

# **Pest Management Plan**

**Date 19<sup>th</sup> January 2024**

**CEPF Grant 114632**

**Ecosystem Restoration Alliance Indian Ocean (ERA)**

***Embracing Ecosystem-based Adaptation for a Sustainable Future in  
Mauritius***

**Baie du Cap Estate Ltd., La Prairie, Mauritius (MUS-3)**

## **Grant Summary**

1. Grantee organization.  
Ecosystem Restoration Alliance Indian Ocean
2. Grant title.  
Embracing Ecosystem-based Adaptation for a Sustainable Future in Mauritius
3. Grant number.  
114632
4. Grant amount (US dollars).  
271,483
5. Proposed dates of grant.  
1<sup>st</sup> April 2024 to 31<sup>st</sup> December 2026
6. Countries or territories where project will be undertaken.  
Mauritius
7. Summary of the project:

Mauritius is often described as a plant diversity hotspot, however the island's ecosystem is among most degraded in the world. Since the human colonisation in the 16th century the island has undergone significant deforestation followed by high rate of extinction of both plants and animals.

Around 25% of the island is still covered in forest of which ca. 17% is a planted forest and the rest is native secondary forest. Unfortunately, the native forest is highly degraded due to many invasive species (plants and animals) and currently only about 2% of the native forest is considered to be of a good quality.

Due to the lack of a properly functioning forest ecosystem and ongoing climate change, Mauritius is facing devastating consequences. The temperature and sea level are rising at faster rate when compared to the global average. Mauritius has already lost up to 10 m of its beach while coral bleaching and death will only accelerate the process. Over recent years Mauritius started to be exposed to different weather anomalies such as more frequent and intense cyclones, flash floods or prolonged droughts.

Mauritius evolved adaptations to weather changes and cyclones with several different microclimates and one of the densest forests across the globe. Additionally, the island was protected by well-developed coral reefs and mangrove forests along with the coastal forest (which is now extinct on the main island).

However, ongoing degradation of the native forest reduces ecosystem services (ES) which are crucial for the survival and wellbeing of the human population and economic activities but also to all the remaining native and endemic flora and fauna, while new weather and climate patterns will disrupt evolved adaptations to weather changes.

A vital role of remnant native forests in Mauritius is to regulate the hydrological cycle including water retention and replenishment of aquifers as well as soil stabilization and protection of lagoons from siltation which is detrimental to coral reefs. Landslides are common in Mauritius along with soil leaching. Heavy rains around mountainous areas bring soil down to the residential areas increasing the damage. Soil leaching increases the use of fertilizers which pollute rivers while the lack of healthy and resilient forest ecosystems fail to filter the water thus bringing pollution to the lagoons and accelerating coral bleaching, increasing lagoon life degradation and coastal erosion.

As the impacts of climate change intensify, understanding and implementing effective adaptation strategies become critical. Ecosystem based adaptations (EbA) offer a nature-based approach that utilizes the services and functions of ecosystems to enhance the resilience of human communities and the environment to climate change. Forest restoration is the key to EbA that will benefit humans and nature. By focusing on strengthening ecosystem functions and services, EbA contributes to building resilience in ecosystems and communities. Research can identify critical factors that enhance resilience and help optimize adaptation strategies for different regions and ecosystems.

This project is dedicated to exploring the intricate relationship between biodiversity conservation, ecosystem service provision, and the application of ecosystem-based adaptations in agriculture. Our objective is to enhance food security and strengthen resilience against the unpredictable nature of climate change. A pivotal part of this project is the restoration of at least 10 hectares of forest within the Baie du Cap Estate, accompanied by extensive research.

8. Date of preparation of this document.  
19<sup>th</sup> January 2024

**Pest Management Approach:** This section should describe your understanding of the problem, your experience with pest management issues, and your proposed actions during the project. Specifically, what do you intend to do and how will you do it? The information presented should include methods of application, e.g. by hand or via aerial spraying.

