



Portucel
Moçambique



CASE STUDY OF THE APPLICATION OF THE MITIGATION HIERARCHY OF IMPACTS ON BIODIVERSITY IN A FOREST SECTOR COMPANY: EXAMPLE OF PORTUCEL MOZAMBIQUE

COMBO: Conservation, Mitigation and Biodiversity Offsets



Maputo, August 2021

Project implementers



Project funders



Local partners



Published by:

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Citation:

Sidat, N., Costa, H., Nobre, F. (2021); “*Case Study of the Application of the Mitigation Hierarchy of Impacts on Biodiversity in a Forest Sector Company: Example of Portucel Mozambique*”; Wildlife Conservation Society and Portucel Mozambique, Maputo, Mozambique; 17 pp.

Acknowledgements:

We would like to thank our donors French Development Agency (AFD), French Facility for Global Environment (FFEM) and MAVA Foundation for their support.

Photos:

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1. CONTEXT

Like any development project carried out in the natural environment, forestry plantations also potentially generate both negative and positive environmental and social impacts. Assuming an environmental performance policy of continuous improvement, in October 2017 Portucel Mozambique signed a Memorandum of Understanding (MoU) with the Wildlife Conservation Society (WCS) Mozambique / COMBO Project to develop a case study on how the company has been applying the Mitigation Hierarchy (MH) of impacts on biodiversity in its eucalyptus forest plantation project in Zambézia province.

Between 2016 and 2020, WCS, Forest Trends and Biotope implemented the first phase of COMBO Program (Conservation, Mitigation and Biodiversity Offsets), which aims to reconcile economic development with conservation of biodiversity. Funding by the Agence Française de Développement (AFD), the Fonds Français pour l'Environnement Mondial (FFEM) and the Mava Foundation, the COMBO Project worked with public and private companies from various sectors whose activities have the potential to cause significant impacts on biodiversity, to develop case studies to support the adoption of best practices in the application of the Mitigation Hierarchy¹ (MH) and develop lessons learned.

This report describes the approach developed between Portucel Mozambique and WCS/COMBO, which included a constructive dialogue, sharing information and experiences about technical and organizational solutions at project and company level. This process looked at what was planned in the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) and what was actually implemented considering not only the legal requirements, but also the fact that the company aims to meet the International Finance Corporation (IFC) Performance Standards and to be certified in forest management (e.g. Forest Stewardship Council - FSC).

1.1 The company Portucel Mozambique and the Zambezia project

The Portucel Mozambique was created in 2009 by *The Navigator Company* (the former Portucel Soporcel Group) which is currently one of the world's leading manufacturers of bleached eucalyptus pulp, first in Europe, and the top European manufacturer of uncoated woodfree printing and writing paper (UWF).

Portucel Mozambique is a Mozambican company and is responsible for setting up one of the country's largest forestry projects integrated with a pulp and energy production industry, which envisages the installation of a Wood Chip Mill (phase 1) and a Pulp Mill (phase 2). In 2009 and 2011, the company received from the Council of Ministers 50 authorizations for the Right of Land Use and Utilization (DUAT) for 50 years (renewable), totaling 356 thousand hectares of land (173 thousand hectares in Zambezia and 183 thousand hectares in Manica), where up to two thirds of the total area can be used for forestry activities (mainly the establishment and management of eucalyptus plantations). The remaining one third is dedicated to agricultural areas, cemeteries/sacred/cultural areas, social areas/infrastructure and areas of interest for conservation purposes, aligned with the mosaic model.

1.2 The company approach towards biodiversity

The sustainability and forestry policy of *The Navigator Company* comprises a number of commitments. In order to achieve those, the company claims that it is continuously investing in reducing the potential environmental impacts of its operations. The company's vision of sustainability also includes the commitment to actively encourage all its partners and stakeholders to work together in their quest for sustainable development.

Portucel Mozambique has implemented a comprehensive mitigation plan which addresses the negative impacts using avoidance as the main criteria.

¹ A process that works in stages to reduce the impacts of a given activity on the environment and is composed of: avoidance, minimization, rehabilitation, restoration, and offsetting.

Ecological sensitive areas were defined under the EIA (2012-14), according to a set of criteria, and the main conclusions were that less than 37% of the entire area of Portucel's DUAT is considered to be ecologically sensitive (based on satellite images from 2010). This is due mainly to a high incidence of activities leading to ecological disturbance prior to the company's arrival (and which continue to happen), such as population growth, itinerant agriculture (currently the most significant ecological disturbance), local livestock farming, charcoal production, tree harvesting for timber (this process selectively removes certain key species and changes the ecosystem), snaring and other sorts of fauna trapping.

Portucel is owned by *The Navigator Company*. In 2014 the International Finance Corporation (IFC), a member of the World Bank, acquired a minority stake. Therefore, Portucel Mozambique needs to comply with IFC's Performance Standards², including Performance Standard 6 (PS6), focused on biodiversity aspects. The company intends to obtain forest management certification (e.g. FSC) and, for that, it has developed the technical prescription for identifying areas of High Conservation Values (HCV)³ in its operations, where any impacts should be avoided.

1.3 Overview of the study area

Although Portucel Mozambique, is developing its forestry project in Manica and Zambézia Province,



Figure 1. Mosaic plantation model

this study had a special focus on Zambézia Province. Portucel project footprint is located in the center of Mozambique, at Zambezia province with 173 thousand hectares of land, via DUAT (Land Use and Acquisition Rights). The forestry project is being implemented through the Mosaic model (Figure 1). It is a shared approach to rural areas, as it integrates plantations with the lands that communities and families retain for their own use. This is an innovative format that respects residential areas, sacred and religious sites, natural forests, protection and conservation areas, agricultural areas, and others indicated by the communities (Figure 2). A major advantage is that families and agricultural fields are not physically displaced, i.e., resettlement of families and communities is avoided.

As illustrated in Figure 3, the forest area is located in four districts, namely:

- Ile, Namarrói, Alto Molocué and Mulevala.

