017 GM salmon, the first GM animal approved as food, were placed on the market in Canada. GM animals for food production are however still controversial and generally not well received by the general public.

4.1.3 Genetic Engineering Methodology

The genetic modification of an organism is known as an "event". An event can be a single modification or multiple modifications. Where multiple modifications are present it is referred to as a "gene stacked event".

A variety of genetic engineering (GE) techniques exists. A lengthy and complete description / explanation of each of the technologies falls outside of the scope of this report. Instead, brief, non-technical descriptions of some of the techniques are provided as background information. The descriptions of the techniques were obtained from National Research Council (US) Committee on Identifying and Assessing Unintended Effects of Genetically Engineered Foods on Human Health (2004). What is important to know is that genetic code is a "universal language", meaning one organism has the ability to read and encode the genes of almost all other organisms. It is as a result of this ability that GE is possible.

Microbial vectors – The plant disease causing *Agrobacterium tumefaciens* naturally occur in soil and has the special trait of being able to transfer a portion of its own DNA into a host plant cell. By doing so, it causes gall disease in susceptible plants. In the 1980s, *Agrobacterium* lacking the disease causing genes were developed, while still maintaining its ability to insert DNA into the host. Substituting the disease causing *Agrobacterium* DNA, with DNA from another species that expresses desirable traits, allows *Agrobacterium* to insert the "new" DNA into a host plant. The DNA is subsequently integrated into the host's cells. By growing a fertile plant from the modified plant cell, produces a plant that may express the desired trait. Since it is a universal language, the host plant will express the traits of the inserted gene by producing the proteins it codes.

Microprojectile Bombardment – With this method, DNA is attached to microscopic pellets, which are "shot" at plant cells. This way, DNA is inserted into the plant cell, and subsequently expressed.

Retroviral Vectors – Retroviruses are viruses able to transport their own genes into the cells they infect. The genes are then integrated with the host cells' genome. With retroviral vectors, certain genes of the virus are removed and replaced by the gene to be introduced into the host. When the virus delivers the new gene together with some enzymes to the host cell, the gene is integrated into the host, which can then express the desired trait. The virus therefore acts like a "Trojan horse".

4.1.4 Global Status of Genetically Modified Crop Production

In general terms, the economic benefits of cultivating GMO crops are well-researched and well-known globally. Empirical evidence of the economic benefits has been available for decades. Countries that adopted GMO technology during the early years have proceeded to steadily increase the area under GM crop cultivation, as well as the number GM varieties grown in their territories. This trend still continues. At the same time, more and more countries are joining this trend by either lifting or relaxing previously introduced bans and restrictions on the importation of GMO food and feedstuffs and/or allowing the cultivation of GMO crops. The main crop producing and exporting countries have almost all adopted GMO technology and, as a result, have continued to expand their agricultural production base, as well as their overall agricultural output and exports.

Cotton was one of the first crops to be bio-engineered and adopted at a global level. It was much easier to accept the introduction of bio-engineered cotton (as a non-food crop) in

contrast to bio-engineered crops cultivated as foodstuffs (both for human and for animal consumption) such as maize, wheat and to a lesser extent, soybeans. Due to less controversy and sensitivity around crops that were not meant to be used as human or animal food, genetically modified cotton became the first crop that was accepted for introduction in farming systems on the African continent and have been cultivated in Africa as far back as the 1990s (Hofs, J.L. & Kirsten, J., Working Paper, 2001-17).

In a regional context, cotton was also the first genetically modified crop to be approved for commercial cultivation in South Africa and, at present, 100% of cultivated cotton in South Africa is from GM seeds. The economic and management benefits obtainable from the use of GM cotton has resulted in a situation where there is no longer any conventional cotton being planted in South Africa.

In 1996, 2.8 million hectares of GM crops were cultivated in the United States of America, China, Canada, Argentina, Australia and Mexico (ISAAA, 1997). By 2018, this figure has grown to 191.7 million hectares in 26 countries by approximately 17 million farmers (ISAAA, 2018). An additional 44 countries imported GMOs for food and feed purposes, which brings the total number of countries adopting GM crops to 70 (ISAAA, 2018). As of 2017, the top five countries growing GMOs in terms of crop area are the United States, Brazil, Argentina, Canada and India. It is also interesting to note that these countries are amongst the biggest organic agricultural producers in the world, along with China, Australia and the EU, which is in itself interesting as it shows the complementarities that do exist between the two fields of agricultural production. They are not mutually exclusive and can indeed co-exist and flourish in the same country. In 2019, the number of countries in Africa that have approved GM crops for food, field trials and/or environmental release doubled from three to six (ISAAA 2019) and by 2023, nine African countries are listed on the ISAAA website as having approvals for GM crops (https://www.isaaa.org/). South Africa, being the largest producer of GM crops with a total of 72 events approved for canola, cotton, maize, rice and soybeans (https://www.isaaa.org/). During the 2020/21 marketing year, 3.3 million hectares of land were cultivated with maize, cotton and soybeans of which approximately 2.8 million hectares were planted with GM variants (Esterhuizen & Cladwell, 2021). All cotton produced in South Africa in this period were GM variants while 85% of maize were GM variants.

The commercialisation of GM crops has occurred at a rapid rate since the mid-1990s, with important changes in both the overall level of adoption and impact occurring in 2016. Positive gains have been divided 48% to farmers in developed countries and 52% to farmers in developing countries. There continues to be very significant net economic benefits at the farm level amounting to US$18.2 billion in 2016 and US$186.1 billion for the period 1996–2016 (in nominal terms). PG Economics (2018) estimates that farmers in developing countries received US$5 for each dollar invested in genetically engineered crop seeds in 2017. About 65% of the gains have derived from yield and production gains with the remaining 35% coming from cost savings.

Genetic engineering technology has also made important contributions to increasing global production levels of the four main crops, having, for example, added 213 million tonnes and 405 million tonnes respectively, to the global production of soybeans and maize since the introduction of the technology in the mid-1990s. Cultivating GMO crops has provided significant benefits to farmers globally, including increased yield and lower production costs. Importantly, GMOs also help to alleviate poverty for the millions of resource-poor farmers and farm families around the world. As countries look to expand their domestic GM product pipelines and crop production, even more farmers will have access to improved seeds and the benefits they provide (PG Economics, 2018).

South Africa and Sudan have had great successes with GM crops (Abdallah 2014; Pellegrino et al. 2018). South Africa is the ninth largest GM crop producing country in the world (Esterhuizen & Cladwell, 2021). South Africa's production of maize (non-GM and GM maize) increased over the last four decades while the area planted, decreased (Figure 4-1)

(Esterhuizen & Cladwell, 2021). Average maize yields per hectare increased from 2.2 tons per hectare to 4.5 tons per hectare since the adoption of GM maize (Figure 4-2) (Esterhuizen & Cladwell, 2021).

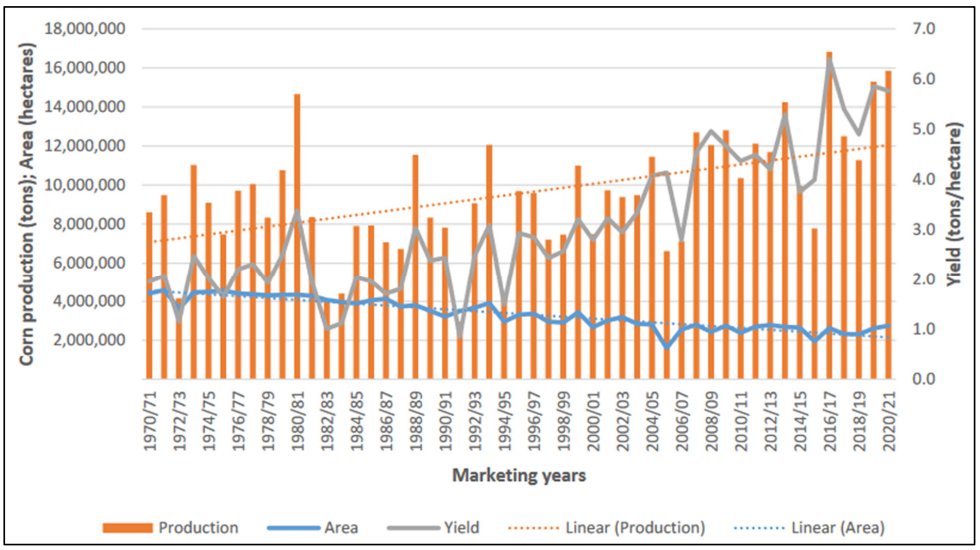

Figure 4-1 Maize production trend in South Africa over the last 50 years (source: Esterhuizen & Cladwell, 2021)

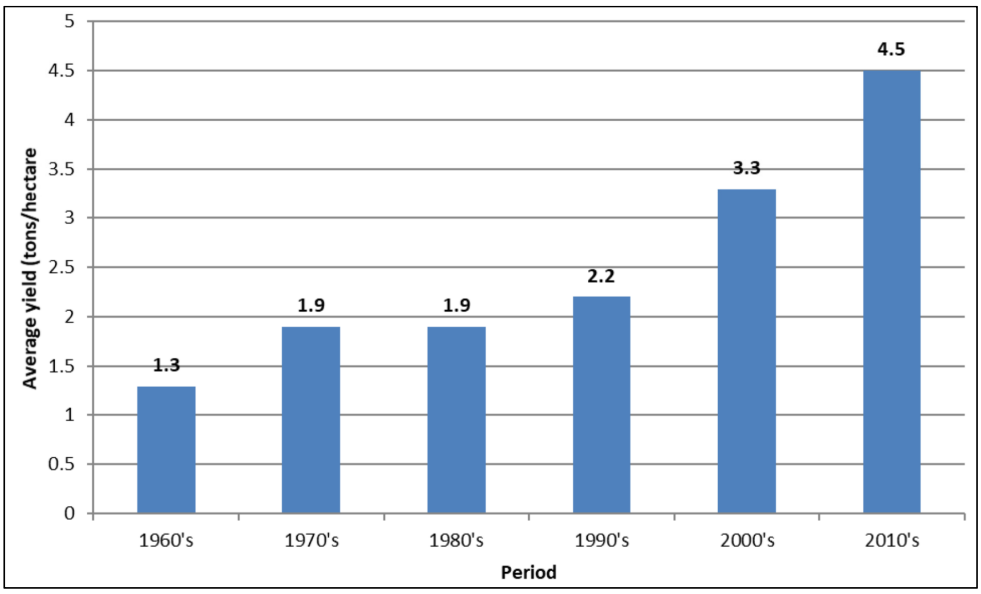

Figure 4-2 South African average maize yield/ha increase (source: Esterhuizen & Cladwell, 2021)

As mentioned, seventy-two GM events have approval for feed, food or environmental release in South Africa. Since the first GM crops were adopted in South Africa a shift in the perception of the public on GM crops and food has occurred. A public perception survey indicated that the understanding and awareness of biotechnology increased significantly between 2004 and 2015

(Gastrow et al. 2017). Forty-nine percent of the population believe GM food is safe to eat while 53% believe it is good for the economy. The increase in positive perception is largely attributable to increased education and knowledge on biotechnology.

4.2 GENETICALLY MODIFIED MAIZE FOR AGRICULTURE IN NAMIBIA

Namibia is a net maize (*Zea Mays*) importer, mostly from South Africa. White maize is one of Namibia's staple food grains while yellow maize are mostly used for animal feed. White maize is planted mainly as a dry-land crop, but also under irrigation where surface water (Hardap Dam, Kavango River) or groundwater is abundant. The main white maize cultivation areas are the maize triangle (Otavi – Grootfontein – Tsumeb), along the Kavango River (Green Schemes), Hardap Scheme and eastern Namibia around Hochfeld and Summerdown. Limited production of white maize also occur in the Zambezi and Omusati Regions. On communal farms maize production is mainly for own use.

The main pests encountered in the cultivation of maize in Namibia is the Lepidopterans (moths and butterflies) *Busseola fusca* (African maize stalk borer), *Spodoptera frugiperda* (fall armyworm) and to a lesser degree *Spodoptera exempta* (African army worm). All three are the larval stage of species of moths. The African maize stalk borer is native to sub-Saharan Africa while the fall armyworm is an alien invasive from the Americas, first encountered in Africa in 2016. The larval stages of these moths can cause massive destruction in maize fields if detected too late or if not actively controlled through pesticide application.

Weeds typically compete with a crop's resources and must in most case be actively managed. This can be achieved either by mechanical removal (tillage and manual labour like hoeing) or herbicide application. Herbicides can be non-selective or selective in nature. Non-selective herbicides will kill all plants it comes in contact with. Selective herbicides will selectively kill certain plants while not damaging others. Selectivity can be based on a plant's age or growing stage, morphology, absorption potential, etc. A feature often used in selective weed control is the difference between monocotyledonous (grasses) plants and dicotyledonous (broadleaf) plants. Certain herbicides will kill only broadleaf weeds while others target only grasses. Since maize is a monocotyledonous plant, herbicides controlling broadleaf plants can be sprayed onto post-emergent maize, but not herbicides for controlling grasses.

Existing GM maize events for agricultural purposes are insect resistance, glyphosate herbicide resistance, as well as both insect and glyphosate resistance. Namibian farmers wish to be granted permission to cultivate GM maize in order to reduce losses in maize production from pests and weeds, as well as reduce costs in cultivation of maize. The following sections discuss the specific events for which permission is required.

4.2.1 Event MON 810

Event MON 810 developed by Monsanto (now incorporated into Bayer) is marketed under the trade name YieldGard®. It is an insect resistant strain, specifically targeting the order Lepidoptera, which comprises of moths and butterflies (and their larvae). It is engineered to express insecticidal toxins from the bacterium *Bacillus thuringiensis* subsp. *kurstaki*, commonly referred to as Btk. *B. thuringiensis krustaki* is a gram-positive, rod-shaped bacterium widely distributed in soil. In nature, Btk produces a delta-endotoxin with insecticidal properties against the orders Lepidoptera, Coleoptera (beetles), Hymenoptera (ants, wasps, bees and sawflies) and Diptera (true flies) as well as the phylum Nematoda (round worms). The endotoxin is in the form of parasporal crystals comprised of one or more proteins – Cry and Cyt proteins. When Btk bacteria is ingested by these organisms, these proteins adversely affects their digestive systems, leading to their death. Due to this ability, Btk is used as biological pest control agent against lepidopterans.

In MON 810, the gene coding for the Cry1Ab protein in Btk was isolated and inserted into the genome of maize. This event allows for the maize, known as Bt maize, to produce the same Cry1Ab protein with insecticidal properties. When larvae of the typical maize pests,

African maize stalk borer and fall armyworm, eat the leaves of Bt maize, they suffer the same fate as ingesting the bacterium itself, thus protecting the maize against these pests.

4.2.2 Event MON 89034

Monsanto also developed event MON 89034 marketed under the tradename YieldGard® VT PRO. It is based on the same Btk bacterium, but expresses the proteins Cry1A.105 and Cry2Ab2, and has improved insecticidal properties over MON 810.

4.2.3 Event NK 603

Event NK 603, marketed as Roundup Ready® maize, is also a Monsanto product. It is resistant to glyphosate, a non-selective post-emergent systemic herbicide. Glyphosate (N-phosphonomethyl-glycine) is absorbed by plants and binds to the plant enzyme enolpyruvylshikimate-3-phosphate synthase (EPSPS). By binding to EPSPS, glyphosate blocks the enzyme's function in the shikimic pathway, preventing the production of aromatic amino acids and metabolites. This ultimately results in plant death by "starvation". Glyphosate is the active ingredient in the herbicide Roundup.

The bacterium, *Agrobacterium* sp. strain *CP4*, is a common soil bacterium that expresses a glyphosate-tolerant EPSPS enzyme. Glyphosate resistant maize is produced by inserting the CP4 EPSPS gene into maize. Glyphosate resistance is thus brought on by the EPSPS enzyme, now produced by the maize, which continues to function in the shikimic pathway. This enables the continued production of aromatic amino acids and metabolites for growth, despite the presence of glyphosate.

4.2.4 Gene Stacked Events

In addition to the single events proposed to be planted in Namibia as discussed above, combinations of these events, or gene stacked events, are also under consideration. Event MON 89034 × NK 603 for example express both insect and glyphosate resistance and was developed by inserting the genes CP4 EPSPS, Cry1A.105 and Cry2Ab2 into maize. Similarly, NK 603 × Mon 810 contains the genes for CP4 EPSPS and Cry1Ab, also providing for insect and glyphosate resistance.

4.3 GENETICALLY MODIFIED COTTON FOR AGRICULTURE IN NAMIBIA

Namibia is a net cotton (*Zea Mays*) exporter as there are no cotton ginneries in Namibia. Cotton is planted mainly as a dry-land crop, but also under irrigation where surface water (Hardap Dam) or groundwater is abundant. The main cotton cultivation areas are the maize triangle (Otavi – Grootfontein – Tsumeb), along the Kavango River (Green Schemes) and the Hardap Scheme.

The main insect pest encountered in the cultivation of cotton in Namibia is the Lepidopteran, *Helicoverpa armigera* subsp. (Arican bollworm). The larval stage of this moth, the caterpillar, feeds on, not only cotton, but a variety of other crops' leaves, flowers buds, pods, fruits and seeds. In cotton they bore into the seed pod (the cotton boll) where they are relatively well protected against typical pesticides. The African bollworm can result in significantly decreased cotton yields where infestations occur and increases cotton production costs as a result of increased requirements for the use of pesticides.

Weeds also compete with cotton's resources and must, similarly to maize (section 4.2), be actively managed through mechanical removal (tillage and manual labour like hoeing) or herbicide application. In contrast to maize, cotton is a dicotyledonous plant, and herbicides controlling broadleaf plants cannot be sprayed onto post-emergent cotton. Only herbicides selective for monocotyledonous plants (i.e. grasses) can be sprayed on cotton.

Existing GM cotton events for agricultural purposes are insect resistance, glyphosate herbicide resistance, as well as both insect and glyphosate resistance. Namibian farmers wish to be granted permission to cultivate GM cotton in order to reduce losses in cotton production from pests and weeds, as well as reduce costs in cultivation of cotton. The following sections discuss the specific

events for which permission is required (the traits, and biotechnology behind them, are similar to that of the maize events, and such similarities will not be repeated here).

4.3.1 Event MON 88913

Event MON 88913, marketed as Roundup Ready™ Flex™ Cotton, is also a Monsanto product. It is resistant to glyphosate and the traits and biotechnology used are similar to, for example, NK 603 maize.

4.3.2 Event MON 88913 x MON 15985

In addition to the single event MON 88913 proposed to be planted in Namibia, a combination of events, or gene stacked event, MON 88913 × MON 15985 developed by Monsanto, is also considered. It is marketed under the trade name Roundup Ready™ Flex™ Bollgard II™ Cotton. Event MON 88913 × MON 15985 expresses both insect and glyphosate resistance and was developed by inserting the genes CP4 EPSPS, Cry2Ab2 and cry1Ac into cotton. While, in terms of its insect resistance trait it is similar to MON 810 and MON 89034 maize by producing Bt proteins, it expresses cry1Ac proteins which is not present in the maize events.

4.4 Aspects of Cultivating GM Maize and Cotton

The production and environmental release of GMOs for food and feed purposes is a controversial topic. Opinions are divided on GMOs and arguments for and against it are centred on, among others, health concerns, biodiversity impacts, food security and ethics. In this section, a summary is provided on various aspects of cultivating GM maize and cotton. A major source used is a very extensive and objective review, of hundreds of studies on GM crops, summarised in the book *Genetically Engineered Crops: Experiences and Prospects*. The book was compiled by The National Academies of Sciences, Engineering, and Medicine, of the United States of America (USA), hereafter referred to as NASEM, who is tasked, among others, to provide independent, objective analysis and advice to the nation of the USA (National Academies of Sciences, Engineering, and Medicine (NASEM), 2016). Where other literature is cited, the source is referenced.

4.4.1 Genetically Modified Crop Yield

The significant increase in the global human population is increasing pressure on food security. Since the early 1800's the world population has increased from one billion to over 8 billion in 2023. By 2050 it is expected to reach 9.7 billion (United Nations, 2019). In order to ensure food security, food and feedstuff production have to become more intensive / productive in order to get better yields without increasing the amount of land cleared for agriculture. Approximately three quarters of global maize production is used as animal feed. It is a high-energy feed for livestock and is fed either unprocessed or processed as an ingredient of feed.

In terms of crop yield, one should distinguish between potential yield and actual yield. Potential yield is the maximum tonnage/ha that a crop can produce given no reducing factors (weeds, pests, diseases, etc.), no limiting factors (i.e. an abundance of water and nutrients) and optimum carbon dioxide levels, radiation, temperature, etc. The actual yield is the real tonnage/ha harvested, which typically are less than potential yield because of reducing factors, limiting factors and less than perfect conditions.

NASEM (2016) concluded that genetic engineering of crops to increase potential yield, does not seem to be more effective than selectively breeding crops for the same purpose. However, GM crops outperforms non-GM crops in terms of actual yield (Brookes 2019; Esterhuizen 2019; Pellegrino 2018). Based on 21 years of data on cultivation of insect resistant GM maize in Spain and Portugal, an increase in yield of 11.5% and more was observed. This, together with reduced expenditure on pesticides (see section 4.4.2), resulted in an average increase in farm income of €173/ha/year (N$2,819 at current exchange rate) (Brookes 2019). In South Africa, the estimated economic gain from using biotech crops in the period 1998 to 2016 is

U$2.3 billion while for 2016 alone it is U$330 million (N$33.8 billion and N$4.8 billion respectively) (Brookes and Barfoot, 2018; ISAAA, 2017). In a meta-analysis of 21 years' worth of field data, Pellegrino et al. (2018) confirmed a 10.1% average actual yield increase in maize. Similarly, a meta-analysis by Klümper and Qaim (2014) indicated a 22% yield increase for Bt maize and cotton (as an aggregate) when compared to traditional non-GM variants. Khuda (2017) modelled the average effects of Bt cotton on short-run profits, yields and farm inputs in Pakistan in 2008/9. In his study he found that Bt cotton yields increased by 9% in comparison with traditional cotton cultivars.

4.4.2 Pesticide Use

Intensive commercial farming methods include the use of insecticides and herbicides to control unwanted (pest) species. In maize, the African maize stalk borer, fall armyworm and African bollworm can account for massive crop losses, if not controlled. These pests were initially controlled with organochlorines and later with organophosphates. Although organophosphates are considered less toxic than the organochlorines, both are still considered to be highly detrimental to the environment. Newer insecticides contain active ingredients such as pyrethroids, carbamates, neonicotinoids and ryanoids.

Reviewing various case studies, NASEM (2019) concluded that reduced volumes of insecticides are applied on Bt crops when compared to non-Bt crops. This is supported by Brookes and Barfoot (2017), Khuda (2017), Pellegrino (2018) and Brookes (2019). The latter noting that 678,000 kg less insecticide active ingredient was used in Spain alone for the period 1998 to 2018. Where Bt and non-Bt fields are near to each other, it has been shown that even non-Bt crops required less insecticides. This is due to the nearby Bt crops reducing pest population sizes. There seems to be some instances where reduction in herbicide use is noted when herbicide resistant crops are planted. However, there is not enough sound scientific evidence to support decreased (or increased) use of herbicides (NASEM 2019). Herbicide resistant crops do however make weed control easier and more effective. Some instances of increased actual yields are also associated with herbicide tolerant crops (Brooks and Barfoot 2018).

4.4.3 Comparison of Costs and Benefits

The decision to allow the cultivation of GM crops in Namibia can be influenced or informed by various aspects and criteria. One of these aspects is the economic costs and benefits of introducing GM crops. It has already been proven at a global stage that GM crops hold substantial financial benefit over conventional crops, especially when faced with extreme climatic conditions and natural disasters such as increased pests' activity. Overall, there continues to be a considerable and growing body of evidence, in peer reviewed literature, that quantifies the positive impacts of crop biotechnology, including its economic benefits. Research over the last two decades has provided overwhelming positive results in favour of GM crops when it comes to the benefits of introduction of GM crops. Graham Brookes and Peter Barfoot have tracked farm income and production impacts since 1996 when the first GM crops were introduced, and their analysis has demonstrated over time that GM crops have a financial benefit over conventional crops. Their analysis concentrated on gross farm income effects because these are a primary driver of adoption amongst farmers (both large commercial and small-scale subsistence). They also quantified the (nett) production impact of the technology, and recognised that broader economic impacts exist, such as on labour usage, household incomes, local communities and economies.

Their research has concluded that in the last 21 years, crop biotechnology has helped farmers grow more food using fewer resources by reducing the damage caused by pests and better controlling weeds. The highest yield increases have occurred in developing countries and this has contributed to a more reliable and secure food supply base in these countries. In South America, herbicide tolerant technology has helped farmers reduce tillage, shortening the time between planting and harvesting, allowing them the opportunity to grow an additional soybean crop after wheat in the same growing season.

With higher yields and less time and money spent managing pests and weeds, farmers have earned higher incomes (also because they have more time at hand to spend on other income-generating activities). This has proved to be especially valuable for farmers in developing countries where, in 2016, an average of $5 was received for each extra dollar invested in biotech crop seeds.

The widespread use of GM crop technology is also changing agriculture's land footprint by allowing farmers to grow more without needing to use additional land. To maintain global production levels at 2016 levels, without biotech crops, would have required farmers to plant an additional 10.8 million hectares (ha) of soybeans, 8.2 million ha of maize, 2.9 million ha of cotton and 0.5 million ha of canola, an area equivalent to the combined land area of Bangladesh and Sri Lanka. To put this in perspective, this is approximately 27% of Namibia's total land area.

Because Namibia has not formally introduced GM crops into its production systems as yet, historical exact data is unavailable and one cannot calculate the exact financial costs/benefit compared to conventional crops at this stage (Namibian Agricultural Trade Forum (ATF), 2023).

While maize cultivation in Namibia has been ongoing uninterruptedly in Namibia for decades, the same is not true for cotton cultivation. Qualitatively, Namibia's agronomic crops and fodder production areas, where traditionally maize, wheat, sunflowers, groundnuts, millet/mahangu, oats and lucerne have been grown, are all suitable for cotton production. Historically, cotton was successfully grown prior to independence and for some time thereafter on the Hardap irrigation scheme as well as in the dryland production areas of the 'maize triangle', the area around Grootfontein and in the Kavango Region. In those years, dryland yields varied from 300 kg to 1.6 tons per hectare (rainfall dependent), while irrigation farmers' averages were around 5 tons per hectare, with some farmers harvesting up to 7 tons/hectare and sometimes 9 tons/hectare on very good soils. Dryland yields per hectare on an annual basis were in most cases not profitable, and a practice whereby cotton stood over to be harvested in year 2 and sometimes year 3 as well, was the only way to ensure overall profitability could be realised (Francois Wahl, Personal Communication, 2023).

In the early 2000's a fundamental shift occurred in the agronomic industry in Namibia and cotton production declined drastically as a result. Two main reasons for this decline include i) the prices of wheat and maize that increased more than twofold; and ii) synthetic fibre prices declined, which competed head-on with cotton fibre, thereby making it no longer that lucrative to produce cotton. In addition, globally, GM cotton was introduced more and more at the time, making other countries', including South Africa's cotton production, more competitive vis-à-vis conventional cotton production that was still being practiced in Namibia, and, as a result, prices in South Africa was also driven down. Namibian cotton production almost came to a complete halt as a result.

