BOTANIC GARDENS CONSERVATION INTERNATIONAL

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World Agroforestry

ACTION PLAN

Restoration plan for Divo Botanic Reserve

Credit: CIFOR-ICRAF

Abbreviations and acronyms

ANADER l'Agence Nationale d'Appui au Développement Rural

BGCI Botanic Gardens Conservation International

CNF Le Centre National de Floristique

IBAAN Institut Botanique Aké-Assi d'Andokoi

CIFOR-ICRAF Centre for International Forestry Research and International Center for Research in Agroforestry

MINEDDTE Ministre de l'Environnement, du Développement Durable et de la Transition Écologique

MENETFP Ministry of National Education, Technical Education and Vocational Training

ME-MINADERPV Ministère d'Etat-Ministère de l'Agriculture du Développement Rural et des Productions Vivrières

MJDH Ministère de la Justice et des Droits de l'Homme

MINEF Ministère des Eaux et Forets

SODEFOR Société de Développement des Forêts

Definitions

Agroforestry: Restoration and sustainable management of existing agricultural land through integration of trees in the agricultural landscape

Assisted Natural Regeneration: Managing the process of natural forest regeneration to achieve forest ecosystem recovery more quickly, through interventions such as fencing, weeding and enrichment plantings

Botanic garden: An institution holding documented collections of living plants for the purposes of scientific research, conservation, display and education

Conservation planning: Aims to increase the effectiveness of conservation action, by ensuring that it is based on (i) science-based evidence, (ii) well-defined goals, (iii) multiple perspectives, and (iv) agreement among those involved about what should be done

Critically Endangered: A species facing an extremely high risk of extinction in the wild

Department: The third-level administrative subdivision of the country, below region and district

Ecological restoration: The actions to re-instate ecological processes, which accelerate recovery of forest structure, ecological functioning and biodiversity levels towards those typical of climax forest

Endangered: A species considered to be facing a very high risk of extinction in the wild

Endemic: Unique to a defined geographic location, such as an island or a country

Farmer Managed Natural Regeneration: Used to support local communities to restore their natural environment through the systematic pruning and management of remnant vegetation in agricultural, pastoral and communal land

IUCN Red List of Threatened Species: The world's most comprehensive information source on the global extinction risk status of animal, fungus and plant species

Natural regeneration: The process of natural forest regrowth, which can occur spontaneously following land abandonment or be assisted by human interventions (see Assisted Natural Regeneration)

Reintroduction: The deliberate movement of individuals of a species to parts of its natural range from which it has been lost with the aim of establishing a new population

Sub-prefecture: The fourth-level administrative subdivisions of the country

Threatened: Species are considered "threatened" if they are assessed under the Critically Endangered, Endangered, or Vulnerable categories

Vulnerable: A species considered to be facing a high risk of extinction in the wild

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Contents

Executive summary

The Réserve Botanique de Divo or Divo Botanic Reserve is 6,802 hectares in size and located in the sub-prefecture of Divo in the Lôh Djiboua Region, southern Côte d'Ivoire. It has been significantly degraded, with remaining pockets of forest just 1-2 hectares big. The main threats to the reserve are from ever-expanding agriculture, primarily small farms of cocoa, rubber and oil palm. In 2023, the first botanical inventory of the reserve was undertaken and found important biodiversity still persisting. Sixteen species were found which are listed as threatened on the IUCN Red List of Threatened Species, including *Tieghemella heckelii* which is listed as Endangered. A dedicated group of local stakeholders are working to prevent its complete destruction and to restore it for future generations. In May 2024, a workshop was held in the town of Divo to develop a restoration action plan. This workshop was attended by 39 participants, with representation from a variety of organisations including local community representatives, government (national and local), NGOs, and academic institutions. A visioning exercise resulted in a qualitative description of what successful restoration of the Divo Botanic Reserve would look like. To achieve this vision during the workshop the key challenges to restoring the reserve were explored and four goals and 17 objectives were developed to mitigate them.

The development of this restoration plan is the first step in the process to achieving the recovery of the Divo Botanic Reserve. To maintain momentum, the most important next step is to form a management committee for the reserve as none of the above can be achieved by any single organisation working in isolation. The management committee will need representation from all key local and national stakeholders. Once it is accepted to make decisions on behalf of the reserve, the task of the management committee will then be to work in partnerships to synergise the conservation actions and maximise impact. To ensure adaptive management going forwards, it will be important that data be collected on the conservation actions, and it is also recommended that the management committee meets regularly to evaluate progress and assign responsibilities with timely deadlines.

Through collaboration and determination, it will be possible to turn a new corner for the reserve such that and by 2030 Divo Botanic Reserve will once again become a treasure of the region, sustainably providing for the local population and with biodiversity recovering to close to what it once was prior to the deforestation and degradation is believed to have begun 50 years ago.