The area is localized inside the historical distribution of two types of generic Miombo woodland (Wild & Barbosa, 1967⁴):

- i. Semi-deciduous Miombo woodland of high precipitation:** in its natural condition, is more or less dense with a denser shrub layer. The dominant species is *Brachystegia spiciformis*. In secondary areas there is abundance of *Albizia adianthifolia*, *Harungana madagascariensis*, *Parinari curatellifolia*, *Oxytenathera abyssinica*, *Bauhinia petersiana*, *Piliostigma thonningii*, *Erythrophleum suaveolens*,



Figure 2. Cohabitation of forest plantations and housing

2 They provide guidance on how to identify risks and impacts and are intended to help avoid, minimize, and manage them as a way of doing business in a sustainable way with regard to project activities.

3 Natural habitats, with extraordinary significance or critical importance due to their high biological, ecological, social or cultural values.

4 Wild, H. & Barbosa, L.A. Grandvaux. 1967. Vegetation map of the Flora Zambesiaca area. Flora Zambesiaca supplement, 71 pp. Collins, Salisbury.

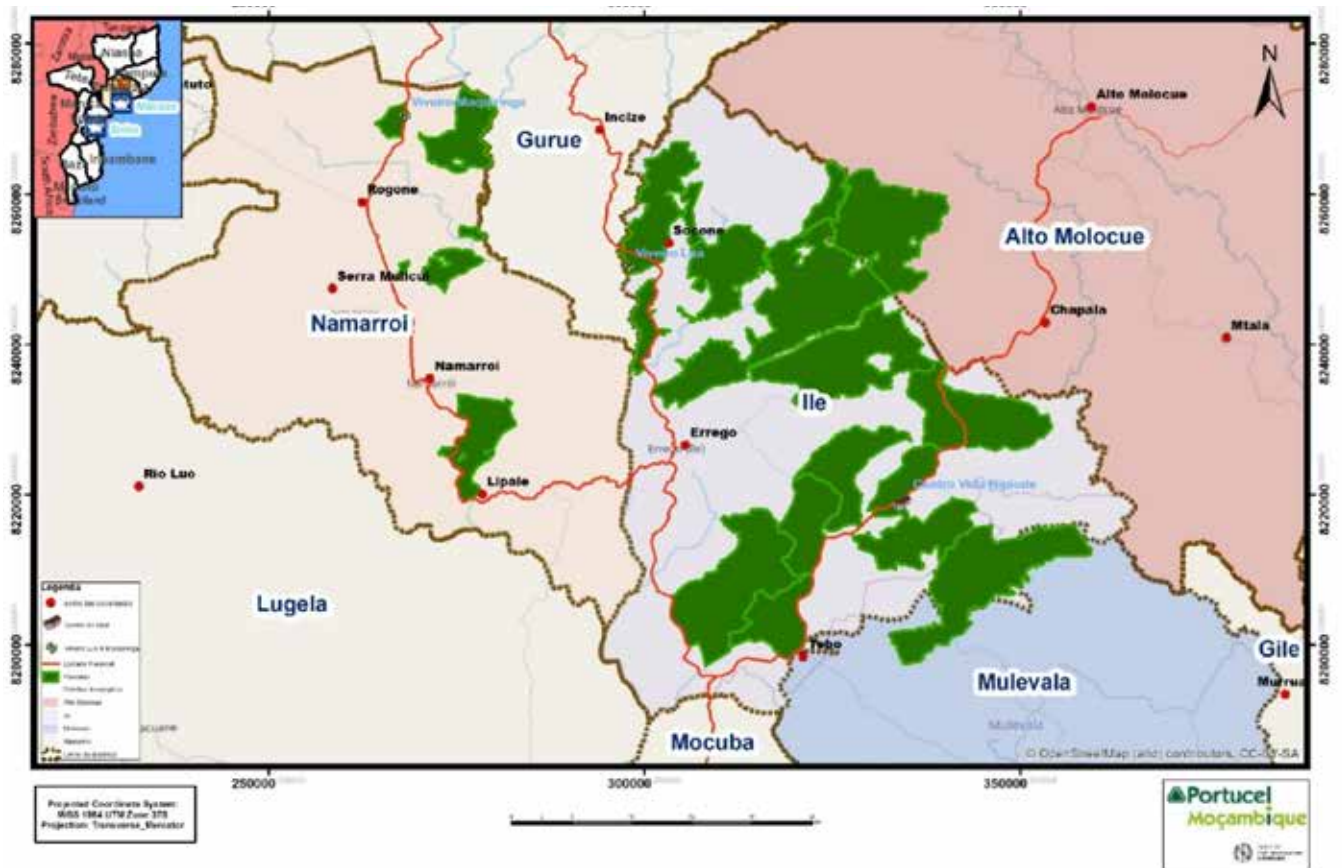


Figure 3. Location of forest area in Zambezia province (Source: Portucel Mozambique)

Pterocarpus angolensis, *Azelia quanzensis*, *Millettia stuhlmanii* and *Pterocarpus polyanthus*.

ii. Open and deciduous Miombo woodland: in areas of good drainage, with sandy to red clay soils *Brachystegia spiciformis* dominates. In the border areas of the seasonally flooded areas there is *Brachystegia boehmii*, *Julbernardia globiflora*, *Burkea africana*, *Parinari curatellifolia*, *Protea*, *Uapaca nitida*, *Maprounea africana*, etc.

During the EIA phase, there was no in-depth fauna mapping in areas of DUAT. However, common bird species such as pied crows, sparrows and common bulbuls were recorded. In addition, one bird of prey, the Lizard Vulture (Lizard Buzzard) was observed, indicating a lack of prey species to sustain bird of prey populations, or hunting of large birds. Few herpetofauna species were observed and these were generally restricted to rocky outcrops.

No direct sightings of mammals were made, indicating a great scarcity of larger vertebrates, mainly due to hunting for protein supplementation by local inhabitants. Indiscriminate and continuous killing of medium-sized fauna drastically alters fauna communities and negatively affects ecosystem functioning.