Currently in Namibia, there are more and more farmers from traditional cattle farming areas in the north, north east and east of Namibia with access to land and water for irrigation, that are diversifying into agronomic, oilseed and horticulture production – thereby expanding the areas in Namibia where land can be cultivated successfully. Fibre production, such as cotton, will also be suitable in these new environments.

As mentioned previously, cotton has been proven as an ideal small-scale cash crop in drier climates, due to its resilience under lower rainfall conditions. It can therefore be deemed as a suitable alternative cash crop in Namibia as well for small-scale and dryland farmers, based on successes achieved elsewhere - globally and in Africa. The main stumbling blocks in convincing small-scale farmers into cotton farming has traditionally been their reluctance to plant non-edible cash crops instead of food crops like mahangu and maize, the lack of a nearby markets and local ginneries, lack of economies of scale/critical mass, long transport distances, transport costs and bulkiness of the product, the labour intensive production system for hand-

picked cotton, and pest/weed control challenges as a result of insect infestation and the need to make use of manual weeding, inter alia (Namibia Agricultural Trade Forum, 2023).

From a quantitative or economic perspective, in order to provide some indication of what the financial costs/benefits could be, a commodity budget can be drawn up to show the estimated costs and incomes to be derived from specific crops. Commodity budgets have been calculated historically by several entities in South Africa for example and for different climatic and farming conditions, many of these similar to the farming conditions and practices that are used in Namibia. An excellent commodity budget tool (© 2023 - Profarmer) has been developed by the Griqualand West Cooperative in South Africa. Many farmers in South Africa and Namibia have historically been using tools such as the Profarmer© Tool to calculate the costs and benefits of farming with specific crops/cultivars in their respective farming areas. Maize and cotton production are also covered by the Profarmer© Tool and updated figures are prepared on an annual basis. An annual subscription allows users access to the Tool and users can include own data and yield/cost/income figures to allow for specific circumstances.

Maize

Maize production and input costs as well as yields and price information have been obtained from the Profarmer© Tool. The results thereof are included in Appendix B. The information has been summarised in Table 4-1 and contains cost calculations for both non-GM (current conventional maize being grown in Namibia) and GM maize (BT maize) and for both dryland and irrigation conditions. Information for yellow maize varieties is also included.

Whereas the exact figures will vary for Namibian conditions and from farm to farm, the important aspect that we are trying to highlight here is the comparison between GM maize and non-GM maize. It is clear that there are some notable differences between conventional maize and GM maize production systems. In general terms, the GM maize is expected to realize higher yields per hectare compared to the conventional maize (due to less damage from insects for example). Notably, there will also be a differentiation when it comes to the production costs. The GM cultivars provide for a lower total production cost/ha compared to conventional maize. This is mainly due to lower costs as a result of reduced pesticide/insecticide/herbicide applications and less tillage. GM maize seeds are however priced at a premium compared to conventional seeds and input costs will be higher as a result, especially under irrigation conditions where a huge investment will be made if yield expectations are to be maximised and 80,000 - 90,000 seed kernels are planted per hectare. The cost of seed will therefore be quite high; however this will be offset by the estimated higher yields, which overall would provide for a positive benefit.

Even though the figures in Table 4-1 are for South African farming systems, the net results should be more or less the same from a Namibian point of view, especially for the production cost side. Namibian production costs are overall around 20-30% higher than South Africa and these costs must be substituted into the budget tool by individual Namibian farmers with their real figures in order to get the exact comparisons. Assumptions need to be made at farm level regarding a couple of variables, such as the price of maize, expected yield, costs of inputs such as fuel, labour, fertiliser, interest rates, etc. At the moment, Namibian maize farmers are receiving higher prices for their maize than farmers in South Africa (ATF, 2019). Depending on the actual price of maize, the break-even yield/ha could be substantially influenced, which could make maize production either more, or less profitable, compared to South African conditions. All that needs to be done is to substitute the Namibian prices for inputs and for the maize harvest for those that currently apply to South African farmers. With a higher maize price, the breakeven yield for Namibian farmers would be much lower and profit margins could materialise at much lower yields. This could influence the decision on how much GM maize seeds are to be planted, which would lower input/production costs even further.

Table 4-1 Summary table: comparative production costs and incomes for GM and non-GM maize cultivars under known South African conditions (2019 figures used)

	Dryland non-GM White Maize	Dryland Bt White Maize	Dryland non-GM Yellow Maize	Dryland Bt Yellow Maize	Irrigated non-GM White Maize	Irrigated Bt White Maize	Irrigated Non-GM Yellow Maize	Irrigated Bt Yellow Maize
Expected Yield (ton/ha)[1]	5.5	5.5	5.5	5.5	13.0	13.0	13.0	13.5[2]
Expected Price (R/ton)	R3,420	R3,420	R3,450	R3,450	R3,420	R3,420	R3,450	R3,450
Gross Value (R/ha)	R18,810	R18,810	R18,975	R18,975	R44,460	R44,460	R44,850	R46,575
Production costs (R/ha incl. interest)	R15,594	R15,516[3]	R15,597	R15,519	R40,692[4]	R41,979	R40,700	R42,113
Breakeven yield (ton/ha)	4.56	4.54	4.52	4.5	11.9	12.27	11.8	12.21
Margin (R/ha)	R3,216	R3,294	R3,378	R3,456	R3,768	R2,481	R4,150	R4,462
Nett benefit/cost (R/ha)[5]	**(R78)**	**R78**[6]	**(R78)**	**R78**[6]	**R1,287**	**(R1,287)**[7]	**(R312)**	**R312**[8]

[1] Expected yield/ha depends on a number of issues, including the specific cultivar that has been developed and released for a particular production year and peculiar on-farm conditions, both controllable (for example seeds planted/ha) and non-controllable (such as rainfall).

[2] Higher yield/ha according to cultivar developer specifications, compared to non-GMO varieties

[3] Lowest production cost/ha for dryland conditions

[4] Lowest production cost/ha for irrigation conditions

[5] Compared to its GM or non-GM counterpart

[6] Highest nett benefit for dryland conditions

[7] Nett cost for irrigation conditions

[8] Highest nett benefit for irrigation conditions

Cotton

In order to provide an economic comparison for purposes of this report, the production and input costs as well as yields and price information of the 2022/23 summer planting season and 2023 winter planting season have been obtained from the Profarmer© Tool and has been included in this report (Appendix C). The information has been summarised in Table 4-2 and contains cost calculations for GM Cotton for both dry-land and irrigation conditions. As mentioned earlier, there are for a couple of decades already no longer any conventional cotton grown in South Africa (the country is 100% GM in so far as cotton production is concerned); hence it is not possible and in any event pointless to obtain production figures for non-GM cotton varieties. Secondly, since Namibia is not producing any cotton currently, and historic production figures for Namibia are also not available any longer, a proper cost/benefit comparison is not possible between Namibian cotton production vis-à-vis GM cotton production. At most, an individual farmer will have to use its own production figures and variables over time in order to build a record of costs/benefits for comparison purposes.

Whereas the exact figures will vary for Namibian conditions and from farm to farm, the important aspects that we are trying to highlight here are the profitability variables for dryland and irrigated GM Cotton. Price of seed cotton per tonne as well as yields per hectare are the most critical and will determine whether cotton in general and GM cotton in particular can be grown profitably under Namibian production conditions or not. The South African averages that have been collected over many years have pointed to a scenario where cotton production is profitable with breakeven yields as per above table (in relation to a specific price obtained in the market for the product).

Should a Namibian farmer be able to obtain a higher (or lower) yield per hectare or a higher (or lower) price for his/her cotton, then obviously the profitability outcome and breakeven yield will be influenced (either positively, or negatively). Namibian farmers will also have to take into account additional transport costs as there are currently no ginneries in Namibia and most probably all cotton will need to be sold in South Africa, hence an additional input cost that needs to be factored in. There are also variances in relation to hand-picked cotton (labour component) vis-à-vis machine picked cotton (capital cost and machinery cost including fuel). All this is farmer unit/system specific and therefore has to be calculated on a case-by-case basis for each farmer.

However, despite the absence of conventional cotton production data for comparative purposes, the results obtained under South African conditions indicates that both dryland and irrigated GM cotton is profitable, with breakeven yields in 2023 and 2022 of 4.58 and 4.66 tons/ha (for irrigated cotton) and 1.24 and 1.41 tons/ha (for dryland cotton) respectively. This was achieved against a 2022 winter cotton price of R11,950/ton and a 2023 summer cotton price of R11,870/ton. A sensitivity analysis, factoring in various price and yield scenarios, is therefore important for each farmer.

Table 4-2 Summary table: production costs and incomes for GM cotton cultivars under known South African conditions (2022 and 2023 data used)

	Dryland GM Cotton (2023 Winter)	Dryland GM Cotton (2022/23 Summer)	Irrigated GM Cotton (2023 Winter)	Irrigated GM Cotton (2022/23 Summer)
Expected Yield (ton/ha)9	1.5	1.5	5.5	5.5
Expected Price (R/ton)	R11,950	R11,870	R11,950	R11,870
Gross Value (R/ha)	R17,925	R17,805	R65,725	R65,285

[9] Expected yield/ha depends on a number of issues, including the specific cultivar that has been developed and released for a particular production year and peculiar on-farm conditions, both controllable (for example seeds planted/ha) and non-controllable (such as rainfall).

Production costs (R/ha incl. interest)	R14,820	R16,765	R54,683	R55,295
Breakeven yield (ton/ha)	1.24	1.41	4.58	4.66
Breakeven price (R/ton)	R9,880	R11,177	R9,942	R10,054
Margin (R/ha)	**R3,105**	**R1,040**	**R11,042**	**R9,990**

Source: Profarmer©. 2023

In general terms, as with other GM crops such as maize, wheat and soybeans, the GM cotton cultivars are expected to realize higher yields per hectare compared to conventional cotton (due to less damage from insects for example). Notably, there will also be a differentiation when it comes to the production costs. The GM cultivars provide for a lower total production cost/ha compared to conventional crops. This is mainly due to lower costs as a result of reduced pesticide/insecticide/herbicide applications, less mechanical weed control and tillage, and reduced fuel and machinery costs. GM seeds are however often priced at a premium compared to conventional seeds and input costs will be higher as a result, especially under irrigation conditions where a huge investment will be made if yield expectations are to be maximised and many seed kernels are to be planted per hectare. The cost of seed will therefore be quite high; however, this will be offset by the estimated higher yields, which overall would provide for a positive benefit.

Assumptions also need to be made at farm level regarding a couple of other variables, such as the price of cotton, expected yield, costs of inputs such as fuel, labour, machinery cost, packing material, transport, fertiliser, interest rates, etc. Since Namibia does not have a cotton gin, the assumptions regarding where the cotton is to be sold is very important. Likewise, transport differentials will need to be taken into account if the buyers are from outside Namibia. In the past, Namibian cotton was hand-picked and sold to South African Ginners in the Mpumalanga and Limpopo Provinces in South Africa. Towards the latter stages of cotton production in Namibia, a ginnery in Modder River in South Africa provided a ginning service to Namibian farmers at a fee. A contract price will therefore need to be negotiated with buyers prior to planting to ensure that accurate profitability calculations can be made in the budgeting process.

Depending on the actual price of cotton, the break-even yield/ha could be substantially influenced, which could make cotton production either more, or less profitable, compared to South African conditions. Of course, the input costs for Namibian conditions will also differ from South African conditions, hence the breakeven yield under Namibian conditions could be higher. Historically, Namibian production costs are overall more expensive than that of South Africa and these costs must be substituted into the budget tool by individual Namibian farmers with their real figures in order to get the exact comparisons. All that needs to be done is to substitute in the budget tool the prices of all inputs and expected yields with Namibian estimates/actual figures, instead of using the provided figures, which currently apply to South African farmers. Also, with a lower cotton price, the breakeven yield for Namibian farmers would be much higher and profit margins could be under pressure, requiring higher yields, and vice versa.

As mentioned elsewhere in this report, yield losses and crop devastation and related financial losses as a result of pests such as the African maize stalk borer, fall armyworm, Africa army worm and cotton boll worm have amplified the need for alternatives that could safeguard crops and yields against these devastating natural phenomena. The negative financial impact that a reduction in yield result in, coupled with the additional costs of spraying of pesticides (direct cost of pesticides as well as additional costs of manpower, fuel and mechanisation costs), all amplify the benefit that the introduction of BT maize could bring for both the small-scale and largescale farmer in Namibia. Army worm breakouts can devastate household food security in a matter of days, while the reduction in yields and additional costs of pesticide application could render largescale commercial irrigated maize non-profitable.

Other alternative GM crops that could show great potential in the traditional Namibian dryland farming areas, as well as the areas under irrigation could also be introduced. These include GM Maize, GM Wheat and GM Soybeans, with these crops having the potential to serve as excellent food and cash crops for farmers in addition to the traditional crops that are currently being produced, both for household food security and commercially. There is currently an upward demand for cotton - worldwide and in the region - and this could be the catalyst to introduce BT cotton as an alternative cash crop to farmers in Namibia. Cotton have already proven to be successfully grown in Namibia in the 1980's and 1990's and a collapse in world prices compared to alternatives such as maize and wheat, as well as synthetic fibres, was some of the reasons why farmers stopped producing cotton (Namibia Agricultural Trade Forum, 2023).

The SADC (Southern African Development Community) Industrialisation Strategy and Roadmap 2015–2063, and in particular the SADC Industrial Development Policy Framework, aims to promote industrialisation, enhance competitiveness, and deepen regional integration through structural transformation, leading to increased manufactured goods and exports. The SADC Region has prioritised the clothing and textile sector as one of nine key sectors to be supported in its industrial development ambitions, and the production of cotton in Namibia could be a catalyst for Namibia to enter into and participate in the highly-valued textiles and garment manufacturing cross-border value chain (https://www.tralac.org/documents/resources/sadc/1281-sadc-industrial-development-policy-framework-2014/file.html).

4.4.4 Trade and Marketing Issues

Given the rapid increase in the production of GMOs and the ever-expanding capabilities of biotechnology applied to food production, it is surprising that in sub-Saharan Africa—the poorest region in the world with the lowest agricultural productivity—very few countries cultivate GM crops. In fact, many countries have instituted outright bans on imported food containing GM products. One of the most high-profile examples was Zambia's ban on GM food imports, including famine relief shipments in the face of millions suffering from starvation, in 2002.

It seems that the main "stumbling block" that prevents the introduction of GM products into consumer markets or the cultivation of GM crops remains the "perception" that GM products are frowned upon by consumers. Their preferences may very well dictate what products will sell best at the corner shop; however, it is not based on a legal requirement or the results from scientific research. Consumers' perceived preference to consume non-GM products remain a voluntary preference and as a result it has been for decades wrongfully perceived that certain countries have "banned" food and feedstuffs containing GM products/ingredients. Countries across Africa and Asia that have been hesitant to introduce GMO crops, have cited the risk of future export losses as a rationale for rejecting GM technology. The reasoning behind this is because they believed that supermarket chains in major markets like the EU and Japan have instituted private standards to avoid GM ingredients in the products they sell (Gruère and Sengupta, 2009).

Over the years however, the perception that the EU has regulations/import bans in place against the importation of foodstuffs from outside that contains GMOs, has proofed to be a myth. Not only do some countries in the EU actively produce GM feed and foodstuffs; but they all allow the importation of GM feed and foodstuffs (even into those countries that may not have actively adopted GM technology in their agricultural production systems). In Germany for example, GM crops are not allowed to be planted, however they do allow feed and foodstuffs containing GMOs to be imported, which is then either consumed directly by the German consumer or finds its way into the agricultural value chains. In the EU, 60% of animal feed is imported (European Commission, 2015). The protein-rich soya in that feed comes overwhelmingly from countries that plant GM soybeans - Brazil, Argentina and the

US. The imported GM soybeans end up in the dairy, beef, pork, chicken industries, amongst others.

In the African context, in recent years, even countries like Zambia, who had a zero tolerance for anything "GMO-like", have started to allow the importation of foodstuffs obtained from GMO products (such as breakfast cereals and prepared foodstuffs containing GMO ingredients) into its domestic market. In July 2019, the National Biosafety Authority (NBA) of Zambia has granted four companies new permits to import products that may contain GMOs (Zambia Reports, 2019). The permits were granted to Gatbro Distributors, Pick n Pay, Southern National Import and Export Limited and Choppies Super Stores. Permits were issued following a recommendation from the Scientific Advisory Committee of the NBA, to the Board, to issue the permits after risk assessment was conducted on the products that may contain GMOs and were found to be safe for human consumption.

According to the Namibian Agricultural Trade Forum (ATF), the importation of GM feed and foodstuffs have never been disallowed in Namibia. Almost all processed agricultural products and foodstuffs are imported from outside Namibia (mainly the EU and South Africa) and the majority of these contain GM ingredients. Namibia is also a nett importer of cereals and other agronomic crops such as wheat, maize (both white and yellow), rice, soybeans, potatoes, etc. Argentina, Canada and South Africa are main suppliers to Namibia and they are mostly cultivating GM crops. In addition to foodstuffs, almost all of Namibia's animal feeds are produced using mostly imported ingredients that contain GMOs (soybeans, cotton seed, oil cake and yellow maize for example). These animal feeds are used by our livestock industries (beef, small stock, chicken, game, dairy, pork), including those livestock sectors that have traditionally been exporting to overseas markets such as Norway and the European Union, as well as regionally to South Africa. These markets historically accepted meat and meat products from countries that either utilise GM products as animal feed or actively grow GM crops themselves. In addition, these markets also allow the use of GM-based animal feed (either imported or locally-produced) in their own meat production value chains. Any sudden or new restrictions or bans on the export of meat from Namibia to these markets (EU, Norway, South Africa for example) - should Namibia start to allow GM crops to be cultivated locally - would therefore be far-fetched and irrational, given that these countries currently allows and historically allowed meat and meat products into their own domestic markets that already historically contained and currently contains GM ingredients (either directly or indirectly in the value chain/manufacturing). The GM crops/events that Namibia intends to cultivate, are also not new, but have been on the market for many years and are well-known, so no new or additional risks are to be introduced into the meat value chains that does not already exist (if any).

The ATF also indicated that the Meat Board of Namibia has confirmed that the export status to the European Union are not negatively influenced by the fact that Namibian animal feed already contains GM ingredients. No legal basis therefore exist that could restrict Namibian meat exports to the EU as a result of GMOs in animal feed. At most, it could be a marketing issue, linked to consumer preferences in specific markets. The latter is however only a voluntary standard, which every consumer is entitled to, and similar to the issue of consumer preference for fair trade or organic-produced products for example.

4.4.5 Biodiversity

It is argued that non-target and beneficial species are also affected in Bt crop fields, resulting in overall reduced biodiversity. Various investigations indicate that Bt crop fields have either no impact on non-target species (Pellegrino 2018) or even result in higher biodiversity than non-Bt fields sprayed with insecticides (NASEM 2019; Carpenter 2011). The literature review by Pellegrino (2018) found only Hymenoptera to be affected and specifically a parasitic wasp, *Macrocentrus cingulum*. However, since the main hosts for this wasp are stalk borers, a decrease in its presence is expected if there is a decrease in stalk borers as a result of the Bt maize.

Typical insecticides sprayed on non-Bt maize are not selective and orders other than Lepidoptera may also be harmed, as well as other classes of animals. Since Bt crops targets mainly Lepidopterans, increased biodiversity can realistically be expected in Bt crop fields. For example, all existing studies indicate that honey bees are not affected by Bt crops (Duan et al. 2008, Ricroch et al. 2018).

Weed diversity in glyphosate resistant crops, after spraying with glyphosate, seems to largely depend on the type of crop (NASEM 2019). In some instances weed diversity is lower and thus arthropod diversity is also lower. In general, in the United States of America, glyphosate resistant crops sprayed with glyphosate, had similar or increased weed diversity than non-GM fields.

In terms of biodiversity within different varieties of the same crop (crop diversity), limited studies are available. However, those that have been conducted do not indicate decreased genetic variety since GM crops were introduced (Carpenter 2011).

4.4.6 Bt Toxin Resistance

Organisms continuously evolve because of random mutations at genetic level and selection pressure. For example, trees, that because of a random mutation had thorny protrusions, were not preferred by herbivores for browsing (i.e. selection pressure). Since these trees had a higher chance of survival, they had a higher chance of cross-pollinating, and thus an increased chance of containing and expressing the genetics for thorny projections. In this way, the random mutation coupled with the selection pressure, resulted in the evolution of thorns for protection against herbivores. This is a very similar process to selective breeding applied by humans to produce certain traits in organisms.

Random mutations can also lead to resistance in insects against the active ingredients of insecticides (see Figure 4-3 for a schematic representation of the process). The best-known example is the resistance that developed in Anopheles mosquitos to dichlorodiphenyltrichloroethane (DDT), during the fight against malaria (Fossog et al. 2013). In addition to DDT resistance, Anopheles mosquitos have also developed resistance against pyrethroids and to some degree against carbamates (Wanjala et al. 2015). Insects that reproduce quickly, with large numbers of offspring, are more prone to developing resistance.

Similar to the insecticide resistance mentioned, insects can also become resistant to Bt toxins in Bt crops. When Bt crops were first approved for agriculture, the prediction by some scientists were, that insects will rapidly become resistant to Bt proteins. The reality was that although incidents of resistance in insect populations against Bt toxins have been described (van den Berg et al. 2013; van Rensburg 2007), it took much longer than initially predicted (Kunert et al. 2011).

Different strategies, which are mostly applicable to both GM crops and normal insecticide use, can delay evolution of resistance in insects. The first is by ensuring a high enough dose of the Bt toxin and / or more than one toxin is produced by the GM crop. In a population of insects, there will be individuals more susceptible to an insecticide, as well as those less susceptible. Spraying low dosages of an insecticide will only kill those more susceptible while the resistant individuals survive. A high dosage of an insecticide is more likely to kill less susceptible (resistant) individuals, thus delaying the evolution of resistance. Using multiple insecticides will also delay resistance, as it is more unlikely for an organism to be resistant to more than one insecticide. The same principle is true with GM crops. Those expressing more than one toxin and / or toxins of a higher dosage will delay evolution of resistance.

The second method used to delay resistance is to plant refuges of similar non-GM crops close to GM crop fields. A refuge of non-Bt maize will, for example, allow for the pests in question to feed and reproduce in the absence of a toxin and thus in the absence of a selection pressure. The population of insects sustained in the refuge will have a lower incidence of resistance. When these individuals mate with Bt toxin resistant individuals, it decreases the number of resistant offspring and delays the evolution of resistance.

Evidence suggest that the high dose / multiple toxins / refuge strategy can successfully delay development of resistance (NASEM 2019). The success will depend on the expression of toxins in the crop as well as appropriately sized refuges. Another factor to consider is that because Bt crops can reduce pest populations significantly, it may become feasible to plant only non-Bt crops in some years, thus further delaying the evolution of resistance.

It should be noted that resistance is possible to both traditional insecticides and Bt toxins. It is a matter of proper management and correct agricultural practices to delay the evolution of resistance. For example, planting of Bt maize and cotton should not completely negate the use of insecticides, but the two should be used together.

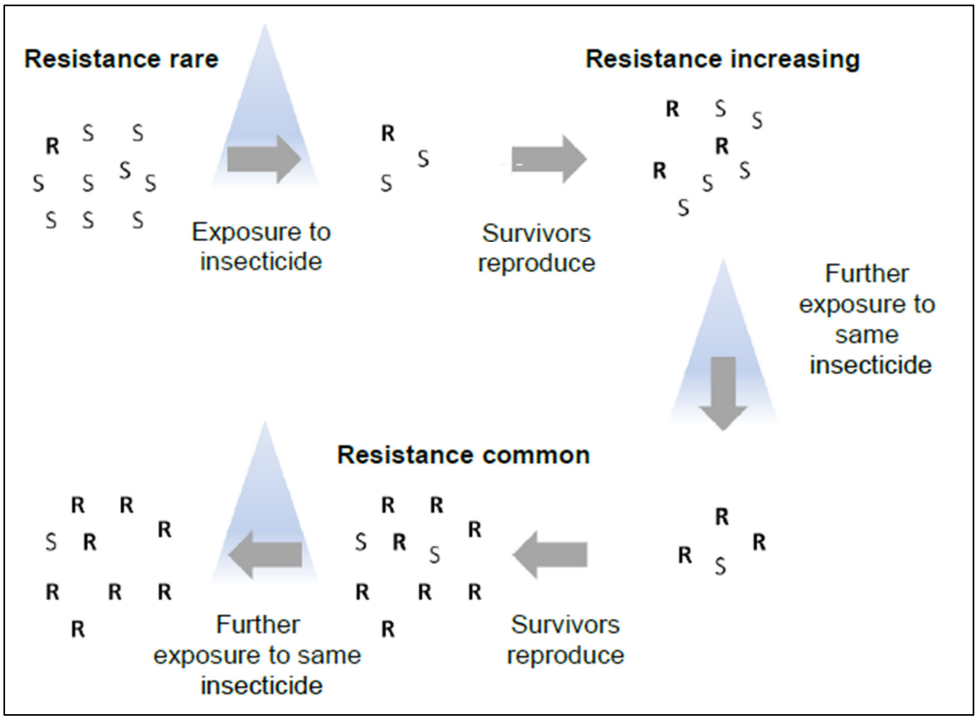

Figure 4-3 Schematic representation of pesticide resistance development (source: IRAC 2011)

4.4.7 Herbicide Resistance

All plants or weeds have the ability to become herbicide resistant / tolerant (Brookes and Barfoot 2018). Hundreds of weeds are herbicide resistant without the involvement of GM crops. These are listed on the International Survey of Herbicide Resistant Weeds website (http://www.weedscience.org) (Figure 4-4). Weeds have also evolved glyphosate resistance before the first herbicide tolerant GM crops were released. However, glyphosate resistance was also encountered where environmental release of glyphosate resistant crops occurred (NASEM 2019; Brookes and Barfoot 2018). Evolution of resistance is mostly similar to that of animals and so are the methods to delay resistance. Integrated weed management practices such as a combination of herbicides, manual hoeing or ploughing will delay evolution of resistance.

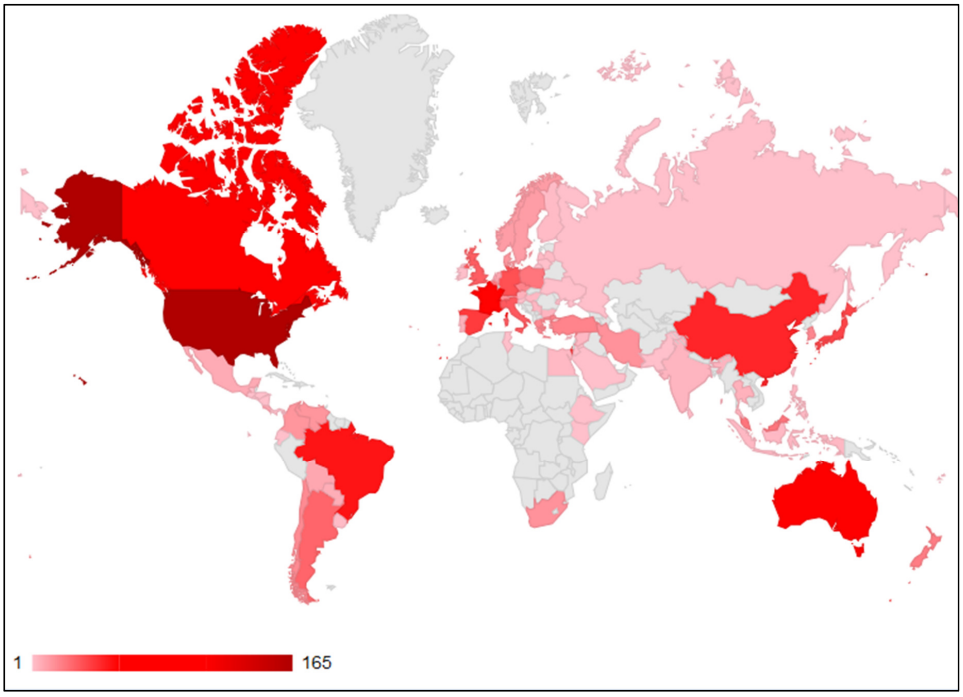

Figure 4-4 Global weed resistance (http://www.weedscience.org/Graphs/GeoChart.aspx)

4.4.8 Gene Flow

Concerns about the potential transfer of the modified gene sequences from a GM crop to closely related species or weeds through horizontal gene transfer (HGT) exist. Horizontal gene transfer is the transfer of genetic material, between single cell and / or multicellular organisms that did not originate from a parental donor. This is in contrast to vertical gene transfer, which is the transfer of genetic material from parent to offspring during reproduction. Horizontal gene transfer is a natural process and forms an important part of evolution. For example, hundreds of genes in humans appears to have originated from bacteria and through HGT they ended up in vertebrates, and ultimately in humans, at some point during vertebrate evolution (Heilig et. al. 2001). HGT is common in prokaryotes while HGT between eukaryotes are considered scarce due to numerous obstacles that have to be overcome to achieve successful HGT (Philips et al., 2022).

