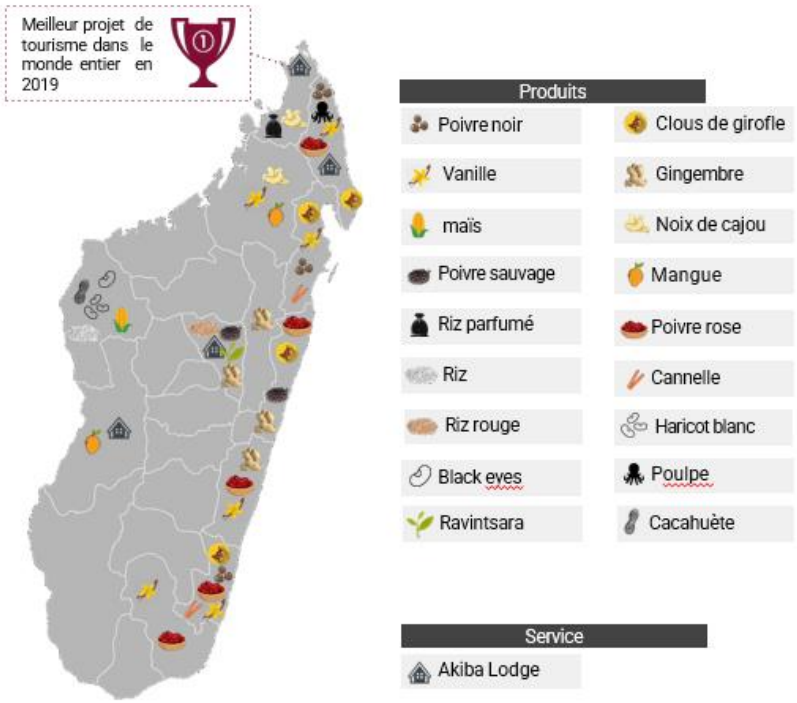
Sahanala Climate Resilience Plan

1. An Introduction to Sahanala

Sahanala is a Malagasy social enterprise that specializes in the production and sale of high-quality agricultural products such as vanilla, nuts and spices. The company operates as an exporter, sourcing raw materials such as vanilla beans from local farmers in Madagascar and processing them to create premium extracts, powders, and other products. Its purpose brings a strong emphasis on environmental sustainability and social development.

"*Our business model is centred around sustainable sourcing practices and fair-trade principles, and we work directly with our producers-members, supporting them through training, resources, and fair prices for their crops, depending on their needs*"

Sahanala's growth strategy focuses on expanding the market reach both locally and internationally, and diversifying our revenue to reduce our dependency on the Vanilla sector. We aim to increase our presence in key markets by promoting premium products including Vanilla to chefs, food manufacturers, and consumers who value quality ingredients, as well as enhancing production capacity and efficiency to meet growing demand for a broader range of agricultural products.



Map of Sahanala activities

1.1 Our structure

Our company is highly inclusive with a fairly simple structure. Each producer-member is gathered within an association and, depending on the sector of activity, each association will be involved in one of the 5 Federations. Key concerns and issues from the growers are voiced in the association, and brought to the Federation, and these are then discussed in a quarterly meeting of the managing board, which serves to set the strategic direction of the company. The strategic plan

is then validated by the General Assembly, where producers are represented. Thus, key company decisions, investments, and its strategic direction, are determined by Sahanala members themselves, ensuring that there is a direct link between the producers-members, and the company's strategic direction.

The 5 Federations cover the following sector:

Vanilla – the largest federation with over 11,000 members grouped into 54 associations. Vanilla production accounts for 60-80% of company revenue, depending on global market price and yields.

Nuts and Spices – includes the production of cashew nuts, ginger and several types of pepper, and accounts for around 9% of company revenue.

Fishing – artisanal fishing of octopus, langoustines and sea fish. The federation comprises 270 members in 9 associations, and accounts for approximately 6% of company revenue.

Tourism – Sahanala runs 4 eco-lodges in harmonious protected areas of Madagascar, which generate around 6% of company revenue.

Maintirano – this is the newest federation, covering production of Maize, Rice and Peanuts, in Maintirano Province in the west of Madagascar. This Federation represents around 15% of Sahanala's revenue.

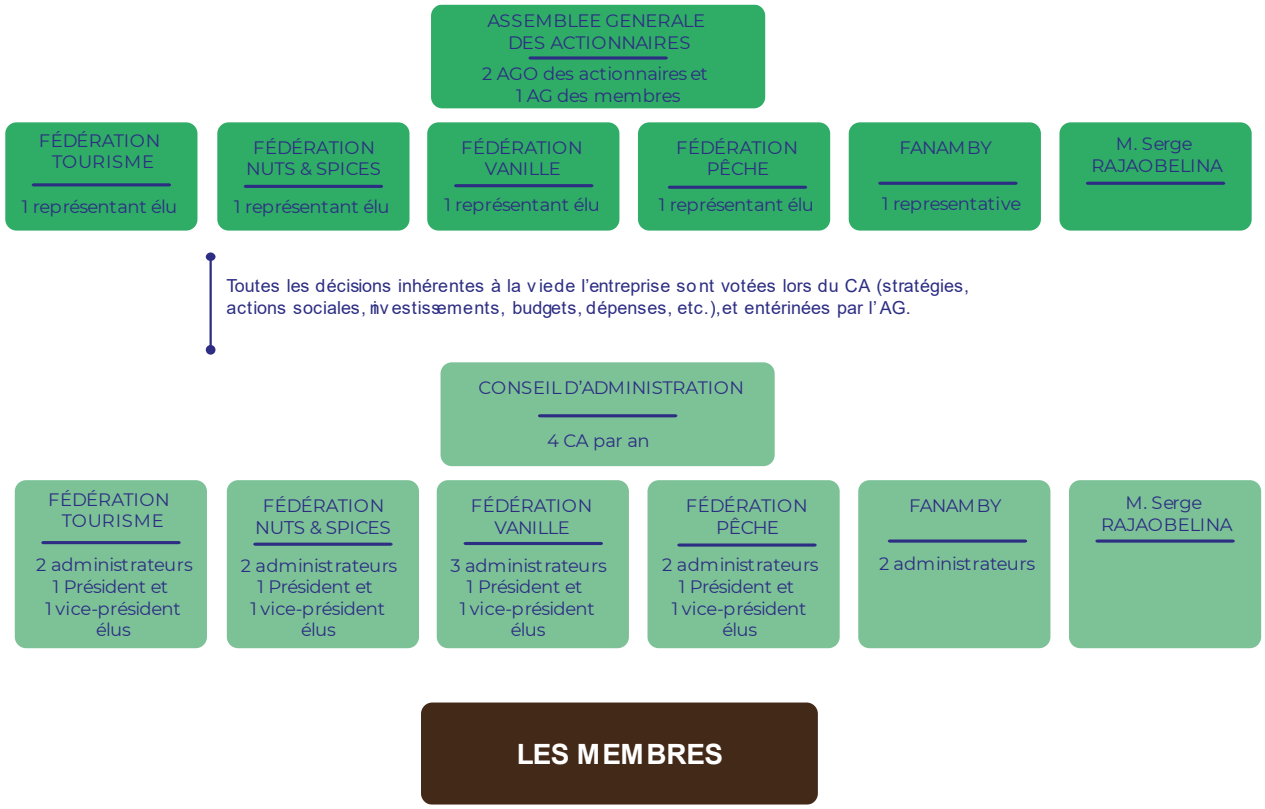


Figure 1-1 - Decision-making structure of Sahanala

The decentralized structure of the company has shaped the approach to its resilience plan. It has been agreed that any impacts deemed material at the Federation level should be addressed directly. In this context, we define material risks as those that, if they destabilize a Federation, could undermine the company's core purpose and its social development objectives. As such, these impacts must be considered critical risks to the organization's long-term success.