The rate of landscape change in the areas of DUAT was already high even before the installation of the Portucel project, and anthropogenic activities have increased substantially (associated with the demographic increase), leading to increased ecosystem degradation and ecological disturbances, such as: Shifting agriculture; Charcoal production; Logging for timber; and Livestock. Shifting agriculture is the most significant ecological disturbance in the areas (Figures 4 and 5).



Figure 4. Degraded areas before Portucel Mozambique project



Figure 5. Charcoal produced by the communities



Figure 6. Manual removal of invasive species

1.4 Main impacts of the project on biodiversity and mitigation measures

During the EIA phase, the potential impacts of the

project on biodiversity were identified and classified into direct, indirect and cumulative as shown in Table 1.

Table 1. Impacts of the project on biodiversity, identified during the EIA phase.

Type of impact	Description
Direct	<ol style="list-style-type: none"> 1. Fragmentation and habitat loss - regional scale; 2. Proliferation of invasive species - local scale; 3. Dispersal of invasive species - regional scale; 4. Creation of habitats/refuges - local scale.
Indirect	<ol style="list-style-type: none"> 1. Biodiversity loss due to the transformation of heterogeneous native forests into eucalyptus forests - local scale; 2. Loss of biodiversity due to acidification of soils and water bodies - local scale;
Cumulative	<ol style="list-style-type: none"> 1. Eutrophication effects, such as cyanobacterial proliferation, increased toxicity, fish mortality and prevention of photosynthesis of aquatic plants - regional scale.

Portucel Mozambique has been implementing the following mitigation measures, illustrated in figures 6, 7 and 8:

PREVENTION: i) Identification and mapping of the most relevant areas for biodiversity, protection of nests, burrows, etc. ; ii) Maintenance and improvement of the network of ecological corridors to maintain landscape connectivity; iii) Prevention of soil contamination to avoid the death of aquatic flora and fauna, using only phytopharmaceuticals allowed under forest

management certification mechanisms and products that are duly approved for use in the national territory; iv) Prevention of cutting trees with large nests and trees around these nests; v) Maintenance the areas of original (and intact) Miombo to allow fauna dispersal in plantation areas; vi) Prevention of cutting trees (at harvesting stage) during the bird breeding season.

MINIMIZATION: i) Fragmentation of biological corridors has been minimized (through the planning and execution of the forestry project - identification



Figure 7. Nurseries, where exotic plants are produced (eucalyptus, for production/planted forest), native trees (umbila, umbaua, chanfuta, etc., for forest restoration activities), as well as fruit trees, for delivery to the communities.

of environmental, social and cultural constraints);
 ii) Sequential/phased operational intervention to minimize disturbance to fauna species and allow them to escape or disperse; iii) Restriction as much as possible of access to areas identified as highly sensitive (identified at project level); iv) Implementation of speed limits to avoid direct fauna collisions and fatalities; iv) Creation of alternative livelihoods for local communities in order to minimize pressure on natural resources that exist in the most ecologically sensitive areas; vii) Planting of sterile genotypes or clones in order to reduce the risk of infestation by invasive species; viii) Manual removal of all invasive species; ix) conducting community environmental awareness raising.

REHABILITATION/RESTORATION: i) Restoration, based on native species, of areas with special protection

interest (near water lines, rocky outcrops, etc) in order to prevent erosion by runoff; ii) Recovery of degraded areas, restoring native vegetation; iii) Correction of any alterations to water lines; iv) The Soil Fertilization and Monitoring Program considers the restoration of ecosystems (including the maintenance of ecological corridors); v) Fire protection plans were considered.

BIODIVERSITY OFFSETS: Although the EMP considers the need to implement biodiversity offsets, it does not specify how, where and when. Therefore, a Biodiversity Offset Management Plan (BOMP) has not yet been developed.

1.5 Project timeline

The main milestones of Portucel Mozambique project, between 2007 and 2018 are illustrated in Figure 9 overleaf.