Credit: Alex Hudson BGCI

1. Introduction

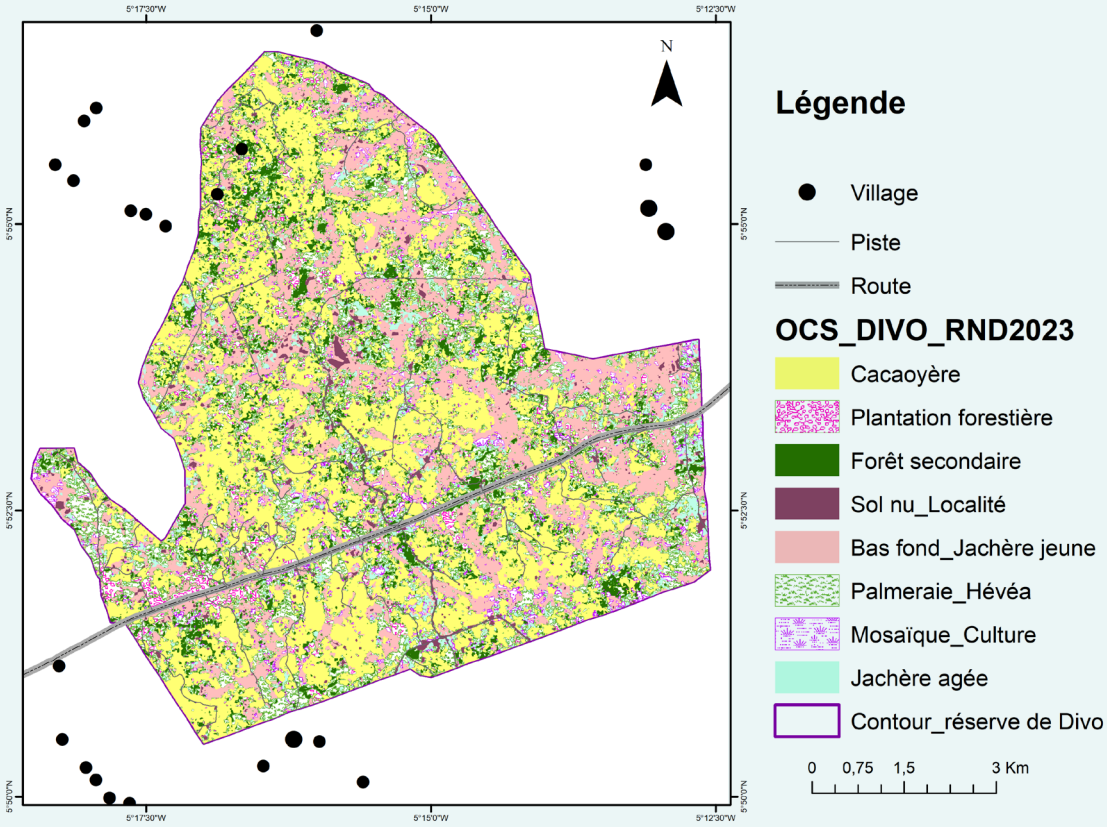
1.1 Divo Botanic Reserve

The Divo Botanic Reserve is 6,802 hectares in size and was created by decree N° 23 59 in 1935 and modified by decrees in 1954 and 1975. It is located 4 km from Divo, the capital and main city of Divo Sub-prefecture, on the Divo-Tiassalé axis (between the villages of Blé and Kpakossou-Carrefour) in the Lôh Djiboua Region of southern Côte d'Ivoire. The reserve was originally semi-evergreen forest but is now mostly under cultivation. Outside of protected areas in Cote d'Ivoire, important forest blocks have disappeared and most of the forest zone of the country can be considered as non-forest (Chatelain *et al.* 1996). Protected and officially gazetted forests have also been very significantly deforested and degraded, with some estimating just six out of 234 government foret classes being still relatively intact (less than 75% deforested).

1.2 Conservation status of the trees within Divo Botanic Reserve

A floristic and land use inventory of Divo Botanic Reserve, with a particular focus on threatened tree species was undertaken by the National Floristic Center of the Félix Houphouët-Boigny University under the supervision of the Centre for International Forestry Research and International Center for Research in Agroforestry (CIFOR-ICRAF) between September and October 2023. A total of 64 plots of varying sizes were surveyed (see Figure 1). A total of 213 plant species with a diameter at breast height (DBH) equal to or greater than 5 cm were identified as trees. Most of the tree species found were in the remaining fragments of secondary forest and 52 of the tree species were among those typically harvested for timber in Cote d'Ivoire.

Figure 1: Position of the different plots inventoried in Divo Botanic Reserve. Photo credit: Centre National de Floristique



The Divo Botanic Reserve has been significantly degraded, with just some remaining pockets of forest of just 1-2 hectares. Small to medium farms, typically of 2-5 ha, of cocoa, rubber and oil palms have replaced much of the original forest. Of the surface area of the reserve, the inventory estimated that 34 % was under cocoa, either in pure stands or mixed with some trees; 23% consisted of lowlands (wetlands) and/or young fallow; 14% consisted of oil palm and/or rubber smallholdings;11% had been planted in woodlots of fast-growing exotic species such as teak and *Gmelina arborea*; and 3% was a mosaic of cassava, maize, beans and other food crops. Just 5% consisted of old fallow and 8% of secondary forest. No primary forest was found.

Sixteen tree species found in the reserve are listed as threatened on the IUCN Red List, with *Tieghemella heckelii* listed as Endangered and 15 as Vulnerable (see Table I). Eight out of 15 were represented by less than five individuals. Five threatened species on the IUCN Red List were encountered only once; *Cordia platythyrsa* (Vulnerable), *Tieghemella heckelii* (Endangered), *Vitellaria paradoxa* (Vulnerable) and *Zanthoxylum mezoneurispinosum* (Vulnerable - seen only in the north of the reserve).

Cola lorougnonis (Critically Endangered) is an endemic tree only found in Côte d'Ivoire and, within the country, only in the department of Divo. It was recorded for the first time in 1957 by the Ivorian botanist Aké-Assi in a forest near the city of Divo. It was recorded from the same forest area in 1972 but geographical coordinates were not noted. In 2008, it was rediscovered at Dékpa forest near Agbaou, a village in the Divo department (Vroh *et al.* 2016). *Cola lorougnonis* was not found during the botanic inventory of Divo Botanic Reserve in 2023.