2. Key risks across company and examples of impacts

We operate across 11 out of the 23 regions of Madagascar, and frequently experience the impact of climate change, including cyclones, flooding and drought. Our members report rainy seasons which are less reliable, increases in heavy rain and flooding, unseasonably hot temperatures, and unsettling changes in the pattern of winds, impacting.

Risks have been assessed for each Federation, and a climate risk assessment conducted to assess how these risks could evolve under different scenarios of climate change. It is evident that the climate in the areas of Madagascar in which we operate will significantly change over the coming years, including an increase in both average and maximum temperatures, with all regions likely to experience record-breaking heat. The northern and western regions are projected to see a sharp increase in the number of days above 30°C.

There is uncertainty regarding changes in rainfall patterns, but scenarios suggest significant decreases in precipitation across our regions, and indications that the rainy season may become shorter and less predictable. While the overall frequency of cyclones may decrease, their intensity will increase. A key change here is the increase in the likelihood of very heavy rainfall, which will increase the risk of major flooding impacting our operations.

Increasing temperatures, and ongoing rainfall variability mean that severe drought will continue to be a recurring risk. Additionally, higher temperatures, combined with potential delays in rainy season onset will increase the risk of forest fires and increase the salinity within mangrove forests- thus impacting the marine ecosystems. Although sea-level is only projected to rise by around 25cm by 2050, even small changes can be significant in magnifying the impact of cyclone storm surges, leading to enhanced rates of coastal erosion.

2.1 Risk Assessment Methodology

We considered a wide range of evidence from recent and historical climate observations, research literature, field visits, climate model analysis and expert opinion to assess climate risks. We assessed future risk in 2050 against three scenarios: ‘warm’, “hot and wet” and ‘hot and dry’ futures with moderate to high rises in relative mean sea levels from CORDEX-Africa climate projections.

A range of risks were assessed for these scenarios including higher temperatures, changing rainfall patterns and extreme events, particularly cyclones and flooding. Each risk was classified from very low to very high according to its probability and consequences (see below) under each climate scenario for the baseline period (1981-2000) and 2050s.

		Consequences				
		1. Insignificant	2. Minor	3. Moderate	4. Major	5. Catastrophic
Probability	5. Almost certain	Moderate	High	Very High	Very High	Very High
	4. Probably	Low	Moderate	Very High	Very High	Very High
	3. Possible	Low	Moderate	Moderate	High	High
	2. Unlikely	Very Low	Low	Moderate	Moderate	High
	1. Remote	Very Low	Very Low	Low	Low	Moderate

2.2 Main Findings

The headline changes to climate risks and their impacts are summarised in the infographic below, and the highest risk classification across all five federations summarised in the table below. At the company level, our greatest risks relate to impacts from cyclones and flooding, and a growing threat from drought. Detail of the key risks per Federation is provided in the federation factsheets that follow.

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MADAGASCAR FUTURE HAZARDS & CLIMATE RISKS

HIGHER TEMPERATURES

Average annual temperature is set to increase by **2.3 °C** by 2050.

Summer temperatures will occur for longer periods of the year.

DRIER SUMMERS

Droughts are expected to become increasingly likely over this century.

By 2050, annual rainfall is set to decrease by up to 21%.

CYCLONES

With projected warming, **storm intensity and frequency will increase,** potentially increasing the number of multi-year events.

LANDSLIDES

Landslides will become more frequent with increased storminess.

In 2022, a landslide caused loss of life and displaced 35,000 people.

HEAT IMPACT ON CROPS

Maximum temperatures could reach **41.7 °C** by 2050, impacting seedling emergence, resulting in **reduced crop yields.**

DROUGHT CROP FAILURE

By 2050, rainfall may be insufficient for vanilla every **1 in 2 years**

The rainy season may become shorter and occur later in the year

CYCLONE CROP DAMAGE

In 2017, category 4 Cyclone Enawo caused widespread flooding and wind damage, with **damage to 30% of Madagascar's vanilla crop.**

OPERATIONS DISRUPTION

Extreme weather, including storms, floods, landslides cause loss of assets and disruption to operations and supply chains.

HEAT STRESS

High temperatures impact on health and productivity. In 2022, 1540 million hours were lost in agriculture in Madagascar due to heat exposure. **This could double by 2050.**

WATER SUPPLY

Only 54.4% of the population has access to basic water services

Employees face health risks associated with poor water supply, or malnutrition due to crop failure.

HEALTH AND SAFETY

Increased incidence of extreme weather will **reduce the number of days suitable for fishing,** as well as overall safety.

MULTI-HAZARDS

Sequences of events can prolong disruption and food insecurity, and reinforce existing dynamics of poverty, vulnerabilities, and in-equalities.

https://sahanala.net/about-us/

Climate risk scorecard for Sahanala's eleven climate risks, for baseline (1981-2000) and future (2050s; 2041-2060) scenarios*.

	Climate Risk	Baseline	2050s		
			Warm	Hot-wet	Hot-dry
	Drought				
	R1: Drought risk to crop failure				
	R2: Drought risk to water supply and health and safety				
	High temperatures				
	R3: Hot weather risk to crop failure				
	R4: Heat stress to workforce and equipment				
	Cyclones and heavy rainfall				
	R5: Cyclones, heavy rainfall and flooding risk to crops				
	R6: Cyclones and flooding risk to health and safety				
	R7: Landslide risk to operations				
	Sea level rise				
	R8: Saline intrusion risk to agricultural land				
	R9: Loss of assets due to sea level rise				
	Interdependencies				
	R10: Multi hazards/compound risk				
	R11: Habitat Loss and Suitability				

** The highest risk class across the five federations is given. Risk level for individual federations, or in specific geographic locations may be different. See the federation factsheets for more detail.*

Risk Class	Very Low	Low	Moderate	High	Very High

2.3 Case studies - recent climate events

Cyclone Gamane, March 2024

Tropical Cyclone Gamane made landfall on 29th March 2024, bringing with it major and prolonged rainfall, and significant damage to the regions of Sava, Diana and Analanjirofo. The National Office for Risk and Disaster Management estimated that over 88,000 people were displaced, with the primary impacts occurring through flooding. Our members suffered significant impacts including damage and destruction of their Vanilla vines, flooding and erosion of rice fields leading to food security, flood damage to houses, some of which were destroyed, and damage to roads and bridges which affected mobility and access to towns for markets and supplies.

In collaboration with a Malagasy non-profit, Fanamby, we supported members by distributing rice, haricot beans and sweet potato vines to over 10,000 members to support the recovery process, as well as providing access to medical supplies and staff.