The concern with gene flow involving GMOs is that the genetic material inserted into a GM organism may be transferred to other organisms and have detrimental effects. Examples include the HGT of antibiotic resistance genes to pathogens (Bennett et al. 2004, Keese, 2008) and virus to virus gene transfer resulting in new diseases (Falk and Bruening 1994; Keese, 2008).

Horizontal gene transfer from a plant to other organisms is a very rare occurrence and is expected to be less frequent than normal background rates (Keese, 2008, WHO 2014, Philips et al., 2022). Furthermore, maize is categorised as low risk in terms of its probability for gene flow to occur (Viljoen and Chetty, 2011; Tsatsakis et al., 2017). Viljoen and Chetty (2011) calculated cross-pollination success over distance. They found that at 45 m the chance for cross-pollination to occur is between 1.0% and 0.1%, at 145 m between 0.1% and 0.01% and at 473 m between 0.01% to 0.001%. Cross-pollination success over distance for cotton also shows a rapid decline in cross-pollination success over distance (Llewellyn et al. 2007). The percentage of seeds testing positive for Cry1A and Cry2A in conventional cotton segregated

from the Bt field by 1 m was 7.9%, at 12.6 m it was 1%, at 25.2 m it was 0.88% and at 48.6 m, 0.79%. Based on the results, Llewellyn et al. (2007) recommend a buffer between GM and conventional cotton of 20 m. Similar results were obtained by Sen et al. (2004) who indicated that as little as 8 to 9 m can provide good isolation. However, for both maize and cotton the success rate for cross-pollination is significantly influenced by external factors such as wind, topography, etc. Also for cotton, the presence of very high numbers of honey bees also increase cross-pollination at greater distances (Llewellyn et al., 2007).

Gene flow is considered to have negligible risks to humans and the environment (Keese, 2008; WHO, 2014) and no cases of adverse environmental effects as a result of HGT between GM crops and wild, related plants have been observed (NASEM, 2019) nor have any reports been made by 2022 of adverse impacts on human health or environmental safety due to HGT from GM plants (Philips et al., 2022).

4.4.9 GMOs as Food and Livestock Feed

Multiple arguments on the safety of GM food and feedstuffs and the risks they pose to humans and animals exist. A very long and detailed discussion falls outside of the scope of this assessment. However, a brief summary of various studies and literature reviews are presented below.

A general health concern is that the modified genes of a GM crop can be transferred to, and incorporated into the genome of, a consumer of a GM crop or its products. Potential adverse health effects may then result from this new genetic material. For example, the Cry1Ab fragments of Bt genes have been detected in animal organs (Mazza et al. 2005). The Bt gene as a whole was however not detected. It should be noted that with all food that is eaten, the fragments of genes can find its way into organs. It is not restricted to GM food only. Thus, should harmful effects realise because of gene fragments entering organs, it can occur with any of the food we eat. A second concern is that the specific protein that is expressed by the inserted gene(s), will be harmful when consumed and that allergens can be produced.

NASEM (2019), Vince et al. (2018) and de Vos et al. (2017) all reviewed existing literature on the health effects of GM feed on livestock. The conclusion reached by all three papers is that there is a lack of published evidence of adverse effects in livestock fed with GM feed. NASEM (2019) concluded: "*On the basis of detailed examination of comparisons of currently commercialized GE and non-GE foods in compositional analysis, acute and chronic animal-toxicity tests, long-term data on health of livestock fed GE foods, and human epidemiological data, the committee found no differences that implicate a higher risk to human health from GE foods than from their non-GE counterparts.*"

The conclusion makes sense since proteins, natural and GM, undergo the same process of denaturation into peptides (segments of amino acids) during the digestion process. Once denatured into amino acids, the characteristics of the original protein are no longer present.

Health impacts of glyphosate sprayed maize are also questioned. A significant contributor to people being sceptic about the health effects of eating glyphosate resistant maize stems from a 2012 study (Séralini et al. 2012). It presented data indicating that the long-term toxicity of glyphosate (specifically in Roundup®) and maize event NK603 (Roundup Ready®) on rats have severe health impacts. This resulted in large public outcry. However, the study was in the meantime retracted due to a lack of scientific accuracy, after the validity of the data was questioned and re-examined. Steinberg et. al., (2019) repeated a similar study and found that after two years of feeding rats NK603 maize, both treated with Roundup and untreated, no adverse health effects could be discerned.

Whereas no evidence of adverse health effects could be found, instances of health benefits are documented. Pellegrino et al. (2018) analysed long-term data on GM maize and stated that lower concentrations of mycotoxins (−28.8%), fumonisin (−30.6%) and thricotecens (−36.5%) are present in maize. NASEM (2019) concluded their review as follows: "*There is*

some evidence that GE insect-resistant crops have had benefits to human health by reducing insecticide poisonings and decreasing exposure to fumonisins."

4.5 GENETICALLY MODIFIED MAIZE AND COTTON IN SOUTH AFRICA

South Africa's GM maize and cotton cultivation is an example to consider in deciding the future of GM maize production in Namibia. It provides some information on the potential advantages, disadvantages and impacts. The following list summarises some of the findings in no specific order of importance:

Positive

- Twenty one years of GM maize cultivation and related studies show that actual yield of GM maize is 5.6% to 24.5% higher than their non GM counterparts (Pellegrino et. al. 2018). Yields for cotton are also higher (Morse et al., 2006).
- Higher yields and reduced pesticide use results in increased profit margins (Morse et al., 2006).
- Since the introduction and widespread cultivation of Bt maize in 1998 in South Africa, the volume of chemical insecticides used has reduced significantly (Kunert, 2011; Mwamahonje and Mrosso, 2016). The same was found for insecticide use on Bt cotton, with significantly less insecticides applied than on conventional cotton for the period 1997 to 2001 (Morse et al., 2006).
- GM maize kernels have 28.8% lower concentrations of toxic compounds naturally produced by fungi which can cause various adverse health effects in humans and livestock. Collectively these toxins are called mycotoxins, and of the mycotoxins, fumonisin is 30.6% less and thricotecens 36.5% less (Pellegrino et. al., 2018).
- Evidence point towards Bt toxins not affecting non-target organisms (Pellegrino et. al. 2018).
- The adoption of GM maize for cultivation in South Africa has led to the stabilisation in the growth rate of the wholesale maize price, thus reducing price risk (Abidoye and Mabaya, 2014).
- Smallholder farmers value the labour-saving benefit (mostly women and children) and increased yields (mostly men) of GM maize and GM cotton (Morse et al., 2008; Gouse, 2012; Gouse et al., 2016). Greater yields provide more income which in turn is spend on education of children, more investment in agriculture, and payment of debt (Morse et al., 2008).

Negative

- Some Bt resistance was detected in the African stalk borer in the Vaalharts irrigation scheme (van Rensburg, 2007). It seems that the lack or wrong implementation of refuges as well as the planting regime (late planting of maize as well as variance in time of planting) may have contributed to the evolution of resistance (van Rensburg, 2007; Kruger et. al., 2009).
- Lack of GM seed availability and cost to smallholder farmers may hamper the adoption of GM cropping in communal areas (Gouse et al., 2016).
- Cross pollination between GM and non-GM maize can occur where fields are near to each other (see Section 4.4.8) (Viljoen and Chetty, 2011).

Whereas most cotton plantations globally are of GM nature, there is a high, albeit small, demand for organic cotton in some niche markets. To exploit this possible opportunity, organic cotton research had been tested in South Africa in the past, but yields were not profitable, and as farmers are not subsidised as in other countries to farm organically, this venture never took off. Organic cotton production requires the use of non-GM (conventional) cottonseed, and since organic production is not commercially viable in South Africa, there is also no conventional cottonseed available. Thus, no organic cotton or conventional cotton are produced in South Africa (https://cottonsa.org.za/cotton-facts/).

Cotton GM varieties are as a result also all deregulated in South Africa, while all cottonseed sold in South Africa contains the Bt-gene. By-products, such as cottonseed oil and cottonseed oilcake that is used for animal feeding, are therefore also effectively genetically modified products.

5 ALTERNATIVES

Table 5-1 highlights the major advantages and disadvantages of traditional non-GM maize and cotton and various strains of GM maize and cotton.

Table 5-1 Alternative maize and cotton types for cultivation

Alternative	Advantages	Disadvantages	Preferred Option
Maize type			
Traditional non-GM maize and cotton	♦ Long established crops of which the positive and negative properties are well known ♦ Cheaper seeds ♦ Seeds easily available ♦ Can keep some harvested maize seed for next planting season	♦ Highly susceptible to crop damage by insects ♦ Reduced crop yields when significant pest outbreaks occur ♦ Maize is only broad leaf herbicide tolerant ♦ Cotton is only grass herbicide tolerant ♦ More labour intensive ♦ More spraying result in more fuel use and thus greenhouse gasses ♦ Increased water use due to need for dilution of insecticides	♦ Cultivation of GM maize and cotton with traditional maize and cotton as refuges. Planting a combination of GM maize and cotton events, or varying GM maize and cotton events between planting seasons, will contribute to delaying the onset of insect resistance.
MON 810	♦ Resistant to main pests like fall armyworm and African stalk borer ♦ Increased actual yields ♦ Reduced insecticide use ♦ Less labour intensive ♦ Less greenhouse gas emissions due to reduced fuel use for spraying ♦ Reduced water use due to less need for dilution of insecticides	♦ Only one BT toxin can potentially lead to more rapid insect resistance to Bt ♦ Seed is more expensive ♦ Seed is less easily obtainable ♦ Requires special knowledge and proper management to prevent potential negative impacts	
MON 89034 (Maize) **MON 15985 (Cotton)**	♦ Resistant to main pests like fall armyworm and African stalk borer ♦ Two Bt toxins has high efficiency and delay insect resistance ♦ Increased actual yields ♦ Reduced insecticide use ♦ Less labour intensive ♦ Less greenhouse gas emissions due to reduced fuel use for spraying	♦ Seed is more expensive ♦ Seed is less easily obtainable ♦ Requires special knowledge and proper management to prevent potential negative impacts	

Alternative	Advantages	Disadvantages	Preferred Option
	♦ Reduced water use due to less need for dilution of insecticides		
NK 603 (Maize) **MON 88913 (Cotton)**	♦ Easier weed control ♦ Increased actual yields	♦ Weeds can become resistant to glyphosate ♦ Requires special knowledge and proper management to prevent potential negative impacts	
Stacked events	♦ Both insect resistance and easier weed control ♦ Increased actual yields ♦ Reduced insecticide use ♦ Less labour intensive ♦ Less greenhouse gas emissions due to reduced fuel use for spraying ♦ Reduced water use due to less need for dilution of insecticides	♦ Pests and weeds can become resistant to Bt proteins and glyphosate ♦ Requires special knowledge and proper management to prevent potential negative impacts	

5.1 NO GO ALTERNATIVE

Maize and cotton production volumes on the existing cleared land for crop production will remain the same, or may even reduce in light of climate change, if the environmental release of GM maize and cotton are not allowed. Namibia will continue to rely heavily on maize imports (which also is GM maize) for most of the country's maize consumption. This results in a net cash outflow from the country. More land will need to be cleared to increase local maize and cotton production. Maize and cotton producers will remain vulnerable to pest outbreaks.

6 ADMINISTRATIVE, LEGAL AND POLICY REQUIREMENTS

The legislation and standards provided in Table 6-1 to Table 6-3 are relevant to the proposed environmental release of GM maize and cotton in Namibia.

Table 6-1 Namibian law applicable to GMOs

Law	Key Aspects	Applicability to Environmental Release of GM Maize
The Namibian Constitution	♦ Promote the welfare of people ♦ Incorporates a high level of environmental protection ♦ Incorporates international agreements as part of Namibian law	♦ Genetically modified maize can potentially provide increased food security, thus promoting the welfare of people ♦ Introduction of GMOs may have environmental impacts
Environmental Management Act Act No. 7 of 2007, Government Notice No. 232 of 2007	♦ Defines the environment ♦ Promotes sustainable management of the environment and the use of natural resources ♦ Provides a process of assessment and control of activities with possible significant effects on the environment	♦ Introduction of GMOs is a listed activity requiring environmental assessment
Environmental Management Act Regulations Government Notice No. 28-30 of 2012	♦ Commencement of the Environmental Management Act ♦ List activities that requires an environmental clearance certificate ♦ Provide Environmental Impact Assessment Regulations	♦ Regulates the environmental assessment process
Biosafety Act Act No. 7 of 2006, Government Notice No. 223 of 2006	♦ Regulate activities involving the research, development, production, marketing, transport, application and other uses of genetically modified organisms and specified products derived from genetically modified organisms ♦ Prohibits planting of GMOs without registration ♦ Provides for formation of the Biosafety Council ♦ Government Notice No. 259 of 2018 declares certain products in Namibia as GMOs or GMO containing products. The schedule includes the maize events MON810, MON89034 and NK603 as well as stacked events of these	♦ Main legislation dealing with the environmental release of GM maize

Law	Key Aspects	Applicability to Environmental Release of GM Maize
Biosafety Act Regulations Government Notice No. 210	♦ Provide regulations for obtaining permits to place GMO Food and feedstuff on the market, for contained use of GMOs, and for field trials and environmental release ♦ Provides for risk assessment reports and risk management plans for GMO related activities ♦ Provides for regulations pertaining to handling, labelling, transport, accidental release, etc. of GMOs	♦ Regulates the environmental release of GM maize and incidental matters ♦ Regulates the environmental assessment process
Research, Science and Technology Act Act No. 23 of 2004, Government Notice No. 283 of 2004	♦ Provide for the promotion, co-ordination and development of research, science and technology in Namibia ♦ Establish the National Commission on Research, Science and Technology	♦ Establishes the National Commission on Research, Science and Technology
Agronomic Industry Act Act No. 20 of 1992, Government Notice No. 107 of 1992	♦ Governs the prohibition, restriction and permitting on the sale, import and export of controlled products	♦ Legislation pertaining to the agronomic industry who will cultivate GM maize
Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act Act No. 36 of 1947, Government Notice No. 1239 of 1947	♦ Governs the registration, importation, sale and use of fertilizers, farm feeds, agricultural remedies and stock remedies ♦ Various amendments and regulations	♦ Genetically modified maize will ultimately form part of farm feeds
Seed and Seed Varieties Act Act No. 23 of 2018, Government Notice No. 368 of 2018	♦ Provides for restrictions on the importation, production and sale of seed ♦ Not in force yet	♦ Expected to control GM seed once enforced
Import and Export Control Act Act No. 30 of 1994, Government Gazette Notice No. 224 of 1994	♦ Controls imports into and exports from Namibia ♦ Provides for issuing of permits with respect to imports and exports	♦ Genetically modified seed imports and potential GM maize or GM maize containing food and feed exports
Soil Conservation Act Act No. 76 of 1969	♦ Law relating to the combating and prevention of soil erosion, the conservation, improvement and manner of use of the soil and vegetation and the protection of the water sources in Namibia	♦ Genetically modified crops allow for easier implementation of conservation tillage (reduced erosion) and less pesticide use

Law	Key Aspects	Applicability to Environmental Release of GM Maize
Public Health Act Act No. 36 of 1919	♦ Provides for the protection of health of all people	♦ Potential health effects of consuming GMOs
Labour Act Act No 11 of 2007, Government Notice No. 236 of 2007	♦ Provides for Labour Law and the protection and safety of employees ♦ Labour Act, 1992: Regulations relating to the health and safety of employees at work (Government Notice No. 156 of 1997)	♦ Application of herbicides on herbicide tolerant GM maize pose potential health impacts, but not more so than pesticide application on non-GM maize
National Agricultural Policy, 1995	♦ Aims to realize the national objectives of reviving and sustaining economic growth, creating employment opportunities, alleviating poverty and reducing inequalities in income ♦ Aims to maintain or increase levels of agricultural productivity	♦ Genetically modified maize can potentially contribute to reaching the aims of the policy by providing increased yields
Namibia Food Safety Policy, 2014	♦ Aims to ensure food safety for all consumers in Namibia, and provide sufficient food safety guarantees on all food products traded nationally, or exported to other countries ♦ This policy ensures that control standards are established and adhered to as regards food production safety, food product hygiene, animal health and welfare, plant health and preventing the risk of contamination from external substances ♦ It lays down conditions for regulations on appropriate labelling for these foodstuffs and food products	♦ Health concerns related to consumption of GMOs

Table 6-2 Relevant multilateral environmental agreements

Agreement	Key Aspects	Applicability to Environmental Release of GM Maize
Stockholm Declaration on the Human Environment, Stockholm 1972.	♦ Recognizes the need for a common outlook and common principles to inspire and guide the people of the world in the preservation and enhancement of the human environment	♦ In agreement with the Namibian Constitution regarding enhancement of the human environment ♦ Genetically modified maize can potentially provide increased food security, thus promoting the welfare of people
United Nations Framework Convention on Climate Change (UNFCCC)	♦ The Convention recognises that developing countries should be accorded appropriate assistance to enable them to fulfil the terms of the Convention	♦ Genetically modified crop production can reduce greenhouse gas emissions through the reduced need for spraying pesticides and thus less exhaust gasses from farm implements
Convention on Biological Diversity, Rio de Janeiro, 1992	♦ Under article 14 of The Convention, EIAs must be conducted for projects that may negatively affect biological diversity	♦ Cultivation of GM crops can affect biodiversity through the reduction of pest species and onset of resistance in pests
Cartagena Protocol on Biosafety, 2000	♦ Adopted by the Convention on Biological Diversity in 2000 and came in force in 2003 ♦ Objective is to protect biological diversity from the potential risks posed by safe transfer, handling and use of Living Modified Organisms (LMOs)[GMOs] resulting from modern biotechnology ♦ Considers risks to human health	♦ Address GMOs directly
International Treaty on Plant Genetic Resources for Food and Agriculture, 2001	♦ Promote conservation, exploration, collection, characterization, evaluation and documentation of plant genetic resources for food and agriculture ♦ Promote the sustainable use of plant genetic resources for food and agriculture	♦ Cultivation of GM crops can potentially affect plant genetic resources
International Plant Protection Convention, Rome, 1951	♦ Promote controlling pests and diseases of plants and plant products and preventing their introduction and spread across national boundaries	♦ Although not directly dealing with GMOs it established International Standards for Phytosanitary Measures (ISPMs) with applicability to GMOs (Table 6-3)
World Trade Organization (WTO)	♦ Global international organization dealing with the rules of trade between nations ♦ The primary purpose of the WTO is to open trade for the benefit of all	♦ The use of GMOs in the production of food and feedstuff may influence international trade

Agreement	Key Aspects	Applicability to Environmental Release of GM Maize
WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement)	♦ Applies to all sanitary and phytosanitary measures which may, directly or indirectly, affect international trade	♦ The use of GMOs in the production of food and feedstuff may influence international trade

Table 6-3 Standards or codes of practise

Standard or Code	Key Aspects	Applicability to Environmental Release of GM Maize
International Standards for Phytosanitary Measures (ISPMs)	♦ Compiled under the International Plant Protection Convention of 1951 ♦ Various standards related to GMOs that deals with plant pests	♦ Some GM plants may present a phytosanitary risk ♦ The potential of GM maize becoming a pest / invasive
Food and Agriculture Organization (FAO) / World Health Organization (WHO): Codex Alimentarius	♦ Provides international standards for all the principle foods, whether processed, semi-processed or raw, for distribution to the consumer ♦ Includes provisions in respect of food hygiene, food additives, residues of pesticides and veterinary drugs, contaminants, labelling and presentation, methods of analysis and sampling, and import and export inspection and certification.	♦ Provides: ○ standards for maize (CXS 153-1985) and whole maize meal (CXS-154-1985) ○ principles for the risk analysis of foods derived from modern biotechnology (CXG 44-2003) ○ guidelines on performance criteria and validation of methods for detection, identification and quantification of specific DNA sequences and specific proteins in foods (CXG 74-2010) ○ compilation of Codex texts relevant to the labelling of foods derived from modern biotechnology (CXG 76-2011) ○ guideline for the conduct of food safety assessment of foods derived from recombinant-DNA plants (CXG 45-2003)

7 IDENTIFIED IMPACTS

The following section provides a brief description of potential impacts (positive and negative) of cultivating GM maize and cotton and highlights the objective for each. The impacts are categorised according to economic, physical / chemical, biological and social impacts.

7.1 ECONOMIC

The financial feasibility of planting GM versus traditional crop cultivars will have to be considered for each farming unit. Ultimately, the goal of introducing GM crops is, among others, to increase profitability by increasing actual yields at times of pest outbreaks or by being able to plant crops in short planting seasons (i.e. late onset of rain in case of dry land cropping). Factors that can decrease profitability include administrative costs related to permitting, more expensive seeds, lower tonnage price for GM vs non-GM crops, additional expenses incurred to ensure GM crops remains contained and segregated from non-GM variants, and possible insurance costs to cover GM crop related events such as product spills during transport, costs for coexistence with neighbours planting non-GM crops, and resistance management. In case of incidents pertaining to GM crops (e.g. non-GM and GM crop contamination), there may be additional costs incurred, for example for decontamination, product withdrawals, compensation or legal costs.

7.1.1 Employment

Objective: To promote sustainable employment.

Planting of certain GM crops, such as Round-Up Ready maize, can lead to reduced labour requirements to perform certain tasks (e.g. manual hoeing of weeds). A lesser component of mostly seasonal and/or temporary workforce may result in the cultivation of such a variant. However, the introduction of GM cotton for cultivation in Namibia may entice more farmers to start planting cotton. To harvest cotton, many farmers will rely on seasonal and/or temporary employees to handpick the cotton, thereby increasing the seasonal and/or temporary workforce component of operations. Furthermore, diversification of farming activities by cultivating GM crops, may increase the overall sustainability of the farm and allow for the time and resources to pursue additional revenue streams. This may offset possible job losses resulting from the planting of GM crops. Many of the farming units in Namibia, have diverse agricultural production units which include agronomy, livestock farming, charcoal production and tourism.

Actions

Enhancement:

- Opportunities for additional income generating activities to be investigated in order to sustain employment.
- Employment of local and Namibians first. Where feasible, employment of the same seasonal and/or temporary workforce year on year.
- Adhere to all the requirements of the Labour Act.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Keep in good standing with Social Security Commission.
- Updated employment records and contracts on file.

7.1.2 Economic Resilience

Objective: Contribution to local and national treasury as well sustaining a stable earning potential for employees and industry.

The impact is based on the assumption that the net economic benefit of GMO cultivation (on a specific farm and in general), will exceed the net benefit of non-GMO cultivation. The assumption is required as the net economic benefit may in some instances not realise (e.g. when no significant pests are present). Should the assumption be correct, the benefit will be experienced greatly by the Proponent, where after multiplier effects will result in increased economic resilience in the regional and national agricultural sectors. Planting of the GMO crops will require less input in terms of pesticide application (including fuel and water) and labour, depending on the GM events planted. Therefore, producers will make time available for additional revenue generating activities to be considered. More successful harvests translates into a more sustainable flow of revenue per agricultural unit, resulting in an increase in the stability of revenue flow.

Cultivation of especially GM maize will reduce the risk to harvest failure and or losses. An indirect impact of the increased economic resilience will see increased planning ability for socio-economic aspects such as health and education.

Actions

Prevention:

- Prior to embarking on the cultivation of GM maize and cotton, each farmer must do feasibility calculations taking specific local conditions into consideration.
- Where feasible and possible, economic gains should be invested into the local agricultural sector and related communities.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Feasibility reports on file

7.1.3 Yield and Revenue

Objective: To increase maize and cotton yields and thus revenue generation at all levels i.e. employee, employer, supplier, processor and national treasury.

At present, there is no difference in the potential yield between conventional maize and cotton and GM variants. However, actual yields for GM variants may be higher due to decreased insect damage, especially during a heavy infestation or plague, and competition with weeds. Coupled to this is the potential for increased profit margins if reduced volumes of pesticides are used, which also mean less fuel and water consumption. GM seed are typically more expensive and crop producers will likely consider the financial benefits of GM maize and cotton vs. conventional maize and cotton in deciding which to plant. Refer to Appendix B and Appendix C for examples of cost guide figures.

Actions

Mitigation:

- Prior to embarking on the cultivation of GM maize or cotton, each farmer must do feasibility calculations taking specific local conditions into consideration.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Feasibility reports on file.

7.1.4 Meat Exports

Objective: No impact on producers of meat for export purposes.

Concerns were raised that international markets may be closed if Namibian livestock consumes GMO containing feed. The reality is that feed produced in, or imported to, Namibia have for a long time contained GM ingredients. The Meat Board of Namibia also confirmed that meat exports to the EU are not negatively influenced because of livestock consuming GMO containing feed (ATF 2019).

Actions

Prevention:

- Continue to adhere to the regulations and legislation pertaining to the agricultural industry which may impose certain restrictions on crops that may be cultivated or how crops are utilized.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Legal register

7.2 PHYSICAL / CHEMICAL

7.2.1 Pesticides in Soil and Groundwater

Objective: No or minimal impact on soil and groundwater as a result of pesticide use.

Pesticides can enter soil, and where porosity is high with shallow groundwater, can reach the water table. Unless organic farming is practiced, pesticide use will persist in both non-GM and GM cropping. As discussed earlier, evidence shows that the volumes of pesticides used are in fact lower for GM crops, especially for insecticides. In terms of herbicides, the concern is that where glyphosate resistant maize or cotton are planted, excessive volumes of glyphosate will be applied to combat weeds. Apart from the additional costs involved with excessive herbicide spraying, the regulations for herbicide use are the same, regardless of the choice of crop (GM vs non-GM). It will therefore be in the best interest of the farmer to maintain a pest management program that is sensible, with reduced potential impacts.

Actions

Prevention:

- Limit herbicide application as far as is practically possible.
- Application of glyphosate herbicide as per the prescribed concentration and application procedures.
- Prevent spray drift by applying herbicides during calm weather conditions.
- Proper training of operational personnel.

Responsible Body:

- Proponent; HSE Officer.

Data Sources and Monitoring:

- Keep record of all instances of herbicide application.

7.2.2 Soil Erosion

Objective: No or minimal soil erosion.