Project Milestones

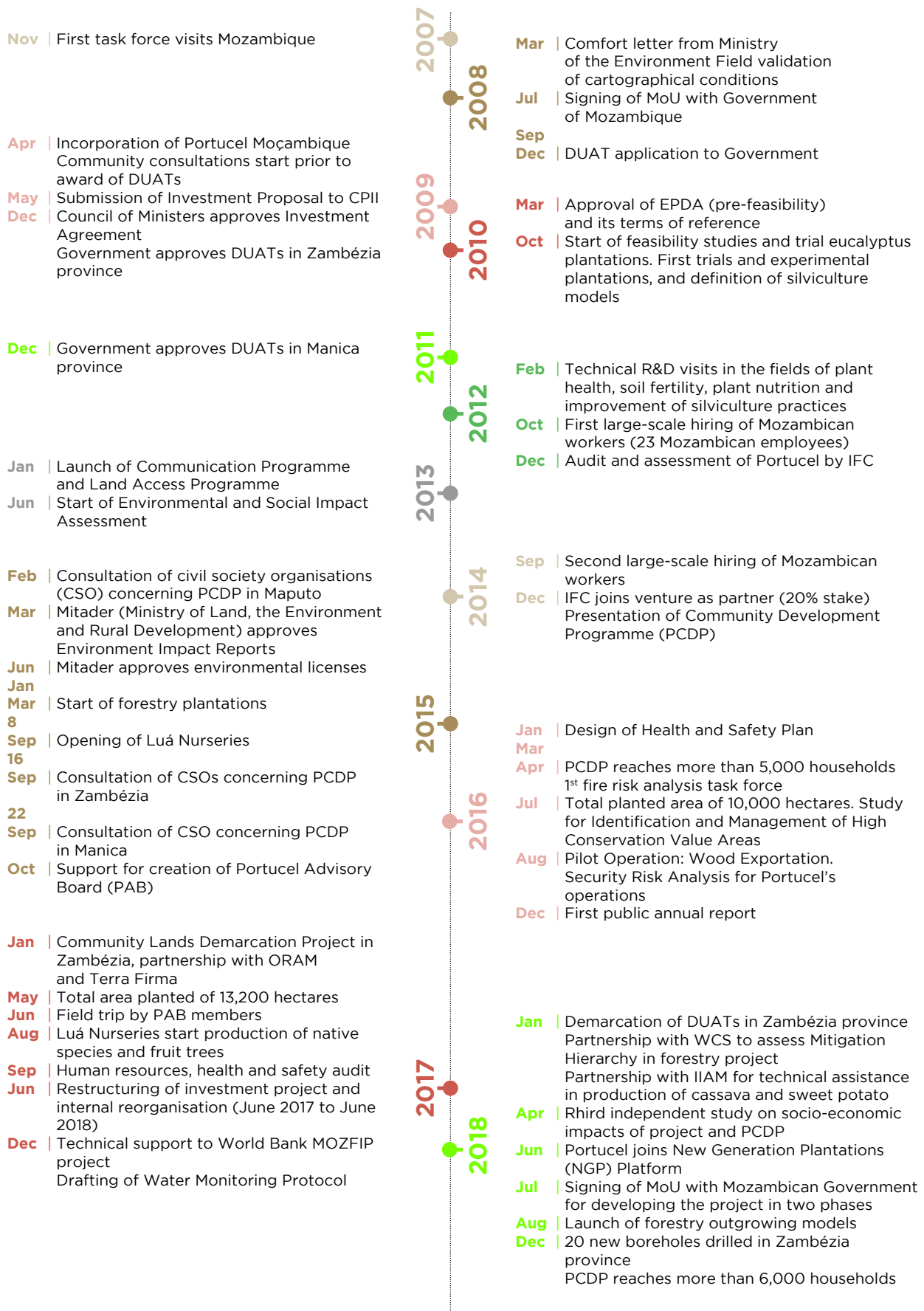


Figure 8. Main milestones of Portucel Mozambique's project between 2007 and 2018 (Source: Portucel Mozambique)

In 2020, Portucel started the wood harvesting phase in part of its eucalyptus plantations located in Manica province. This phase is part of the project's activities cycle and it is the first time it has been carried out, thereby embodying the commitment to job creation and economic development in the project areas. The timber harvest will generate an additional volume of local employment and have a significant economic impact on the value chain.

From the business point of view, this is a relevant occasion to learn more about the administrative and legal requirements necessary for the operation, which are essential in all phases of the project. It is also the

opportunity to evaluate and improve the performance of the species planted, to test the logistical alternatives, to develop the conditions for forestry development, to train national staff, to integrate the communities more and more into sharing the project's value and to strengthen and consolidate knowledge and relations with partners.

Portucel is convinced that, with this operation, Mozambique will become internationally recognized as a country exporting wood from sustainable forestry plantations. This operation is part of a wider project to process wood in Mozambique, after which it will export, initially, processed wood "chips".



Figure 9. Occupational Health and Safety training, for wood harvesting operations

2. OBJECTIVE OF THE CASE STUDY

To develop a case study on how Portucel Mozambique has been applying the Mitigation Hierarchy in its eucalyptus forest plantation project in

Zambezia province, developing lessons learned and recommendations for improvement, highlighting good practices for eventual adoption of this approach.

3. METHODOLOGY

WCS/COMBO focused on a constructive and impartial engagement with the company and its forestry project. The intention was not to conduct an audit of the company's performance, but rather to gain insight into how Portucel Mozambique arrived at actual results, on the ground, considering the key challenges it encountered and solutions developed. The development of the case study with Portucel Mozambique was carried out through the following process:

- **MoU development**, involving i) initial engagement with the company to discuss potential to develop a case study (February of 2017); ii) initial review of MoU by the company; iii) WCS, Biotope and Forest Trends corporate review; iv) finalization and signature of MoU with Portucel Mozambique in October of 2017⁵.
- **Technical scoping**, started with the identification of key topics and associated questions. A checklist was then prepared to highlight key principles or assumptions about biodiversity impact mitigation from best practice guidance and it was discussed with the company to select which topics should be covered under the case study.
- **Implementation and analysis**, which went through the following steps:
 - i. One-to-one interviews with the Director of Sustainability

- ii. Review existing documents, reports and data relating to mitigation and biodiversity;
 - iii. Refine Industry Case Study checklist to ensure it was relevant, considering the project's characteristics;
 - iv. Initial review of checklist with company to discuss priority questions, identify key experiences and review existing documents and data (Figure 10);
 - v. Gap analysis on how the mitigation hierarchy was implemented by the company, the company's policies, procedure for project elaboration, considering the EIA developed, the EMP, complementary studies, IFC's PS 6 and FSC Principles 6 and 9, with emphasis on the latter, which is related to the maintenance or enhancement of HCV Areas;
 - vi. Initial analysis of results by WCS/COMBO Mozambique team;
 - vii. Discussion on the recommendations related to the mitigation hierarchy approach;
 - viii. Preparation of draft case study report and review with the company.
- **Reporting**, consisted in i) prepare the detailed project case study report; ii) review of analysis and reports with the company; iii) preparation of the final case study report, iv) developing a summary report and v) share the summary report with relevant stakeholders.



Figure 10. Meeting between Portucel Mozambique and the COMBO Project, to refine the industry case study checklist and ensure it was relevant for Portucel Mozambique, considering the characteristics of the project (Credits: WCS/ COMBO Mozambique).

⁵ MoU signed between WCS and PORTUCEL Moçambique [here](#)

4. RESULTS

4.1 Challenges and solutions for the project

After the initial screening presented in the previous topic and discussions between COMBO team and the Director of Sustainability of Portucel Mozambique key topics were identified to the development of the case

study. Table 2 summarizes the challenges and solutions developed by the company for each of these topics, as well as the lessons learned recommended by WCS/COMBO to Portucel Mozambique to improve the application of the MH to the project.