Table I: Species identified within Divo Botanic Reserve that are assessed threatened on the IUCN Red List of Threatened Species and the number of individuals found per species

Taxon name	Number of individuals	IUCN Red List Status
Pterygota macrocarpa K. Schum.	242	VU
Nesogordonia papaverifera (A. Chev.) Capuron ex N. Hallé	149	VU
Entandrophragma angolense (Welw.) C. DC.	74	VU
Sterculia oblonga Mast.	34	VU
Terminalia ivorensis A. Chev.	14	VU
Berlinia occidentalis Keay	7	VU
Leplaea cedrata (A. Chev.) E. J. M. Koenen & J. J. de Wilde	7	VU
Khaya ivorensis A. Chev.	6	VU
Garcinia kola Heckel	4	VU
Entandrophragma candollei Harms	2	VU
Entandrophragma utile (Dawe & Sprague) Sprague	2	VU
Cordia platythyrsa Bak.	1	VU
Milicia regia (A. Chev.) C. C. Berg	1	VU
Tieghemella heckelii (A. Chev.) Pierre ex Dubard	1	EN
Vitellaria paradoxa C. F. Gaertn.	1	VU
Zanthoxylum mezoneurispinosum (Aké Assi) W. D. Hawth.	1	VU

1.3 Existing conservations efforts

A new forest code, adopted in 2019, provides the overall framework for action to conserve, extend and restore forests in Côte d'Ivoire. Under the provisions of the code, local and national stakeholders began in 2020 to work together to restore Divo Botanic Reserve. A summary of these efforts is in Table II.

Most planting activities in the reserve have deployed a restricted number of species, of which many are exotic. Common exotics that have been planted include teak *(Tectona grandis)*, neem (*Azadirachta indica)*, Gmelina etc. However, some planting included indigenous species, including some that are threatened, such as *Entandrophragma candollei, Entandrophragma utile* and *Pterygota macrocarpa.*

Besides restoration of forest, since 2019, there have also been concerted efforts in Cote d'Ivoire and more specifically in the Divo area to create agroforests for the cocoa farms which had largely driven the deforestation. For this, it became important strengthen the nursery sector to supply sufficient quantities of seedlings to enable full sun cocoa smallholdings to transition to growing cocoa with compatible trees. Nurseries grew in size and diversity of the species they raised as cocoa companies and cooperatives rolled out agroforestry. These excellent intentions were consistently hampered, however, by difficulty in obtaining seed of important native species. Often nursery operators were forced to collect from small number of mother trees, risking the loss of genetic diversity. Furthermore, these mother trees were often located far from the Divo area and were unprotected.

In 2023, a Darwin Initiative- funded project was implemented to build local capacity to use a wide array of indigenous, particularly threatened, tree species in local conservation strategies. This included an inventory of Divo botanic reserve, and seed collection and propagation support as well as a planning workshop with stakeholders reported on here.

Table II: Species identified in the Divo Botanic Reserve, assessed as threatened on the IUCN Red List of Threatened Species, and number of individuals encountered per species

Year	Conservation actions
2020	- 11,200 tree seedlings of young teak *(Tectona grandis)* plants, *Gmelina arborea, Albizia* spp., *Terminalia superba* and *Terminalia ivorensis* planted on 14 ha by CEF Divo
2021	- 2,500 tree seedlings planted on 3.5 ha by CEF Divo - 1,200 tree seedlings planted by the YODE Foundation and SIRO on 2 ha - 1,000 tree seedlings planted local elected officials on 1.5 ha
2022	- 180,000 young tree seedlings planted by CIFOR-ICRAF, Génie Bio and MINEF on approximately 350 ha with local communities. Species included *Gmelina arborea, Albizia* spp., *Terminalia superba* and *Terminalia ivorensis* - 800 tree seedings planted by CEF Divo with the DJAKA Festival on 1 ha - 3,500 tree seedlings planted by BGFI on 5 ha - 6,000 plus tree seedlings distributed to communities within the reserve for use in agroforestry - More than 200 farmers engaged in planting activities
2023	- 20,000 saplings of *Mitragyna ciliata* planted on approximately 15 ha of lowlands/wetlands - 23 participants from 12 institutions trained to be trainers of others in seed collection and propagation skills for threatened trees - 58 community members and nursery operators trained by 3 of the above trainers - Seeds of three endangered tree species – *Omphalocarpum ahia, Terminalia ivorensis* and *Pterygota macrocarpa* – collected and propagated for future plantings

1.4 Scope of the project and process

In May 2024, CIFOR-ICRAF in collaboration with Botanic Gardens Conservation International (BGCI), the National Floristic Centre (CNF) and the Ministry of Water and Forests (MINEF) hosted an in-person workshop entitled “Restoration plan Divo Botanic Reserve”. This workshop was attended by 39 participants, with representation from 18 organisations spanning local community groups, local and national government, NGOs, and academic institutions.

During this workshop, the conservation planning process was introduced and context for the process given. Presentations on Divo Botanic Reserve’s tree diversity, threats facing the reserve, and current conservation actions for threatened trees were delivered. A visioning exercise followed that resulted in a qualitative description of what successful restoration of the Divo Botanic Reserve would look like.

Working groups were established on active restoration, passive restoration, agroforestry and sustainable alternative livelihoods. Each working group discussed the following:

- Causes and impacts of major issues to the preservation and long-term restoration of the reserve
- Agreement of priority strategies to mitigate issues
- Agreement of what existing restoration opportunities could be mobilised for targeted groups and what kinds of further action or planning should be initiated, and
- Agreement on who will take the next steps towards progressing these recommendations.

Lastly, a session was held on the next steps to maintain momentum, reduce duplication of effort, and build and sustain partnerships for the identified conservation actions from each working group.

1. Introduction


Credit: Alex Hudson BGCI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2. The strategy developed

2.1 Vision

After much discussion, participants adopted the following vision:

"By 2023 Divo Botanic Reserve is restored and valued as a treasure of the Lôh-Djiboua region, and is managed sustainably by a local partnership of actors for the benefit of the people and biodiversity."