Globally, millions of tons of soil is lost through erosion each year. A significant portion of this is because of poor farming practices and tillage. Tilling is often employed to uproot weeds prior to planting of fields. This ensures all broad leaf and grassy weeds are removed. By planting glyphosate resistant maize and cotton the need for tillage is made redundant and conservation agriculture can be practiced since post emergent weeds among crops can be controlled. By practicing conservation tillage, there is less likelihood of soil loss due to water runoff and wind.

Actions

Prevention:

- Implement conservation tillage practises.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- None

7.3 BIOLOGICAL

7.3.1 Pesticides Resistance

Objective: To delay, or ideally prevent, the onset of pesticide resistance in insects and weeds.

In GM crop fields, pesticide resistance has been reported in insects (against Bt proteins) and weeds (against glyphosate). This is however no different from pesticide resistance reported in non-GM crop fields. Over reliance on the use of glyphosate and the lack of crop and herbicide rotation by farmers, in some regions, contribute to the development of weed resistance. In order to address this problem and maintain good levels of weed control, farmers have increasingly adopted more integrated weed management strategies incorporating a mix of herbicides, other herbicide tolerant crops and cultural weed control measures. These include, using other herbicides with glyphosate rather than solely relying on glyphosate; using herbicide tolerant crops that are tolerant to other herbicides, such as glufosinate; and using cultural practices such as mulching. These add cost to the GM herbicide tolerant production systems compared to about 10–15 years ago, although relative to the current conventional alternative, the GM herbicide tolerant technology continues to offer important economic benefits.

Actions

Prevention:

- Develop and implement an insect and weed resistance management plan in collaboration with the seed supplier.
- The plan should among others include:
  - all farmers must adhere to the refuge strategy as stipulated by the GM seed supplier.
  - as part of the insect resistance management plan, intermittently apply insecticides to kill any pest insects that may have developed Bt resistant traits.
  - application of glyphosate herbicide as per the prescribed concentration (i.e. not lower or higher concentrations as this may be ineffective) and application procedures.
  - weed control prior to planting which should include herbicides of alternative active ingredients to allow killing of weeds that may have developed resistance to glyphosate.
  - weed control prior to its production of viable seeds.
  - cleaning of farm implements to prevent distribution of potential resistant weeds.
  - crop rotation.

Responsible Body:

- Proponent; HSE Officer; seed supplier

Data Sources and Monitoring:

- Insect and weed resistance management plan.
- Regular inspection of all fields to ensure early detection of extraordinary damage to crops that would indicate Bt resistance.
- If Bt resistance is expected, implement the insect resistance management plan and notify the NCRST and seed supplier.
- Inspection of all fields after application of glyphosate to ensure early detection of surviving weeds that may indicate resistance.
- If glyphosate resistance is expected, implement the weed resistance management plan and notify the NCRST and seed supplier.
- Keep record all instances of suspected insect or weed resistance. Note at least the species, date, extent and measures taken.
- Keep record of all instances of insecticide and herbicide application as a measure to combat weeds or to prevent / delay resistance in insects and weeds. Note at least the date, insecticide and/or herbicide used, concentration of active ingredients as applied, and the reason for application.

7.3.2 Biodiversity / Non-Target Species

Objective: To prevent or minimize impacts on biodiversity and non-target species.

Pesticides by nature are harmful to the environment. Since typical insecticides are not species specific, they affect many non-target species. Planting Bt crops that targets specifically Lepidopterans, reduce the need for spraying insecticides. Using less insecticides are overall more beneficial for the environment and results in increased biodiversity as compared to fields treated with traditional insecticides.

The aim with weed control is to rid the crop fields of all weeds. Therefore, whether it is achieved by spraying a broad-spectrum herbicide like glyphosate, or by using a combination of manual and chemical control, the result is the same. The only instance where non-target species will be affected by herbicide application, is where spray drift occurs. Spray drift can be prevented by applying pesticides during calm conditions.

Actions

Prevention:

- Limit pesticide application as far as is practically possible.
- Application of pesticides as per the prescribed concentration and application procedures.
- Prevent spray drift by applying pesticides during calm weather conditions.
- Proper training of operational personnel.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Keep record of all instances of insecticide and herbicide application. Note at least the date, insecticide and/or herbicide used, concentration of active ingredients as applied, and the reason for application.

7.3.3 GM Crops Becoming Invasive

Objective: No GM maize establishing outside of farmland.

Concerns have been raised regarding the possibility of GM crops establishing themselves outside of farmland with the potential of becoming invasive. After decades of planting traditional maize and cotton, no instances of this have been recorded and it is highly unlikely that the GM cultivars will be any different. Neither maize nor cotton has any closely related species occurring naturally within Namibia, thus further decreasing the possibility of them establishing and becoming invasive.

Actions

Prevention:

- Contain GM seeds and prevent spillages during transport.
- Spill clean-up plan where accidental spills occur during transport.
- Prevent theft of GM crop seeds.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Spill management plan.
- Record all spills and include maize strain, date, location and spill clean-up measures with photo records.
- Submit the spill report to the NCRST.

7.3.4 Horizontal Gene Transfer

Objective: No health impacts as a result of horizontal gene transfer and no conflict with organic or non-GMO farmers.

As discussed in this report, HGT is considered to have negligible risks to humans and the environment and no cases of adverse environmental effects as a result of HGT between GM crops and wild, related plants have been observed.

Actions

Prevention:

- Communicate the intention to plant GM variants to neighbours indicating buffer and/or isolation zones to neighbours who do not plant GM variants,
- Maintain a buffer and/or isolation zone of 800 m (or a distance as directed by the seed supplier) between GM and non-GM fields.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Seed supplier guidelines and contractual obligations of farmer.
- Keep record of any potential cross-contamination events and report to NCRST.

7.4 SOCIAL

Evaluating social aspects associated with the cultivation of GM produce, are complex and sensitive at times. Impacts range from feelings about the subject (and related future aspirations) to demographic change processes such as seasonal migration of a workforce. Community structures and belief systems are different on a local, regional and even sometimes, national scale. Therefore, the local context of every producer will have to be considered during individual assessments on a microeconomic scale. The assessment should consider the specific crop or trait, or the combination, which may be important as to determine which indicators to measure / evaluate. Aspects to be covered should include the following during their assessment: benefits to society, economically linked prosperity, health and welfare, freedom of choice, food supply, cultural heritage, safety, biodiversity and environmental services. The first two aspects also form part of the economic considerations of the his report while the latter two are included in the biophysical considerations. Of importance is to note that there is very little information or research done considering the social impact of GMOs in Namibia.

For this report the following main aspects, are broadly covered:

- Feelings and aspirations for the future,
- Social cohesion,
- Community health, and
- Cultural aspects.

If more sustainable employment realises in the agricultural sector, migration of workers to rural farming areas (limited to geographical areas which support maize and cotton production) may occur as workers search for employment. Increased migration to farming units may increase the integration of various cultural groups. Integration of culture and increased migration of labourers may increase the spread of HIV/AIDS. It is expected that possible migration to rural areas will not significantly affect the current migration trend in Namibia which has seen increased rates of urbanization.

7.4.2 Feelings and Aspiration for the Future

Objective: To achieve optimal consensus regarding the cultivation of GM crops and promote the positive aspects in terms of agricultural markets.

Concerns about the use and cultivation of GM variants, mainly maize, permeates certain communities and action groups throughout the world. In Namibia, concerns have also been raised on a national scale and include perceived threats to the Namibian beef export markets as well as community health concerns in consuming related food. Aspiration for the future are bleak and negatively perceived as it is anticipated that GM cultivation will affect the meat trade and the overall health economy of Namibia negatively. Camped in with these concerns, are those questions related to the possible economic harm of non-GMO farmers. Cross pollination organic non-GM crops and GM crops, as well as the risk of pesticide spray drift are issues which have been raised. For the latter, there is no difference in the risk between fields of non-GM and GM crops near organic fields. The potential for cross-pollination in maize and cotton decrease relatively quickly with increased distances between fields. Trials by Viljoen and Chetty (2011) on maize indicated a maximum distance of 650 m at which cross-pollination occurred under South African conditions. The use of buffers and/or isolation zones between non-GM and GM maize can prevent cross-pollination. This may however not be feasible where farms are small and near each other. It will be the responsibility of the GM maize farmer to establish the buffer and/or isolation zones as contractually agreed with the seed supplier.

An opposing view, concerning the cultivation of GM variants, reflects positive aspirations for the Namibian agricultural sector with increased local food production for human and animal use. Successful cultivation of GM maize and cotton is considered to increase the stability of markets through more reliable yield and harvest expectations. The aspiration focusses on increased food security in Namibia with secondary spin-offs such as improved soil conservation and reduced greenhouse gas emissions, etc. Improved security of supply is considered to affect the markets favorably. Both views towards GM cultivation are applicable on a National, regional and local scale.

Farmers will continue to have a choice between farming systems and choice of crop. Cultivation of GM maize in Namibia will remain optional, as is organic or non-GM cropping / farming. With increasing GM crop production, a positive spinoff for organic producers is the creation of a niche market, targeting a sector of the community who are willing to pay more for food perceived as healthier (organic).

Actions

Prevention / Enhancement:

- Education and dissemination of accurate, scientific, information pertaining to the cultivation of GMOs.
- Maintain a buffer and/or isolation zone of 800 m (or a distance as directed by the seed supplier) between GM and non-GM fields.

Responsible Body:

- Proponent
- Consultants

Data Sources and Monitoring:

- Seed supplier guidelines and contractual obligations of farmer.
- Keep record of any potential cross-contamination events and report to NCRST.

7.4.3 Social Cohesion

Objective: To achieve optimal coexistence between GMO and non-GMO cultivating farmers and consumers.

Social change processes which could affect community cohesion, mostly on a local scale, include changes in social structure of a community, conflicts and community adaptability. Criteria for measurement of the aspect are too complex for a national scale, however, well achievable for local evaluations. For example, an increased potential for conflicts between neighbouring farmers, (which cannot easily be separated from the overall effects of conventional agriculture). An increased potential conflict risk may result between neighbouring farmers, should coexistence measures not be applied properly (by either), or if fear of contamination increases. These conflicts could lead to serious community rifts, especially in small rural communities were people depend, to some extent, on each other (e. g. neighbourly help, shared machinery). Such conflicts could be amplified by a change in social structure due to negative economic effects. For example, if a non GMO farmer's fields are contaminated by GMO crops, the non GMO farmer may sustain economic losses which could affect their role in the community and related structure.

In contrast to the above, farming communities who share the same position towards the cultivation of GMO's, could be unified and have increased levels of community cohesion, corporation and collaboration. For the purposes of this report, both possibilities and related mitigation and or enhancement measures have been included.

Actions

Prevention/Enhancement:

- Education and dissemination of accurate, scientific, information pertaining to the cultivation of GMOs during community meetings.
- Communication of plans and intentions to cultivate GMO crops.
- Agreements on the specific GMO management measures such as the setting and adherence to buffer and/or isolation zones, contamination contingency plans (inclusive of remuneration for losses / insurance etc.).
- Agreement, prior cultivation of GMOs, on conflict remediation measures to be taken.
- Sharing, where feasible, information and challenges with local neighbours in addressing concerns prior to them becoming unresolvable.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Communication record kept on file.
- Any neighbour agreements kept on file.

7.4.4 Community Health and Welfare

Objective: To reduce environmental contamination, increase food security and livelihoods.

Although there are points of view that the consumption of GMO produce have detrimental health effects, there are many independent research articles which refutes this. The matter will not be discussed within the scope of this report as it ties in with the feelings towards GMO cultivation. Rather, community health and welfare will be considered in a broader sense, looking at aspects such as food security, labour (income) and environmental degradation.

GMO cultivation has the potential to safeguard crops against pests, thereby increasing the overall yield. Cumulatively, this could (considering GMO maize), increase the amount of food available locally, if and when such crops are plagues by pests. The overall gain would be an increase in food security which could be beneficial for the largest segment of the Namibian population. An increase in food security, affects the overall community health, especially for those living in poverty. An increase in production of GMOs might however also see a reduced availability of non-GMO produce, thereby reducing the food choices available to those who are against its cultivation and / or consumption.

Changed labour conditions may result in the cultivation of GM variants. Labour and remuneration directly affect households and related communities. Seasonal labour is considered as one of the groups which may be affected the most. Increased employment opportunities in for example the cultivation of cotton, may increase earning potential of the seasonal workforce, which are also employed during harvesting of many other vegetables such as onions, potatoes, pumpkins, table grapes, etc. Increased labour requirements could also result in a change in regional migration patterns. The opposite is true for those instances where reduced employment opportunities realise (such in the case of Round-Up ready maize). In such case, the probability of poverty/vulnerability increases. Therefore, community health could be negatively impacted.

An overall cultivation plan includes the aim to reduce the use of pesticides on crops (Bt crops) while also enabling less reliance on tillage. Both of these fundamental approaches in agriculture, contribute to overall global conservation efforts. Reducing reliance on chemical pesticides, reduces the risks of contamination though over application of pesticides, while safeguarding non-target species such as bees. Finally, the reduced use of pesticides, especially for BT maize and cotton, will reduce human contact with chemicals. There would thus be a decrease in potential medically important consequences of exposure to pesticides and chemicals.

The greatest risks related to environmental health, however still include the misuse or over application of herbicides such as Round-Up; and the build up of chemical resistance in target species. The former is not directly related to the GMO product, but rather to the individual using the product. Chemical mismanagement is not only linked to GMO producers, but can also occur on non-GM crop producing farms. Unlike non GMO producers though, GMO farmers have a strict reporting regime in efforts to kibosh chemical mismanagement and related affects. Should resistance in insects develop, for example with BT maize and cotton, an application of an alternative pesticide will be required to eliminate such resistance. It should be noted that resistance may also develop where GM crops are not involved, such as the well documented case of resistance in mosquitos to insecticides (Riveron et al. 2016).

In Namibia, conservation agriculture was identified as one of vices to combat soil degradation. Eliminating or even just reducing tillage, reduces Namibia's greenhouse gas emission rate which is linked to the reduced rate of tractor use. Since planting of glyphosate tolerant GM crops makes it easier to practise conservation tillage, it could, if done responsibly, contribute positively to Namibia's overall soil conservation and climate change strategies.

Actions

Prevention/Enhancement:

- Keep to cultivation plan of GM variants and report any resistance development according to reporting requirements.
- Identify technically and financially feasible pollution prevention and control techniques to avoid or minimize adverse impacts on human health and the environment.
- Where applicable (located close to communities), avoid or minimize the potential for community exposure to hazardous materials (chemicals) and substances that may be released through cultivation.
- Ensure that appropriate mitigation and management measures are taken to address risks and potential impacts on community health and safety arising from an influx of project-related workers (for example, ensure adequate water and sanitation is available to all seasonal employees).
- Promote the preservation of water quality, along with integrated pest management and integrated soil fertility management to minimize the use of agrochemicals and ensure that wastewater is properly treated before it is discarded.
- A pest management plan must be developed when the use of a significant volume of pesticides is foreseen.
- When required to be used to reduce probability of insect or weed resistance, hazards of pesticide must be carefully considered, and the least toxic pesticides must be selected that are: (i) known to be effective; (ii) have minimal effects on non-target species and the environment; and (iii) minimize risks and impacts associated with the development of resistance in pests.
- Measures must be taken to avoid or minimize adverse impacts on ecosystem services from project activities. Any risks or potential adverse impacts on ecosystem services that may be exacerbated by climate change, should be identified and an mitigation plan provided, (for example over abstraction of groundwater for crop cultivation).
- Provide safety and health training, including on the proper use and maintenance of machinery and personal protective equipment.
- Employ local and Namibians first.
- Where implementable, use of technologies, practices and models that generate more and better employment opportunities (both directly and indirectly) for men and women equally, including the youth.
- Adhere to all requirements of the Labour Act and the Environmental Health Act.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Pesticide use register.
- Keep all records if any resistance reporting was conducted.
- Keep records of employment.
- Keep records of health and safety training.
- Keep records of soil and water (quality sampling).

7.4.5 Cultural Aspects

Objective: Conserve and coexist with cultural tradition related to conventional and traditional crop cultivation.

In considering the preservation of cultural heritage in terms of agriculture, reference is made to the traditional practises as well as the autonomy of local populations. The former refers to traditional production techniques or the use of specific crop variants, whereas the latter refers to the freedom of the population to decide on GMO-free production or GMO-free areas. Additional heritage or archaeological resources will be subject to standard chance-find-procedures.

Maize and cotton are not crops which are traditionally grown in the rural areas of Namibia. Nonetheless, the Namibian Government has set up various projects in assisting farmers in producing crops for commercial and own use. Some of these are irrigation based projects which aim at increasing the contribution of agriculture to the country's gross domestic product and to simultaneously achieve the social development and upliftment of communities, located within areas suitable for crop farming. The bulk of maize production in Namibia is however achieved through commercial farming techniques, driven by the availability and traditional use of existing implements and seed available. The bulk of producers use conventional tillage and planting techniques of non-GMO maize, some planted as dryland crops and some under irrigation (mainly pivot irrigation systems). Recent years have seen an increase in irrigation based production, which in itself, signifies a change in the traditional methods of cultivation. Cultivation of GMO maize will both impact conventional crop production techniques (of those who plant it) as well as the traditional label of Namibia, being a GMO maize producing country.

Introduction of GMO maize and related cultivation methods. have the potential to overshadow GMO-free / organic production leading to reduced sustainability of such cultivation.

Actions

Prevention:

- Education and dissemination of accurate, scientific, information pertaining to the cultivation of GMOs.
- Should any aspect of the cultivation, utilize cultural heritage, including knowledge, innovations or practices of local communities (specifically) to benefit the project or for commercial purposes, communities should be informed of: (i) their rights under national law; (ii) the scope and nature of the proposed use; and (iii) the potential consequences.
- The public consultation process should include groups affected by the project, main users, custodians, local communities, relevant government authorities and interested NGOs.
- For archaeological resources, about the chance find procedures for the preservation of such resources.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Keep consultation record

8 PERMIT APPLICATION

The approval of EIAs for the cultivation of GMOs, and subsequent issuing of a clearances, does not automatically allow farmers to import seeds to cultivate GM maize. An application for environmental release has to be submitted to the Biosafety Council, NCRST, by each farmer. This application must among others be accompanied by the SEA and its SEMP and an emergency response plan. Standard procedures for importation of seeds continue to apply, except that more stringent regulations are in place for its transport and handling.

Typically, environmental release of a GMO for agricultural purposes is preceded by field trials. For the proposed GM maize and cotton events and their stacks, sufficient evidence is available in the form of scientific literature spanning two decades and more of GM maize and cotton cultivation in South Africa, as well as various other countries worldwide. During this period some lessons were learned, specifically for example the importance of pest management plans to prevent development of resistance. This information is now freely available. The need for field trials are therefore considered to be redundant in the Namibian context.

9 CONCLUSION

Members of the APA intends to apply for the registration of GM maize (MON 810, MON 89034, NK 603 and stacks thereof) and GM cotton (MON88913 and MON88913 × MON15985) for purposes of environmental release in Namibia. These events provide for crops with insect resistance, glyphosate resistance as well as a combination of insect and glyphosate resistance. In general terms, GMOs are ideally placed to support the Namibian economy and the Namibian Government in its endeavours to ensure food security and food self-sufficiency. With less and less resources available due to climate change, more frequent droughts and outbreaks of pests and diseases, the negative effect of chemicals and pesticides on the Namibian fauna and flora, it is more than opportune to introduce GM crops for cultivation into Namibia. Such a step could turn otherwise marginal agronomic areas into profitable production areas and assist in the alleviation of hunger and poverty for those small-scale farmers that produce for household food security.

A large part of the population objects to the idea of genetic engineering and the consumption of GM foods. While some of the objections are based on moral and ethical beliefs, other objections stem from being misinformed or being selective in the sourcing of literature to support anti-GMO campaigns. Some objections, however, do warrant caution as is the concern about development of resistance in pests. Resistance in pests is however not restricted to GM crops, but results from poor pest management practises in both non-GM and GM crop cultivation.

In a country like Namibia, with mostly marginal agronomic potential, and likely to be significantly affected by climate change, it makes sense to diversify agronomic practices by introduction GM crops into the system. Based on extensive literature reviews as touched on in this report, there is no concrete evidence that GM maize and cotton's negative impacts are such that it should not be allowed for environmental release. That being said, it remains important for farmers to be obligated to follow the regulations and recommendations prescribed for each specific GM event. This includes the management plan prepared as part of the environmental impact assessment. Furthermore, GMOs pose very little threat to organic initiatives, as these can co-exist in the same country, as already proven in many other countries that have adopted both organic and GM production systems. The US for example has the biggest organic market in the world and it is growing at an impressive rate, despite the US also being one of the biggest producers and exporters of GM crops (FiBL & IFOAM – Organics International, 2018).

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Appendix A: Newspaper Clippings

SA pensioengeld 'weg' in SME-plundery

Catherine Sasman

'n Bedrag van N$60 miljoen, wat aan die Nasionale Voorsorgfonds van die Suid-Afrikaanse Munisipale Werkersunie (Samwu) behoort, is maar net een van die sogenaamde beleggings wat in die SME Bank-plundery verdwyn het.

Die *Mail & Guardian* het onlangs berig die bedrag van N$60 miljoen is by 'n SME rekening inbetaal sonder die pensioenfonds se skriftelike toestemming.

Volgens beëdigde verklarings voor die hooggeregshof afgelê, het die voormalige uitvoerende hoof van die SME Bank, die Zimbabwiër mnr. Tawanda Mumvuma, op 12 Oktober 2016 die besturende direkteur van JM Busha Asset Managers aangesê om die N$60 miljoen na die Namibiese bank oor te plaas.

Dié bedrag is die volgende dag na die SME Bank vanuit 'n VBS Mutual Bank-rekening oorgeplaas.

Op dieselfde dag het Mumvuma 'n promesse in JM Busha se guns onderteken, en sodoende aanspreeklikheid vir die N$60 miljoen vir die SME Bank aan JM Busha Asset Managers geskep.

'BELEGGING' GEWAARBORG

Die *Mail & Guardian* het berig dat, ten spyte van die SME Bank wat nou gelikwideer word, mnr. Joseph Busha, die beleggingsfonds se uitvoerende hoof, volhou die N$60 miljoen kan weer met rente verhaal word.

Busha het in 'n onderhoud met die SME Bank se likwidateurs, mnre. David Bruni en Ian McLaren, verlede jaar in Oktober aangevoer hy is deur Mumvuma bedrieg.

Die hoofbeamptes van die Suid-Afrikaanse pensioenfonds, mnr. Themba Mfeka, het aan die *Mail & Guardian* gesê deel van die funds se "belegging" in die SME Bank is deur die Namibiese regering en fondsdirekteurs gewaarborg.

Mfeka het verder beweer daar is regsaksie teen die SME Bank-direkteurs.

'n Anonieme bron het Mfeka se aantygings ontken.

Me. Tania Pearson, die SME Bank se voormalige regsverteenwoordiger wat met die likwidasieproses in die hof moes help, sê in hofstukke die JM Busha-"belegging" en ander was pogings om die plundering weg te steek.

Finansiële rekords en bankstate toon minstens N$247,6 miljoen is tussen Desember 2013 en Januarie 2017 uit die SME Bank se rekeninge by Standard Bank en FNB Namibia aan die vermeende ontvangers van die gesteelde geld betaal.

Baie van hierdie onwettige betalings is as fondse vir rekenaarhardeware of boukostes verdoesel, en toe buitengewoon groot bedrae moeilik geraak het om te verduidelik, het die bedrieërs dit "beleggings" begin noem.

In Junie 2016 het die SME Bank se eksterne ouditeur (BDO Namibia) 'n aantal transaksies bevraagteken en afskrifte van onder meer beleggingsooreenkomste versoek.

Die goewerneur van die Bank of Namibia (BoN), mnr. Iipumbu Shiimi, het ook onraad begin vermoed, maar het geen terugvoering van die SME Bank ontvang nie.

Toenemende druk op die bank het Mumvuma, mnr. Mauwane Kotane van Mamepe Capital (waarin SME Bank glo 'n aantal beleggings gemaak het), en mnr. Andile Ramavhunga, uitvoerende hoof van die South African VBS Mutual Bank, 'n komplot laat bedink om bedrae elders te kry om terug in die SME Bank se rekeninge te betaal.

Só is ouder meer die Suid-Afrikaanse Munisipale Pensioenfonds vir N$60 miljoen gemelk.

Pearson het gesê Mumvuma, Kotane en Ramavhunga het in November 2016 dokumente opgestel om aan "allerlei" voor te lê dat N$57 miljoen aan die SME Bank uit 'n sogenaamde "belegging" teruggebaal is, wat die SME Bank by VBS Mutual Bank gehad het.

"In werklikheid het hulle verdere aanspreeklikheid vir die SME Bank geskep, naamlik 'n bedrag van N$60 miljoen wat aan JM Busha Asset Managers verskuldig is," het Pearson gesê.

– catherine@republikein.com.na

Die nou verlate SME Bank. FOTO: MARC SPRINGER

Reusepeste slaan toe

Die herfskommandowurm rig gewasse grootskaalse skade aan. FOTO'S FAO

Noordelike, sentrale gebiede geraak

Kommandowurms, wat boere se weldlng en gewasse kan verwoes, het in van die streke kop uitgesteek.

Elvira Hattingh

Die herfskommandowurm het sy opwagting in Namibië se Zambezi-, Oshana- en Oshikotostreek gemaak.

Terselfdertyd het die Afrika-kommandowurm in die Oshana-, Oshikoto- en Omusatistreek uitgebroei.

Die ministerie van landbou, water en bosbou het gister 'n mediaverklaring uitgereik om die uitbreking van die peste te bevestig en voeg by verskeie hektaar grond is reeds geraak.

Intussen sê kommersiële boere in die Mieliedriehoek hulle loop reeds drie weke lank onder die herfskommandowurm deur, terwyl gerugte die ronde doen dat klein groepe van die Afrika-kommandowurm ook in die Outjo- en Otavi-gebied uitgebroei het.

Volgens die ministerie is die herfskommandowurm op 6 Januarie op Sibbinda, Kongola, Ngoma, Bukalo, Itomba, Nsundwa, Kasheshe en Musanga in die Zambezistreek opgemerk.

"Die gewasse is tans in verskillende groeistadiums, van die ontkieming- tot blomstadium, en is uiters kwesbaar vir peste soos die herfs- en Afrika-kommandowurm," het die ministerie se uitvoerende direkteur, mnr. Percy Misika, in die verklaring gesê.

Misika het ook bevestig streke wat pesdoders beskikbaar het, moet met bespuitingsprogramme begin sodat die peste nie verder moet versprei nie.

Intussen het mnr. Klaas Malan, 'n akkerbouer uit Namibië se Mieliedriehoek, bevestig boere in dié omgewing voer drie weke lank al 'n stryd teen die herfskommandowurm.

Hy sê hulle moet voortdurend pesdoders spuit en hy doen dit snags wanneer voordelige insekte soos bye nie rondvlieg nie, sodat hy hulle nie ook doodmaak nie.

Malan sê die herfskommandowurm beskadig mieliekoppe, wat beteken boere kry swakker graderings vir mielies wat hulle wil verkoop.

Die ministerie verduidelik die herfskommandowurm, wat sy oorsprong in Amerika het, is die eerste keer in die 2016-'17-seisoen in Namibië opgemerk.

Boonop het dié pes die ongewone vermoë om vinnig te versprei en is dit 'n uitdaging om dit te beheer omdat dit weerstandig teen verskeie pesdoders is.

