Darwin Initiative Main & Extra: Final Report

To be completed with reference to the "Project Reporting Information Note": (https://www.darwininitiative.org.uk/resources/information-notes/).

It is expected that this report will be a **maximum of 20 pages** in length, excluding annexes.

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Darwin Initiative Project Information

Scheme (Main or Extra)	Main
Project reference	28-012
Project title	Native grass forage management to feed people and protect forests Alternative titles: Harena Voajanahary sy Kijana Mamokatra; Darwin Initiative - Productive Pasture Partnership (DI-PPP)
Country(ies)	Madagascar
Lead Organisation	Royal Botanic Gardens, Kew (Kew or Kew Madagascar, KM)
Project partner(s)	Missouri Botanical Gardens Madagascar (MBG), Royal Botanic Garden Edinburgh (RBGE, Caroline Lehmann), University of Pretoria, Plant and Soil Sciences Department and Enterprises University of Pretoria (UP, Wayne Truter), Sarobidy Rakotonarivo, consultant sociologist (ESSA, University of Antananarivo, School of Agronomy), John Morton, Natural Resources Institute, University of Greenwich, UK (NRI)
Darwin Initiative grant value	£454,221
Start/end dates of project	1 November 2021 - 31 March 2025
Project Leader name	Maria Vorontsova & Mamy Tiana Rajaonah
Project website/blog/social media	Project Facebook page https://www.facebook.com/KMCCMBG Photos at https://www.flickr.com/photos/36803481@N06/ ; videos at https://www.youtube.com/channel/UCF-IArgyzK3zMvdG0fCe7hw
Report author(s) and date	Maria Vorontsova, Livasoa Randriamanalina, Nanjarisoa Prisca

1 Project Summary

Poverty in the Central Highlands of Madagascar is partly driven by poor livestock nutrition. Inefficient exploitation of pastures and native forage grasses, and poor fire management lead to low pasture nutrition as well as damage to fire-sensitive forest patches. Disconnected approaches to agriculture and conservation are preventing progress as interventions fail to consider local ecosystems their human residents and their food systems. Poverty is becoming worse, with an average daily household income of 0.56 USD in Itremo (KMCC 2019), and the recorded percentage of the country's population below the poverty line expected to increase to 76.5% for 2020 (World Bank 2020). Since the late 1980s KMCC and MBG built close relationships with the pastoral communities closest to the forest patches now protected as Itremo, Ibity, and Ankafobe New Protected Areas (figure 1), giving us a detailed understanding of the local situation (KMCC 2012, MBG 2012, 2018). Our 2019 Darwin scoping project carried out surveys on cattle, grazing practice, and local opinions on these issues.

Malagasy grasses were dismissed as non-native weeds until research by Vorontsova demonstrated ubiquitous and diverse native and endemic species (Vorontsova & Rakotoarisoa 2014, Vorontsova et al. 2016; Hagl et al. 2020). Grasslands were assumed to be anthropogenic until research into their ecology led by Lehmann and Vorontsova in 2016 onwards identified ancient assemblages of highland grazing grasses (Solofondranohatra et al. 2020).

Humped zebu, *Bos indicus* cattle, are of central importance in Madagascar as cultural symbols, rural banks, tradeable products, and working animals. This living tradition has grown disconnected from agricultural policy and herds have dwindled from 23 million in the early 1980s to about 6 million today (IFC 2018) and per capita annual consumption of beef dropped from 17kg per person in the 1970s to just 2kg per person in 2010 (MINAE 2012). Ankafobe, Ibity, and Itremo households own between 0-18 animals each, but most are undernourished and calving less than once a year due to inefficient grazing practice and limited use of crop residues.