2.2 Goals

Goal 1 : Protection and restoration: Divo Botanic Reserve is protected and biodiversity restored

Goal 2 : Collaborative management: Divo Botanic Reserve is collaboratively managed and monitored by an adequately resourced group of local stakeholders

Goal 3 : Local communities benefit: The needs of the local communities are understood and sustainable livelihood opportunities are put in place to halt deforestation and degradation of the reserve

Goal 4 : Valued as a regional treasure: Divo Botanic Reserve is valued for its important biodiversity and has become a regional focal point for tourism and research

3. Restoration actions

Goal 1 : Protection and restoration: Divo Botanic Reserve is protected and biodiversity restored

Objective #1: A supply of suitable native species is available locally for restoration interventions

In southern Côte d'Ivoire, the secondary forest patches within Divo Botanic Reserve represent one of the last refuges of forest species left in the region. They represent an important source of genetic diversity and opportunity for regeneration potential (Chatelain *et al.* 1996).

It will be necessary to determine which species have been lost from the reserve. Historical botanical records (e.g. herbarium specimens), other forest fragments in the region (e.g. Agbaou Dékpa forest reserve) and local indigenous knowledge can all be a source of knowledge to build up a picture of the diversity which use to be present, and which could be restored. For example, *Hunteria ghanensis* (Endangered) is only known from Côte d'Ivoire and neighbouring Ghana has been recorded in the Herbarium of the Centre National de Floristique to have been found in the reserve in the 1950's. It could therefore be a target species for reintroduction. To build up a supply of seedlings to restore the reserve, it will be necessary to identify and protect mother trees to reduce the risk of inbreeding and loss of genetic diversity.

A survey of nine nursery operators close to the reserve in 2023 found that 44 different tree species were propagated, of which 24 were native (54%). Of the native tree species, six are listed as Vulnerable (*Milicia regia, Terminalia ivorensis, Khaya ivorensis, Pterygota macrocarpa*, *Garcinia kola* and *Nesogordonia papaverifera*) and one is listed as Endangered *(Tieghemella heckelii)*. Nursery operators identified 10 native species for which mother trees are absent or few in number in the Divo region or to be found located at a considerable distance from the reserve. The tree species that nursery operators described as most challenging to obtain seeds for were *Tieghemella heckelii, Milicia regia, Garcinia kola* and *Irvingia gabonensis*.

Conservation actions	Action lead & collaborators	Timeline
1.11 Use the botanical inventory, historical records and local forest fragments to identify the target plant species to restore the reserve 1.12 Locate and map mother trees of the target species 1.13 Maintain an up-to-date stock list of which species are currently available for purchase in local nurseries 1.14 Sustainably collect plant material from the target species, prioritising native species not found in local nurseries, following best practices (e.g. guidance from the Royal Botanic Gardens Kew Millenium Seed Bank) 1.15 Propagate target species in nurseries close to the reserve	**CNF** **CIFOR-ICRAF**	**2024**

Objective #2: Create a diverse forest canopy including threatened tree species that is sequestering large amounts of carbon, protecting the water sources and providing a rich habitat for wildlife

Several different restoration approaches can be used to restore destroyed or degraded forest, with the most appropriate being dependent on seed sources being available, dispersers being present at or near to the restoration site and the level of degradation. It is important to determine for each area, which restoration approach will be the most appropriate. For example, for areas surrounding the patches of secondary forest, assisted natural regeneration may be possible due to the presence of mother trees and fauna (e.g. pollinators and dispersers). In other areas where the land is completely degraded, and no secondary forest is present in the vicinity it will be likely that more species will need to be planted to restore ecological processes. Additionally, rare and threatened species are often unlikely to be recruited into restoration sites naturally, as they may have lost their dispersers and/or their seed source is low. Therefore, including such species into the planting mix can help ensure their conservation.

It was noted during the botanical inventory a lack of fauna was observed in the reserve, therefore, to be able determine what wildlife is persisting a fauna inventory is planned to take place in 2024 by l'Université Nangui Abrogoua.

Associated with the EU Regulation on Deforestation Free Products, any areas deforested for chocolate agricultural purposes after December 31, 2020 will not be able to sell into the EU market from 30 December 2024. Therefore, any areas mapped as deforested since December 31, 2020 that are being used to grow *Theobroma cacao*, will be ideal targets for restoration actions since the farmers working there will be less able to access viable incomes.

Conservation actions	Action lead & collaborators	Timeline
2.1 Develop a detailed map of the reserve identifying which areas need restoration (including which species should be planted taking into consideration different climate change scenarios) and which areas are suitable for assisted natural regeneration	**CNF** CIFOR-ICRAF	**2024**
2.2 Train the local population in forest restoration techniques (e.g. nursery management, seed collection, planting and monitoring)	**CIFOR-ICRAF** MINEF Universities ONG ANADER	**2024-2025**
2.3 Plant target tree species in priority areas including threatened tree species	**MINEF** CNF Génie Bio CIFOR-ICRAF	**2024-2027**
2.4 Implement assisted natural regeneration in priority areas	**MINEF** CNF Génie Bio CIFOR-ICRAF	**2024-2027**
2.5 Monitor restoration interventions to understand impacts on all biodiversity (plants, pollinators – e.g. insects - and dispersers – birds and mammals)	**MINEF** **CNF** **Génie Bio** CIFOR-ICRAF	**2024-2028**

Objective #3: Reduce use of phytosanitary products

Côte d'Ivoire has been using modern crop protection methods using phytosanitary products (including synthetic pesticides, herbicides and fertilisers) for several decades. For the year 2016 alone, the quantity of pesticides imported is estimated at 20,000 tons, two-thirds of which were herbicides (Traoré and Haggblade 2017). Research has found that the amount of herbicide that comes into contact with target organisms during treatment is limited. It is estimated at 0.3% against 97.7% of the treatment that is discharged into the environment (Tissu *et al.* 2006).