Dit volg nadat CropLife SA se dr. Gerhard Verdoorn onlangs gewaarsku het dié twee peste kan in Namibië uitbreek ná Namibië's onder erge motplae gebuk gegaan het.

Hy en sy kollegas het gesê die motte is moontlik dié van die Afrika-kommandowurm.

Verdoorn het toe gesê weerstoestande is ideaal vir die uitbroei van peste, met die warm tropiese, vogtige lug wat uit Wes-Afrika, die Kongo en Zaïre oor Suider-Afrika beweeg.

"Die Afrika-kommandowurm is 'n baie ernstige pes wat jou veld groot skade kan aanrig. Dit teer hoofsaaklik op weiding en sal soms ook gewasse invaar," het hy gesê.

Hy sê die Afrika-kommandowurm is endemies aan Suider-Afrika, wat beteken dit kom natuurlik hier voor, maar reën en vog veroorsaak dat dit in groot getalle uitbroei.

– elvira@republikein.com.na

Zambezi farmers face fall armyworm outbreak

2019-02-26 John Muyamba

RUNDU - The Ministry of Agriculture, Water and Forestry has confirmed there is an outbreak of fall armyworms in the Zambezi Region after it was reported on February 14 to have attacked crops in various areas – and considering the poor rain prospects this will affect the harvest immensely. According to the ministry the outbreak poses a significant threat to smallholder farmers, mainly maize farmers. and has become a threat to food security.

In the 2016/2017 cropping season approximately 50 000 hectares of maize and millet were estimated to have been damaged by these worms that adversely affected 27 000 households. The fall armyworms were spotted in Sachona, Kongola, Ngoma, Bukalo, Kasheshe and Musanga. "Following these reports the Ministry of Agriculture, Water and Forestry took assessment missions in the affected areas on 18 and 19 February which confirmed that over 100 hectares of farmland are adversely affected by the worms. Crops in these areas are at different growth stages, from vegetative to flowering stage which is highly susceptible to fall armyworms," Margaret Kalo, spokesperson for the agriculture ministry said.

Research shows that the fall armyworms prefer maize, but can also feed on more than 80 additional species of crops, including rice, sorghum, millet, sugarcane, vegetable crops and cotton.

Fall armyworms were initially detected in Central and Western Africa in early 2016 and they quickly spread across virtually all of Sub-Saharan Africa. In July 2018 it was also confirmed in India and Yemen. Because of trade and the moth's strong flying ability, it has the potential to spread further.

Farmers will need great support through integrated pest management to sustainably manage the pest in their cropping systems. The lifespan of the fall armyworm from egg to larva to moth lasts from one to three months, and it is during the larva stage that it creates the most crop damage. Research also shows the moth can fly up to 100 km per night and the female moth can lay up to a total of 1 000 eggs in her lifetime

This reporter has learned on the website of the Food and Agriculture Organization (FAO) of the United Nations that FAO have developed a mobile phone app which can aid farmers to monitor fall armyworms in their crop fields here in Africa and farmers can research it and see how it can assist them.

There are a number of ways to try to manage this pest in maize and other crops, but because it is a new pest to Africa, none of them are guaranteed to be effective and research is going on to develop more effective solutions.

However, there are some cultural and manual practices that can help reduce their effectiveness like the use of intercropping, and crop rotation with non-grass species such as cassava can reduce crop damage.

Handpick and destroy egg masses and larvae, or collect and drop larvae in hot water. Killing one caterpillar prevents the appearance of more than 1500-2000 new caterpillars within less than four weeks, while using good quality seeds can increase plant vigour and potentially reduce damage, farmers are advised.

2019-02-26 John Muyamba

Worms engulf Namibia

Home / Worms engulf Namibia

By **Southern Times** -- Jan 24, 2020 -- **0 Comments**

Timo Shihepo

Windhoek - After a prolonged period of drought, Namibian farmers have yet another problem to tackle in the form of fall army worms and African army worms which are currently attacking their crops.

The areas most affected by the fall army worms and African army worms outbreak are in the Zambezi, Oshana and Oshikoto regions.

"Following these reports, this confirmed the several hectares of farmland are adversely affected by the worms. The crops in these areas are at different growth stages, from germination, vegetative to flowering stages, which is highly susceptible to fall army worms and African army worms," said Ministry of Agriculture, Water and Forestry executive director, Percy Misika.

The fall army worm is a pervasive agricultural pest native to south and central America that ruthlessly worked its way across the African continent, after arriving in West Africa and hitting Nigeria in 2016.

The agricultural ministry said the worms then made their way to south of the Sahara and into Namibia in 2016/2017 cropping season.

"The fall army worm has spread quickly due to its short reproductive cycle and ability to travel long distance quickly during its adult (moth) stage," said Misika.

The fall army worm's lifespan from egg to larva to moth lasts from one to three months. It is during the larva stage that it creates the most crop damage. The agricultural ministry said that the fall army worm is difficult to control because it reproduces fast and in larger numbers and can migrate long distances, hides within growing leaves and is also resistant to several pesticides.

"Okapuka (worms) is in abundance here. I think we might need to buy seeds and replant again because they are really causing havoc," Kambwali, a farmer in Oshikoto region, told *The Southern Times*.

In an effort to help the farmers, the Ministry of Agriculture, Water and Forestry has directed the regions with pesticides to start the spraying programme with immediate effect in order to contain the pests in areas where they have been reported.

"In addition, all the crop growing regions were directed to intensify awareness campaigns through the local radio service in order to educate farmers on the identification, ecology and control of the pest. The Ministry will continue with surveillance, using pheromone traps in areas which are not yet reported to be affected by the pest to ensure timely control of the fall army worm and African worm outbreak," said Misika.

Appendix B: Cost Guide Figures for Bt Maize and non-GMO maize

Non-GM White Maize Dryland

Cost Guide Figures

profarmer

Sub Crop	Publications	Pricing Date	White Maize (GM-free) (Ton)
Maize (White - GM-free) - Dryland	Winter 2023	2023-07-15	5.50

Income					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
White Maize (GM-free)	5.50	Ton	3 420.00	R/ton	R18 810
Gross Production Value					**R18 810**

Expenses					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Seed (White Maize GM-free)	25 000.00	Kernels/ha	0.05	R/pip	R1 250
Fertiliser - Macro elements	1.00	Ha	4 630.26	R/ha	R4 630
Fertiliser - Micro elements	1.00	Ha	126.50	R/ha	R127
Fuel (Diesel)	63.15	L/ha	19.51	R/l	R1 232
Herbicide	1.00	Ha	699.19	R/ha	R699
Insecticide	1.00	Ha	2 376.94	R/ha	R2 377
Fungicide	1.00	Ha	1 291.34	R/ha	R1 291
Other Chemicals	1.00	Ha	0.00	R/ha	R0
Aeroplane	2.00	Applications	260.00	R/ha	R520
Insurance - Maize	18 810.00	Rand	2.00	%	R376
Harvester Maize - Dryland	1.00	Ha	675.00	R/ha	R675
Transport	5.50	Ton	165.00	R/ton	R908
Mechanization - Repair and Maintenance	1.00	Ha	749.78	R/ha	R750
Safex Hedging Cost	5.50	Ton	3.00	R/ton	R17
Total Direct Cost					**R14 851**

Interest					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Interest	6 188.04	Rand	12.00	%	R743

Total Production Cost	R15 594
Margin Above Cost	R3 216
Breakeven Yield/Ha	4.56
Breakeven Price/Ton	R2 835

Sensitivity Analysis

Crop Yield (t/ha)	R3 120	R3 220	R3 320	R3 420	R3 520	R3 620	R3 720
2.50	-R7 794	-R7 544	-R7 294	-R7 044	-R6 794	-R6 544	-R6 294
3.50	-R4 674	-R4 324	-R3 974	-R3 624	-R3 274	-R2 924	-R2 574
4.50	-R1 554	-R1 104	-R654	-R204	R246	R696	R1 146
5.50	R1 566	R2 116	R2 666	R3 216	R3 766	R4 316	R4 866
6.50	R4 686	R5 336	R5 986	R6 636	R7 286	R7 936	R8 586
7.50	R7 806	R8 556	R9 306	R10 056	R10 806	R11 556	R12 306
8.50	R10 926	R11 776	R12 626	R13 476	R14 326	R15 176	R16 026

Fertiliser (Macro Elements)		
N	107.5	Kg/ha
P	21.5	Kg/ha
K	20.0	Kg/ha
Ca	3.4	Kg/ha
Mg	6.3	Kg/ha
S	12.0	Kg/ha

GM White Maize Dryland

Cost Guide Figures

profarmer

Sub Crop	Publications	Pricing Date	White Maize (Ton)
Maize (White - GM) - Dryland	Winter 2023	2023-07-15	5.50

Income					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
White Maize	5.50	Ton	3 420.00	R/ton	R18 810
Gross Production Value					**R18 810**

Expenses					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Seed (White maize)	25 000.00	Kernels/ha	0.07	R/pip	R1 750
Fertiliser - Macro elements	1.00	Ha	4 630.26	R/ha	R4 630
Fertiliser - Micro elements	1.00	Ha	126.50	R/ha	R127
Fuel (Diesel)	63.15	L/ha	19.51	R/l	R1 232
Herbicide	1.00	Ha	699.19	R/ha	R699
Insecticide	1.00	Ha	1 802.59	R/ha	R1 803
Fungicide	1.00	Ha	1 291.34	R/ha	R1 291
Other Chemicals	1.00	Ha	0.00	R/ha	R0
Aeroplane	2.00	Applications	260.00	R/ha	R520
Insurance - Maize	18 810.00	Rand	2.00	%	R376
Harvester Maize - Dryland	1.00	Ha	675.00	R/ha	R675
Transport	5.50	Ton	165.00	R/ton	R908
Mechanization - Repair and Maintenance	1.00	Ha	749.78	R/ha	R750
Safex Hedging Cost	5.50	Ton	3.00	R/ton	R17
Total Direct Cost					**R14 777**

Interest					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Interest	6 157.06	Rand	12.00	%	R739

Total Production Cost	R15 516
Margin Above Cost	R3 294
Breakeven Yield/Ha	4.54
Breakeven Price/Ton	R2 821

Sensitivity Analysis

Crop Yield (t/ha)	R3 120	R3 220	R3 320	R3 420	R3 520	R3 620	R3 720
2.50	-R7 716	-R7 466	-R7 216	-R6 966	-R6 716	-R6 466	-R6 216
3.50	-R4 596	-R4 246	-R3 896	-R3 546	-R3 196	-R2 846	-R2 496
4.50	-R1 476	-R1 026	-R576	-R126	R324	R774	R1 224
5.50	R1 644	R2 194	R2 744	R3 294	R3 844	R4 394	R4 944
6.50	R4 764	R5 414	R6 064	R6 714	R7 364	R8 014	R8 664
7.50	R7 884	R8 634	R9 384	R10 134	R10 884	R11 634	R12 384
8.50	R11 004	R11 854	R12 704	R13 554	R14 404	R15 254	R16 104

Fertiliser (Macro Elements)		
N	107.5	Kg/ha
P	21.5	Kg/ha
K	20.0	Kg/ha
Ca	3.4	Kg/ha
Mg	6.3	Kg/ha
S	12.0	Kg/ha

Non-GM White Maize Irrigation

Cost Guide Figures

profarmer

Sub Crop	Publications	Pricing Date	White Maize (GM-free) (Ton)
Maize (White - GM-free)	Winter 2023	2023-07-15	13.00

Income					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
White Maize (GM-free)	13.00	Ton	3 420.00	R/ton	R44 460
Gross Production Value					**R44 460**

Expenses					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Seed (White Maize GM-free)	90 000.00	Kernels/ha	0.05	R/pip	R4 500
Fertiliser - Macro elements	1.00	Ha	12 448.02	R/ha	R12 448
Fertiliser - Micro elements	1.00	Ha	1 205.39	R/ha	R1 205
Fuel (Diesel)	69.15	L/ha	19.51	R/l	R1 349
Herbicide	1.00	Ha	909.98	R/ha	R910
Insecticide	1.00	Ha	3 027.79	R/ha	R3 028
Fungicide	1.00	Ha	1 291.34	R/ha	R1 291
Other Chemicals	1.00	Ha	89.00	R/ha	R89
Aeroplane	2.00	Applications	260.00	R/ha	R520
Insurance - Maize	44 460.00	Rand	2.00	%	R889
Harvester Maize	1.00	Ha	1 350.00	R/ha	R1 350
Transport	13.00	Ton	165.00	R/ton	R2 145
Irrigation - Escom	690.00	mm/ha	8.09	R/mm	R5 582
Irrigation - Water Board	690.00	mm/ha	1.99	R/mm	R1 373
Irrigation - Scheduling	1.00	Ha	114.00	R/ha	R114
Mechanization - Repair and Maintenance	1.00	Ha	787.89	R/ha	R788
Pivot Cost - Repair and Maintenance	1.00	Ha	1 133.00	R/ha	R1 133
Safex Hedging Cost	13.00	Ton	3.00	R/ton	R39
Total Direct Cost					**R38 754**

Interest					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Interest	16 147.49	Rand	12.00	%	R1 938

Total Production Cost	R40 692
Margin Above Cost	R3 768
Breakeven Yield/Ha	11.90
Breakeven Price/Ton	R3 130

Sensitivity Analysis

Crop Yield (t/ha)	R3 120	R3 220	R3 320	R3 420	R3 520	R3 620	R3 720
10.00	-R9 492	-R8 492	-R7 492	-R6 492	-R5 492	-R4 492	-R3 492
11.00	-R6 372	-R5 272	-R4 172	-R3 072	-R1 972	-R872	R228
12.00	-R3 252	-R2 052	-R852	R348	R1 548	R2 748	R3 948
13.00	-R132	R1 168	R2 468	R3 768	R5 068	R6 368	R7 668
14.00	R2 988	R4 388	R5 788	R7 188	R8 588	R9 988	R11 388
15.00	R6 108	R7 608	R9 108	R10 608	R12 108	R13 608	R15 108
16.00	R9 228	R10 828	R12 428	R14 028	R15 628	R17 228	R18 828

Fertiliser (Macro Elements)		
N	286.0	Kg/ha
P	52.0	Kg/ha
K	80.0	Kg/ha
Ca	10.0	Kg/ha
Mg	10.0	Kg/ha
S	25.0	Kg/ha

GM White Maize Irrigation

Cost Guide Figures

profarmer

Sub Crop	Publications	Pricing Date	White Maize (Ton)
Maize (White - GM)	Winter 2023	2023-07-15	13.00

Income					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
White Maize	13.00	Ton	3 420.00	R/ton	R44 460
Gross Production Value					**R44 460**

Expenses					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Seed (White maize)	90 000.00	Kernels/ha	0.07	R/pip	R6 300
Fertiliser - Macro elements	1.00	Ha	12 448.02	R/ha	R12 448
Fertiliser - Micro elements	1.00	Ha	1 205.39	R/ha	R1 205
Fuel (Diesel)	69.15	L/ha	19.51	R/l	R1 349
Herbicide	1.00	Ha	909.98	R/ha	R910
Insecticide	1.00	Ha	2 453.44	R/ha	R2 453
Fungicide	1.00	Ha	1 291.34	R/ha	R1 291
Other Chemicals	1.00	Ha	89.00	R/ha	R89
Aeroplane	2.00	Applications	260.00	R/ha	R520
Insurance - Maize	44 460.00	Rand	2.00	%	R889
Harvester Maize	1.00	Ha	1 350.00	R/ha	R1 350
Transport	13.00	Ton	165.00	R/ton	R2 145
Irrigation - Escom	690.00	mm/ha	8.09	R/mm	R5 582
Irrigation - Water Board	690.00	mm/ha	1.99	R/mm	R1 373
Irrigation - Scheduling	1.00	Ha	114.00	R/ha	R114
Mechanization - Repair and Maintenance	1.00	Ha	787.89	R/ha	R788
Pivot Cost - Repair and Maintenance	1.00	Ha	1 133.00	R/ha	R1 133
Safex Hedging Cost	13.00	Ton	3.00	R/ton	R39
Total Direct Cost					**R39 980**

Interest					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Interest	16 658.17	Rand	12.00	%	R1 999

Total Production Cost	**R41 979**
Margin Above Cost	**R2 481**
Breakeven Yield/Ha	12.27
Breakeven Price/Ton	R3 229

Sensitivity Analysis

Crop Yield (t/ha)	R3 120	R3 220	R3 320	R3 420	R3 520	R3 620	R3 720
10.00	-R10 779	-R9 779	-R8 779	-R7 779	-R6 779	-R5 779	-R4 779
11.00	-R7 659	-R6 559	-R5 459	-R4 359	-R3 259	-R2 159	-R1 059
12.00	-R4 539	-R3 339	-R2 139	-R939	R261	R1 461	R2 661
13.00	-R1 419	-R119	R1 181	R2 481	R3 781	R5 081	R6 381
14.00	R1 701	R3 101	R4 501	R5 901	R7 301	R8 701	R10 101
15.00	R4 821	R6 321	R7 821	R9 321	R10 821	R12 321	R13 821
16.00	R7 941	R9 541	R11 141	R12 741	R14 341	R15 941	R17 541

Fertiliser (Macro Elements)		
N	286.0	Kg/ha
P	52.0	Kg/ha
K	80.0	Kg/ha
Ca	10.0	Kg/ha
Mg	10.0	Kg/ha
S	25.0	Kg/ha

Non-GM Yellow Maize Dryland

Cost Guide Figures

profarmer

Sub Crop	Publications	Pricing Date	Maize (BT-free) - Dryland (Ton)
Maize (Yellow - GM-free) - Dryland	Winter 2023	2023-07-15	5.50

Income

Product Name	Product Quantity	Measure Unit	Price	Measure Unit	Product Cost
Maize (BT-free) - Dryland	5.50	Ton	3 450.00	R/ton	R18 975
Gross Production Value					**R18 975**

Expenses

Product Name	Product Quantity	Measure Unit	Price	Measure Unit	Product Cost
Seed (Maize BT-free)	25 000.00	Kernels/ha	0.05	R/pip	R1 250
Fertiliser - Macro elements	1.00	Ha	4 630.26	R/ha	R4 630
Fertiliser - Micro elements	1.00	Ha	126.50	R/ha	R127
Fuel (Diesel)	63.15	L/ha	19.51	R/l	R1 232
Herbicide	1.00	Ha	699.19	R/ha	R699
Insecticide	1.00	Ha	2 376.94	R/ha	R2 377
Fungicide	1.00	Ha	1 291.34	R/ha	R1 291
Other Chemicals	1.00	Ha	0.00	R/ha	R0
Aeroplane	2.00	Applications	260.00	R/ha	R520
Insurance - Maize	18 975.00	Rand	2.00	%	R380
Harvester Maize - Dryland	1.00	Ha	675.00	R/ha	R675
Transport	5.50	Ton	165.00	R/ton	R908
Mechanization - Repair and Maintenance	1.00	Ha	749.78	R/ha	R750
Safex Hedging Cost	5.50	Ton	3.00	R/ton	R17
Total Direct Cost					**R14 855**

Interest

Product Name	Product Quantity	Measure Unit	Price	Measure Unit	Product Cost
Interest	6 189.42	Rand	12.00	%	R743

Total Production Cost	R15 597
Margin Above Cost	R3 378
Breakeven Yield/Ha	4.52
Breakeven Price/Ton	R2 836

Sensitivity Analysis

Crop Yield (t/ha)	R3 150	R3 250	R3 350	R3 450	R3 550	R3 650	R3 750
2.50	-R7 722	-R7 472	-R7 222	-R6 972	-R6 722	-R6 472	-R6 222
3.50	-R4 572	-R4 222	-R3 872	-R3 522	-R3 172	-R2 822	-R2 472
4.50	-R1 422	-R972	-R522	-R72	R378	R828	R1 278
5.50	R1 728	R2 278	R2 828	R3 378	R3 928	R4 478	R5 028
6.50	R4 878	R5 528	R6 178	R6 828	R7 478	R8 128	R8 778
7.50	R8 028	R8 778	R9 528	R10 278	R11 028	R11 778	R12 528
8.50	R11 178	R12 028	R12 878	R13 728	R14 578	R15 428	R16 278

Fertiliser (Macro Elements)		
N	107.5	Kg/ha
P	21.5	Kg/ha
K	20.0	Kg/ha
Ca	3.4	Kg/ha
Mg	6.3	Kg/ha
S	12.0	Kg/ha

GM Yellow Maize Dryland

Cost Guide Figures

profarmer

Sub Crop	Publications	Pricing Date	Maize (BT) - Dryland (Ton)
Maize (Yellow - GM) - Dryland	Winter 2023	2023-07-15	5.50

Income					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Maize (BT) - Dryland	5.50	Ton	3 450.00	R/ton	R18 975
Gross Production Value					R18 975

Expenses					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Seed (Maize BT)	25 000.00	Kernels/ha	0.07	R/pip	R1 750
Fertiliser - Macro elements	1.00	Ha	4 630.26	R/ha	R4 630
Fertiliser - Micro elements	1.00	Ha	126.50	R/ha	R127
Fuel (Diesel)	63.15	L/ha	19.51	R/l	R1 232
Herbicide	1.00	Ha	699.19	R/ha	R699
Insecticide	1.00	Ha	1 802.59	R/ha	R1 803
Fungicide	1.00	Ha	1 291.34	R/ha	R1 291
Other Chemicals	1.00	Ha	0.00	R/ha	R0
Aeroplane	2.00	Applications	260.00	R/ha	R520
Insurance - Maize	18 975.00	Rand	2.00	%	R380
Harvester Maize - Dryland	1.00	Ha	675.00	R/ha	R675
Transport	5.50	Ton	165.00	R/ton	R908
Mechanization - Repair and Maintenance	1.00	Ha	749.78	R/ha	R750
Safex Hedging Cost	5.50	Ton	3.00	R/ton	R17
Total Direct Cost					R14 780

Interest					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Interest	6 158.44	Rand	12.00	%	R739

Total Production Cost	**R15 519**
Margin Above Cost	**R3 456**
Breakeven Yield/Ha	4.50
Breakeven Price/Ton	R2 822

Sensitivity Analysis

Crop Yield (t/ha)	R3 150	R3 250	R3 350	R3 450	R3 550	R3 650	R3 750
2.50	-R7 644	-R7 394	-R7 144	-R6 894	-R6 644	-R6 394	-R6 144
3.50	-R4 494	-R4 144	-R3 794	-R3 444	-R3 094	-R2 744	-R2 394
4.50	-R1 344	-R894	-R444	R6	R456	R906	R1 356
5.50	R1 806	R2 356	R2 906	R3 456	R4 006	R4 556	R5 106
6.50	R4 956	R5 606	R6 256	R6 906	R7 556	R8 206	R8 856
7.50	R8 106	R8 856	R9 606	R10 356	R11 106	R11 856	R12 606
8.50	R11 256	R12 106	R12 956	R13 806	R14 656	R15 506	R16 356

Fertiliser (Macro Elements)		
N	107.5	Kg/ha
P	21.5	Kg/ha
K	20.0	Kg/ha
Ca	3.4	Kg/ha
Mg	6.3	Kg/ha
S	12.0	Kg/ha

Non-GM Yellow Maize Irrigation

Cost Guide Figures

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Sub Crop	Publications	Pricing Date	Maize (BT-free) (Ton)
Maize (Yellow - GM-free)	Winter 2023	2023-07-15	13.00

Income					
Product Name	Product Quantity	Measure Unit	Price	Measure Unit	Product Cost
Maize (BT-free)	13.00	Ton	3 450.00	R/ton	R44 850
Gross Production Value					**R44 850**

Expenses					
Product Name	Product Quantity	Measure Unit	Price	Measure Unit	Product Cost
Seed (Maize BT-free)	90 000.00	Kernels/ha	0.05	R/pip	R4 500
Fertiliser - Macro elements	1.00	Ha	12 448.02	R/ha	R12 448
Fertiliser - Micro elements	1.00	Ha	1 205.39	R/ha	R1 205
Fuel (Diesel)	69.15	L/ha	19.51	R/l	R1 349
Herbicide	1.00	Ha	909.98	R/ha	R910
Insecticide	1.00	Ha	3 027.79	R/ha	R3 028
Fungicide	1.00	Ha	1 291.34	R/ha	R1 291
Other Chemicals	1.00	Ha	89.00	R/ha	R89
Aeroplane	2.00	Applications	260.00	R/ha	R520
Insurance - Maize	44 850.00	Rand	2.00	%	R897
Harvester Maize	1.00	Ha	1 350.00	R/ha	R1 350
Transport	13.00	Ton	165.00	R/ton	R2 145
Irrigation - Escom	690.00	mm/ha	8.09	R/mm	R5 582
Irrigation - Water Board	690.00	mm/ha	1.99	R/mm	R1 373
Irrigation - Scheduling	1.00	Ha	114.00	R/ha	R114
Mechanization - Repair and Maintenance	1.00	Ha	787.89	R/ha	R788
Pivot Cost - Repair and Maintenance	1.00	Ha	1 133.00	R/ha	R1 133
Safex Hedging Cost	13.00	Ton	3.00	R/ton	R39
Total Direct Cost					**R38 762**

Interest					
Product Name	Product Quantity	Measure Unit	Price	Measure Unit	Product Cost
Interest	16 150.74	Rand	12.00	%	R1 938

Total Production Cost	R40 700
Margin Above Cost	R4 150
Breakeven Yield/Ha	11.80
Breakeven Price/Ton	R3 131

Sensitivity Analysis

Crop Yield (t/ha)	R3 150	R3 250	R3 350	R3 450	R3 550	R3 650	R3 750
10.00	-R9 200	-R8 200	-R7 200	-R6 200	-R5 200	-R4 200	-R3 200
11.00	-R6 050	-R4 950	-R3 850	-R2 750	-R1 650	-R550	R550
12.00	-R2 900	-R1 700	-R500	R700	R1 900	R3 100	R4 300
13.00	R250	R1 550	R2 850	R4 150	R5 450	R6 750	R8 050
14.00	R3 400	R4 800	R6 200	R7 600	R9 000	R10 400	R11 800
15.00	R6 550	R8 050	R9 550	R11 050	R12 550	R14 050	R15 550
16.00	R9 700	R11 300	R12 900	R14 500	R16 100	R17 700	R19 300

Fertiliser (Macro Elements)		
N	286.0	Kg/ha
P	52.0	Kg/ha
K	80.0	Kg/ha
Ca	10.0	Kg/ha
Mg	10.0	Kg/ha
S	25.0	Kg/ha

GM Yellow Maize Irrigation

Cost Guide Figures

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Sub Crop	Publications	Pricing Date	Maize (BT) (Ton)
Maize (Yellow - GM)	Winter 2023	2023-07-15	13.50

Income					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Maize (BT)	13.50	Ton	3 450.00	R/ton	R46 575
Gross Production Value					**R46 575**

Expenses					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Seed (Maize BT)	90 000.00	Kernels/ha	0.07	R/pip	R6 300
Fertiliser - Macro elements	1.00	Ha	12 449.69	R/ha	R12 450
Fertiliser - Micro elements	1.00	Ha	1 205.39	R/ha	R1 205
Fuel (Diesel)	69.15	L/ha	19.51	R/l	R1 349
Herbicide	1.00	Ha	909.98	R/ha	R910
Insecticide	1.00	Ha	2 453.44	R/ha	R2 453
Fungicide	1.00	Ha	1 291.34	R/ha	R1 291
Other Chemicals	1.00	Ha	89.00	R/ha	R89
Aeroplane	2.00	Applications	260.00	R/ha	R520
Insurance - Maize	46 575.00	Rand	2.00	%	R932
Harvester Maize	1.00	Ha	1 350.00	R/ha	R1 350
Transport	13.50	Ton	165.00	R/ton	R2 228
Irrigation - Escom	690.00	mm/ha	8.09	R/mm	R5 582
Irrigation - Water Board	690.00	mm/ha	1.99	R/mm	R1 373
Irrigation - Scheduling	1.00	Ha	114.00	R/ha	R114
Mechanization - Repair and Maintenance	1.00	Ha	787.89	R/ha	R788
Pivot Cost - Repair and Maintenance	1.00	Ha	1 133.00	R/ha	R1 133
Safex Hedging Cost	13.50	Ton	3.00	R/ton	R41
Total Direct Cost					**R40 108**