A collection of images showing the damage caused by the Cyclone Gamane and the associated floods.

Maintirano Floods

Our expansion of maize production in the Maintirano area was severely delayed due to major flooding after extreme rainfall. Rice fields were completely flooded as well, resulting in a major decrease in rice production in the area. While most maize fields were not directly flooded, the floods destroyed bridges and roads, cutting off access to key areas for several months. This prevented equipment from reaching the sites and delayed ground preparation, significantly hindering progress compared to the strategic plan. Given that this expansion is crucial for diversifying our operations and reducing reliance on vanilla production, the impact was substantial.

2.4 Federation factsheets

The factsheets below provide details on risks for each federation, in addition to a sheet on cross cutting risks and multi-hazards affecting all federations (such as risks to health and safety). The factsheets summarise: what is the risk and the impacts and how the risk is projected to change by the 2050s. Actions for managing the risks for each federation are also summarised. See Sahanala's commitments in the next section for more details.

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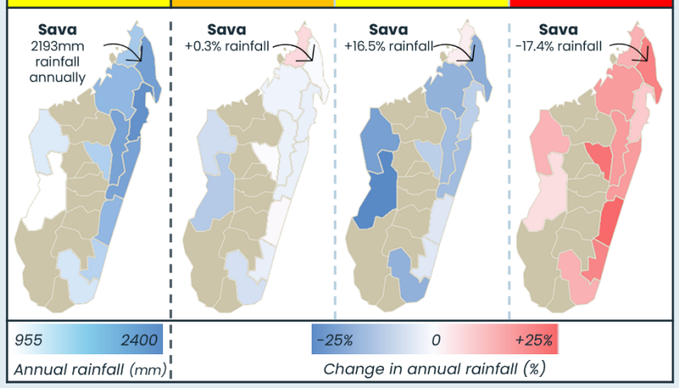
CROSS CUTTING, INTERDEPENDENT AND MULTI-HAZARD RISKS AND ADAPTATION

DROUGHT RISK TO WATER SUPPLY

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry



What is the risk?

Madagascar is not considered to be water scarce at a national scale, however, **only 54.4% of the population has access to basic water services**. Eastern Madagascar receives steady rainfall throughout the year, whereas southern Madagascar is semi-arid and exhibits seasonal water stress, with rivers running dry seasonally, further to groundwater vulnerable to long droughts.

Future shifts in rainfall distribution could result in greater impacts on water supply. With livelihoods dependent on successful harvests, employees face health risks associated with poor water supply, or malnutrition due to loss of income and/or poor food supply, which has historically led to migration away from drought.

HEAT STRESS TO WORKFORCE & EQUIPMENT

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

Maximum temperatures may **increase by up to 3°C by the 2050s**. High temperatures put stress on Sahanala's workforce and equipment at various stages of crop production.

Heat stress significantly reduces worker productivity. In 2022, agriculture in Madagascar lost **1540 million hours** due to heat exposure. **This could double by 2050.** Subsequently, crop yields could be impacted, particularly vanilla, which needs hand pollinating.

Farmers are at high risk of health conditions including dehydration, heat exhaustion and heatstroke.

Moreover, **heat-related impacts on health and productivity reinforce existing dynamics of poverty, vulnerabilities, and inequalities.**

MULTI-HAZARD & COMPOUND RISKS

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

Compound risks, such as the sequence of cyclones followed by droughts, can lead to prolonged food insecurity by destroying crops, contaminating water supplies and preventing recovery and new growth.

CYCLONES, HEAVY RAINFALL & FLOODING RISK TO SAFETY

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

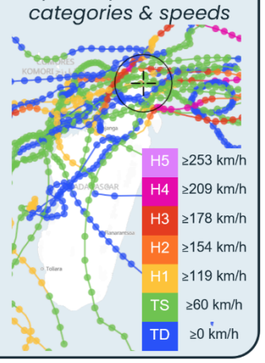
Cyclones and heavy flooding have the potential to impact affect workforce health and safety, both at work and in the wider community and affecting residential areas, and food and water supply. The storm surges, high winds and associated flooding can:

- Damage infrastructure and essential services.
- Cause outbreaks of water-borne diseases due to contaminated waterways.
- Damage housing and quality of life of workers.
- Reduce the number of safe working days, particularly for fisheries.

Madagascar's direct losses and emergency costs from tropical cyclones amounts to $107 million annually.

The exposure of Maintirano to cyclones is much lower than that of vanilla, nuts and spices due to a reduced number of cyclones hitting the west coast. With temperatures projected to increase, **storm intensity and frequency of events will increase**.

North Madagascar tropical cyclone tracks, categories & speeds



MANAGING MUTLI-HAZARD AND INTERDEPENDENT RISKS

GOVERNANCE	RISK MANAGEMENT	MONITORING	TARGETS
Improved board oversight of climate risks will ensure a comprehensive and **integrated approach to addressing multi-hazard and interdependent risks** to enhance resilience against the multifaceted impacts of climate change . *(G1, G2, G3)*	**Finance:** strategic investment decisions, climate resilience loans, disaster recovery insurance and funding *(R1, R8, R9, R10)*. **Education and awareness raising:** Review Technical Assistance (TA) curriculum, use Sahanala radio to share knowledge *(R3, R4, R5)*. **Monitoring and reviewing risks:** Regularly review risk register, deploy weather stations and develop seasonal forecasts *(R2, R6)*.	Deploy low-cost weather stations *(M2)*.	Diversify to reduce reliance on vanilla – 50% of revenue by 2030 *(T1)*. Designate climate adaptation officers by 2026 *(T2)*, adaptation integrated into TA by 2027, *(T3)* and produce adaptation funding proposal by 2026 *(T4)*.

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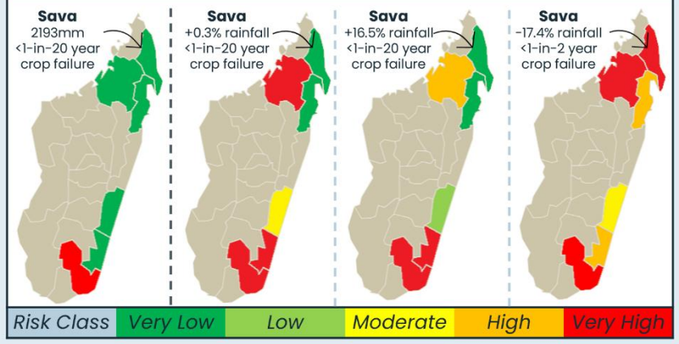
VANILLA CLIMATE RISKS AND ADAPTATION*

*See also interdependent and multi-hazard risks sheet

DROUGHT RISK TO CROP FAILURE

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry



What is the risk?

Vanilla orchids are sensitive to water stress and require a **minimum of 1500mm of rainfall each year**. Reduced water availability can impact on their growth, can lead to reduced flowering and poor pod development, directly impacting yield and quality.

In Sahanala's vanilla growing regions, **wet season rainfall is projected to become up to 20% less by the 2050s.** Therefore, while the chance of crop failure due to drought has been very low historically, by the 2050's, Analanjirofo could experience vanilla crop failure due to low rainfall every 1-in-3 years, while Sava, Atsimo Atsinanana and Sofia could experience **vanilla crop failure due to low rainfall approximately every 1-in-2 years** under the hot-dry future scenario.