Table 2. Challenges and the solutions developed by the company to overcome the former, and lessons learned provided by WCS/COMBO to Portucel Mozambique to improve the application of the MH in the project.

Topics	Challenges	Solutions developed by the company	Lessons learned
1. Sector-specific challenges (process compatibility with the MH and No Net Loss - NPL⁶ approaches)	Lack of information to develop an adequate EIA.	Assessments were conducted using a tiered approach.	Gaps in biodiversity data can be addressed by using a tiered approach.
	High costs to collect biodiversity field data and limited local capacity.	Biodiversity data collection was combined with the extensive social surveys.	Data collection can be optimized by working with local communities.
	Lack of reference or guidance on habitat condition.	The company reached out to partners to establish consensus on habitat assessments.	Reference scenarios for biodiversity assessments can be supported by conservation and scientific communities.
	Lack of awareness by stakeholders on ecological role and impact of plantations.	Raise awareness on the future of the overall landscape.	Socio-ecological approach needed to be effective at the landscape scale.
	Different dimensions of biodiversity need different management approaches.	Efforts made to understand land-use and natural resource management systems.	Combine or link biodiversity and community to work closely within the company's internal structure.
	Shared management of a landscape with different land uses and different operators.	Incentives implemented through performance based to support the communities / land-users.	Design land-use plans at the right scale, to allow appropriation from the community.
	Initiatives against the company not always based on facts.	Portucel's relationship management policy is to investigate all cases that are reported to it. The company always carries out these inquiries. Additionally, the company maintains regular communication with all stakeholders involved in these communications.	Creating synergies will decrease the likelihood of targeted initiatives based on false or partial information; Communicate in a timely and effective manner; Build coalitions with stakeholders in the same landscape, and coordinate approaches; Communication within and outside the company; Good biodiversity practices and any relevant impacts should be disclosed.
	Need for greater institutional capacity building to implement the laws that govern the sector, with implications for the project's development pace.	Until publication of this case study, it was not possible to develop solutions to overcome these issues.	Contribute to capacity building at the national level. e.g. by supporting initiatives like COMBO.

⁶ It means that losses of representative values of the most important biodiversity in the country or area are offset by quantitative and qualitative conservation gains generated through the implementation of offset projects, after prior implementation of the respective steps of the impact mitigation hierarchy

Topics	Challenges	Solutions developed by the company	Lessons learned
	Inexperience of certain service providers in understanding the need to comply with environmental, social and reporting requirements of their operations. Difficulty in defining and operationalizing actions (successfully) to preserve and conserve areas defined by the company as having environmental and social values, due to the existing human pressure.	Create and disseminate terms of reference/contract clauses more efficiently to subcontractors; Introduce sanctions to encourage compliance with biodiversity requirements; The company needs a Biodiversity Action Plan (BAP) to be referenced by employees and subcontractors.	A Biodiversity Action Plan and internal systems and capacity to oversee it are essential, all the way to field staff and subcontractors.
2.Alignment of MH / NNL approach with local regulations and administrative practice	Lack of alignment between some mitigation measures included in EMP and project possibilities/feasibility.	The EMP have been revised to be implemented according to all the procedures that the company already has.	Regular engagement with EIA licensing authority should be done and the original EMP should be regularly revised.
	Difficulty in obtaining a document that allows the company to consistently verify the implementation of the EMP measures that should be prioritized according to the % of project completion.	Procedures have been created to avoid, reduce and/or minimize impact at different levels (environmental and social), for each type of impact identified in EIA.	A control document is needed as part of the Environmental Management System (EMS) to allow the teams to verify the implementation of specific measures of the EMP; The EMS should explicitly include a BAP
3.Accessing and organizing internal resources to apply the MH	Lack of well-trained forestry project team in HCVs areas.	During the operation phase, the forestry technicians should follow the procedures and have to identify any specific specific occurrence that is detected.	Need for well-trained forestry project team, as well as, keep regular training.
	Need to organize internal staff.	Define an environmental/ sustainability management team.	Need for at least an environmental/ sustainability officer per field team/zone.
4. Baselines (data availability and lack of capacity)	Need for information on local biodiversity.	Data was collected during the EIA; Procedure and technical prescription to identify sites and biodiversity data available and included in the forest plans.	Collecting data from various sources, including especially 'on the ground' field-collected data is essential for better planning and improved operations complying with best practice.
	Biodiversity not adequately mapped.	No solutions have yet been to adequately map the biodiversity.	Adequate, updated biodiversity maps need to be available, on a relevant scale.
	Lack of personnel with technical knowledge about local biodiversity.	Hiring more resources for the project department and the Sustainability Directorate.	An internal structure adjusted to the project and technical capacity should be created.
	Lack of a baseline establishing biodiversity priorities.	The HCV technical prescription presents some baseline.	Develop a Biodiversity Action Plan (BAP) to define clear objectives toward biodiversity.
5. Non-offsetable residual impacts	Residual impacts were not quantified.	The only way to check the residual impacts is through indicators that may arise from the grievance mechanism and / or the monitoring and evaluation reports.	Need to develop this topic internally; It is important to have a good monitoring / oversight team; Develop training sessions for the project department, Planning Directorate and Sustainability Directorate on related topics, in partnership with WCS/COMBO; It is important to identify the residual impacts and the potentially non-offsetable impacts in the ToR for the EIA.