The application of large-scale spraying of pesticides is likely to negatively impact plant-pollinator interactions and dispersal agents. This in turn will limit the amount of natural regeneration and the ability of the reserve to recover without human interventions. Additionally, pesticides can be applied without protective measures which can also cause human health issues. It is therefore important to try and reduce the use of phytosanitary products in the reserve and to increase acceptability and availability of alternative methods.

For farms located outside of the reserve it could be a good opportunity to explore organic certification as a means for additional income. For example, the NGO Nitidae has been working within the Mé Region to increase organic cocoa agroforestry systems. Within this region old unproductive cocoa fields are often converted to monoplantations of rubber. To half this process they established an organic cocoa cooperative with voluntary farmers who still had trees persisting on their cocoa plantations and provided a source of income through the organic certification which guarantees a premium price (Nitidae 2021).

Conservation actions	Action lead & collaborators	Timeline
3.1 Raise awareness (through radio spots, posters and signs) of the dangers of using phytosanitary products on human health and the environment	**CIFOR-ICRAF** **Local elected officials** Local communities	**2024-2028**
3.2 Establish a demonstration plot where agroecology is practiced	**CIFOR-ICRAF** **Local elected officials**	**2025**
3.3 Make alternative options available (e.g. organic compost)	**CIFOR-ICRAF** **Local elected officials** Local communities	**2024-2028**

Objective #4: Reduce incidents of fire being used as a farming technique

The presence of forest fires in and around the reserve presents a challenge to restoration. Forest fires increase the mortality of tree species that are not fire tolerant and can also suppress natural regeneration. Most fires are caused by human activities such as hunting and preparing the land for agriculture Although forest fires are more common in the northern part of the country (i.e. the savanna zone), the high levels of deforestation which have taken place in the evergreen and semi-deciduous forest zones and the increasing dry seasons have made fires in the forest zone more common. During the 1982-1983 drought devastating wildfires occurred across the country, including the semi-deciduous and evergreen forests. It is estimated that 45,000 ha of forest were lost and resulted in the 21 people being killed (FAO 2001).

Effective fire management needs to take a number of different approaches including prevention, pre-suppression and suppression. Prevention activities include establishment of fire breaks.

Conservation actions	Action lead & collaborators	Timeline
4.1 Monitor for incidents of fire at the reserve through the use of drones and satellite images	**MINEF** BGCI Universities NGOs Local elected officials	**2025-2028**
4.2 Train local stakeholders and equipment provided to tackle forest fires	**CIFOR-ICRAF** **MINEF** Village and community chiefs/community leaders	**2024-2028**
4.3 Raise awareness among populations about good farming practices (e.g. establishment of a demonstration site to illustrate implementation of fire preventative actions)	**CIFOR-ICRAF** **MINEF** Village and community chiefs/community leaders	**2024-2028**

Goal 2 : Collaborative management: Divo Botanic Reserve is collaboratively managed and monitored by an adequately resourced group of local stakeholders

Objective #5: Secure the integrity of the reserve boundaries

The Ministère de l'Intérieur demarcated village lands in Côte d'Ivoire in 2017. However, at present there are no physical structures marking the boundary of Divo Botanic Reserve apart from a sign near the entrance from the main road. High levels of deforestation are taking place within the reserve, but it is difficult to distinguish it from the surrounding landscape. This has led to encroachment and installation of farms, schools and whole villages. Enforcement could be improved through the planting of native trees to clearly mark the boundary, which can then be patrolled by a joint force of MINEF and local communities. Bruner *et al.* (2001) found that the effectiveness of a protected area correlates with enforcement and boundary demarcation.

Among the many factors that affect the existence and the sustainability of forests, a main threat is the illegal activities (e.g. agricultural expansion and logging), which can cause unmanaged and irreparable deforestation. Despite the effort of the authorities taking actions for surveillance and information collection of forest environments aimed at confronting illegal activities, the problem persists, and it is difficult to reduce with only ground-based methods as on-site monitoring by staff and patrols. New technology-based solutions need to be exploited such as wireless surveillance systems (Trailguard and Ambush-cam, sensors for acoustic surveillance, etc.).

Conservation actions	Action lead & collaborators	Timeline
5.1.1 Mark the external boundary of the reserve by planting 40 km with three rows of fast-growing native tree species such as *Spathodea campanulata*, *Hildegardia barteri* and *Spondias mombin* 5.1.2 Mark the internal roadside boundary of the reserve by planting 150 m treeline on either side of the road	**MINEF** CIFOR-ICRAF BGCI Community leaders	**2024-2025**
5.2 Label trees with sensors	**MINEF** **CIFOR-ICRAF** Community leaders Religious leaders	**2024-2025**
5.3 Regularly monitor and maintain the boundary (with four patrols a month) consisting of a joint force of MINEF and local community members	**MINEF** Local communities	**2025-2028**
5.4 Punish offenders	**MINEF** **CIFOR-ICRAF** Community leaders Religious leaders	**2025-2028**

Objective #6: Restoration interventions are sustainable

Previous restoration interventions in the reserve have been limited by the lack of resources for follow up monitoring and maintenance. Monitoring is a vital component of any restoration project. It is an opportunity to measure the success of a project's restoration interventions and provides evidence for management decisions. The duration of monitoring for restoration projects is often too short, which means that the success and long-term recovery of the forest is not properly evaluated.

Forest patrols that are conducted jointly with local community members have been found to effectively reduce poaching and illegal farming/logging. A study by Gonedelé Bi *et al.* (2019) found that illegal activities at Dassioko Sud Forest Reserve decreased immediately and significantly following initiation of patrols involving community members from surrounding local villages. For joint patrols to be successful, suitable incentives will need to be determined in discussion with local community members. Technology can be utilised to help forest patrols. For example, within Cavally Forest Reserve, a Starling satellite tool has made it possible to monitor deforestation alerts in real time. Feeding directly to patrols, it makes them far more able to respond quickly to incursions (Earthworm Foundation 2023).