Unique fire-sensitive forest patches at Itremo, Ankafobe, and Ibity New Protected Areas (Figures 2-4) are home to 15 endemic mammal species, 27 bird species, and 713 plant species. Late dry season fires lit in grasslands to stimulate forage become out of control and penetrate forest boundaries. Such fires have occurred in Ankafobe and Itremo annually (KMCC 2012, MBG 2012, 2018), undermining community-led forest conservation. Poor fire management practices arise from the outdated view that all fires are bad, unnatural, and must be prevented. Modern research confirms that "frequent–cool–small" fires typical for human-inhabited tropical grasslands are a normal component of Madagascar's highland ecosystems like those of mainland Africa, and impossible to prevent (Kull 2004, Archibald 2013, Lehmann et al. 2022a). Contrary to popular misconceptions, highland fires have significantly decreased from 1998 to 2015 (Andela 2017). Misunderstanding of fire regimes, technically incorrect fire assessment practices that misinterpret satellite counts of fires, and management failures were apparent at Lehmann's 2019 fire management workshop. Research in Ibity confirms that standard fire suppression policies failed to reduce the area burned from 1985 to 2015 (Alvarado 2018).

We brought a modern approach to address a gap in Madagascar's environmental governance. Grasses and grasslands are neglected through the assumption they are of little value compared to forests. Fires are a long-term problem Madagascar does not have the expertise to manage. We aimed to boost the wealth of 90 households and their village communities by integrating botanical knowledge, grassland ecology, agricultural science and fire management expertise to trial management methods which supported key **forage grasses** (output 1), improved **livestock nutrition** (output 2), and **reduced forest fires** (output 3).

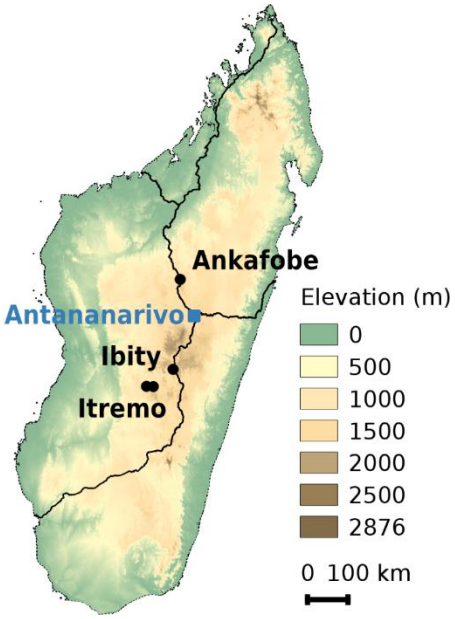

Figure 1. Map of the 3 project sites in Madagascar, by Sarah Z. Ficinski. Kew and MBG head offices are located in Antananarivo. Two parts of the Itremo PA are shown; the project is located in West Itremo.