Topics	Challenges	Solutions developed by the company	Lessons learned
6. Landscape-level approach (including avoidance areas)	No previous assessments were done before the EIA.	The project identified and avoided ecologically sensitive areas as well as other constraints.	Assess historical registers / data related to the areas of DUAT given to the company.
	Need to include specific mitigation measures in the EMP.	The company along with EIA consultants reviewed and updated the EMP.	Ensure that all the mitigation measures are adequately aligned with the project characteristics and are feasible.
	Need to verify if the measures of the EMP are being implemented in each forest project.	No solutions have yet been developed to verify if the measures of the EMP are being implemented in each forest project.	Develop a document or table/checklist to allow the verification by project teams. <i>Note: the evaluation is done annually with the environmental audits.</i>
7. Community engagement	Insufficient use of the community engagement mechanisms for biodiversity purposes.	Revision of the Stakeholder Relationship Model for a new model of engagement with communities for this specific purpose; Pilot project for the creation of Natural Resource Management Committees.	Use Natural Resources Management Committees to overcome this challenge. Invest on communication, using games to raise awareness and share knowledge about how the use of resources has impacts on the community livelihoods (or via community environmental awareness).
	Environmental awareness of the communities	At the time of the case study publication there are no solutions developed by the company.	Carry out the mapping of socio-cultural heritage.
	Inhibition, by Portucel Mozambique, to prohibit certain areas by community use (e.g. areas with conservation and protection potential).	At the time of the case study publication there are no solutions developed by the company.	Incentivize the development of local land use plans liaising with the Natural Resources Management Committees. Implementation of community environmental awareness.
8. Engagement with government on biodiversity actions	Increase engagement with the Government on biodiversity, looking for capacity building synergies	The company included the Government in prioritization of biodiversity, by consulting the local government structure in the process for the identification of Areas of HCV on category 5 and 6.	
	Training in the application of legal requirements associated with the biodiversity issues.	Promote synergies and sharing of experiences with the competent entities in the application of programs, strategies and laws, namely the Flora and Habitat Conservation Program and the Fauna Conservation Program.	Promote capacity building and awareness actions for the local government.
9. Permanence of set-asides and offsets (including legal arrangements for land use and financing structure)	Although the company knows the areas to preserve, it does not have a methodology that defines, in a concrete and simple way, the forest limits to be preserved (species and size).	Procedure created to determine potential HCVs as set-aside areas.	Partnerships with communities to create community conservation areas should be established.
	Miss-interpretation of biodiversity offsets.	Reservation of 3 areas of sensitive habitats identified and suggested to be managed as biodiversity offsets. However these should have been recognized as avoidance areas.	Need to improve technical knowledge and understand the concepts by developing training sessions on related topics in partnership with WCS/COMBO.

Topics	Challenges	Solutions developed by the company	Lessons learned
10. Monitoring and reporting progress towards biodiversity goals, and adaptive management	No baseline established for defining biodiversity priorities.	The HCV technical prescription presents some baseline information.	Biodiversity objectives or targets need to be clearly identified in the ESIA and EMP.
	No references to a specific Biodiversity Action Plan (BAP)	The Environmental Management Plan (EMP) includes a set of guidelines, plans and sectorial programs.	Develop a detailed BAP and integrate biodiversity in the operational plans; Determine the strategy/action plan to implement the sectorial programs referred in the EMP.
	Adaptive management	Integration of management actions in the revised EMP.	Integrate the management actions missing in the EMP, when the project is renewing its environmental license or any other time during operation.



Figure 11. Creating partnerships with stakeholders (top); team on the ground working with the community (bottom).

5. BEST PRACTICE RECOMMENDATIONS FOR PORTUCEL MOZAMBIQUE TO ACHIEVE A NET POSITIVE IMPACT ON BIODIVERSITY

Portucel Mozambique has been implementing several steps of the MH, which have a direct result on reducing the project's negative impacts on biodiversity. However, the different activities have not been developed under a coordinated strategy such as a Biodiversity Action Plan. Additionally, the EMP does not associate the different mitigation actions to each of the steps of the MH. Considering that Portucel Mozambique has got internal policies which have the objective of making their business environmentally sustainable with reduced impacts on wildlife, complying with IFC's PS6 and to FSC's Principle 6, it is recommended that the company organizes and systematizes its mitigation approach in a Biodiversity Action Plan/ Biodiversity Management Plan.

One possible suggestion to improve the application of the mitigation hierarchy is to apply the approach

developed by Aiama et al. (2015), who have described how the four steps of the mitigation hierarchy can be applied to Agriculture and Forest (A&F) sectors, in the way to achieve NNL/NG⁷ identifying clear measures related to their typical activities.

Considering the characteristics of the landscape where the project is located and its state before Portucel Mozambique started its operations, the following scenario of the approach developed by Aiama et al. (2015) was considered: "Use of ecologically degraded areas for forestry operations (natural forest, plantations)", which fits the context of the region where the project has been implemented. Table 3 illustrates how this scenario could be applied to the Portucel Mozambique project in the Zambezia landscape, with the final column providing recommendations on how the company can improve the application of the MH.

Table 3. Application of the stages proposed by Aiama et al. (2015) to Portucel Mozambique project, comparison with actions already implemented by the company and recommendations to improve the application of the mitigation hierarchy.

MH stages	Steps proposed by Aiama et al., 2015	Actions already implemented by the company	Recommendations
1. Identify priority biodiversity values in the project region and define NPI goals	<p>1a. Map all priority biodiversity values identified in the region:</p> <ul style="list-style-type: none"> - Within the DUAT area - Beyond operational area <p>1b. Select the priority biodiversity features that the project can meaningfully influence and define NPI goals:</p> <ul style="list-style-type: none"> - Goal 1 - NPI for secondary habitat areas and riparian areas within the DUAT area, and beyond where feasible; - Goal 2 - NPI for one threatened species within and beyond project areas (if exists). 	<p>1a. Identification of ecologically sensitive areas</p> <ul style="list-style-type: none"> - Identification of some of the HCV areas and development of a technical prescription to identify others - Identification of areas of Medium-high semi-dry Miombo woodland and open and deciduous Miombo woodland <p>1b. Selection of Ecologically sensitive areas, HCVs areas and Miombo woodland as the priority biodiversity features to consider</p> <ul style="list-style-type: none"> - No Net Loss or Net Positive Impact goals have not yet been defined. 	<ul style="list-style-type: none"> - Implement the HCV technical prescription developed for Portucel Mozambique plantations, assessing as much areas as possible to identify biodiversity elements that trigger HCV areas; - Undertake fieldwork surveys to confirm the occurrence of species of conservation concern / threatened species - Reassess the priority biodiversity features that can be influenced by the project, and define the NPI goals for each of these.