Conservation actions	Action lead & collaborators	Timeline
6.1.1 Identify forest relics with the best value as seed sources 6.1.2 Forest patrols target these sites as a priority 6.1.3 Communicate the importance of these sites (e.g. set up information signs) 6.1.4 Prioritise activities that address threats to these sites	**MINEF** CIFOR-ICRAF	**2025-2028+**
6.2 Map all restoration interventions and make them publicly available for maintenance and monitoring teams	**CIFOR-ICRAF** MINEF	**2025-2028+**
6.3 Train experts on GIS and remote sensing and other new monitoring methods (e.g. drones, satellite images, software, etc.)	**BGCI** **Financing bodies** MINEF Universities and research institutes NGOs Local elected officials	**2024-2025**
6.4.1 Identify suitable local community members and train in surveillance and monitoring 6.4.2 Capacity build the local population on the importance of surveillance and monitoring 6.4.3 Collaboratively develop suitable incentives for local communities to participate in surveillance and monitoring	**MINEF** Village and community leaders Local communities	**2025-2027**
6.5 Carry out monitoring of restored areas	**MINEF** CIFOR-ICRAF Village and community leaders Local communities	**2025-2028+**
6.6 Carry out maintenance of restored areas and replacement of dead plants	**MINEF** CIFOR-ICRAF Village and community leaders Local communities	**2025-2028+**

Objectif n° 7 : Strengthen the capacity of local forestry administration

Currently Divo Botanic Reserve has no forest station out of which MINEF can operate, limiting its ability to effectively monitor restoration interventions and deal with illegal activities. Additionally, MINEF lacks key resources to maximise its impact in the reserve. Drones and satellite technology would increase the ability to monitor a larger area than is possible by foot and can ensure that patrols, even with limited staff, can be as effective as possible.

MINEF staff often come from a forestry background and, although this leaves them well equipped to deal with more commonly planted exotic plantation species, they may be less knowledgeable about native species and the technical aspects of ecological restoration. It is therefore recommended that staff receive training on key topics for successful ecological restoration.

Conservation actions	Action lead & collaborators	Timeline
7.1 Build forest station in the reserve for MINEF officers	**MINEF** CIFOR-ICRAF	**2025**
7.2 Support the local forest administration with the necessary equipment (e.g., drones, GPS, motorcycles, computers)	**MINEF** CIFOR-ICRAF	**2025-2026**
7.3 Train MINEF officers to successfully implement forest restoration at the scale required at the reserve	**MINEF** CIFOR-ICRAF	**2026**

Objective #8: Prevent further agricultural expansion

Côte d'Ivoire is the world's largest cocoa producer, and approximately two-thirds of the country's working population depends on cocoa for its income (World Bank 2019). Historically, cocoa has been the biggest driver of deforestation in the country. The reserve is no exception with small plantations of cocoa occupying 34% of its surface area. It is important that for any ecological recovery to take place, that the small patches of forest fragments that remain are preserved, and that agriculture expansion is halted. Preventing encroachment back into areas where restoration activities have taken place is also essential and has already been identified as an issue. Within Dassioko Sud Forest Reserve in Côte d'Ivoire, Gonedelé Bi *et al.* (2019) found that decisive action such as destroying illegal farm resulted in significant declines in multiple forms of illegal activity.

Conservation actions	Action lead & collaborators	Timeline
8.1 Identification of new agriculture plantations	**MINEF** **Génie Bio** Community leaders Religious leaders	**2024-2027**
8.2 Issue notice to offenders that new agriculture plantations will be removed	**MINEF** **Génie Bio** Community leaders Religious leaders	**2024-2027**
8.3 Reforestation of plantations with native species	**MINEF** **Génie Bio** Community leaders Religious leaders	**2024-2027**
8.4 Follow-up and maintenance	**MINEF** **Génie Bio** Community leaders Religious leaders	**2024-2027**

Objective #9: Establish a local management committee

For decisions on management options, agreement is needed between the various stakeholders. A management committee that includes representatives from these different sectors can help to ensure that any decisions made are inclusive and to benefit everyone living in and around the reserve. This will help to improve sensitisation of decisions and ensure people adhere to decisions once made. It is important that the management committee has clear terms of reference so that there is clear understanding of the role of the committee and what is expected of them. Additionally, the committee will need long-term, sustainable resourcing. Ideally there needs to be fair gender and youth representation.

To ensure that the improved management of the reserve can be quantified it is recommended that different management tools are explored. For example, the Management Effectiveness Tracking Tool (METT) developed by the World Bank and WWF Alliance is an open access resource which allows for the tracking of an individual protected area over time. It has already been used to track the management of other protected areas in the country e.g. Banco National Park's METT score increased by 5 points (from 61% to 66%) between 2017 and 2019 (UNEP 2019).

Conservation actions	Action lead & collaborators	Timeline
9.1 Take a prefectural order to create a management committee made up of key local stakeholders including representatives of women and the youth	**CORPS Prefectoral** **MINEF** **CIFOR-ICRAF**	**2024**
9.2 Make the prefectural decree operational and hold regular meetings of management committee	**MINEF** CORPS Prefectoral	**2024-2025**

Goal 3 : Local communities benefit: The needs of the local communities are understood and sustainable livelihood opportunities are put in place to halt deforestation and degradation of the reserve

Objective #10: Understand the socio-economic status of people in and around the Reserve

To determine the most suitable alternative livelihood activities to reduce pressure on the reserves already almost depleted natural resources, it is necessary to understand as much as possible the socio-economic status of the people living in and in the periphery of the reserve. The following information would be useful to collect; gender, size of agricultural plots, produce being grown, ownership of land (including proof of ownership), use of phytosanitary products, whether children go to school or children work in agriculture.