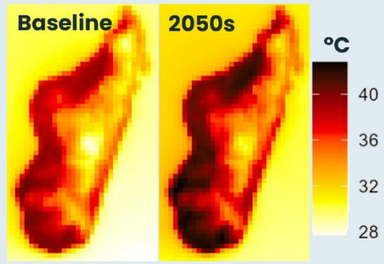
HEAT RISK TO CROP FAILURE

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

Vanilla is tolerant to a wide range of temperatures (20°C to 32°C). However, rising temperatures and **heat stress can affect the growth cycle of vanilla orchids**, potentially leading to reduced flowering and **lower yields** of vanilla beans. **Key equipment** used to process the vanilla pods may **overheat**.

Madagascar has been experiencing **increasingly severe heatwaves** due to climate change. Projections show that maximum temperatures will **increase by up to 3°C by the 2050s**.



Max of max temperatures

LANDSLIDE RISK TO OPERATIONS

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

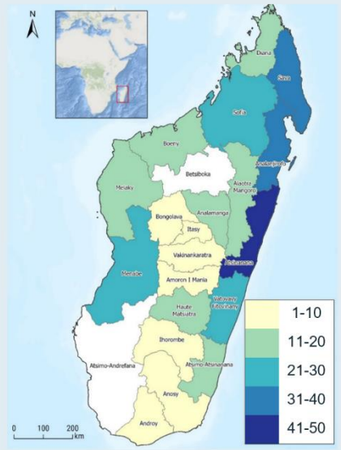
Increased frequency and intensity of heavy rainfall will impact slope and bedrock stability and landslide occurrence proportionally, subsequently disrupting agricultural operations.

CYCLONES, HEAVY RAINFALL AND FLOODING RISK TO CROPS

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

Cyclones consist of a range of hazards including wind, storm surge and flooding caused by heavy rainfall. Madagascar is highly exposed to tropical cyclones, and the impact of cyclones on vanilla production can be severe, causing **substantial damage to vanilla plantations through strong winds and heavy rains**, resulting in physical damage to vanilla vines, uprooting of plants, breaking of trellises, and flooding of fields. The aftermath of a cyclone can lead to significant crop losses and prolonged recovery periods for plantations.



Number of cyclones 2000-2023

With temperatures projected to increase, **storm intensity and frequency of events will increase, potentially increasing the number of multi-year events** as the western Pacific ocean continues to warm.

In the most extreme case todays 1-in-100 year event could become a 1-in-25 year event, by the 2050s.

MANAGING THE RISKS TO VANILLA CROPS

GOVERNANCE	RISK MANAGEMENT	MONITORING	TARGETS
Improved board oversight of climate risks will ensure that the impacts of climate change on the vanilla federation are fully reviewed, monitored, **sufficiently financed** and **effectively and strategically managed**. *(G1, G2, G3)*	**Finance:** strategic investment decisions, climate resilience loans, disaster recovery insurance and funding *(R1, R8, R9, R10)*. **Education and awareness raising:** Review Technical Assistance (TA) curriculum, use Sahanala radio to share knowledge *(R3, R4, R5)*. **Monitoring and reviewing risks:** Regularly review risk register, deploy weather stations and develop seasonal forecasts *(R2, R6)*. **Innovation:** Develop climate resilient vanilla varieties and practice *(R7)*.	Track the the calendrier de floraison and key agro-climate variables *(M1)*. Deploy low-cost weather stations *(M2)*.	Diversify to reduce reliance on vanilla – 50% of revenue by 2030 *(T1)*. Designate vanilla climate adaptation officers by 2026 *(T2)*, adaptation integrated into TA by 2027, *(T3)* and produce adaptation funding proposal by 2026 *(T4)*.

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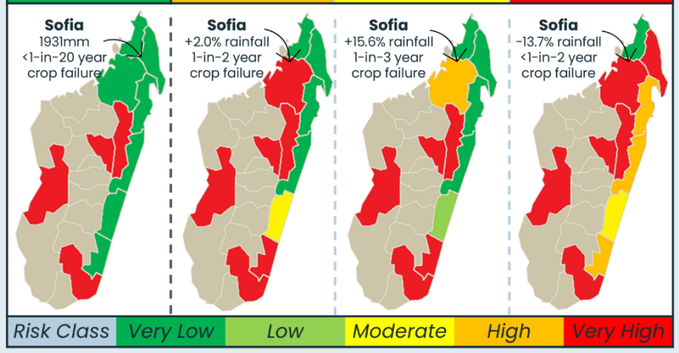
NUTS & SPICES CLIMATE RISKS AND ADAPTATION*

*See also interdependent and multi-hazard risks sheet

DROUGHT RISK TO CROP FAILURE

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry



What is the risk?

The nuts and spices federation's operating regions largely overlaps that of the Vanilla federation geographically and, with comparable minimum rainfall requirements (1500mm) for ginger, pepper, and cashew nuts, therefore impacts are largely similar.

Some growing regions are already experiencing rainfall shortages every year, and under future climates, rainfed irrigation will still need to be supplemented with irrigation to avoid crop failure.

Sofia and Atsimo Atsinanana could experience **poor yields approximately every 1-in-2 years in the 2050s**, despite crop failure being highly unlikely (<1-in-20 year) in the baseline period, indicating the greatest impact in these regions without adaptation.

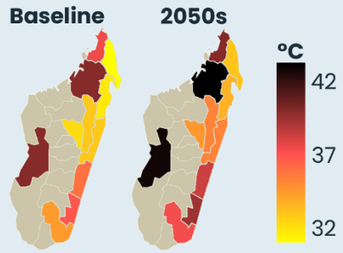
HEAT RISK TO CROP FAILURE

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

Average of maximum daily temperatures currently exceed upper temperature tolerances for ginger (25°C) in most growing regions and for pepper (29°C) in Diana and Menabe. Cashew has the widest tolerances, however, extreme temperatures in Menabe could exceed 41°C by the 2050s, which could be critical for crop failure.

Key equipment used to process nuts & spices may overheat in extreme weather conditions. This could increase maintenance costs or cause delays.



Max of max temperatures

LANDSLIDE RISK TO OPERATIONS

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

Increased frequency and intensity of heavy rainfall will impact slope and bedrock stability and landslide occurrence proportionally, subsequently disrupting agricultural operations.

CYCLONES, HEAVY RAINFALL AND FLOODING RISK TO CROPS

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

Nuts and spices are grown in Madagascar across the country in northern, eastern, western and central locations. Many nuts and spices are therefore exposed to cyclones, particularly nuts & spices grown in the eastern coast of Madagascar. Similarly, heavy rainfall and landslides occur in these areas, exposing the crops to these hazards.

Cyclones and heavy flooding along with landslides can displace sowed seeds, preventing the nuts and spices from germinating. Waterlogging can create unsuitable soil conditions for most nuts and spices to germinate affecting crop yield, further to creating conditions that allows mold, fungus and diseases to form on the crop.