9. Current and anticipated pest problems relevant to the project.

Invasive alien plants are the greatest threat to the preservation of Mauritius' remnant forest. At Baie du Cap, most common exotic trees are Tecoma (*Tabebuia pallida*) and Chines Guava (*Psidium cattleianum*) which form dense monotypic stands and suppresses other species. Guava is a very fast growing tree and easily outcompetes native and endemic plant species. Among the exotic species recorded are *Ardisia crenata*, *Furcraea foetida*, *Ravenala madagascariensis*, *Hiptage benghalensis*, *Ligustrum robustum* var. *walkerii*, *Syzygium jambos*, *Litsea glutinosa*, *Wikstroemia indica*, *Clidemia hirta* and *Leucaena leucocephala* which are listed among the 100 worst invasive species by the Invasive Species Specialist Group. The fast-growing invasive guava (*Psidium cattleianum*), which is the most problematic. It occurs in large numbers and regenerate quickly after being cut down. It can spread rapidly if unmanaged. In open restoration sites (areas of low quality native forest), emerging weeds such as *Mikania micrantha* and *Chromolaena odorata*, are fast-growing light loving species with short generation times. Regular maintenance weeding is needed to control such species.

10. Current and proposed pest management practices.

Our proposed practices include the following methods depending on the species to be controlled:

-Herbaceous species, namely vines, herbs and grasses: uprooted (no herbicide) when they compete for resources with native plants. This is generally only done within a 0.5m

diameter around small native plants. Grasses are encouraged between, but not encroaching, planted seedlings as they help stabilize soil, act as a natural weed mat and keep soil humidity. Herbaceous weeds, excluding vines, which do not compete with young plants, are left if not in close proximity. Once a closed canopy forms and a dense leaf litter develops, light-loving weeds are less problematic.

-Large trees (>4m): ring-barking with a machete followed by the application of herbicide to encourage the tree to die slowly and minimize damage from falling branches.

-Soft-wood trees such as ravenale (*Ravenala madagascariensis*) are controlled by injecting herbicide about 1m above the base. A hole is made with a drill to the center of the trunk and then herbicide injected with a syringe. A wooden pole slightly larger than the hole is then used as a stopper to prevent the tree exuding the herbicide. This method ensures that softwood trees die slowly and fall over with minimal damage to surrounding plants.

-Small trees: if these can be cut without damage to surrounding native vegetation then they are cut close to the base and herbicide applied directly to the cut stump.

The cut stumps of most woody species re-sprout and produce multiple stems hence the herbicide is used to minimize the re-growth.

Fast-growing weeds are the greatest threat to open restoration sites, to reduce weed establishment:

-Avoid adjacent open restoration sites as weeds can spread rapidly over large areas, increasing the need for regular maintenance. Keeping natural vegetation barriers reduces the spread of weeds between sites, thereby reducing management.

-Thin invaded areas and gradually replace the exotic vegetation to minimize light levels.

-Use woodchip mulch to create a weed mat and prevent weeds emerging. Once a closed native canopy has developed, lower light levels and leaf litter minimize the number of light loving weeds.

-Broadcast seeds of a light-loving native (such as *Urena lobata*) to outcompete the weeds.

Removal of cut or uprooted material is important for some species (e.g. *Mikania micrantha*, *Furcraea foetida*, *Hiptage benghalensis*, *Cassytha filiformis*, *Kalanchoe pinnata*).

11. Relevant integrated pest management experience within the project area, country or region.

Herbicide trials and advice from the University of Mauritius, Forestry Services and National Parks and Conservation Services have guided the design of a weed management strategy.

12. Assessment of proposed or current pest management approach and recommendations for adjustment where necessary.

The proposed weed management approaches are built on advice, experience and trials from multiple partners.

**Pesticide Selection and Use:** This section should provide a comprehensive understanding of the pesticide that will be selected, why it was selected and what efforts were made to assess risks to human health. Note that this section should also present information on the potential impacts that the selected pesticide(s) will have on natural ecosystems and non-target species.

13. Description of present, proposed and/or envisaged pesticide use and assessment of whether such use is in line with international good practice.

Garlon 4 (active ingredient: triclopyr). The only broad spectrum systematic herbicides that targets broad leaf weeds and woody species that are readily available in Mauritius from reputable companies are Garlon 4 and Tordon 101. Originally Tordon 101 was used but this herbicide was deemed less safe due to its volatility, longer decomposition rate and because it was verbally reported to have greater nontarget effects on indigenous plants. Garlon 4, albeit more expensive, was chosen instead as it is classified as class III (slightly hazardous) by the WHO Recommended Classification of Pesticides by Hazard (2005). Garlon 4 is applied only to cut stumps, ring-barked trunks, or injected into tree trunks so the risks of affecting non-target organisms are minimal. As application is directed and there is no foliar spraying, there is little chance of herbicide seeping into the groundwater.