Interest					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Interest	16 711.50	Rand	12.00	%	R2 005

Total Production Cost	R42 113
Margin Above Cost	R4 462
Breakeven Yield/Ha	12.21
Breakeven Price/Ton	R3 119

Sensitivity Analysis

Crop Yield (t/ha)	R3 150	R3 250	R3 350	R3 450	R3 550	R3 650	R3 750
10.50	-R9 038	-R7 988	-R6 938	-R5 888	-R4 838	-R3 788	-R2 738
11.50	-R5 888	-R4 738	-R3 588	-R2 438	-R1 288	-R138	R1 012
12.50	-R2 738	-R1 488	-R238	R1 012	R2 262	R3 512	R4 762
13.50	R412	R1 762	R3 112	R4 462	R5 812	R7 162	R8 512
14.50	R3 562	R5 012	R6 462	R7 912	R9 362	R10 812	R12 262
15.50	R6 712	R8 262	R9 812	R11 362	R12 912	R14 462	R16 012
16.50	R9 862	R11 512	R13 162	R14 812	R16 462	R18 112	R19 762

Fertiliser (Macro Elements)		
N	286.1	Kg/ha
P	52.0	Kg/ha
K	80.1	Kg/ha
Ca	10.0	Kg/ha
Mg	10.0	Kg/ha
S	25.0	Kg/ha

Appendix C: Cost Guide Figures for GM Cotton: Dry-land vs. Irrigated

GM Cotton Dry-land – Summer

Cost Guide Figures

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Sub Crop	Publications	Pricing Date	Cotton - Dryland (Ton)
Cotton - Dryland	Summer 2022/23	2022-10-15	1.50

Income					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Cotton - Dryland	1.50	Ton	11 870.00	R/ton	R17 805
Gross Production Value					**R17 805**

Expenses					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Seed (Cotton)	5.00	Kg/ha	138.07	R/kg	R690
Fertiliser - Macro elements	1.00	Ha	2 669.25	R/ha	R2 669
Fertiliser - Micro elements	1.00	Ha	344.45	R/ha	R344
Fuel (Diesel)	69.59	L/ha	23.62	R/l	R1 644
Diesel (Picker)	10.00	L/ha	23.62	R/l	R236
Herbicide	1.00	Ha	528.00	R/ha	R528
Insecticide	1.00	Ha	755.40	R/ha	R755
Fungicide	1.00	Ha	0.00	R/ha	R0
Other Chemicals	1.00	Ha	248.50	R/ha	R249
High Boy sprayer	6.00	Applications	200.00	R/ha	R1 200
Insurance - Cotton	17 805.00	Rand	9.00	%	R1 602
Cotton picker - Dryland	1.00	Ha	3 750.00	R/ha	R3 750
Packaging - Plastic (Cotton)	0.65	Bales	680.00	R/bale	R439
Transport Cotton	1.50	Ton	310.00	R/ton	R465
Mechanization - Repair and Maintenance	1.00	Ha	1 293.71	R/ha	R1 294
Marketing Cost Cotton - statutorily & Nakpo	1.50	Ton	110.00	R/ton	R165
Total Direct Cost					**R16 031**

Interest					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Interest	6 679.43	Rand	11.00	%	R735

Total Production Cost	R16 765
Margin Above Cost	R1 040
Breakeven Yield/Ha	1.41
Breakeven Price/Ton	R11 177

Sensitivity Analysis

Crop Yield (t/ha)	R11 120	R11 370	R11 620	R11 870	R12 120	R12 370	R12 620
0.75	-R8 425	-R8 238	-R8 050	-R7 863	-R7 675	-R7 488	-R7 300
1.00	-R5 645	-R5 395	-R5 145	-R4 895	-R4 645	-R4 395	-R4 145
1.25	-R2 865	-R2 553	-R2 240	-R1 928	-R1 615	-R1 303	-R990
1.50	-R85	R290	R665	R1 040	R1 415	R1 790	R2 165
1.75	R2 695	R3 132	R3 570	R4 007	R4 445	R4 882	R5 320
2.00	R5 475	R5 975	R6 475	R6 975	R7 475	R7 975	R8 475
2.25	R8 255	R8 817	R9 380	R9 942	R10 505	R11 067	R11 630

Fertiliser (Macro Elements)		
N	31.0	Kg/ha
P	12.0	Kg/ha
K	16.0	Kg/ha
Ca	0.0	Kg/ha
Mg	0.0	Kg/ha
S	2.3	Kg/ha

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GM Cotton Dry-land -Winter

Cost Guide Figures

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Sub Crop	Publications	Pricing Date	Cotton - Dryland (Ton)
Cotton - Dryland	Winter 2023	2023-04-15	1.50

Income					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Cotton - Dryland	1.50	Ton	11 950.00	R/ton	R17 925
Gross Production Value					**R17 925**

Expenses					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Seed (Cotton)	5.00	Kg/ha	138.07	R/kg	R690
Fertiliser - Macro elements	1.00	Ha	2 172.63	R/ha	R2 173
Fertiliser - Micro elements	1.00	Ha	323.23	R/ha	R323
Fuel (Diesel)	69.59	L/ha	20.81	R/l	R1 448
Diesel (Picker)	10.00	L/ha	20.81	R/l	R208
Herbicide	1.00	Ha	528.00	R/ha	R528
Insecticide	1.00	Ha	755.40	R/ha	R755
Fungicide	1.00	Ha	0.00	R/ha	R0
Other Chemicals	1.00	Ha	248.50	R/ha	R249
High Boy sprayer	6.00	Applications	200.00	R/ha	R1 200
Insurance - Cotton	17 925.00	Rand	11.00	%	R1 972
Cotton picker - Dryland	1.00	Ha	2 125.00	R/ha	R2 125
Packaging - Plastic (Cotton)	0.65	Bales	680.00	R/bale	R439
Transport Cotton	1.50	Ton	290.00	R/ton	R435
Mechanization - Repair and Maintenance	1.00	Ha	1 404.08	R/ha	R1 404
Marketing Cost Cotton - statutorily & Nakpo	1.50	Ton	110.00	R/ton	R165
Total Direct Cost					**R14 114**

Interest					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Interest	5 880.76	Rand	12.00	%	R706

Total Production Cost	**R14 820**
Margin Above Cost	**R3 105**
Breakeven Yield/Ha	1.24
Breakeven Price/Ton	R9 880

Sensitivity Analysis

Crop Yield (t/ha)	R11 200	R11 450	R11 700	R11 950	R12 200	R12 450	R12 700
0.75	-R6 420	-R6 232	-R6 045	-R5 857	-R5 670	-R5 482	-R5 295
1.00	-R3 620	-R3 370	-R3 120	-R2 870	-R2 620	-R2 370	-R2 120
1.25	-R820	-R507	-R195	R118	R430	R743	R1 055
1.50	R1 980	R2 355	R2 730	R3 105	R3 480	R3 855	R4 230
1.75	R4 780	R5 218	R5 655	R6 093	R6 530	R6 968	R7 405
2.00	R7 580	R8 080	R8 580	R9 080	R9 580	R10 080	R10 580
2.25	R10 380	R10 943	R11 505	R12 068	R12 630	R13 193	R13 755

Fertiliser (Macro Elements)		
N	31.0	Kg/ha
P	12.0	Kg/ha
K	16.0	Kg/ha
Ca	0.0	Kg/ha
Mg	0.0	Kg/ha
S	2.3	Kg/ha

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GM Cotton Irrigated - Summer

Cost Guide Figures

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Sub Crop	Publications	Pricing Date	Cotton (Ton)
Cotton	Summer 2022/23	2022-10-15	5.50

Income					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Cotton	5.50	Ton	11 870.00	R/ton	R65 285
Gross Production Value					**R65 285**

Expenses					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Seed (Cotton)	12.00	Kg/ha	138.07	R/kg	R1 657
Fertiliser - Macro elements	1.00	Ha	16 512.36	R/ha	R16 512
Fertiliser - Micro elements	1.00	Ha	785.90	R/ha	R786
Fuel (Diesel)	72.43	L/ha	23.62	R/l	R1 711
Diesel (Picker)	40.00	L/ha	23.62	R/l	R945
Herbicide	1.00	Ha	528.00	R/ha	R528
Insecticide	1.00	Ha	4 157.40	R/ha	R4 157
Fungicide	1.00	Ha	0.00	R/ha	R0
Other Chemicals	1.00	Ha	1 468.25	R/ha	R1 468
High Boy sprayer	6.00	Applications	200.00	R/ha	R1 200
Insurance - Cotton	65 285.00	Rand	9.00	%	R5 876
Cotton picker	1.00	Ha	4 500.00	R/ha	R4 500
Packaging - Plastic (Cotton)	2.37	Bales	680.00	R/bale	R1 608
Transport Cotton	5.50	Ton	310.00	R/ton	R1 705
Irrigation - Escom	800.00	mm/ha	6.82	R/mm	R5 456
Irrigation - Water Board	800.00	mm/ha	1.91	R/mm	R1 528
Irrigation - Scheduling	1.00	Ha	114.00	R/ha	R114
Mechanization - Repair and Maintenance	1.00	Ha	1 284.69	R/ha	R1 285
Pivot Cost - Repair and Maintenance	1.00	Ha	771.00	R/ha	R771
Marketing Cost Cotton - statutorily & Nakpo	5.50	Ton	110.00	R/ton	R605
Total Direct Cost					**R52 412**

Interest					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Interest	26 205.93	Rand	11.00	%	R2 883

Total Production Cost	R55 295
Margin Above Cost	R9 990
Breakeven Yield/Ha	4.66
Breakeven Price/Ton	R10 054

Sensitivity Analysis

Crop Yield (t/ha)	R11 120	R11 370	R11 620	R11 870	R12 120	R12 370	R12 620
4.00	-R10 815	-R9 815	-R8 815	-R7 815	-R6 815	-R5 815	-R4 815
4.50	-R5 255	-R4 130	-R3 005	-R1 880	-R755	R370	R1 495
5.00	R305	R1 555	R2 805	R4 055	R5 305	R6 555	R7 805
5.50	R5 865	R7 240	R8 615	R9 990	R11 365	R12 740	R14 115
6.00	R11 425	R12 925	R14 425	R15 925	R17 425	R18 925	R20 425
6.50	R16 985	R18 610	R20 235	R21 860	R23 485	R25 110	R26 735
7.00	R22 545	R24 295	R26 045	R27 795	R29 545	R31 295	R33 045

Fertiliser (Macro Elements)		
N	180.0	Kg/ha
P	50.0	Kg/ha
K	110.0	Kg/ha
Ca	18.0	Kg/ha
Mg	15.0	Kg/ha
S	24.0	Kg/ha

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GM Cotton Irrigated Winter

Cost Guide Figures

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Sub Crop	Publications	Pricing Date	Cotton (Ton)
Cotton	Winter 2023	2023-04-15	5.50

Income					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Cotton	5.50	Ton	11 950.00	R/ton	R65 725
Gross Production Value					**R65 725**

Expenses					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Seed (Cotton)	12.00	Kg/ha	138.07	R/kg	R1 657
Fertiliser - Macro elements	1.00	Ha	13 527.69	R/ha	R13 528
Fertiliser - Micro elements	1.00	Ha	765.78	R/ha	R766
Fuel (Diesel)	72.43	L/ha	20.81	R/l	R1 507
Diesel (Picker)	40.00	L/ha	20.81	R/l	R832
Herbicide	1.00	Ha	528.00	R/ha	R528
Insecticide	1.00	Ha	4 157.40	R/ha	R4 157
Fungicide	1.00	Ha	0.00	R/ha	R0
Other Chemicals	1.00	Ha	1 468.25	R/ha	R1 468
High Boy sprayer	6.00	Applications	200.00	R/ha	R1 200
Insurance - Cotton	65 725.00	Rand	11.00	%	R7 230
Cotton picker	1.00	Ha	4 250.00	R/ha	R4 250
Packaging - Plastic (Cotton)	2.37	Bales	680.00	R/bale	R1 608
Transport Cotton	5.50	Ton	290.00	R/ton	R1 595
Irrigation - Escom	800.00	mm/ha	8.09	R/mm	R6 472
Irrigation - Water Board	800.00	mm/ha	1.93	R/mm	R1 544
Irrigation - Scheduling	1.00	Ha	114.00	R/ha	R114
Mechanization - Repair and Maintenance	1.00	Ha	1 392.95	R/ha	R1 393
Pivot Cost - Repair and Maintenance	1.00	Ha	1 133.00	R/ha	R1 133
Marketing Cost Cotton - statutorily & Nakpo	5.50	Ton	110.00	R/ton	R605
Total Direct Cost					**R51 588**

Interest					
Product Name	**Product Quantity**	**Measure Unit**	**Price**	**Measure Unit**	**Product Cost**
Interest	25 793.75	Rand	12.00	%	R3 095

Total Production Cost	R54 683
Margin Above Cost	R11 042
Breakeven Yield/Ha	4.58
Breakeven Price/Ton	R9 942

Sensitivity Analysis

Crop Yield (t/ha)	R11 200	R11 450	R11 700	R11 950	R12 200	R12 450	R12 700
4.00	-R9 883	-R8 883	-R7 883	-R6 883	-R5 883	-R4 883	-R3 883
4.50	-R4 283	-R3 158	-R2 033	-R908	R217	R1 342	R2 467
5.00	R1 317	R2 567	R3 817	R5 067	R6 317	R7 567	R8 817
5.50	R6 917	R8 292	R9 667	R11 042	R12 417	R13 792	R15 167
6.00	R12 517	R14 017	R15 517	R17 017	R18 517	R20 017	R21 517
6.50	R18 117	R19 742	R21 367	R22 992	R24 617	R26 242	R27 867
7.00	R23 717	R25 467	R27 217	R28 967	R30 717	R32 467	R34 217

Fertiliser (Macro Elements)		
N	180.0	Kg/ha
P	50.0	Kg/ha
K	110.0	Kg/ha
Ca	18.0	Kg/ha
Mg	15.0	Kg/ha
S	24.0	Kg/ha

Page 1 of 1

Appendix D: Consultant's Curriculum Vitae

ENVIRONMENTAL SCIENTIST **André Faul**

André entered the environmental assessment profession at the beginning of 2013 and since then has worked on more than 2300 Environmental Impact Assessments including assessments of the petroleum industry, harbour expansions, irrigation schemes, township establishment and power generation and transmission. André's post graduate studies focussed on zoological and ecological sciences and he holds a M.Sc. in Conservation Ecology and a Ph.D. in Medical Bioscience. His expertise is in ecotoxicological related studies focussing specifically on endocrine disrupting chemicals. His Ph.D. thesis title was The Assessment of Namibian Water Resources for Endocrine Disruptors. Before joining the environmental assessment profession he worked for 12 years in the Environmental Section of the Department of Biological Sciences at the University of Namibia, first as laboratory technician and then as lecturer in biological and ecological sciences.

CURRICULUM VITAE ANDRÉ FAUL

Name of Firm	:	Geo Pollution Technologies (Pty) Ltd.
Name of Staff	:	ANDRÉ FAUL
Profession	:	Environmental Scientist
Years' Experience	:	23
Nationality	:	Namibian
Position	:	Environmental Scientist
Specialisation	:	Environmental Toxicology
Languages	:	Afrikaans – speaking, reading, writing – excellent
		English – speaking, reading, writing – excellent

EDUCATION AND PROFESSIONAL STATUS:

B.Sc. Zoology/Biochemistry	:	University of Stellenbosch, 1999
B.Sc. (Hons.) Zoology	:	University of Stellenbosch, 2000
M.Sc. (Conservation Ecology)	:	University of Stellenbosch, 2005
Ph.D. (Medical Bioscience)	:	University of the Western Cape, 2018

First Aid Class A	EMTSS, 2017; OSH-Med 2022
Basic Fire Fighting	EMTSS, 2017; OSH-Med 2022

PROFESSIONAL SOCIETY AFFILIATION:

Environmental Assessment Professionals of Namibia (Practitioner)

AREAS OF EXPERTISE:

Knowledge and expertise in:

- Water Sampling, Extractions and Analysis
- Biomonitoring and Bioassays
- Biodiversity Assessment
- Toxicology
- Restoration Ecology

EMPLOYMENT:

2013-Date	:	Geo Pollution Technologies – Environmental Scientist
2005-2012	:	Lecturer, University of Namibia
2001-2004	:	Laboratory Technician, University of Namibia

PUBLICATIONS:

Publications:	5
Contract Reports	+230
Research Reports & Manuals:	5
Conference Presentations:	1

Appendix C: Tree Information

Trees recorded in quarter degree squares 1917DB (Curtis & Mannheimer, 2005)

Name	Common Name	Conservation Concerns
Acacia ataxacantha	Flame-thorn	None.
Acacia erioloba	Camel-thorn	Protected by forestry legislation.
Acacia fleckii	Sand-veld Acacia	None.
Acacia hebeclada subsp hebeclada	Candle-pod Acacia	None.
Acacia hereroensis	Mountain-thorn	None.
Acacia karroo	Sweet-thorn	None.
Acacia kirkii subsp kirkii var kirkii	Floodplain Acacia	May be declining in Etosha and North-west.
Acacia luederitzii var luederitzii	Kalahari Acacia	None.
Acacia mellifera subsp detinens	Blue-thorn Acacia	Aggressive invasive.
Acacia nilotica subsp kraussiana	Scented-pod Acacia	None.
Acacia reficiens subsp reficiens	Red-thorn	Very aggressive invader.
Acacia tortilis	Umbrella Thorn	None.
Acacia tortilis subsp spirocarpa	Umbrella-thorn	None.
Albizia anthelmintica	Worm-cure Albizia; Aru	The low numbers of young trees recorded are a concern, as is the number of dead trees in some areas. It is protected by forestry legislation.
Aloe littoralis	Windhoek Aloe	Potentially threatened by pachycaul trade. Protected by the nature conservation ordinance and listed in CITES Appendix II.
Bauhinia petersiana subsp	White Bauhinia	None.
Berchemia discolor	Bird Plum	Protected by forestry legislation, as well as by traditional Owambo cultures for its fruit and shade. The population does not appear to be in any real danger at the moment, but communities could be encouraged to plant this species.

Name	Common Name	Conservation Concerns
Boscia albitrunca	Shepherd's Tree	Although widespread and hardy, it is heavily utilised by people and animals. The difficulty that young plants have in becoming established is a concern, but fortunately there appears to be a healthy and widespread population of young plants. Protected by forestry legislation.
Burkea africana	Burkea	Excessive fire may be compromising recruitment by destroying seeds. Overharvesting for timber may also be of concern in future. Protected by forestry
Caesalpinia rubra	Purple Caesalpinia	None.
Carissa bispinosa subsp bispinosa	Y-thorn Carissa; Common Num-num	Rare in Namibia, but probably not threatened. Widespread in South Africa.
Carissa edulis	Simple-spined Carissa; Climbing	None.
Catophractes alexandri	Trumpet-thorn; Rattlepod	Invasive in some areas.
Cissus nymphaeifolia	Wild Grape	None.
Combretum apiculatum subsp apiculatum	Kudu-bush	None.
Combretum hereroense subsp hereroense	Mouse-eared Combretum	None.
Combretum imberbe	Leadwood	Although heavily utilized by people, regrowth is good and growth of young trees is vigorous. Because of its religious importance and many uses, it is protected locally. Old specimens warrant protection as monuments. Protected by forestry legislation.
Commiphora africana	Hairy Corkwood; Poison-grub Commiphora	None.
Commiphora angolensis	Sand Corkwood	None.
Commiphora glandulosa	Tall Common Corkwood; Tall firethorn Corkwood	None
Commiphora glaucescens	Blue-leaved Corkwood	None.
Commiphora pyracanthoides	Fire Thorn Corkwood; Small Common Corkwood	None.
Commiphora tenuipetiolata	Satin-bark Corkwood	None.
Croton gratissimus	Lavender Croton; Lavender fever berry	None.
Croton gratissimus var	Lavender Croton	None.

Name	Common Name	Conservation Concerns
Croton gratissimus var subgratissimus	None	None.
Croton menyhartii	Rough-leaved Croton	None.
Cyphostemma juttae	Blue Kobas, Namibian grape, Wild grape	Endemic with very small population and threatened with pachycaul trade. Least concern according to IUCN criteria. Protected by Nature Conservation Ordinance. Protected by forestry legislation.
Datura ferox	Thorn Apple	Alien species not a threat in
Datura innoxia	Thorn Apple	Alien species not a threat in
Datura spp	Thorn Apple	None.
Dichrostachys cinerea subsp africana	Kalahari Christmas Tree; Sickle-bush	Of concern because of its effects on other species (invasive).
Diospyros lycioides	Bluebush; Monkey plum; Star-apple	None.
Diospyros lycioides subsp lycioides	Bluebush	None.
Dombeya rotundifolia	Wild Pear	Two varieties rotundifolia and velutina. Velutina is endemic and classified as least concern.
Ehretia alba	White-puzzle Bush	None.
Ehretia namibiensis subsp namibensis	Namibian Puzzle-bush	None.
Elaeodendron transvaalense	Transvaal Saffron; Bushveld Saffron	None.
Elephantorrhiza elephantina	Elands-bean	None.
Elephantorrhiza suffruticosa	Skew-leaved Elephant Root	None.
Erythrina decora	Namib Coral-tree	Endemic to Namibia and very uncommon throughout its range. Worthy of protection very few young trees. Protected by forestry legislation.
Erythrococca menyharthii	Northern Red-berry	Population could be declining.
Euclea divinorum	Magic Guarri	None.
Euclea undulata var myrtina	Common Guarri; Mountain Ebony	None.
Euphorbia guerichiana	Paper-bark Euphorbia	CITES Appendix II.

Name	Common Name	Conservation Concerns
Faidherbia albida	Winter-thorn; Ana Tree	Dams of the Swakop River have adverse impacts on this tree. Protected by forestry legislation.
Ficus cordata subsp cordata	Namaqua Rock-fig	Protected by forestry legislation.
Ficus sycomorus	Sycamore Fig	Affected in areas with excessive underground water abstraction causing springs to dry up. Lack of young trees. Local communities protect the trees for their fruit and shade. Protected by forestry legislation.
Ficus thonningii	Common wild Fig; Stranglerfig	None.
Flueggea virosa subsp virosa	White-berry Bush	None.
Gomphocarpus fruticosus	Milkweed; Wild Cotton	None.
Grewia bicolor var bicolor	Two-coloured Raisin-bush	None.
Grewia flava	Velvet Raisin	None.
Grewia flavescens	Sandpaper Raisin	None
Grewia retinervis	Kalahari Raisin	None.
Grewia schinzii	Shaggy Raisin; Rusty-haired Raisin	None.
Grewia tenax var tenax	Small-leaved Cross-berry	None.
Grewia villosa var villosa	Mallow Raisin	None.
Gymnosporia buxifolia	Common Spikethorn	None
Gymnosporia senegalensis	Confetti Spikethorn	None.
Helinus integrifolius	Soap creeper	None.
Heteromorpha stenophylla	Karstveld Wild-parsley	None.
Hyphaene petersiana	Makalani Palm	Should be monitored due to extensive harvesting. Protected by forestry legislation.
Kirkia acuminata	Common Kirkia	None.
Lannea discolor	Live-long	Protected by forestry legislation.
Lantana angolensis	None	None.
Lantana camara	Lantana	Alien should be controlled in wetter areas. Not a threat in Namibia.

Name	Common Name	Conservation Concerns
Maerua schinzii	Ringwood Tree	Increasingly impacted by humans and giraffes. Protected by forestry legislation.
Montinia caryophyllacea	Wild Clove-bush	None.
Mundulea sericea	Silverbush	None.
Obetia carruthersiana	Angola Nettle	None.
Ochna pulchra	Peeling-bark Ochna	None.
Olea europaea subsp cuspidata	Wild Olive	None.
Osyris lanceolata-quadripartita	African sandalwood	None.
Ozoroa crassinervia	Namibian Resin-tree	Near-endemic stretching into the Richtersveld.
Ozoroa insignis	Africa Resin-tree	None.
Ozoroa paniculosa	Common Resin-bush	None.
Pachypodium lealii	Bottle Tree	Vulnerable to pachycaul trade. Lack of young trees is a concern. Protected by nature conservation ordinance. Listed on CITES Appendix II. Near-endemic extending into extreme southern areas of Angola. Protected by forestry legislation.
Pavetta zeyheri	Small-leaved Bride's-bush	May be declining.
Peltophorum africanum	Muparara	None.
Philenoptera nelsii subsp nelsii	Kalahari Omupanda; Kalahari Apple-leaf	None.
Pouzolzia mixta	Snuggle-leaf; Soap Nettle	None.
Rhigozum brevispinosum	Simple-leaved Rhigozum	None.
Searsia ciliata	Sour Karee	None.
Searsia lancea	Willow Rhus	May be affected by a disease. Protected by forestry legislation previously *Rhus lancea*.
Searsia marlothii	Bitter Karee	None.
Schinziophyton rautanenii	Manketti; Mongongo nut; False balsa	Increased use for carving might be a concern. Great food value. Greatly damaged by veld fires. Protected by forestry legislation.

Name	Common Name	Conservation Concerns
Sclerocarya birrea	Marula	Protected locally by communities that use them. Protected by forestry legislation.
Securidaca longepedunculata	Violet-tree	None.
Spirostachys africana	Tamboti	Protected by forestry legislation.
Steganotaenia araliacea var araliacea	Carrot-tree	None.
Tarchonanthus camphoratus	Camphor Bush	None.
Terminalia brachystemma	Kalahari Cluster-leave	Probably under recorded.
Terminalia prunioides	Purple-pod Terminalia	None.
Terminalia sericea	Silver Cluster-leave	None.
Tinnea rhodesiana	Maroon Bells	May be overlooked.
Triaspis hypericoides subsp nelsonii	None	None.
Vangueria infausta subsp infausta	Velvet Wild-medlar	None.
Ximenia americana var microphylla	Blue Sourplum	None.
Ximenia caffra var caffra	Large Sourplum	None.
Ziziphus mucronata	Buffalo-thorn	Protected by forestry legislation.