The crops are exposed to widespread destruction from high winds and flooding. In January 2023, Tropical Cyclone Cheneso brought wind speeds of 90km/hour and caused widespread flooding and damage to 141,000 hectares of cropland across Madagascar, resulting in economic losses and food insecurity

Hectares of cropland damage, Cyclone Cheneso, January 2023

Region	Hectares
Diana	3300
Sava	2491
Analanijirofo	2372
Analamanga	773
Vatovavy-Fitovinany	9261
Alaotra-Mangoro	10,856
Atsinanana	7060

MANAGING THE RISKS TO NUTS AND SPICES

GOVERNANCE	RISK MANAGEMENT	MONITORING	TARGETS
Improved board oversight of climate risks will ensure that the impacts of climate change on the nuts & spices federation are fully reviewed, monitored, **sufficiently financed** and **effectively and strategically managed**. *(G1, G2, G3)*	**Finance:** strategic investment decisions, climate resilience loans, disaster recovery insurance and funding *(R1, R8, R9, R10)*. **Education and awareness raising:** Review Technical Assistance (TA) curriculum, use Sahanala radio to share knowledge *(R3, R4, R5)*. **Monitoring and reviewing risks:** Regularly review risk register, deploy weather stations and develop seasonal forecasts *(R2, R6)*.	Track the the calendrier de floraison and key agro-climate variables *(M1)*. Deploy low-cost weather stations *(M2)*.	Diversify to reduce reliance on vanilla – 50% of revenue by 2030 *(T1)*. Designate nuts & spices climate adaptation officers by 2026 *(T2)*, adaptation integrated into TA by 2027, *(T3)* and produce adaptation funding proposal by 2026 *(T4)*.

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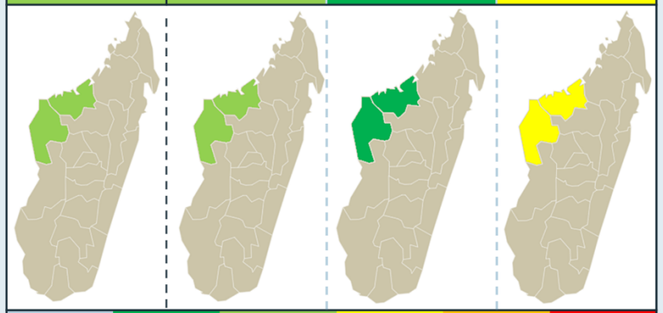
MAINTIRANO CLIMATE RISKS AND ADAPTATION*

*See also interdependent and multi-hazard risks sheet

DROUGHT RISK TO CROP FAILURE

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry



What is the risk?

Exposure to drought is currently low in primary growing areas for the Maintirano Federation, but climate change impacts on rainfall distribution are set to impact the sowing, growing and harvesting stages of the Maintinaro federations main crops of rice and maize. **The length of the rainy season is set to shorten.** Subsequently, growing short crops twice in a year is less likely to be possible under future climates.

Further, due to changing rainfall patterns displacing the sowing period, **sowing may require more precise timing**, which could lead to overall reduction in the area that can be sown, or increased crop failure do to sowing too early, in addition to **increased vulnerability to compound hazards** (i.e. if a storm or other hazard occurs during the narrowing sowing period).

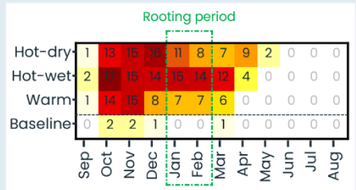
HEAT RISK TO CROP FAILURE

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

Both maize and rice exhibit similar optimal seedling emergence and rooting temperatures of 25-28°C, with this plant life stage occurring during the summer. Although lower thresholds occur at other plant life stages, they correspond with cooler periods of the year. Therefore, **germination and rooting represent the most critical stages relative to heat stress**.

Under future climates, average temperatures above 28°C will be common, further to maximum temperatures **frequently above 28°C**, particularly in Menabe, which could lead to **reduced crop yields**.



Days per month average temperature >28°C in the 2050s in Menabe

LANDSLIDE RISK TO OPERATIONS

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

Increased frequency and intensity of heavy rainfall will impact slope and bedrock stability and landslide occurrence. Risk in Maintirano is more limited due to topography.

CYCLONES, HEAVY RAINFALL AND FLOODING RISK TO CROPS

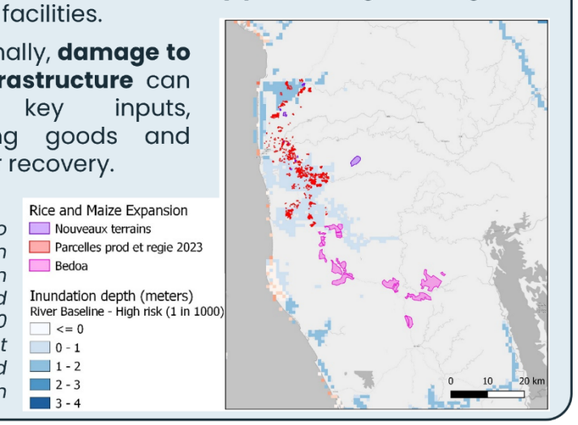
Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

Cyclone exposure for the Maintirano Federation is low with cyclones hitting the west coast exhibiting **less destructive windspeeds as those that impact the east coast**. However, heavy rainfall associated with cyclones can drive flood risk, and the **expansion areas are currently at risk of river flooding;** in 2023, Sahanala experienced significant flood damage.

The strongest cyclone that has impacted the west coast of Madagascar was Belna in 2019 with wind speeds of 135 km/hr (category 1 storm). Belna caused **devastation to crops** in Melaky and Menabe. Cyclones such as Belna could **destroy processing buildings** and storage facilities.

Additionally, **damage to key infrastructure** can delay key inputs, exporting goods and disaster recovery.



Maintinaro federation expansion areas and 1-in-1000 year event river flood depth

MANAGING THE RISKS TO MAINTIRANO CROPS

GOVERNANCE	RISK MANAGEMENT	MONITORING	TARGETS
Improved board oversight of climate risks will ensure that the impacts of climate change on the Maintirano federation are fully reviewed, monitored, **sufficiently financed** and **effectively and strategically managed**. (*G1*, *G2*, *G3*)	**Finance:** strategic investment decisions, climate resilience loans (*R1*, *R8*). **Education and awareness raising:** Review Technical Assistance (TA) curriculum, use Sahanala radio to share knowledge (*R3*, *R4*, *R5*). **Monitoring and reviewing risks:** Regularly review risk register, deploy weather stations and develop seasonal forecasts (*R2*, *R6*).	Track the the calendrier de floraison and key agro-climate variables (*M1*). Deploy low-cost weather stations (*M2*).	Designate Maintirano climate adaptation officers by 2026 (*T2*), adaptation integrated into TA by 2027, (*T3*) and produce adaptation funding proposal by 2026 (*T4*).