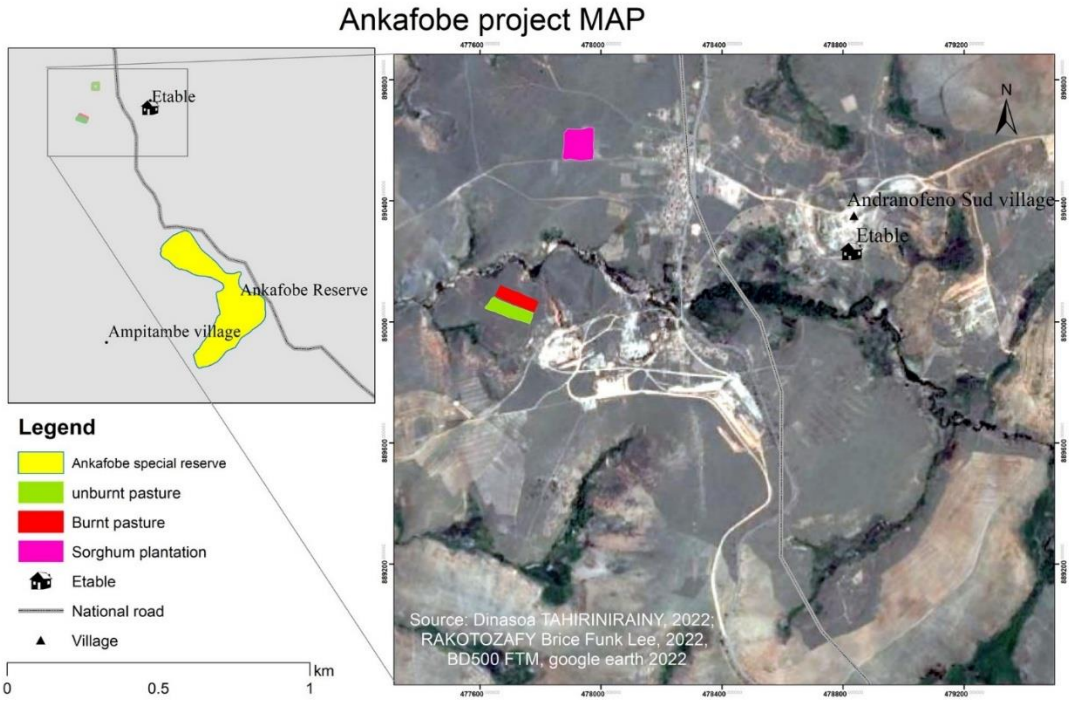

Figure 2. Map of project activities in Ankafobe, by Dinasoa Tahirinirainy and Brice Funk Lee Rakotozafy. Etable = cowshed. Beneficiary households are located in the Andranofeno Sud village; the project forest patch is inside the reserve.

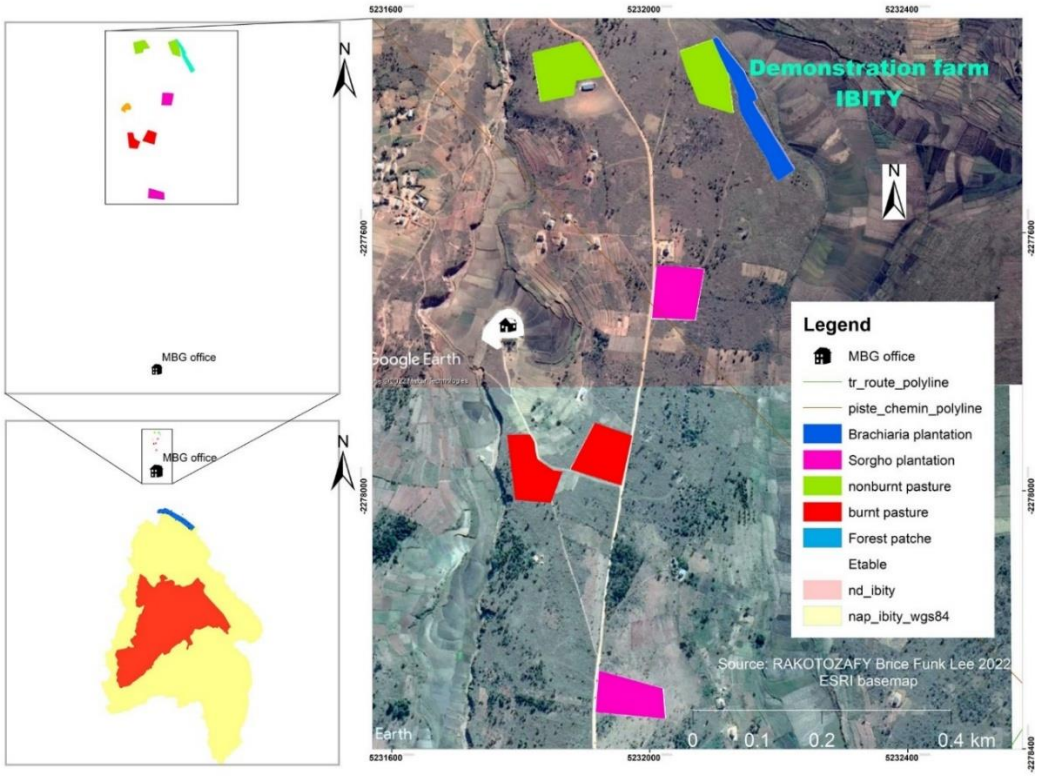

Figure 3. Map of project activities in Ibity, by Brice Funk Lee Rakotozafy. NAP = New Protected Area.