⁷ Biodiversity Net Gain (LG) or Net Positive Impact (NPI) is when the gains from proper implementation of the mitigation hierarchy exceed the losses.

MH stages	Steps proposed by Aiamo et al., 2015	Actions already implemented by the company	Recommendations
<p>2. Map locations, compile trends, and establish a baseline or reference scenario for the selected biodiversity features</p>	<p>2a: Map spatial data on biodiversity features that have been designated for NPI goals. 2b: Compile information on trends of these biodiversity features 2c: Establish an objective baseline specific to a certain moment in time, describing the condition of the biodiversity features.</p>	<p>2a: Mapping of Ecologically sensitive areas, HCVs areas and Miombo woodland. 2b: Miombo woodland – several activities that led to the deforestation, degradation and ecological disturbance of Miombo were documented such as: itinerant agriculture; coal production; cutting of trees for wood; livestock. 2c: No time reference target has been set for the condition of biodiversity features.</p>	<ul style="list-style-type: none"> - Map spatial data related to the selected biodiversity features for which NPI goals need to be achieved. - Assess the available information, working with remote sensing to determine the trends for ecologically sensitive and HCV areas, as well as the selected biodiversity features for which NPI goals need to be achieved. - Establish an objective baseline, describing the condition of the selected biodiversity features and assess unmitigated project impacts against this
<p>3. Overlay ongoing or expected project intervention plans to mapped biodiversity data and apply the mitigation hierarchy</p>	<p>Step 1 - Avoidance actions: In a degraded area there will likely be some natural habitat remaining and these are all priority areas for avoidance: Area-based – all secondary habitat and riparian areas are set-aside; Impact-based – hazardous agrochemicals can be avoided, no removal of deadwood that support vulnerable species (forestry) in area of operations.</p> <p>Step 2 - Minimization actions: As the area is degraded, there is limited productive activity occurring but new production systems are designed to minimize impacts on natural areas (as they become restored). Area-based actions - plan to improve connectivity (so as to minimize fragmentation of restored areas) from the outside area through buffer zones and stepping stones; Practice-based actions in area of operations – impacts minimized with integrated pest management, limits on agrochemical application and/or improved crop productivity (agriculture, plantations), adoption of Sustainable Forest Management (SFM) approaches.</p> <p>Step 3 - Restoration actions: Placement of production areas in</p>	<p>Step 1 - Avoidance actions: <i>Area based:</i> i) Identification and mapping the biodiversity protected areas, nests, burrows, etc., ii) maintain (and improve) the network of continuous ecological corridors, iii) the most ecologically sensitive areas and intact in the DUAT area were identified as no go areas or potential biodiversity offset areas; iv) the sensitive Miombo woodland was removed from the areas of DUAT and was aggregated in the system of the most ecologically sensitive areas <i>Impact based:</i> i) avoid contamination of soils to prevent death of aquatic flora and fauna (only using chemicals approved by FSC); ii) avoid cutting trees with large nests and the trees around these nests; iii) maintain the existence of small portion of original Miombo to allow the dispersion of fauna in the plantation areas; iv) avoid to cut down the trees during birds breeding season or even during migratory events of species included in IUCN's Red List.</p> <p>Step 2 - Minimization actions: <i>Area-based:</i> i) fragmentation of biological corridors was minimized (through avoidance); ii) restrict access, as much as possible, to the identified high sensitivity areas; iii) implement speed limits, especially in sensitive or natural areas identified in order to avoid collisions and direct fatalities of fauna; iv) create choices for local community subsistence to minimize the pressure on the natural</p>	<p>Step 1 - Avoidance actions: Besides what is already being done by Portucel Mozambique, set-aside the HCVs that are identified and work with local communities, establishing partnerships to safeguard these areas through performance-based agreements and by creating community conservation areas or sanctuaries, to minimize the pressure on the priority biodiversity features that should achieve NPI. Natural Resource Management Committees can be used. Create a link between the already existing social program and the BAP/BMP</p> <p>Step 2 - Minimization actions: - When identifying HCVs, use always as possible a connectivity-based approach - Review the Procedure for Monitoring Water Quality, to include biological parameters that could negatively impact the biodiversity features that exist in the management units, and then promote measures to maintain and / or improve conservation values.</p> <p>Step 3 - Restoration actions: - The Technical Norms/Standards for the installation of eucalyptus plantation and the Forest Project, which has a relevant task in</p>