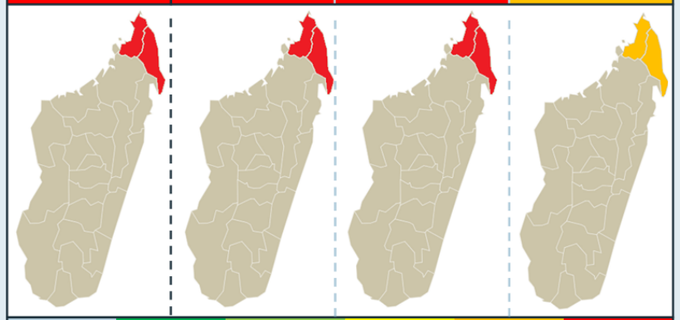
SAHANALA
MADAGASCAR

FISHERIES CLIMATE RISKS AND ADAPTATION*

*See also interdependent and multi-hazard risks sheet

CYCLONES, HEAVY RAINFALL AND FLOODING RISK TO HEALTH & SAFETY

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry



What is the risk?

Sudden severe winds and their associated waves are responsible the majority of **casualties and loss of boats** in fishing communities. Following a consistent decrease in available fishing hours over the period 1979-2020, further to less predictable weather patterns, climate change is expected to increase the incidence of extreme weather and high winds, both **affecting the number of days suitable for fishing** and overall safety for Sahanala's fishing associations.

The likely **increase in cyclone intensity will affect** both the **safety of fishers** while at sea, as well as **Sahanala's fishery assets**, including the processing site at Apondra, with ongoing sea-level rise exacerbating the impact of storm surges.

HABITAT LOSS & SUITABILITY

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

Climate change, through a combination of increased sea-surface temperatures, changes to marine currents, combined with habitat destruction and overfishing will increase pressure on coral reefs and mangroves, **with particular threats from coral bleaching and changes to mangrove salinity.** Both ecosystems are critical for biodiversity and play an important role in maintaining productive fisheries.

The majority of revenue in the Fisheries federation is generated through Octopus fishing. Octopus are an adaptable species, however, research suggests that climate change could drive a potentially **significant reduction in O. Vulgaris (octopus) species along the north coast of Madagascar.**

DROUGHT RISK TO WATER SUPPLY

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

Future shifts in rainfall distribution could result in **greater impacts on water supply and sanitation**, although lower impacts are projected in Sahanala's fisheries, located in wetter northern regions of Diana and Sava.

*See also interdependent risks sheet

LOSS OF ASSETS DUE TO SEA LEVEL RISE

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry
+ 5cm (by 2020)	+ 20cm	+ 34cm (+77cm by 2100)	+ 25cm

What is the risk?

The fisheries federation it is at the greatest risk from sea-level rise and coastal erosion. A high scenario indicates **0.34m sea level rise by 2050**, and a medium scenario of 0.25m. Risk of direct loss of land or assets due to coastal erosion and inundation is low. However, sea level rise **will increase the impact of storm surges** during cyclones, with more frequent or intense coastal flooding; enhanced coastal erosion; loss and change of coastal ecosystems.

HEAT STRESS TO WORKFORCE & EQUIPMENT*

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

Fishery workers are at high risk of multiple health conditions including dehydration, heat exhaustion, and heatstroke.

In Diana, **days with maximum temperature above 35°C are set to double** from one month to two months per year by 2050, which will reduce worker productivity and heighten health risks for workers.

*See also interdependent risks sheet

MANAGING THE RISKS TO FISHERIES

GOVERNANCE	RISK MANAGEMENT	MONITORING	TARGETS
Improved board oversight of climate risks will ensure that the impacts of climate change on the Fisheries federation are fully reviewed, monitored, **sufficiently financed** and **effectively and strategically managed**. *(G1, G2, G3)*	Climate-driven changes in habitat suitability are closely linked to other pressures from humans, therefore needing an integrated approach to fisheries management and marine habitat protection in order to reduce species loss. **Finance:** strategic investment decisions, climate resilience loans *(R1, R8)*. **Education and awareness raising:** Review Technical Assistance (TA) curriculum, use Sahanala radio to share knowledge. *(R3, R4, R5)*. **Monitoring and reviewing risks:** Regularly review risk register, deploy weather stations *(R2, R6)*.	Deploy low-cost weather stations *(M2)*. Monitor sea-level rise, salinity and rates of coastal erosion *(M3)*.	Designate Fisheries climate adaptation officers by 2026 *(T2)*, adaptation integrated into TA by 2027, *(T3)* and produce adaptation funding proposal by 2026 *(T4)*.

SAHANALA MADAGASCAR

TOURISM CLIMATE RISKS AND ADAPTATION*

*See also interdependent and multi-hazard risks sheet

HABITAT LOSS & SUITABILITY

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

Madagascar's unique wildlife is the major driver of Sahanala's tourism business, with lodges positioned to provide access to unique ecosystems across the island. Our tourism business operates within protected areas, and has been designed to provide local communities with alternative sources of income so as to reduce deforestation pressure.

Although the business model recognises the need to protect these environments, climate change adds and additional stress to these environments, and may impact on both ecosystem integrity and the distribution of key species, with increasing fire risk a particular concern. Without action, climate change is likely to decrease the number of species in Madagascar. High intensity cyclones may damage habitats and facilities, with the environment around Sahanala's northern Anjahakely and Daraina lodges, most exposed.

CYCLONES, HEAVY RAINFALL AND FLOODING RISK

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

As with most infrastructure, our tourist lodges suffer damage in the event of storms, cyclones and flooding, as well as damage to access roads leading to lodge closures. Damage to lodges can be significant and require major investment to repair, causing specific accommodation, or whole lodges, to be unusable for a period of time, and thus affecting revenue.

As an example, the 5th Akiba lodge that we used to operate remains closed at present, having suffered the cumulative impact of storm and flood events that have not yet been able to be repaired. Meanwhile, flooding of access roads in early 2025 caused the Anjahakely and Marafandilla lodges to close for 3 months, and the Anjozorobe lodge to close for 1 month.

LANDSLIDE RISK TO OPERATIONS

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

There is no direct landslide risk to our lodges, however, increasing heavy rainfall may increase road blockages from landslides, affecting access for both visitors to the lodge but also key equipment.

*See also interdependent risks sheet

DROUGHT RISK TO WATER SUPPLY

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

Drought is not currently a significant risk to our lodges and we are not a business that requires significant volumes of water. In a hot, dry scenario, however, there may be significant pressure on water resources, and we would need to monitor to see if water provision becomes a problem.

*See also interdependent risks sheet

HEAT STRESS TO WORKFORCE & TOURISTS*

Baseline 1981-2000	2050s Warm	2050s Hot-wet	2050s Hot-dry

What is the risk?

It is considered unlikely that overall tourist numbers would be affected by increases in maximum temperatures, however, there may be a need for additional consideration of how to maintain visitor comfort during the hottest months due to risks from heat stress .

*See also interdependent risks sheet

MANAGING THE RISKS TO TOURISM

GOVERNANCE	RISK MANAGEMENT	MONITORING	TARGETS
Improved board oversight of climate risks will ensure that the impacts of climate change on the Tourism federation are fully reviewed, monitored, **sufficiently financed** and **effectively and strategically managed**. *(G1, G2, G3)*	Continued community-led conservation to reduce existing human pressures will enhance the resilience of key ecosystems to climate change, however there may also be a need for more active monitoring, and targeted improvements to road sections at risk of flooding. **Finance:** strategic investment decisions *(R1)*. **Education and awareness raising:** Review Technical Assistance (TA) curriculum. *(R3)*. **Monitoring and reviewing risks:** Regularly review risk register *(R2)*. **Akiba lodge environmental agreements** (*R14*), ***Identify road sections at risk of flooding*** (*R15*)	Monitor key species distribution and habitat condition *(M4)*. Enhance forest fire monitoring and response *(M5)*	Designate Tourism climate adaptation officers by 2026 *(T2)*, adaptation integrated into TA by 2027, *(T3)* and produce adaptation funding proposal by 2026 *(T4)*.