Appendix D: Proof of Public Consultation

Notified IAPs

Name	**Surname**	**Organisation**
Agatha	Mweti	Otjozondjupa Regional Council
Memory	Garonga	Otjozondjupa Regional Council
Claudia	Dohman	Leyboldshohe FMB/00377
Jolanda	Murangi	Namwater
George	Garab	Otavi Constituency Office
René de	Smicht	Hanssenia FMB/00019
Sabine	Menne	Heinshof FMB/00026
Madelein	Malan	PfeiffersfeldeE FMB/00362 OdeumFMB/00363
Rakel	Johannes	Namibian Organic Association (NOA)
Mareike	Aufderheide-Voigts	
Eckhart	Förtsch	
Vera	Corry	

Notification Letter Otjiwarongo Regional Council

Chief Regional Officer
04 MAR 2024
P.O. Box 1682
Otjiwarongo

GEO Pollution Technologies

TEL.: (+264-61) 257411 ♦ FAX.: (+264) 88626368
CELL.: (+264-81) 1220082
PO BOX 11073 ♦ WINDHOEK ♦ NAMIBIA
E-MAIL: gpt@thenamib.com

To: **Chief Regional Officer**
Otjozondjupa Regional Council
Otjiwarongo
Namibia

28 February 2024

Re: **Environmental Scoping Assessment and Environmental Management Plan for Agricultural Activities and the Environmental Release of Genetically Modified Maize on Farm Venus, Otjozondjupa Region**

Dear Sir/Madam

Geo Pollution Technologies (Pty) Ltd was appointed by JN Malan to undertake an environmental assessment for agricultural activities and the environmental release of genetically modified (GM) maize on farm Venus FMB/000379/0000A in the Otjozondjupa Region (see location map on page 2). The assessment will be conducted according to the Environmental Management Act of 2007 and its regulations as published in 2012.

Project: Environmental Scoping Assessment and Environmental Management Plan for Agricultural Activities and the Environmental Release of Genetically Modified Maize on Farm Venus, Otjozondjupa Region

Proponent: JN Malan

Environmental Assessment Practitioner: Geo Pollution Technologies (Pty) Ltd

The Proponent has collectively cleared approximately 170 ha for dryland cultivation. The main crops cultivated is maize, sorghum and sunflowers. In order to improve productivity, the Proponent wishes to replace the traditional maize cultivars with insect and/or roundup resistant GM strains. In addition to crop cultivation, the Proponent also has a hospitality operation with four self-catering rooms that can accommodate 11 persons and six campsites that can accommodate 36 persons.

The environmental scoping assessment will include all pertaining to the transport, storage and planting of GM maize seeds, the management of the crops during the growing period, the application of pesticides to the crops, harvesting of the crops, and the handling and transport of the harvested maize to the markets. Although relatively small, the hospitality operation will also be included in the report. This will include the receipt of guests and general cleaning and maintenance of the facilities. General operations also include activities such as electricity supply, waste handling and sewage disposal.

The Regional Council is invited to register with the environmental consultant to receive further documentation and communication regarding the project. By registering, a communication channel will be established between the Regional Council and the environmental practitioner. The Regional Council will further be provided with .an opportunity to provide input that will be considered in the drafting of the environmental assessment report and management plan. Please register either by:

Fax: 088-62-6368 or **E-Mail:** venus@thenamib.com

Should you require any additional information please contact Geo Pollution Technologies at telephone 061-257411.

Sincerely,
Geo Pollution Technologies

Quzette Bosman
Social and Environmental Assessment Practitioner

Background Information Document

ENVIRONMENTAL SCOPING ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN FOR AGRICULTURAL ACTIVITIES AND THE ENVIRONMENTAL RELEASE OF GENETICALLY MODIFIED MAIZE ON FARM VENUS, OTJOZONDJUPA REGION

BACKGROUND INFORMATION DOCUMENT

Prepared by:

Prepared for:

JN Malan

November 2023

1 INTRODUCTION

Geo Pollution Technologies (Pty) Ltd was appointed by JN Malan (the Proponent) to undertake an environmental assessment for the environmental release of genetically modified (GM) maize on farm Venus FMB/000379/0000A in the Otjozondjupa Region (Figure 1-1). The total area currently under dry land cultivation by the Proponent is 170 ha. The main crops cultivated is maize, sorghum and sunflowers. In order to improve productivity, the Proponent wishes to replace the traditional maize cultivars with insect and/or roundup resistant GM strains. In addition to crop cultivation, the Proponent also has a hospitality operation with four self-catering rooms that can accommodate 11 persons and six campsites that can accommodate 36 persons.

An environmental clearance certificate (ECC) for the environmental release (cultivation) of genetically modified organisms (GMO) is required as per the Environmental Management Act No. 7 of 2007 (EMA). A scoping environmental assessment report (SR) and an environmental management plan (EMP) are proposed to be submitted to the Ministry of Environment, Forestry and Tourism's Department of Environmental Affairs (DEA) in consideration of an application for an ECC. The environmental assessment will include all operational aspects related to the cultivation of GM maize by the Proponent and will include the hospitality component and farming related activities like fuel storage.

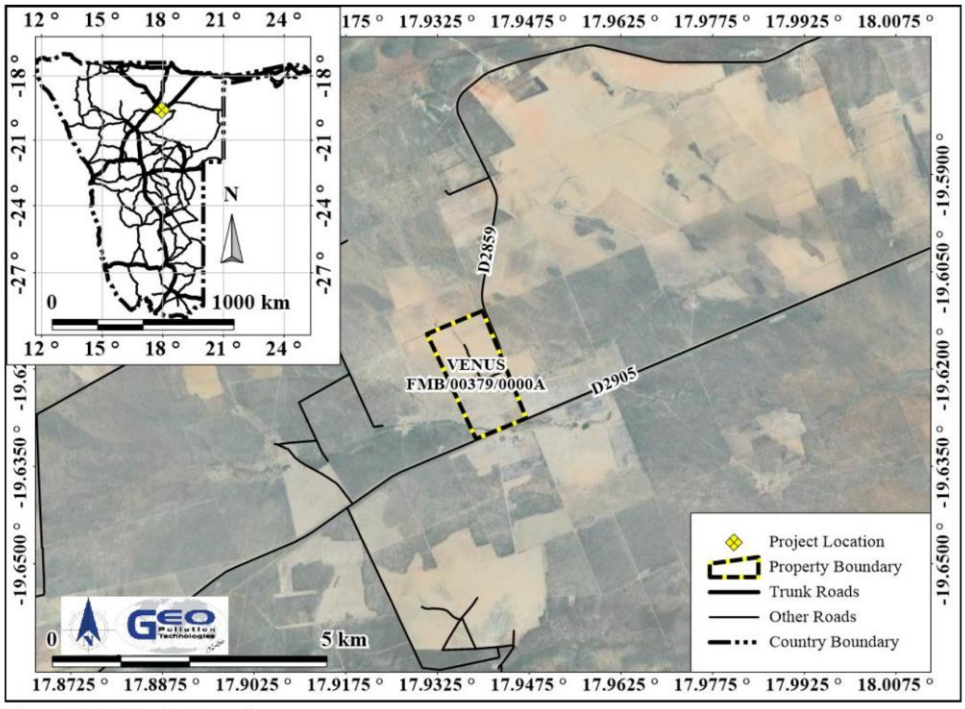


Figure 1-1 Project location

2 PURPOSE OF THE BID

With this background information document (BID), GPT aims to provide interested and affected parties (IAPs) with information about the project and interact with them regarding it. All IAPs are therefore invited to register with GPT for the project in order to:

- Provide GPT with information which should be taken into account in the assessment of impacts;
- Share any comments, issues or concerns related to the project; and
- Review and comment on the reports (SR and EMP).

3 PROJECT DESCRIPTION

The Proponent owns the farm with all infrastructure required for the cultivation of GM maize already in place, since the farm has traditionally been a crop cultivation unit for many years. Activities associated with the project have been divided into the following phases: planning, operational and the decommissioning phase. A brief outline of expected activities for each phase is detailed below.

3.1 PLANNING PHASE

Planning is an ongoing process in preparation of the planting of GM maize as well as during and after the planting of such crops. As part of planning, it is the responsibility of the Proponent to ensure they are and remain compliant with all legal requirements. The Proponent must also ensure that all required management measures are in place prior to and during all phases, to ensure potential impacts and risks are minimised. Typical planning activities include:

- Obtain permits and approvals from local and national authorities including approval for environmental release of GMOs from the National Commission on Research, Science and Technology, a consumer fuel installation certificate from the Ministry of Mines and Energy and registration with the Namibian Tourism Board.
- Make provisions to have a health, safety and environmental coordinator to implement the EMP.
- Ensure provisions for a fund to cater for environmental incidents if ever required.
- Ensure all appointed contractors and employees enter into agreements which include the EMP.
- Establish and/or maintain a reporting system to report on aspects of operations and decommissioning as outlined in the EMP.

3.2 OPERATIONAL PHASE

Genetically modified crops have the potential to increase profitability by mainly reducing input costs related to pest control. The two main traits in the GM maize cultivars proposed to be planted are insect and RoundUp resistance.

Insect resistance is achieved by the insertion of certain gene segments of the *Bacillus thuringiensis* bacterium which produces a protein that is toxic to target pests of the insect order Lepidoptera (moths and butterflies). Specifically the larvae stages (caterpillars) are targeted as they die when eating the crops, therefore breaking the life cycle of the pest species.

RoundUp is the trade name of a systemic herbicide containing the active ingredient glyphosate. RoundUp resistance in crops has, among others, the advantage of a reduced need for mechanical weeding of fields. Also, often fields are prepared for planting by first allowing the weeds to germinate and grow, then spraying such weeds with herbicides, and once dead, planting of crops can commence. During short growing seasons, this is not always possible and by planting RoundUp resistant crops, you can immediately start planting and then spray while both the weeds and crops are on the field. RoundUp resistance is achieved by inserting gene segments from the bacteria *Agrobacterium* sp. strain CP4. It produces an enzyme that is tolerant to glyphosate, thus allowing the GM crop to grow in the presence of glyphosate.

The following is a list of the GM maize cultivars (or events) proposed for environmental release.

GM Event	Crop Type	Trait
MON 810	Maize	Insect Resistance
MON 89034	Maize	Insect Resistance
NK 603	Maize	RoundUp Resistance
MON 89034 × NK 603	Maize	Insect Resistance and RoundUp Resistance
NK 603 × MON 810	Maize	Insect Resistance and RoundUp Resistance

The main operational activities that will be addressed in the SR pertain to the transport, storage and planting of GM maize seeds, the management of the crops during the growing period, the application of pesticides to the crops, harvesting of the crops, and the handling and transport of the harvested

maize to the markets. Although relatively small, the hospitality operation will also be included in the SR. This will include the receipt of guests and general cleaning and maintenance of the facilities. General operations also include activities such as electricity supply, waste handling and sewage disposal.

3.3 Decommissioning Phase

In the context of GM crop cultivation, decommissioning refers to the termination of cultivation of any GM crop. Such decommissioning is not foreseen during the validity of the ECC. Decommissioning will however be assessed. Should decommissioning occur at any stage, aftercare will be required to ensure no GM maize remains on the cultivated fields and that regrowth be controlled by chemical and/or mechanical means.

Decommissioning of selected infrastructure may occur and will also be assessed. Should decommissioning occur at any stage, rehabilitation of the area may be required. Decommissioning will entail the complete removal of all infrastructure including buildings and underground infrastructure. Pollution present on the site, if any, must then be remediated.

3.4 Preliminary Identified Impacts

During the environmental assessment all components of the environment will be considered, however only those components which are being impacted on significantly, or are deemed to be sensitive, will be assessed. These include the following:

- Socio-economic contributions
- Health and safety risks
- Ecosystem and biodiversity impacts
- Cross pollination of GM and non-GM crops
- Soil and groundwater pollution
- Fire risks
- Waste and effluent generation and disposal
- Traffic
- Noise

4 PUBLIC CONSULTATION

GPT invites all IAPs to provide in writing, any issues and suggestions regarding the project. This correspondence must include:

- Name and surname
- Organization represented or private interest
- Position in the organization
- Contact details
- Any direct business, financial, personal or other interest which you may have in the approval or refusal of the application

All contributions become public knowledge and will be circulated along with the reports as per the EMA requirements. The comments, inputs and suggestions will also be submitted to the DEA along with how any issues have been addressed in the SR. The public participation process will remain ongoing during the environmental assessment.

The project team may be contacted on the contact details below:

Geo Pollution Technologies (Pty) Ltd.
Telephone: (+264-61) 257411
Fax: (+264) 88626368
E-mail: venus@thenamib.com

Your Rights as an IAP according to the Environmental Management Act, No7 of 2007, Government Notice No 30 (Environmental Impact Assessment Regulations)

Section 23. (1) A registered interested or affected party is entitled to comment in writing, on all written submissions made to the Environmental Commissioner by the applicant responsible for the application, and to bring to the attention of the Environmental Commissioner any issues which that party, believes may be of significance to the consideration of the application, as long as -

(a) comments are submitted within 7 days of notification of an application or receiving access to a scoping report or an assessment report;
(b) the interested and affected party discloses any direct business, financial, personal or other interest which that party may have in the approval or refusal of the application.

(2) Before the applicant submits a report compiled in terms of these regulations to the Environmental Commissioner, the applicant must give registered interested and affected parties access to, and an opportunity to comment in writing on the report.

(3) Reports referred to in sub regulation (2) include (a) scoping reports; (b) scoping reports amended and resubmitted; (c) assessment reports; and (d) assessment reports amended and resubmitted.

(4) Any written comments received by the applicant from a registered interested or affected party must accompany the report when the report is submitted to the Environmental Commissioner.

(5) A registered interested or affected party may comment on any final report that is submitted by a specialist reviewer for the purposes of these regulations where the report contains substantive information which has not previously been made available to a registered interested or affected party.

Section 24: The applicant responsible for an application must ensure that the comments of interested and affected parties are recorded in reports submitted to the Environmental Commissioner in terms of these regulations, and comments by interested and affected parties on a report which is to be submitted to the Environmental Commissioner may be attached to the report without recording those comments in the report itself.

Press Notice: The Namibian Sun 22 and 29 February 2024

Sun
THURSDAY 22 FEBRUARY 2024 | NEWS | 5

• AUTHORITIES TAKE URGENT STEPS TO PROTECT POPULATION

Oshikoto battles steep rise in malaria cases

More than 250 cases of malaria have been reported in the Oshikoto Region between January and 18 February this year.

LAUDIA REITER
WINDHOEK

Oshikoto regional health director Joshua Nghipangelwa has urged community members to seek early treatment following an outbreak of malaria in the region.

According to Nghipangelwa, 256 cases of malaria were reported between January and 18 February this year.

"The regional crisis response team and the district response team have started responding to the outbreak," he said.

He added that the team has investigated a majority of cases and visited the most-affected areas to educate the population about the risks and to distribute long-lasting insecticidal mosquito nets.

"We have also introduced new methods to contain the increasing malaria cases in the region by combatting breeding sites with larvae and spraying houses that have reported cases," Nghipangelwa said.

On the ground

He said health authorities are testing and treating cases both at health facilities and within the community, conducted by community health workers.

"These cases are sporadic. The entire region is affected, but the most-affected constituency is Okankolo."

Nghipangelwa said Onandjokwe District Hospital has recorded the highest number of cases with 92, and most of these cases originated from the Okankolo constituency.

Tsumeb Hospital has recorded 84 cases and Omuthiya District Hospital recorded 80 cases from January to 18 February.

"Everyone is at risk of contracting malaria, so no one is safe," he warned.

He urged residents of the region to protect themselves from mosquito bites both outdoors and in their homes.

Ohangwena outbreak

In late January, Namibia Media Holdings reported that the Ohangwena Region had recorded a total of 392 cases of malaria.

Of these, 154 cases were documented locally in Ohangwena, while 238 cases originated elsewhere.

George Jeremiah, the acting regional health director, said at the time that there has been a shortage of testing materials over the past two months, and they now rely exclusively on microscopic tests conducted in laboratories in the region.

"Looking at the statistics for 2023, malaria cases have slightly increased. The local cases are very dangerous, indicating that the vector is within Namibia and not outside," he said in January.

In their efforts to contain the further spread of malaria, the region deployed a team of 241 sprayers to the three districts last year.

Justine Haikali, the senior environmental and health practitioner in Ohangwena and coordinator of the malaria spraying programme, said the teams had covered 35% of at-risk villages.

She added that only a few households still refused to have their houses sprayed – unlike in the past when many resisted.

Health authorities also reported that in 2023, four people in the region died from malaria.

AT RISK: Health authorities are taking steps to counter rising malaria cases in the Oshikoto Region. PHOTO: FILE

//Karas governor optimistic about regional development

ELIZABETH KHEIBES
WINDHOEK

//Karas regional governor Aletha Frederick says Namibia's oil and gas discoveries present unprecedented opportunities for the region's economic growth and prosperity.

"The potential for massive new green hydrogen development further solidifies our region's position as a key player in Namibia's sustainable energy future," she said during a recent regional consultative meeting for the National Development Plan 6 (NDP6).

The governor said she envisions the region becoming not only "a hub of economic activity but also a beacon of sustainable development in Namibia. With the right support and financing from the national government, we have the power to eradicate poverty, hunger and unemployment in our region."

In addition, Frederick highlighted the importance of local community participation in the vast opportunities presented by regional development.

"As we embark on this journey of envisioning the future of our region, it is imperative that we recognise the immense potential that lies within //Karas – a region blessed with abundant mineral and natural resources, a thriving fishing industry, significant mining activities and an expanding tourism sector," she said.

Frederick also called for the full development of the region's agricultural sector, which is currently "underutilised".

POTENTIAL: //Karas regional governor, Aletha Frederick. PHOTO: FILE

POLICE OFFICER'S FRAUD CASE CONTINUES

KRISTIEN KRUGER
WINDHOEK

The trial of the former police officer Ricardo Nestor, who was initially charged with fraud amounting to more than N$10 million, continued in court this week.

However, Nestor is now only facing three charges of fraud related to N$720 000 after the court acquitted him of six charges.

He has already taken the stand and testified in his own defence. The case has been postponed to 19 April for final submissions before conviction.

Nestor further filed an application under Section 174 of the Criminal Procedure Act, arguing that the State had not presented enough evidence for the court to find him guilty.

Direct evidence lacking

Judge Philanda Christiaan acquitted Nestor of six out of the nine charges he faced in November. She found that they had not succeeded in proving a case beyond a reasonable doubt against Nestor.

Christiaan further stated that the State's case is primarily based on circumstantial evidence, with no direct evidence linking Nestor to the crimes committed.

"There are no facts presented that prove that the accused had access to the computers, the login credentials or the internet banking profiles of any of the complainants," Christiaan said in her judgment.

STILL IN COURT: Fraud accused Ricardo Nestor and his legal representative, Albert Titus. PHOTO: FILE

She further said there is no evidence that Nestor received or drew on the funds transferred from these accounts.

The charges on which he was acquitted relate to allegations that Nestor defrauded Namibia Marble and Granite near Karibib and/or Carmen Bianca Wittreich of an amount of N$10 million. Additionally, there is a further charge that he defrauded, among others, Spot-On Discount Liquor and Meransha Properties.

Additional charges

The charges that Nestor still faces pertain to Tayo Namibia. It is alleged that Nestor falsely represented to Tayo Namibia that the bank account of Walcon Construction had been changed from Bank Windhoek to Standard Bank and that Tayo Namibia should pay an amount of N$720 000 into the Standard Bank account for work that was purportedly done by Walcon Construction.

Nestor is currently in custody at Windhoek Central Prison.

kristien@nmh-hub.com.na

City acts swiftly against illegal paper dump

ELIZABETH KHEIBES
WINDHOEK

On Monday, a pedestrian in Windhoek's Agste Laan witnessed unidentified individuals dumping thousands of documents from the education ministry at an unauthorised location.

The documents included old question papers and curriculum vitae. The ministry's executive director, Sanet Steenkamp, confirmed that the photos and videos sent to her by Namibian Sun displayed several personal and public documents from the ministry being discarded unlawfully.

"These are indeed from the ministry, from the examination directorate. I have since given clear instructions that they need to retrieve these documents and correctly dispose of them," Steenkamp said.

"Some things are usually kept for archival purposes, and in this case, I believe that someone did not do what was expected of them. We apologise for this," she added.

Aggressive

According to the witness to the unlawful document dump, the culprits passed a designated dumpsite in the Kupferberg area and "carelessly" got rid of the documents at a random place.

"I approached the private vehicle and tried to question the men about the dumping, but that led to aggressive responses instead," the bystander said.

"I started taking photos and videos that I planned to share to get help clearing up the area," the source, only known as Ruben, explained.

City acts promptly

City of Windhoek officials, who were given access to the photos and video, later tracked down the driver from a licence plate that was shown in the images and resolved the matter.

"We managed to locate the illegally dumped waste alongside Sam Nujoma Road on the way to Daan Viljoen. Due to the nature of the waste, which is paper that can easily blow away, our team cleaned up," the City said.

"We also managed to locate the culprit through the vehicle registration number and he will be fined an amount of N$1 608 for illegal dumping. This will be billed on his municipal account," city spokesperson Lydia Amutenya said.

Amutenya highlighted continuous efforts by the municipality to keep the streets of Windhoek clean and said they cannot tolerate illegal dumping of waste.

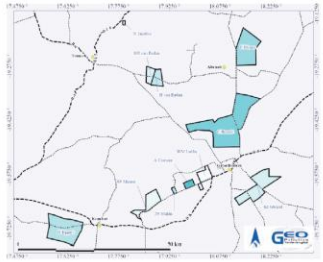
"Waste must be disposed of properly at our respective landfill. We also have waste recycling initiatives where this type of waste can be recycled," she said.

Ondangwa electrification project advances

PUBLIC PARTICIPATION NOTICE

ENVIRONMENTAL IMPACT ASSESSMENTS FOR AGRICULTURE AND ENVIRONMENTAL RELEASE OF GENETICALLY MODIFIED MAIZE AND COTTON FOR CULTIVATION

Geo Pollution Technologies (Pty) Ltd (GPT) was appointed by the Proponents: A Coetzee, F Blume, H van Eeden, HB Eggert, JN Malan, JW Brandt, KI Günzel, NJ Jacobsz, RH van Eeden, RP Menne and WF Lubbe, to undertake environmental assessments for agricultural activities and the environmental release of genetically modified (GM) maize and cotton for cultivation on their respective farms in the Otjozondjupa and Oshikoto Regions, as indicated in the below map. Additional information about the respective Proponents' farms and farming activities can be obtained from GPT or viewed at: http://www.thenamib.com/projects/projects.html



The environmental assessments will be conducted according to the Environmental Management Act of 2007 and its regulations published in 2012. Depending on the respective Proponents' individual farming activities, aspects related to cultivation of GM maize and cotton, water abstraction, fuel storage and hospitality and tourism facilities, will be included.

All interested and affected parties are invited to register with GPT. By registering you are provided with the opportunity to share any comments, issues or concerns related to the projects, for consideration in the environmental assessments. Additional information can be requested from GPT: Tel: +264-61-257411; Fax: +264-88626368; E-Mail: gmo@thenamib.com

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Geo Pollution Technologies
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• LIGHTS ON

The Ondangwa council has provided 300 electrical connections **and is working on connecting around 153 households at the moment.**

TUYEIMO HAIDULA
ONDANGWA

As the Omahenene electrification project in Ondangwa advances, the council hosted a community meeting on Tuesday to inform affected residents of the procedures that will be used to connect their houses.

The project, funded by the mines and energy ministry and executed by Nored, was initially scheduled to be implemented in the 2020–21 financial year, but due to Covid-19, it was rescheduled to take place between September 2023 and January this year.

Ondangwa town spokesperson Petrina Shitalangaho-Mutikisha said council provided 300 electrical connections and is currently working on connecting around 153 households.

"We would like to extend our heartfelt thanks to the residents of Uuskopa, Omahenene and Epya for their patience and cooperation during the construction work in Omahenene. Their understanding and support have allowed this project to be carried out as planned without any interruption or delay from their side," Shitalangaho-Mutikisha said.

Omahenene is one of the oldest informal settlements in Ondangwa and is classified as a low-income area.

Quality of life

Shitalangaho-Mutikisha added that the process of household connections has started, and homeowners who qualify for household connections will get connected.

"They will be required to have a letter of recommendation from the council with matching details of what is on their certified copy of the Namibian identification document," she explained.

"Overall, the importance of house electrical connections cannot be overstated, as they are integral to the safety, functionality and comfort of modern homes," Shitalangaho-Mutikisha added.

She said although in the past there were a number of challenges associated with an area without electricity, this will now be a thing of the past with streets, dark areas and homes being electrified.

She urged residents to look after their property, saying the council will focus on electrifying other areas and not repairing vandalised items.

PROGRESS: The Ondangwa electrification project is advancing. PHOTO: TUYEIMO HAIDULA

Press Notice: Die Republikein 22 and 29 February 2024

PUBLIC PARTICIPATION NOTICE

ENVIRONMENTAL IMPACT ASSESSMENTS FOR AGRICULTURE AND ENVIRONMENTAL RELEASE OF GENETICALLY MODIFIED MAIZE AND COTTON FOR CULTIVATION

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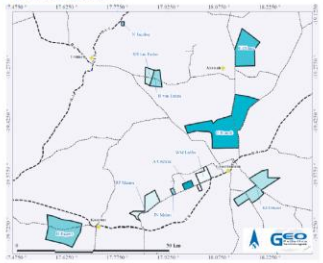

The environmental assessments will be conducted according to the Environmental Management Act of 2007 and its regulations published in 2012. Depending on the respective Proponents' individual farming activities, aspects related to cultivation of GM maize and cotton, water abstraction, fuel storage and hospitality and tourism facilities, will be included.

All interested and affected parties are invited to register with GPT. By registering you are provided with the opportunity to share any comments, issues or concerns related to the projects, for consideration in the environmental assessments. Additional information can be requested from GPT: Tel: +264-61-257411; Fax: +264-88626368; E-Mail: gmo@thenamib.com

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Site Notice


Meteorite
Camping
Venus 379
Klaas & Madelein Malan


GEO
Pollution
Technologies
PUBLIC NOTICE:
Environmental Scoping Assessment and Environmental Management Plan for Agriculture Activities and the Environmental Release of Genetically Maize on Farm Venus, Otjozondjupa Region
In terms of the Environmental Management Act (No. 7 of 2007) and the Environmental Impact Assessment Regulations (Government Notice No. 30 of 2012), notice is hereby given to all potential interested and affected parties that an application will be made with the environmental commissioner for an environmental clearance certificate for the following:
Project: Environmental Scoping Assessment and Environmental Management Plan for Agricultural Activities and the Environmental Release of Genetically Modified Maize on Farm Venus, Otjozondjupa Region.
Proponent: JS Malan.
Environmental Practitioner: Geo Pollution Technologies (Pty) Ltd
The Proponent has collectively cleared approximately 170 ha for dryland cultivation. The main crops cultivated is maize, sorghum and sunflowers. In order to improve productivity, the Proponent wishes to replace the traditional maize cultivars with insect and/or roundup resistant GM strains. In addition to crop cultivation, the Proponent also has a hospitality operation with four self-catering rooms that can accommodate 11 persons and six campsites that can accommodate 36 persons. The assessment will include all pertaining to the transport, storage and planting of GM maize seeds, the management of the crops during the growing period, the application of pesticides to the crops, harvesting of the crops, and the handling and transport of the harvested maize to the markets. Although relatively small, the hospitality operation will also be included in the report. This will include the receipt of guests and general cleaning and maintenance of the facilities. General operations also include activities such as electricity supply, waste handling and sewage disposal.
As part of the assessment Geo Pollution Technologies consult with interested and affected parties. You are hereby invited to register as an interested and affected party with Geo Pollution Technologies. Registration provides you with an opportunity to submit comments, issues or concerns related to the farm, for consideration in the environmental assessment. Please send your written registration or comments to:
Fax: 088-62-6368 or E-mail: venus@thenamib.com
Should you require any additional information please contact Geo Pollution Technologies at 061-257411.
Thank you in advance.
Geo Pollution Technologies

IAP Details	Comment / Concern	Response
Claudia Dohman WhatsAPP 2024/04/09	A bit late, but these are my concerns: 1. Cross pollination with my maize....some of the fields are right next to mine. (6m and 100m) 2. A lot of Glyphosate will be used and as our water levels of our boreholes here are at 6 to 12m . I am concerned that the Glyphosate will end up in the groundwater. 3. I am just concerned that my neighbours won't adhere to the regulations of planting GMO maize. As I have seen in the past, the people who were supposed to check whether there were GMOs planted, were maybe scared of the farmers or the techniques were not right. The maize was there and nothing was found. Maybe it is very difficult to control what the farmer does. Thank you.	Thank you Kindly Claudia. We will consider it in our reporting. Your time is appreciated. Sincerely,

Comments and Responses Report: Comments from the Namibian Organic Association Received: 12 November 2024 via Email

Comment 1

12 November 2024

Subject: Response to the Environmental Impact Assessment by Geo Pollution Technologies for the cultivation of genetically-modified maize Farms Otago and Hermanskamp, Otjozondjupa Region

Interested and Affected Party: Namibian Organic Association (NOA)

NOA Board members:

Mareike Voigts (Chairperson)
Eckhart Förtsch (Vice Chairperson)
Vera Corry (Secretary)
Selma Nasheya
Jacobina Lumambo
Johannes Negongo
Dirk Bockmühl
Immo Böhm
Lydia Nakupanda

To whom it may concern,

Please find attached here some comments and queries with regard to the Environmental Impact Assessment for the cultivation of genetically modified maize on farms Otago and Hermanskamp. Attached also is a position paper by the Namibian Organic Association from April 2023 in response to the importation of genetically modified feed by AGRA.