MH stages	Steps proposed by Aiama et al., 2015	Actions already implemented by the company	Recommendations
	<p>the most degraded portions of the landscape.</p> <p>Restoration of all degraded riparian areas in the DUAT area; restoration of native species where feasible (particularly for agriculture, agroforestry and plantations). In principle there should be no residual impacts provided ALL mitigation measures plan to be implemented. Additional natural habitats (e.g., riparian zones) and carried out restoration with native species (e.g. agroforestry systems with native species), which will have a positive impact on the selected priority biodiversity features.</p> <p>Step 4 - Offset actions: 4.1: Assess residual impacts: In principle there should be no residual impacts provided ALL mitigation measures plan to be implemented. Additional natural habitats are being created and native species are being introduced through restoration and this will deliver positive impact for the selected priority biodiversity features. 4.2: Assess possible conservation gains of priority biodiversity features and implement offset actions: In principle if all mitigation measures plan to be implemented, compensation action off-site is not required as positive impacts for priority biodiversity features are generated on-site through restoration actions - serving as restoration offsets on-site. Additional conservation actions should still be encouraged, particularly to protect natural habitat areas that may be under pressure of conversion as productivity is increased in the region .</p>	<p>resources in the ecological sensitive areas.</p> <p>Practice-based: i) sequential/stepped operational intervention to minimize disturbance of the fauna and allow its escape or dispersal; ii) planting sterile genotypes or clones selected for low levels of seed production or even modified for sterility could reduce the risk of infestation of invaders; iii) remove manually all invasive species that could be escaped from the plantation blocks; iv) install bird (nesting) and bat boxes to diversify the potential of refuge areas.</p> <p>Step 3 - Restoration actions: - Restore the disabled plantations, by planting resistant species as well as grassland areas, to avoid the erosion by runoff; - Recover degraded areas by construction, restoring native vegetation; - Correct changes in waterlines; - The Soil Monitoring Program considers the restoration of ecosystems (including the maintenance of ecological corridors); - Fire protection plans were considered; - Evidence of erosion should be collected.</p> <p>Step 4 - Offset actions 4.1: Residual impacts were not assessed; besides that, biodiversity objectives or targets were not clearly identified nor quantified. Currently, the only way to assess residual impacts is by using indicators that may arise from the grievance mechanism and / or the monitoring and evaluation reports. This topic has not been well developed internally. 4.2: Not applicable so far considering what was explained above.</p>	<p>ensuring i) initial assessment and ii) assessment between what was planned and realized, needs to consider restoration actions when there are impacts on Miombo woodlands resulting from the construction of infrastructure.</p> <p>- A specific team should be assigned the role of oversight and monitoring of restored areas (e.g. river crossings and around new roads); this team should work with the sub-contractors to improve their performance both on avoiding certain areas and restoring always that is necessary.</p> <p>Step 4 - Offset actions: - Review the EMP, clarifying which mitigation actions are associated to each of the steps of the mitigation hierarchy; clarify the differences between avoidance (set-asides areas within the plantation areas) and offset actions (areas outside the plantation that should be receiving counterbalance and formally protected); - Develop internal capacity on No Net Loss, mitigation of impacts and biodiversity offsets; - As the operation moves forward, identify and quantify the project's residual impacts; - Define and quantify the biodiversity objectives or targets that should be achieved to compensate for the residual impacts; - Development of a Biodiversity Offset Management Plan (BOMP) according to the guidelines developed for Mozambique.</p>

MH stages	Steps proposed by Aiamo et al., 2015	Actions already implemented by the company	Recommendations
4 and 5. Implement the resulting project plan from stage 3 and a monitoring plan to assess progress towards the NPI goal		<p>The information collected from the company shows that the first three steps of the mitigation hierarchy were planned and are being implemented; however, they were not structured as such. Although there is not any reference to a specific Biodiversity Action Plan (BAP), the EMP includes a set of guidelines, plans and sectorial programs, which intend to address the impacts that were identified in the ESIA. However, the information is not presented in a structured way where there is a direct link with each step of the mitigation hierarchy and with the impacts that were identified in the EIA.</p> <p>More recently, for each impact presented in EIA, the company has been creating procedures that, although not yet operational, they seek to avoid, reduce or minimize impacts at different levels (environmental and social).</p>	<ul style="list-style-type: none"> - Development and implementation of a Net Positive Impact (Net Gain) approach for the biodiversity objectives or targets identified; - Development and implementation of a Biodiversity Action Plan (BAP), which will determine which actions should be included in the EMP and in the Biodiversity Offset Management Plan. - Development of a long-term monitoring plan (within the EMP and the BOMP), with periodic fieldwork and remote sensing verifications for the selected biodiversity features to assess progress of mitigation actions against the biodiversity objectives and/or targets identified. - Improvement of Environmental Management system, particularly on biodiversity by developing a document/checklist to allow the teams to verify if the measures defined in the EMP are being implemented in each forest plantation project.



Figure 12. Daily monitoring of plants in Portucel Mozambique's nursery

6. CONCLUSIONS AND KEY LESSONS LEARNED

Portucel Mozambique aims to comply with its own policies - of *The Navigator Company*, with the PS of the IFC and with the principles and criteria of the voluntary forest certification schemes. To improve its business performance, the Portucel Mozambique has developed the Technical Guidelines (technical guidance) for Identifying, Monitoring and Managing HCV areas in its concession area. In addition to being mandatory under the forest management certification scheme, HCV areas are considered fundamental to ensure the sustainability of forestry operations, which is an important point in the company's forestry policy.

This case study has helped the company with undertaking a deeper analysis on how the mitigation hierarchy has been implemented in the Zambezia and Manica concessions in relation to biodiversity. The discussions held between WCS / COMBO and Portucel Mozambique allowed the company to identify what were the major challenges and solutions have been developed to overcome those to date, define key lessons and identify additional steps that should be implemented by the company, to improve its performance and eventually by other companies with similar projects (see Table 2).



Wildlife Conservation Society (WCS): established in 1895 it is a non-profit entity, organized under the laws of the United States of America, with headquarters in New York that is dedicated to saving wildlife and wild places around the world through science, conservation actions, education and inspiring people to value nature. It has a presence in over 60 countries, and provides support to over 270 Conservation Areas worldwide. WCS started its program in Mozambique in 2012.

COMBO Program: the program began in 2016 through a project with the same name, originally called Conservation, Mitigation and Biodiversity Offsets. The second phase began in 2021. Led by WCS, in partnership with Biotope and Forest Trends, and originally funded through the French Development Agency (AFD), French Facility for Global Environment (FFEM) and MAVA Foundation, the program aims to reconcile economic development with the conservation of biodiversity and ecosystem services.

Portucel Mozambique: A company incorporated under the Mozambican law, set up in 2009 by The Navigator Company, is responsible for setting up a forestry project integrated with a pulp production industry in the country.. The company received two authorizations in 2009 and 2011 from the Council of Ministers of Mozambique for the planting of up to 246 thousand hectares of land for 50 years, renewable, under a project with high social and economic benefits for the provinces of Manica and Zambezia, in particular, and for the country as a whole. Portucel Mozambique's investment represents a contribution to improving the country's trade balance, as well as to rural, forestry, agricultural and industrial development in Mozambique.