3. Our approach to adaptation

Our members suffer acutely from the impacts of floods and cyclones, and the growing unpredictability of rainfall and temperature patterns, which undermine traditional growing practices and reduce yields. While we have not previously had a programme of activities specifically dedicated to adapting to Madagascar's changing climate, as an environmentally and socially conscious organisation there are several activities that we have implemented to build resilience amongst our members.



Reforestation and restoration

Sahanala has a well-established tree-planting programme, which is active in all of the regions in which we operate. In the first three quarters of 2024 we planted 75 ha, with 75,000 plants, selected for their suitability to local environmental conditions. The reforestation programme has benefits for climate adaptation, climate mitigation, as well as providing wider environmental and biodiversity improvements. It also helps to sensitize our members to the importance of environmental protection and stewardship.

Diversification

Sahanala recognizes that the current economic model that is highly dependent on vanilla production leaves us vulnerable to global price fluctuations and the impacts of extreme events such as floods and cyclones, as well as increasing risks from drought, heat, and rainfall variability. To address this, we have begun diversifying our revenue streams by expanding rice and maize production in the Maintirano region. Although this decision was not initially driven by climate change adaptation, developing activities in a region less prone to cyclones will help offset some of the financial impacts of such events and strengthen the company's resilience. A more diversified revenue base will also ensure that we can continue supporting our members in recovering from extreme events.

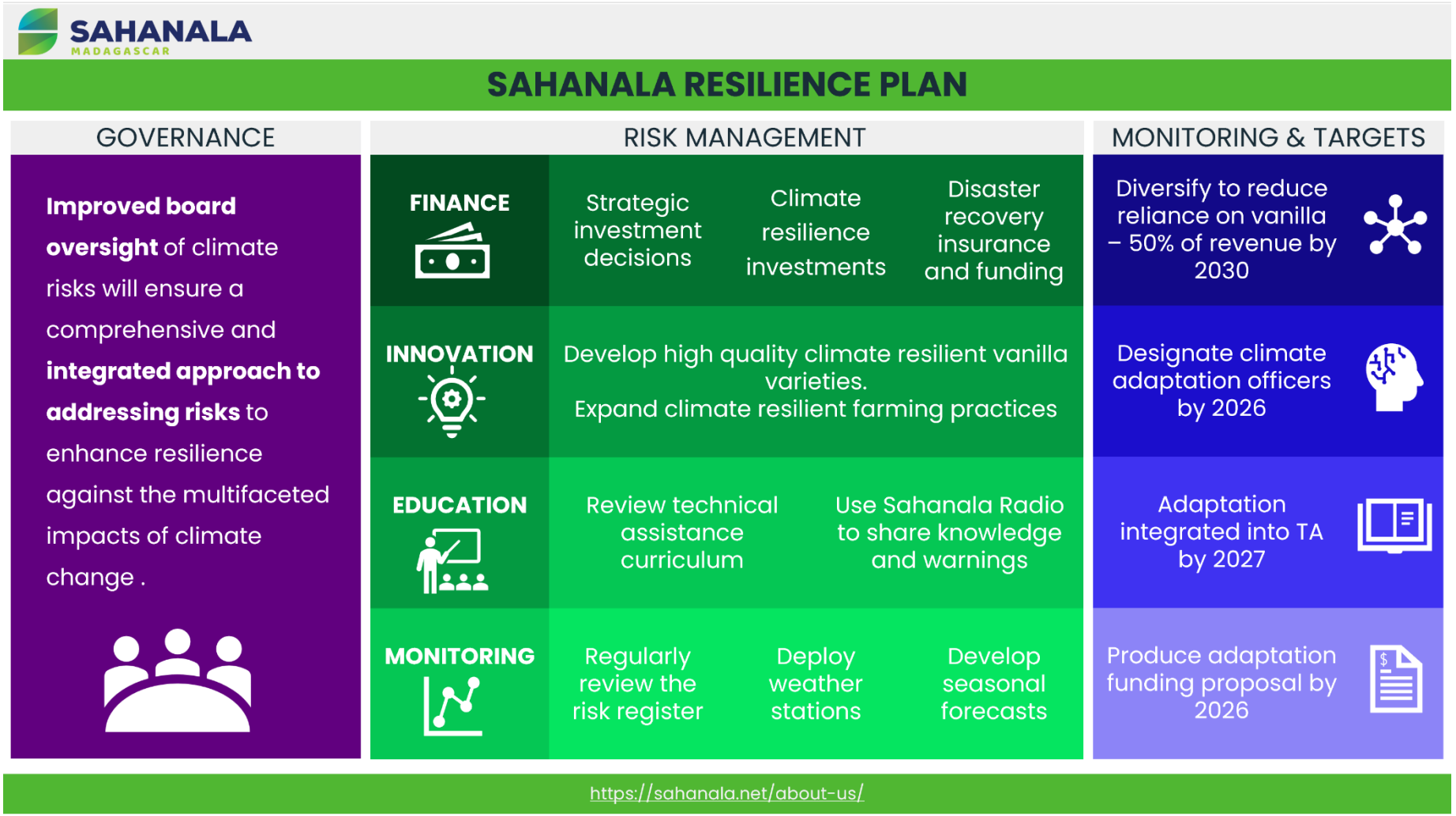
Disaster Recovery

We work closely with the National Office for Risk and Disaster Management to provide our members with immediate additional food and medical supplies in the wake of disasters such as cyclones or flooding, making use of our aviation service to deliver supplies within affected regions. For example, following Cyclone Garame, we supported members by distributing rice, haricot beans and sweet potato vines to over 10,000 members. This process helps our members to recover faster, and supports them to get back to productive livelihoods as quickly as possible. In this way the resilience of both members and their communities, and Sahanala overall, is strengthened.

Coastal Protection

We recognize that our fisheries federation is among the most vulnerable to the impacts of climate change, particularly sea-level rise, reef bleaching, fluctuating salinity, and coastal erosion. In response, we have undertaken several initiatives aimed at strengthening coastal and community resilience. This includes targeted investments in hard infrastructure, such as the construction of a sea wall to protect the fisheries processing facility, as well as a strong emphasis on nature-based solutions like mangrove planting and protection. In collaboration with Fanamby, we have significantly expanded mangrove coverage, which not only safeguards against coastal erosion and storm surges but also enhances fisheries productivity and provides vital environmental benefits. These efforts are integral to building long-term resilience, both for the communities dependent on fisheries and for the coastal ecosystems that support them.

3.1 Sahanala commitments and phased plan for resilience



Our participatory structure provides the foundation for a set of adaptation actions that will increase the resilience of our members, and Sahanala as a whole. Here we set out a number of commitments and plan to increase our resilience to the impacts of climate change. These actions have been organized into 3 categories: governance, risk management and monitoring & targets.