14. Indication of the type and quantity of pesticides to be financed by the CEPF grant (in volume and dollar value) and/or assessment of increase in pesticide use resulting from the project.

Funding from CEPF is not being sought to cover the costs of the herbicide.

15. Chemical, trade and common names of pesticide(s) to be used.

Triclopyr, trichlopyr: 3,5,6-trichloro-2-pyridinyloxyacetic acid butoxethyl ester 61.6 %, Garlon 4

16. Form(s) in which pesticide(s) will be used (e.g., pellet, block, spray).

The herbicide is applied on cut trunks using a brush to limit the spread of the herbicide from sprayers due to e.g. wind.

17. Specific geographic description of where the pesticide(s) will be applied: province, district, municipality, landowners [do not give names of individual persons], and map coordinates (if available); and the total area (hectares) to which the pesticide(s) will be applied.

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Garlon 4 will be used to remove invasive plants on 10ha of the forest.

18. Assessment of environmental, occupational and public health risks associated with the transport, storage, handling and use of the proposed products under local circumstances, and the disposal of empty containers.

Garlon 4 is classified as class III (slightly hazardous) by the WHO Recommended Classification of Pesticides by Hazard (2005). Garlon 4 is applied only to cut stumps, ring-barked trunks, or injected into tree trunks so the risks of affecting non-target organisms are minimal. As application is directed and there is no foliar spraying, there is little chance of herbicide seeping into the groundwater. There is a low risk of herbicide contaminating waterways as there are no rivers or streams on site, only natural drains which are dry

except following heavy rainfall. The application of herbicide is not done during rainfall or if there is a threat of rainfall to avoid it being leached into the soil, affecting non-target organisms and because this water-soluble herbicide would be less effective.

19. Description of plans and results for tracking of damage to natural ecosystems and/or harm to non-target species prior to pesticide application and subsequent to pesticide application.

Damages to non-target species will be monitored by regularly visiting the site post-herbicide application and experimental plots. As herbicide does not immediately affect plants, it is possible to monitor impacts once weeding has been done. This is also easier to lower tree density. Any impacted plants can be readily identified by loss of leaves, wilting, bark damage and tree death.

20. Prerequisites and/or measures required to reduce specific risks associated with envisaged pesticide use under the project (e.g., protective gear, training, upgrading of storage facilities, etc.).

As with all chemicals, there are risks to human health arising from intentional or unintentional direct consumption, improper application resulting in the herbicide coming into direct contact with people or wildlife, inhalation of aerial sprays, or following food consumption. The risks are deemed minimal because of the following:

-Application procedure: directed, no foliar or aerial spraying.

-Rapid absorption of herbicide in through the plant cuticle, becoming completely rainfast within 2 hours.

-Low toxicity to humans. The US Environmental Protection Agency classifies it as Category D – “meaning there is no evidence it causes cancer in humans”.

-Follow manufacturer’s recommendations in terms of health and safety and application rates.

-Use of Bazasol Red, a colorant dye, to indicate where the herbicide has been applied, prevent unintended double applications, and to safeguard the staff as the dye can be detected if it comes into contact with skin or clothing. Dye markers allow for greater precision and accuracy as spray patterns can be easily identified, giving early indications of drift to non-target areas. Colorants also help reveal any faults in nozzles, applicators or safety clothing, and so can help to reduce operator contamination. Broken or poorly functioning equipment is replaced and only good quality applicators are purchased.

-Annual staff training about the risks of herbicide use and how to apply and handle herbicide safely both for the environment and staff well-being.

-Provision of vinyl gloves, gardening gloves and masks to reduce contact with the skin and inhalation. -Labelling of containers used for the application of herbicides and storage in a locked cupboard in an area only accessible by authorized personnel.

-A first aid kit is carried by personnel and one is kept in the staff mess room at all times. There are two trained first aiders on site. All staffs have access to doctor, an allowance of sick leave and medical insurance. Activities are always performed in teams.

-A Material Safety Data Sheet for Garlon 4 is kept with the chemical, with instructions on what to do should the product be ingested.

-Participation in weeding activities by the general public will be restricted to hand-pulling to avoid the use of herbicides as well as potentially dangerous tools.

-If herbicide application is needed in an area frequented by the general public, then this work will be done before the arrival of visitors. Visitors will be requested to remain on the paths and be explained that herbicides have been applied.