At Cavally Nature Forest Reserve 755 people living close to the reserve were interviewed to determine their economic and social resilience. After this engagement the project led by the Earthworm Foundation developed livelihood options to be as sustainable as possible. As a result, 350 women have access to Village Savings and Loans Associations, 460 producers were engaged in alternative income generating activities, 160 producers were coached on Good Agricultural and Environmental practices and 250 children received birth certificates (to enable them to access higher education) (Earthworm Foundation 2023).

Conservation actions	Action lead & collaborators	Timeline
10.1 Identify and survey the people implementing activities in and around the reserve collecting information on their socio-economic status, and whether living inside or outside of the reserve	**CIFOR-ICRAF** ANADER MINEF Village and community leaders	**2024**
10.2 Create a database and map activities taking place in and around the reserve (e.g. land used for agricultural)	**CIFOR-ICRAF** **MINEF** Ministry of agriculture	**2025**

Objective #11: Involve farmers in the implementation of agroforestry

In 2021, the EU and Côte d'Ivoire initiated a policy dialogue on sustainable cocoa to address the root causes of unsustainable cocoa production ahead of the adoption of the EU Deforestation Regulation in June 2023. Cocoa agroforestry involves introducing companion trees into cocoa farms to create a canopy for the health and productivity of the understory tree, *Theobroma cacao*, which is originally from Latin America, as well as for biodiversity and ecosystem services. Full-sun cocoa farming remains popular. However, the southwestern and eastern cocoa belts farmers are increasingly taking up cocoa agroforestry practices. Increasingly unpredictable rainfall patterns are one of the driving factors behind this shift.

Since 2019, CIFOR-ICRAF has been introducing companion species into cocoa farms. Research has been undertaken to determine which companion species will not be detrimental to the productivity of the *T. cacao* crop, from shade, increased pests & diseases, or the uptake of water and nutrients from the soil. Shade tolerant genotypes of *T. cacao* (Arévalo-Gardini *et al.* 2021) also need to be promoted, made accessible and used.

Conservation actions	Action lead & collaborators	Timeline
11.1 Raise awareness on the importance of agroforestry and inform farmers about the ARS 1000 standard (sustainable cocoa production and traceability)	**CIFOR-ICRAF** **BGCI** MINEF Ministry of Agriculture	**2025**
11.2 Train local community members in agroforestry techniques (e.g. staking, drilling, planting, plant production, monitoring)	**CIFOR-ICRAF** **MINEF** Ministry of Agriculture Local community members	**2025**
11.3 Choose species for agroforestry	**CNF** **CIFOR-ICRAF** **BGCI** MINEF	**2025**
11.4 Collect and acquire seeds	**CNF** **CIFOR-ICRAF** **Network of nursery growers** MINEF	**2026-2028**
11.5 Produce seedlings by setting up nurseries	**CNF** **CIFOR-ICRAF** MINEF	**2026-2028**
11.6 Plant seedlings	**IFOR-ICRAF** MINEF	**2027-2028+**
11.7 Monitor and assess planted plants to understand success and failures	**CIFOR-ICRAF** MINEF	**2027-2028+**

Objective #12: Alternative activities to generate income for the population are implemented

Alternative income activities are needed for those that live within and around the reserve to reduce the necessity of them to use the land for agriculture or poaching activities that damage biodiversity and ecological integrity. Alternative incomes could come from payment for security and surveillance activities, tourism, or alternative uses of the land. There are also options external to the reserve itself. It will be necessary upon identification of stakeholders and their social conditions to ensure a dialogue to find alternatives and co-create solutions that will work for both people and biodiversity. In one promising model, to try and halt the expansion of cocoa farmers in Mabi-Yaya Nature Reserve in the Mé region in 2021, the NGO Nitidae trained young people in renewable energies and beekeeping. It also established women savings and credit groups to support income generating activities in eight villages (Nitidæ 2021).

Conservation actions	Action lead & collaborators	Timeline
12.1 Train local communities in pig, poultry, fish farming, nursery management, beekeeping, mushroom production (Myciculture), snails (heliciculture), aulacodes (aulacodiculture)	**ANADER** **Genie Bio** MINEF Community leaders Religious leaders CIFOR-ICRAF/BGCI Ministry of Agriculture/ ANADER/ Ministry of Fisheries and Animal Resources	**2024-2025**
12.2 Provide support for alternative income generating activities	**ANADER** **Genie Bio** **ONG** MINEF Community leaders Religious leaders	**2024-2025**
12.3 Monitor and build capacity of beneficiaries	**ANADER** **CIFOR-ICRAF** MINEF Community leaders Religious leaders	**2025-2027**

Goal 4 : Valued as a regional treasure: Divo Botanic Reserve is valued for its important biodiversity and has become a regional focal point for tourism and research

Objective #13: Raise awareness of the importance of restoring Divo Botanic Reserve

Restoring areas of degraded forests can restore vital ecosystem services such as the provision of water sources, natural pest control, improved soil health and microclimate. In the reserve, restoring tree cover will also increase biodiversity, which in an addition to its intrinsic value can also provide a potential source of additional income through tourism and Non-Timber Forest Products such as the fruit and nuts of the bush mango tree *(Irvingia gabonensis)* and petit cola tree *(Garcinia kola)*, which are already valued by local communities. If harvested sustainably, these could provide an additional source of income. In Taï National Park, Kouassi *et al.* (2019) found that repeated awareness campaigns consisting of theatre performances and/or film screenings resulted in a fall in bushmeat consumption. After exposure to four multimedia campaigns, the decrease exceeded 62%. This study highlights the importance of recurring exposure to maximise the impact of conservation activities in rural communities.