Governance

There are a set of measures that could be put in place to strengthen our governance of climate-related risks, which currently happens on an ad-hoc basis. This includes:

G1. Ensure that there is a person in charge of climate change adaptation, either by creating the role of climate change officer within the organisation, or including this portfolio within the responsibilities of our environment officer.

G2. Provide support to the Federations to build capacity so that each Federation also has a climate adaptation representative or champion.

G3. Add climate change as a standing agenda item on the Board/*Conseil d'Administration*, to ensure that risks relating to climate change are regularly discussed.

Risk Management

R1. We do not currently have a systematic process for including climate risk and adaptation in our strategic decision-making. We will seek to create a simple process to include climate change in strategic investment decisions – for example the siting of new facilities – which also takes advantage of the enhanced monitoring processes we will put in place (see M1 and M2).

R2. Climate risk register – the findings of the associated climate risk assessment will form the basis of our new climate risk register. This will be regularly reviewed and updated, based on the emerging information collected in M1 below. All risks will have a clear owner, and target.

R3. Review our existing Technical Assistance curriculum and identify key areas where climate risk and adaptation needs to be included. This might include awareness-raising of key risks and likely changes in climate, best practice information on climate-smart agricultural practices, and information on growing more drought-resistant crops to support the subsistence production of our growers. Subsequently develop this material.

R4. Following the development of the technical assistance material, give a specific climate change adaptation focus to the next programme of technical assistance.

R5. Enhanced use of Sahanala Radio – we currently have one operational radio station, and have received a license for a second, in Maintirano. These radio stations provide a good avenue for awareness-raising on climate adaptation, and the dissemination of warnings and other relevant information. We will explicitly seek to develop a programme of climate-related information that can be relayed through these stations.

R6. Although our members make use of public weather forecasts delivered through the radio, it has been noted that:

- *These are not always reliable due to the highly varied nature of the landscapes in which we operate.*
- *The use of seasonal forecasts to support planting and growing decisions has not yet been adopted.*

We will therefore seek to work with partners to identify whether tailored seasonal forecasts exist that could support our members, and if not whether there are options for their development. In parallel, we will explore the deployment of low-cost weather stations (see below) in order to better understand weather conditions in our areas.

R7. Climate resilient vanilla varieties and practice – building on our existing research and breeding programme for Vanilla, we will seek to trial varieties which are more resilient to drought and heat. In parallel, we will identify example demonstration sites where growers could implement the full set of CSA principles from our curricula, in order to demonstrate their value and increase adoption.

R8. As a company we already have a well-developed system for small-scale loans to our members which are then paid back through produce. These loans are currently designed as a set of options which can cover labour costs, and other key inputs. We will explore the option of adding specific options within this designed to build climate resilience. This would need to follow significant sensibilisation, however, in order to demonstrate the value of these options.

R9. As a company we experience significant weather and climate-related financial impacts, both because of reductions in production, and our commitment to provide our members with food and medical supplies to help them recover from significant events. Insurance is one way of managing this risk, but while disaster insurance and index-based crop insurance offer strong potential, they have not been widely available in Madagascar. To address this gap, in collaboration with partners, we will explore:

- Newly emerging pilots of index-based insurance (e.g. World Bank), and disaster recovery insurance.
- Financial risk-sharing mechanisms that we as a company could put in place.

R10. Following a disaster we provide direct assistance to our members. To manage the cost of this, we will consider reserving a small portion of our profits to build up a disaster recovery fund which can used for these cases.

R11. Flooding is a significant risk, and a major flood in 2023 caused significant losses in Maintirano, and has slowed down the growth of the Federation, which is key to our diversification strategy. The drainage and flood protection upgrades required are beyond that which Sahanala can fund ourselves. As such, we will look to develop a funding proposal, in partnership with the local district, for a programme of flood protection and drainage improvements in Maintirano, with a specific focus on accessing sources of climate or sustainable finance.

R12. Maintirano Pivot Irrigation: We have identified the need for pivot irrigation to support our own Maize growing operations in Maintirano, which, among other benefits would significantly increase our resilience to drought and rainfall variability. This is, however, a major investment, and one which is not yet funded. As such, we will seek funding opportunities, including accessing sources of climate finance, to support implementation of pivot irrigation for Maize.

R13 Our Tourism operations rely on the continued conservation of key ecosystems and habitats, for which climate change poses an additional threat. Our model is inherently conservation-focused, with 10% of Akiba lodge revenues invested in conservation measures. We will, however, in partnership with Fanamby, review whether existing conservation management plans need to be adapted to account for climate change.

R14 For each Akiba lodge we will establish a collaboration agreement for each site that specifies the responsibilities of the members, Fanamby, and the lodge with regards to actions to build resilience, including catchment management, and the management of wood and other forest resources.

R15 Identify the sections of key access routes which cause lodges to be cut off when flooded, and possible solutions to ensure more year-round access. These improvements could be included within the proposal suggested in **R11.**

Monitoring and Targets

There is a need to better record and monitor the effects of climate change to build a stronger evidence base for our decision-making. We propose a dual approach to monitoring, seeking to incorporate improved meteorological monitoring, with association-based collection of data.

M1. We already ask our associations to track and record certain information for us, for example the flowering calendar, which records how many vanilla flowers are blooming each day, allowing us to track the peak flowering period and forecast the moment of maximum harvest. In a similar approach, we could ask the associations to record key agro-climatic information including:

- Dates of beginning of the rainy season
- Any significative dry periods within the season
- Dates of the end of the rainy season
- Number of days hot enough to affect crop production
- Any other significant events (flooding, abnormal winds, days fishing lost to bad weather etc)

This information could be collected and analysed by Sahanala, building up a picture of localised changes and allowing us to adjust the advice provided to associations if required.

M2. A key problem identified is the lack of local meteorological data, which both limits out understanding of changes, and our ability to tailor the general meteorological information provided publicly to provide relevant forecasts and advisories. We will explore options for the deployment of low-cost weather stations in targeted locations to close this gap.

In tandem, these actions will help us to strategically monitor changes in our areas of operations and better understand and manage evolving risks.

M3. As mentioned above, there is a need to monitor rates of sea-level rise, salinity and coastal erosion, to ensure that additional protection can be planned as required. As such, we will explore low-cost monitoring options that will provide a baseline to begin to gather this information.

M4. Monitor the distribution of key species, and the condition of habitat in order to proactively manage the combination of threats from climate change and human pressures.

M5. Enhance capacity to monitor forest fires, including the potential to use forecasts of dangerous fire conditions to predict likely occurrence. Strengthen capacity to respond to fires when started.

Targets

As an organisation we commit to the following key targets:

T1. A 50:50 split in revenue by 2030 between Vanilla and our other activities. This diversification will reduce the impact of poor vanilla yields, as well as global price volatility.

T2. The designation of climate adaptation officer for both HQ (by 2025) and for each Federation (2026).

T3. Climate adaptation to be integrated into our existing technical assistance programme by 2027.

T4. Developing at least one proposal for climate adaptation-related funding by the end of 2026.