Response 1: The response is well received and the position paper by the Namibian Organic Association from April 2023, in response to the importation of genetically modified feed by AGRA, is noted.

Comment 2

Background

The Namibian Organic Association is a membership-based voluntary association that was founded in 2009 by producers and consumers passionate about healthy, sustainably produced food. The organization's mandate is to grow the organic sector in Namibia, thereby increasing the accessibility of local, healthy, nutritious food to all Namibians. This is done through awareness raising campaigns, training workshops, offering certification for organically produced food for the local market, and more recently, by engaging with government through the establishment of a Technical Working Group on Organic Agriculture and Agroecology which will form part of the Food Security Working Group under the Office of the Prime Minister (OPM).

Standing with organic movements across the globe, NOA and its members are guided by the four principles of organic agriculture, namely: Health, Ecology, Fairness and Care (as defined by the International Federation of Organic Agriculture Movements, IFOAM – Organics International), as well as by the 13 principles of Agroecology. These principles guide management practices across the value chain of the food system and contribute directly to multiple Sustainable Development Goals (SDGs): -

SDG 1: Eradication of poverty
- SDG 2: Eradication of hunger
- SDG 4: Ensuring quality education
- SDG 5: Achieving gender equality
- SDG 6: Increasing water-use efficiency
- SDG 8: Promoting decent jobs
- SDG 12: Ensuring sustainable consumption and production
- SDG 13: Building climate resilience
- SDG 15: Halting the loss of biodiversity.

NOA stands for food sovereignty through sustainable food production that is practiced through crop diversity, seed saving and seed sharing, using seeds adapted to local environments as well as conventional crop breeding methods to enhance production within local environments. Capacity building within the country through supporting farmers – subsistence, small-scale and commercial – is a main focus for NOA.

With regard to the cultivation of genetically modified organisms (GMOs), NOA calls for:
- Transparent processes and full public participation
- Fully independent research trials/studies
- Risk assessments for GMOs to include herbicide/pesticide impacts

- All GMO products to be clearly labelled to inform consumers.
NOA would also like to point to the study by Noack et al. (2024), which highlights that while much of the literature focus on yields of GM crops, there is very little focus on the social and environmental impacts of GMO cultivation. This is also highlighted in a report by the African Centre for Biodiversity, which NOA urges all decision-makers, environmental impact assessors and farmers to familiarize themselves with, as well as the references therein:
• Africa Centre for Biodiversity. 2020. GMOs in South Africa 23 years on: Failures, biodiversity loss and escalating hunger

Response 2: Background introduction is noted.

Comment 3
Queries/comments on the Environmental Impact Assessment (EIA):
1. GM Maize that is herbicide resistant (event NK603) is cultivated in conjunction with the herbicide 'Roundup', the active ingredient of which is glyphosate. While this product is still available in Namibia on the shelves, it is well documented that this chemical is carcinogenic (OEHHA, 2019) and has been linked to several chronic diseases, such as non-Hodgkin lymphoma, with exposure to glyphosate increasing the chance of cancer by 40% (Zhang, et al., 2019). Furthermore, the "adjuvants" (chemical additives) that are used in the formulation of Roundup make it even more toxic than glyphosate alone, which is largely unknown to the public and decision- makers (Mesnage et al., 2015). The EIA does not deal sufficiently with the impacts of glyphosate (the active ingredient in Round up) on the health of humans and animals.

Response 3: The authors of the EIA are well aware of the inherent dangers of not only an herbicide like glyphosate (and RoundUp), but also many other commonly used pesticides, including those used by the laymen around their own homes and gardens. Many of these have not received the attention of glyphosate, as they are not linked to GM crops. They are however used on crops we buy in our stores on a regular basis. In an ideal world, we think it is safe to assume that, all other things being equal, no single person will willingly choose a crop grown with pesticides over a crop grown without any. Unfortunately, reality is quite different from idealism, and factors like the price of organic vs non-organic foods influence this decision, especially in a country where a large portion of population lives below the poverty line.
The above being said, the debate on the carcinogenicity of glyphosate is ongoing. However, a critical analysis of the Zangh et al. (2019) paper by the US EPA, found various flaws in the Zhang et al. study and concluded that the study by Andreotti et al. (2018) remains the largest, best-designed high quality study, and their categorization of glyphosate as "*not likely to be carcinogenic to humans*" remains.
The very detailed review of GM crops by the National Academies of Sciences, Engineering, and Medicine (2016) had to conclusions on cancer incidence linked to GM crops:
FINDING: The incidence of a variety of cancer types in the United States has changed over time, but the changes do not appear to be associated with the switch to consumption of GE foods. Furthermore, patterns of change in cancer incidence in the United States are generally similar to those in the United Kingdom and Europe, where diets contain much lower amounts of food derived from GE crops. The data do not support the assertion that cancer rates have increased because of consumption of products of GE crops.
FINDING: There is significant disagreement among expert committees on the potential harm that could be caused by the use of glyphosate on GE crops and in other applications. In determining the risk from glyphosate and formulations that include glyphosate, analyses must take into account both marginal exposure and potential harm.
It may be worthwhile studying the National Academies of Sciences, Engineering, and Medicine (2016) document.
Ultimately, it remains crucial that farmers apply RoundUp, as with all other pesticides, according to the prescribed instructions and in a responsible manner.
References:
Andreotti G, Koutros S, Hofmann JN, Sandler DP, Lubin, JH, Lynch CF, Lerro CC, De Roos AJ, Parks CG, Alavanja MC, Silverman DT. 2018. Glyphosate use and cancer incidence in the Agricultural Health Study. JNCI: Journal of the National Cancer Institute. 110(5): 509–516. doi:10.1093/ jnci/djx233.
National Academies of Sciences, Engineering, and Medicine. 2016. Genetically Engineered Crops: Experiences and Prospects. Washington, DC: The National Academies Press. doi: 10.17226/23395.

Comment 4
2. Given that there are several movements in the EU and the US to ban this chemical for use in the agricultural sector, NOA would like to raise the question as to whether it is imperative to set up a cultivation

system that is totally reliant on the use of this herbicide? What would the economic implications be if this chemical is banned in the EU (and the US) where many of Namibia's beef exports are destined to?
Response 4: Most of, if not all, animal feed used to supplement cattle's diets, especially now during drought conditions, already contain GMOs. Also, as indicated in the specialist study, the Meat Board of Namibia has confirmed that the export status to the European Union are not negatively influenced by the fact that Namibian animal feed already contains GM ingredients, inclusive of RoundUp Ready Maize. It is also not an irreversible cultivation system. Permits for planting of GM crops needs to be renewed on an annual basis.
Comment 5 3. It is often argued that the cultivation of herbicide resistant GM maize leads to a decrease in herbicide use. There are, however, studies showing the exact opposite (Perry, et al., 2016). Not only does herbicide use remain the same as before, or even increase, but because herbicide resistance does develop in weeds, more herbicide is used, or even more toxic herbicide alternatives are being used, e.g. glufosinate, dicamba, 2-D (REFERENCE). Bayer recommends overlapping use of residual herbicides with glyphosate, the examples of which that are given are partly already banned in the EU or in the process of being banned (e.g. Atrazine, Simazine, Metribuzin, Metachlor). Is the cultivation of herbicide-resistant ('Roundup Ready') GM maise then a sensible and sustainable system to invest into?
Response 5: Likewise, there are studies indicating that there are no definitive proof that herbicide use increase. See the National Academies of Sciences, Engineering, and Medicine (2016) report. Furthermore, herbicide resistance in weeds is not a concern in GM crops only. It also develops under traditional crop farming where weeds are sprayed prior to planting of fields. The same argument can therefore be made for non-GM crops.
Comment 6 4. Pg. 21: It is argued here that GM crops need to be used because the use of herbicides (on non-GM crops) leads to weed resistance. This statement is problematic since it is also the use of herbicides in GM herbicide-resistant crops that leads to weed resistance (Heap and Duke, 2018; even highlighted in a report by Bayer on glyphosate), perhaps even more so as farmers that use herbicide-resistance GM crops start to rely on only one herbicide, rather than an Integrated Pest Management approach which entails a more holistic approach to pest management and thereby reduces the risk of herbicide or pesticide resistance developing.
Response 6: Noted. Throughout the EIA and specialist report it is clearly stated that weed resistance to herbicides can occur in both non-GM and GM crops. However, the statement referred to has been rephrased to better express the argument. It now reads: *Some weeds have developed resistance to some herbicides, leading to a need to* *rotate both crops and herbicide groups in order to keep crops weed-free. Where broad-leafed weeds developed resistance, glyphosate tolerant GM maize may be beneficial as such weeds can still be eliminated on post-emergent maize.* Ultimately, it is thus equally important to have adequate pest management systems for both GM and non-GM crops.
Comment 7 5. Further to the previous point, a reduced use of pesticides is typically only reported in cultivation systems that are already using significant amounts of agro-chemicals (IAAASTD Report, Pg 45). In this light, it is questionable whether the cultivation of Bt and herbicide-resistant maize in Namibia on a farm where the amount of chemical use might not have been monitored continuously, would realistically lead to a reduction in pesticide use.
Response 7: It is logical that the largest reduction in pesticide use would be in systems making use of a lot of agro-chemicals (pesticides). Subsistence farmers for example, seldom use pesticides at all. The National Academies of Sciences, Engineering, and Medicine (2016) report highlights numerous studies, all indicating reduced use in insecticides on GM crops. In fact their conclusion is: *FINDING: In all cases examined, use of Bt crop varieties reduced application of synthetic insecticides in those fields. In some cases, the use of Bt crop varieties has also been associated with reduced use of insecticides in fields with non-Bt varieties of the crop and other crops.* Furthermore, it is unlikely, especially in Bt maize, that farmers will willingly use expensive insecticides if they are not needed.
Comment 8 6. Maize is a wind-pollinated plant, which is not mentioned in the EIA report. Therefore, the risk of cross-pollination is very real as pollen can be carried across substantial distances by wind. This would impact

those neighbours that want to grow non-GM crops, and could also impact their aspirations for organic certification which would directly impact their economic resilience/status. Contrary to what the EIA states, contamination of non-GM crops on neighbouring farms have impacted these farmers' ability to pursue organic certification (Paull, 2019).

Response 8: In the climate section of the report mention is made, under implications, that pollen may be carried by the wind in a westerly direction. Furthermore, having reviewed the Paull 2019 article, of which he is the only author, it is safe to say that from the tone of the article, and the fact that the author is an advocate of organic agriculture, there is great bias towards organic agriculture. This also stems from his lack of including positive aspects of GM crops, which there definitely are.
Nevertheless, the EIA report indicates a buffer (isolation zone) of 800 m between GM and non-GM fields, or as directed by the seed supplier. A counter argument can also be made by farmers intending to plant GM crops. Many farmers have indicated losses of millions of dollars as a result of fall and African armyworms. If they are not allowed to plan GM crops to counter these losses, due to a nearby organic farmer, their own economic resilience is also impacted.

Comment 9
7. More difficult growing conditions can be expected in the future due to climate change, increased temperatures and unpredictable weather patterns. Resilience lies within crop diversity, which is more apparent in local varieties than in GMO crops.

Response 9: The statement *"More difficult growing conditions can be expected in the future due to climate change, increased temperatures and unpredictable weather patterns."* directly supports the idea of planting GM crops as it provides a level of flexibility not offered by non-GM crops. For example, with dry-land non-GM crops, farmers have to time field preparation and weed control based on weather predictions. Should the rain arrive too late in the planting window, farmers will either risk investing a lot of money by planting without good rains, or not plant at all. With herbicide tolerant GM crops, planting can occur much later in the planting window, as no weed control is required prior to planting, since weed control can be performed post emergent.
New GM traits are continuously investigated, with a strong focus on drought tolerance. Such a trait can play a crucial role in food security in dry African countries which already suffers food shortages.
Local varieties will still be planted as refuges when GM-crops are planted.

Comment 10
8. There are currently only 24 countries in the world that allow growing of GM crops (Paull, 2019), with most countries having strict rules and regulations in place that require food stuffs to be clearly labelled to contain GMOs, which highlights consumers reluctance to consuming GMOs.

Response 10: 27 countries planted GM crops by 2023and the area under GM crop cultivation, globally, has increased from 170.1 million hectares to 206.3 million hectares. Directly linking the number of countries planting GM crops to consumer reluctance, i.e. consumer reluctance causes fewer countries to plant GM crops, is inaccurate. There are numerous other factors to consider, among them the lengthy and cumbersome processes to follow in order to get approval for environmental release of GM crops. It therefore does not necessarily represent the populations' sentiment. This is also supported by the fact that many more countries, including Namibia, import GM crops for food and feed.
The luxury to refuse to eat food containing GM products, may be an affordable option in for example certain European countries. The reality of most developing countries is however very different. The following screen capture is just a single example that highlights this difference:


OPINION COMMENTARY Follow

We May Starve, but at Least We'll Be GMO-Free

Unlike the Europeans we copied, Zimbabwe can't afford such an unscientific ideological luxury.

By Nyasha Mudukuti

March 10, 2016 6:51 pm ET

From: https://www.wsj.com/articles/we-may-starve-but-at-least-well-be-gmo-free-1457653915
Comment 11 9. The EIA shows that insect and weed resistance needs to be monitored. How does the farmer undertake this, and is it a realistic actionable measure that the farmer is able and willing to continue to do? Who will regulate this? What happens when resistance is recorded? NOA cautions that once resistance has developed it cannot be undone. The proponent will be responsible for ensuring that resistance does not occur through implementing alternative pesticides, but how is this controlled and enforced?
Response 11: As stated earlier, weed and insect resistance to pesticides can occur in cultivation of both GM and non-GM crops. The advantage of GM crops is that there at least is legislation and controls in place to prevent and detect this, whereas with non-GM crops there are none. Ultimately the Biosafety Council under the National Commission on Research Science and Technology, Ministry of Higher Education, Technology and Innovation is mandated to prescribe regulations pertaining to the cultivation of GM crops, if permits for this are issued.
Comment 12 10. Given the stringent management plans and regulations/control of various aspect pertaining to the cultivation of GM maize (e.g. planting of refugia, avoiding crosspollination, use of herbicides, etc.) for which not only the proponent is responsible for, but also the environmental regulators/health & safety inspectors, NOA raises the question as to whether the relevant authorities actually have the expertise and capacity to regulate and control such a highly contentious cultivation scheme. This was also highlighted in a report for South Africa by the African Centre for Biodiversity in relation to GMO cultivation in the country (ACBio, 2020). Given that many Namibian farmers already seem to be illegally cultivating GM maize, it is questionable if the government institutions responsible for regulating and overseeing the legal cultivation of GMO crops in the country have the capacity and resources to do, to ensure that there is no contamination and cross-pollination.
Response 12: The application process for the planting GMO's is substantial. Apart from this EIA process, any applicant should also apply to the Biosafety Council under the NCRST. The requirements for this application include emergency response plans for both transport and cultivation of GM crops. Approved and legal cultivation of GM crops will be better controlled, with checks and balances in place.
Comment 13 11. The EIA/proponent argues that the cultivation of GM maize will lead to more employment opportunities and an increase in technical expertise in the country. The same can, however, be argued for adopting or integrating a more sustainable agricultural system as offered through organic agricultural and agroecological practices – both creating employment opportunities and improving technical expertise in the country as these farming systems are based on a foundation of a very good understanding of ecology, the environment, markets, etc., in order to flourish, while at the same time safeguarding the environment and producing food that is clean and nutritious. A report by the United Nations found that organic agriculture promotes job creation, providing for more than 30% more jobs per hectare than non-organic farms (De Schutter, 2011).
Response 13: The EIA report does not claim that that the cultivation of GM maize will lead to more employment opportunities and more technical expertise than organic agricultural and agroecological practices. It simply highlights potential benefits of this project. Naturally a farm making use of for example manual labour to eliminate weeds, will have to employ more people than when insecticides are applied. It however comes at significant cost which may ultimately be carried over to the consumer. As stated earlier, the Namibian population, save for a small niche market, cannot afford the prices that accompanies organic food production. A visit to the weekly biomarket in Windhoek presents a clear indication of this when the number and demographic of patrons are considered. Furthermore, the higher production costs can also reduce the feasibility of crop production to such a level where farmers stop producing crops, especially if pests continually result in significant losses.
Comment 14 12. Research has shown that there is already resistance that has developed in fall army worm and stem borer to the Bt toxin (Huang et al., 2014; Kruger et al., 2011). Furthermore, a study conducted in 2020, showed that despite initial reductions in pesticide use, farmers use more pesticides today compared to before the introduction of Bt cotton (Kranthi & Stone, 2020). Once resistance has developed, even if only after a few years, farmers need to start using insecticides again – resistance cannot be undone.
Response 14: This concern has already been addressed in previous points above and the specific case as discussed by Kruger et al. (2011) was presented in the specialist report (page 22 0f 71).

Comment 15 13. *Bt toxin* a. Bt from plants can remain in the soil for over 2 months (Strain & Lidy, 2015; Feng et al. 2015) – the EIA does not address the long-term impacts of this toxin in the soil, especially on soil life. *b*. The potential impact on higher tropic levels have also not been addressed.
Response 15: The same study by Strain & Lidy (2015) states: "The Bt proteins are highly specific and only lethal upon ingestion, limiting the scope of toxicity to target insects. However, concern of exposure to non-target organisms and negative public perceptions regarding Bt crops has caused controversy surrounding their use." Literature overwhelmingly reiterates that the Bt proteins are very species specific. No evidence could be found of Bt proteins being toxic in higher trophic levels. The conclusion therefore remains that Bt maize are less harmful in ecosystems than traditional insecticide application.
Comment 16 14. Another worthwhile read is the 2022 publication "Pesticide Atlas" of a consortium of different organisations under the leadership of the Heinrich Böll Stiftung, with statistics proving that GMO cultivation and the associated use of pesticides has been a failure and carries grave consequences for human health and the global environment (https://eu.boell.org/sites/default/files/2023-04/pesticideatlas2022_ii_web_20230331.pdf). This publication not only lists facts and statistics, but also reflects on the European public's resistance to GMO and harmful chemicals. Europe is the most important market for Namibian agricultural exports.
Response 16: The focus of the Pesticide Atlas is pesticides in general and not GM crops. In science, ideas are never entirely proven or disproven. Instead, they are accepted or rejected based on supporting and opposing evidence, with conclusions subject to revision when new evidence or perspectives emerge. The evidence presented in the Pesticide Atlas to "[proof]that GMO cultivation and the associated use of pesticides has been a failure and carries grave consequences for human health and the global environment" is weak and highly correlative. Furthermore, this concern has been addressed in the points above.
Comment 17 15. Pg. 51: The risk of biodiversity loss should be categorized as 'highly probable'. The following paragraph is relevant here, taken from the ACBio 2020 report: *'GMOs are central to the industrialised version and vision of agriculture punted across the globe. Expanding monocrops and GMOs severely affect global ecological functions through deforestation (specifically the large grain producers of the world) and encroachment into natural habitats, polluting soils and waterways by highly toxic chemicals. There is an overall reduction in the nutrition of food through the creation of nutritionally depleted soils (Schjoerring et al., 2019). The environmental and social toll of industrial agriculture has been recognised widely, with many experts calling for an urgent shift towards biodiverse agroecological production systems (De Schutter, 2010; HLPE, 2019; IPES-Food, 2016).'* If Namibia now allows GMO cultivation, it follows the trap of many industrialised countries of depleting soils and reducing productivity of their agricultural system.
Response 17: Refer to section 4.4.5 of the specialist report. Scientific studies have shown that biodiversity can actually improve under GM crop cultivation. The problem as illustrated in the concern is not directly correlated with GM crop cultivation, but goes hand in hand with industrialised agriculture, of which GM crop cultivation may be part of, but so is non-GM crop cultivation. Maize, whether GM or non-GM, remains a monoculture. That is why crop rotation is important, and is practiced by most Namibian farmers. Furthermore, in the Namibian setting, as far as commercial farming where GM crops will mainly be cultivated is concerned, "slash-and-burn agriculture" is not practiced. Thus, the statement "*Expanding monocrops and GMOs severely affect global ecological functions through deforestation" is not valid*.
Comment 18 16. NOA would like to raise the concern that the 'road back' from GM maize cultivation is even more difficult than converting to organic/agroecological systems now. For example, once herbicide resistant weeds have developed through incorrect and overuse of herbicides, we cannot simply undo this development. Furthermore, once soil health is destroyed due to the use of herbicides and other chemicals, it will become increasingly difficult to cultivate this land.
Response 18: As stated earlier, the same risks exist with non-GM crops cultivated under traditional methods of pesticide use. To try and achieve an agricultural industry where no pesticides are used at all, is, even though ideal, unrealistic.
Comment 19 17. NOA would like to highlight that the wording in the document does not reflect an entirely objective voice and could easily influence the reader: when talking about the risks of GM maize cultivation, the writer

uses the words 'it **may** lead to XYZ', whereas when highlighting the potential benefits of GM maize cultivation, the writer uses the words 'it **will** lead to XYZ'.
Response 19: It is not the intention to be subjective. Examples include: • In the sentence "Increased **potential** yields in maize crops, through the cultivation of GM maize, will improve the economic resilience of the farm by offsetting losses that may periodically be incurred in other income streams" it is stated that it is potential increased yields, and it is true that increased yields generate more income. • Various potential and definite impacts **will** emanate from the operations, maintenance/construction and decommissioning phases. • The use of GMO maize **is expected** to increase the success rate and nett economic benefit of operations. **However,** due to the variability of GMO seed prices, input costs etc, the nett benefit **will vary** year on year. It is nonetheless **foreseen**, based on historic cultivation of GMO in other developing countries, that the overall revenue generation capacity **will** be increased, contributing to the sustainability of operations and related employment.

Appendix E: Consultants' Curriculum Vitae

ENVIRONMENTAL ASSESSMENT PRACTITIONER **Quzette Bosman**

Quzette Bosman has 16 years' experience in the Impact Assessment Industry, working as an Environmental Assessment Practitioner and Social Assessment practitioner mainly as per the National Environmental Legislation sets for South Africa and Namibia. Larger projects have been completed in terms of World Bank and IFC requirements. She studied Environmental Management at the Rand Afrikaans University (RAU) and University of Johannesburg (UJ), including various Energy Technology Courses. This has fuelled a passion towards the Energy and Mining Industry with various projects being undertaken for these industries. Courses in Sociology has further enabled her to specialize in Social Impact Assessments and Public Participation. Social Assessments are conducted according to international best practise and guidelines. Work has been conducted in South Africa, Swaziland and Namibia.

CURRICULUM VITAE QUZETTE BOSMAN

Name of Firm	:	Geo Pollution Technologies (Pty) Ltd.
Name of Staff	:	QUZETTE BOSMAN
Profession	:	Social Impact Assessor / Environmental Assessment Practitioner
Years' Experience	:	16
Nationality	:	South African
Position	:	Senior Environmental Consultant
Specialisation	:	ESIA & ESMP; SIA
Languages	:	Afrikaans – speaking, reading, writing – excellent English – speaking, reading, writing – excellent German –speaking, reading - fair
First Aid Class A		EMTSS, 2017
First Aid LSM		OSH-Med International 2022
Basic Fire Fighting		EMTSS, 2017
Basic Industrial Fire Fighting		OSH-Med International 2022

EDUCATION AND PROFESSIONAL STATUS:

BA	Geography & Sociology	:	Rand Afrikaans University, 2003
BA	(Hons.) Environmental Management	:	University of Johannesburg, 2004

PROFESSIONAL SOCIETY AFFILIATION:

Namibian Environment and Wildlife Society
International Association of Impact Assessors South Africa (IAIA SA)
Member 2007 - 2012
Mpumalanga Branch Treasurer 2008/2009

OTHER AFFILIATIONS
Mkhondo Catchment Management Forum (DWAF): Chairperson 2008-2010
Mkhondo Water Management Task Team (DWAF): Member 2009

AREAS OF EXPERTISE:

Knowledge and expertise in:

- environmental impact assessments
- project management
- social impact assessment and social management planning
- community liaison and social monitoring
- public participation / consultation, social risk management
- water use licensing
- environmental auditing and compliance
- environmental monitoring
- strategic environmental planning

EMPLOYMENT:

2015 - Present	:	Geo Pollution Technologies – Senior Environmental Practitioner
2014-2015	:	Enviro Dynamics – Senior Environmental Manager
2010 - 2012	:	GCS – Environmental Manager (Mpumalanga Office Manager)
2007 - 2009	:	KSE-uKhozi - Technical Manager: Environmental
2006 -2007	:	SEF – Environmental Manager
2004 - 2005	:	Ecosat – Environmental Manager

PUBLICATIONS:

Contract reports	: +190
Publications	: 1

ENVIRONMENTAL ASSESSMENT PRACTITIONER **Johann Strauss**

Johann Strauss holds an B.A degree in Geography with Psychology and Environmental Management from the Northwest University (NWU) South Africa. He is currently in the process of pursuing his honours degree in environmental management from the University of South Africa (UNISA). He entered the environmental assessment profession at the end of 2022 and since then has worked on various Environmental Impact Assessments including assessments of the petroleum industry, irrigation schemes, tourism and transport industry.

CURRICULUM VITAE JOHANN STRAUSS

Name of Firm	:	Geo Pollution Technologies (Pty) Ltd.
Name of Staff	:	Johann Strauss
Profession	:	Environmental Assessment Practitioner
Years' Experience	:	2
Nationality	:	Namibian
Position	:	Environmental Consultant
Specialisation	:	Environmental Impact Assessments
Languages	:	Afrikaans – speaking, reading, writing – excellent English – speaking, reading, writing – excellent

EDUCATION AND PROFESSIONAL STATUS:

B.A Geography with Psychology and Environmental Management : North West University, 2021

AREAS OF EXPERTISE:

Knowledge and expertise in:

- Environmental impact assessments
- Environmental management plans
- Environmental monitoring
- Environmental auditing and compliance

EMPLOYMENT:

2022-Date : Geo Pollution Technologies – Environmental Consultant

PUBLICATIONS:

Contract reports : 17