21. Basis of selection of pesticide(s) authorized for procurement under the project, taking into consideration the risks identified under Section 19, and the availability of newer and less hazardous products and techniques (e.g. bio-pesticides, traps).

Garlon 4 is chosen as it is rapidly absorbed through the plant cuticle, becoming completely rainfast within 2 hours and is regarded as having low toxicity to humans. The US Environmental Protection Agency classifies it as Category D - "meaning there is no evidence it causes cancer in humans".

22. Name and address of source of selected pesticides [do not give names of individual persons].

Dow AgroSciences LLC 9330 Zionsville Road Indianapolis, IN 46268

23. Name and address of vendor of selected pesticides [do not give names of individual persons].

Blychem Ltd., Royal Road, St. Pierre, Mauritius

24. Name and address of facility where pesticides will be stored.

Baie du Cap Estate Ltd. Herbicide is stored in a locked cupboard in a locked store.

**Policy and regulatory framework, and institutional capacity:** This section should describe the institutional and legal framework under which the pesticide(s) will be applied, with reference to the documentation and standards required under local and national law and international good practice. Where a particular pesticide is not regulated at the target site, you must identify similar pesticides and the applicable regulation in neighboring countries that could apply, and international good practice. You must also explain why this particular pesticide is necessary, even in the absence of national laws.

25. Policies on plant/animal protection, integrated pest management, and humane treatment of animals.

Animal Welfare Act 2013

The Plant Protection Act 2006

The Dangerous Chemical Control Act 2004

Mauritius Sugarcane Industry Research Institute examines integrated pest management approaches: <http://www.msiri.mu/index.php?rub=18> 27.

26. Description and assessment of national capacity to develop and implement ecologically based invasive alien species control [where relevant].

Mauritius has been controlling and tackling invasive alien plants for more than two decades. Actively involved in the control of invasive plants are the National Parks and Conservation Services, Forestry Services and private sector companies.

27. Description and assessment of the country's regulatory framework and institutional capacity for control of the distribution and use of pesticides.

The Local Government Act 2011 necessitates that all vendors in pesticides are regulated and have relevant licences. Under the Dangerous Chemical Control Act 2004 an import permit is required for the sale of herbicides. This is issued and enforced by the Ministry of Health & Quality of Life.

28. Proposed project activities to train personnel and strengthen capacity [list the number of people and what they are being trained in].

Field staff (10 people) will be trained annually in weeding, health and safety, planting techniques, nursery management and plant propagation.

29. Confirmation that the appropriate authorities were approached and that the appropriate licenses and permissions were obtained by the project.

The Ministry of Agro-Industry and Food Security/Forestry Services granted granting a permission to Baie du Cap Ltd. to weed 8ha of private mountain reserve and restore forest on 5ha of governmental land.

**Participatory preparation:** This section aims to outline the range of informed consultations that you have had both with experts to optimize the potential for success, and with stakeholders, particularly local communities, who are potentially affected by the use of pesticides (due to, for instance, proximity, use of certain areas for free-ranging livestock or non-timber forest product collection, etc.).

30. Dates, and results of expert consultations, if necessary.

Permission for weeding activities in the mountain reserve has been granted by the Forestry Services.

31. Dates, and results of consultations with local communities.

The land on which the herbicide will be used is private

**Monitoring and evaluation:** This section aims to outline the steps you will take to monitor and evaluate the purchase, storage, application and effects of the pesticide(s) in the target area.

32. Description of activities related to pest management that require monitoring during implementation.

Purchase, storage and use of herbicide will be monitored.

33. Monitoring and supervision plan, implementation responsibilities, required expertise and cost coverage.



Purchase monitoring: all items are signed for and sales are summarized annually providing a record of how much product is purchased.

Stocktake: daily record of stocktake is kept.

Use: the amount of herbicide used in weeding activities, together with the person hours, per restoration site is recorded. This enables analysis of amount of herbicide per hectare to weed different habitat types and in relation to the frequency and number of weed management activities. Use of herbicide can also be checked against purchase.

34. **Disclosure:** CEPF requires that pest management plans are disclosed to affected local communities and other stakeholders prior to project implementation. Please describe the efforts you have taken to disclose this plan.

The pest management plans have been disclosed and accepted by Baie du Cap Ltd.  
No local communities will be affected through the use of the herbicide.