Conservation actions	Action lead & collaborators	Timeline
13.1 Develop and disseminate awareness-raising messages in local languages in local media (e.g. radio, posters and signs) and through local community meetings	**MINEF** **CIFOR-ICRAF** **Locally elected officials** Local radios Community leaders Religious leaders	**2024-2025**
13.2 Use of religious guides and community leaders in outreach	**MINEF** **CIFOR-ICRAF** Community leaders Religious guides	**2024-2025**
13.3 Use griots to pass messages in local languages	**MINEF** **CIFOR-ICRAF** Griots Community leaders Religious guides	**2024-2025**

Objective #14: Increase involvement of political and administrative authorities

It is of utmost importance that, when illegal activities are identified by rangers, there is support from the legal system to charge perpetrators. If authorities do not effectively prosecute offenders, it will not deter others from undertaking illegal activities (Gonedelé Bi *et al.* 2019). At present, perpetrators are not always prosecuted for carrying out illegal activities within the reserve. This is, at least partially, due to a lack awareness and capacity to properly administer decisions. Financial mechanisms as well as enforcement ability are both lacking as tools that local political and administrative authorities can use easily.

Conservation actions	Action lead & collaborators	Timeline
14.1 Raise awareness among political figures	**MINEF** **CIFOR-ICRAF** Genie Bio Community leaders Religious leaders	**2024-2025**
14.2 Interministerial order to implement actions for the conservation of the reserve	**MINEF** **MEMINADERPV** **MJDH** **MENV** Genie Bio Community leaders Religious leaders	**2025**
14.3 Publish decisions on violations in a timely manner	**MINEF** **MJDH** Genie Bio Community leaders Religious leaders	**2025**

Objective #15: Raise awareness and increase communication on the legal status of the reserve

Although the reserve has been under official protection since 1935 and human activities within the boundaries are not legally permitted, this is not always known by community members, particularly those who may have moved to the area more recently. It is important that the status of the reserve as a protected area is regionally known and that there be a forum within which community members can ask questions and receive information.

Conservation actions	Action lead & collaborators	Timeline
15.1 Make the status of the reserve known to all of society through media such as radio, social media and the written press	**MINEF** Radio Written press Genie Bio Community leaders Religious leaders	**2024-2025**
15.2 Set up a forum to provide an opportunity for feedback from local communities	**MINEF** Community leaders Religious leaders	**2024-2025**

Objective #16: The reserve is utilised as a place of learning

With so little primary forest remaining in the region and increasing number of people living within urban areas, even degraded forest can act as an important resource to raise awareness of the impact of human activities on the landscape and to highlight the biodiversity that still persists and how it can be protected, and how biodiversity that has been lost can be recovered. The most effective way to foster environmental stewardship by local communities (including school children) is through visiting the forest first hand.

Additionally, limited ecological research has taken place in the reserve. There is an opportunity to partner with universities to be able to conduct studies to fill important knowledge gaps (e.g. pollinator interactions). It will also be important to ensure that research is undertaken on the impact of restoration activities so that the recovery of the ecosystem can be determined.

Conservation actions	Action lead & collaborators	Timeline
16.1 Develop interpretation materials to facilitate learning about the reserve	**CIFOR-ICRAF**	**2024-2025**
16.2 Collaborate with local schools to encourage field visits to the reserve	**MENETFP** MINEF CIFOR-ICRAF	**2025-2028**
16.3 Develop partnerships with universities to use the reserve as a site for ecological research	**Universities**	**2024-2028**

Objective #17: The reserve becomes a tourist destination

There is potential to attract both international and domestic tourism to the reserve, resulting in an additional source of income. In parallel with recovering tree and associated diversity, making the reserve suitable for eco-tourism should be a priority. For example, resources can be developed on the birds found in the reserve to support the establishment of nature walks. Additionally, cultural tourism could be explored. Palm trees such as raffia – the leaves of which can be woven into textiles – and rattans, climbing palms that are economically for making baskets and furniture, are native to the reserve. They could be planted, sustainably harvested and marketed as a unique local product. Le Jardin des Palmiers de Divo, established in 2014, is dedicated to the propagation of these socio-economically important plants and could take the lead on this. Additionally, the Association for the Renovation of Dida Culture (ARCULDI) will also be an important partner; many skilled local artisans are members and produce products that are unique to the Divo region.

Conservation actions	Action lead & collaborators	Timeline
17.1 Facilities developed to maximise the tourist potential of the reserve (e.g. visitor centre, accessible foot paths, informative signage)	**Ministère du Tourisme** **MINEF**	**2025-2027**
17.2 Media developed to promote the reserve (e.g. video)	**Ministère du Tourisme** **MINEF**	**2026-2027**

4. Next steps

The development of this restoration plan is the first step in the process to achieving the recovery of the Divo Botanic Reserve. To maintain momentum, the most important next step is to form a management committee for the reserve as none of the above can be achieved by any single organisation working in isolation. The management committee will need representation from all key local and national stakeholders. Once it is accepted to make decisions on behalf of the reserve, the task of the management committee will then be to work in partnerships to achieve the four goals and 17 objectives outlined above to synergise the conservation actions and maximise impact.

To ensure adaptive management going forwards, it will be important that data be collected on the conservation actions, and it is also recommended that the management committee meets regularly to evaluate progress and assign responsibilities with timely deadlines.

Through collaboration and determination, it will be possible to turn a new corner for the reserve such that and by 2030 Divo Botanic Reserve will once again become a treasure of the region, sustainably providing for the local population and with biodiversity recovering to close to what it once was prior to the deforestation and degradation is believed to have begun 50 years ago.

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Action plan

Restoration plan for Divo Botanic Reserve

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