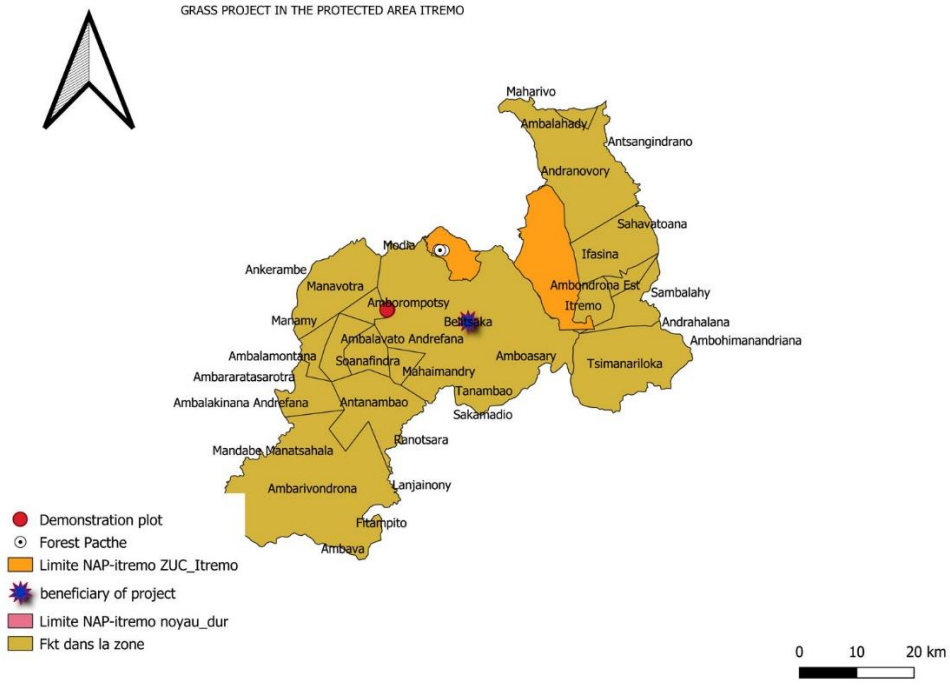

Figure 4. Map of project activities in Itremo, by Romain Benjamina. NAP = New Protected Area. Fkt = Fokontany, local administrative units labelled with names of the local villages. Project activities are distributed over a wider area.

2 Project Partnerships (project staff diagram in appendix 1)

Kew is a world leader in plant diversity science and conservation, enabling taxonomists to apply their knowledge to real world challenges. Leader Vorontsova is a grass taxonomist studying the grasses of Madagascar since 2010 and documenting 541 grasses on the island

(Vorontsova et al. 2016). **KM (previously KMCC)** is the Kew site in Madagascar operating under a host state agreement (Accord de siège) with the Madagascar government and running increasingly influential botanical conservation and development projects across Madagascar since 1999. Rajaonah and Randriamboavonjy were instrumental in establishing the Itremo New Protected Area and bring established relationships with the Environment Ministry, the regional authorities in Ambositra and Ambatofinandrahana, and Itremo local communities since 2010.

MBG is the largest plant-focused conservation organisation in Madagascar and a leader in community-centred approaches to conservation, securing local association-led protection for eleven PAs including the easily accessible Ankafobe and Ibity PAs. Ibity is home to Madagascar's best understood savanna ecosystem (Alvarado 2015; Ralainarivo 2021) and during this project became the country's first modern savanna fire management plan (Rakotozafy 2022). This project was part of MBG's ongoing work to strengthen PA management through development projects in the surrounding areas. It reflects the close working relationship between Kew and MBG Madagascar and has complement other collaborations.

[confidential paragraph please] The separate management structures of KM and MBG may have contributed to somewhat poorer results in Ibity and Ankafobe, as Itremo received more frequent and direct agricultural advice. See also discussion of Ankafobe and forest fire under 3.1.

South African mid-elevation semi-natural pastures are climatically equivalent to our highland Madagascar sites, sharing *Loudetia simplex* and other key forage grasses, and enabling technology transfer from a South African system that acknowledges the evolutionary value of grazers for grassland biodiversity. The **UP** FPLRS programme works to establish livestock farming enterprise for small-scale farmers focusing on good rangeland management and optimal agronomic pasture support systems with associated agribusiness models in South Africa. **Wayne Truter's** AF4RICA laboratory specialises in forage nutrition analysis and the mobilisation of academic expertise to deliver commercial agricultural solutions. Practical agriculture and farming lead, Truter is also a commercial livestock farmer and a popular and effective practical farm advisor. Truter started collaborating with Vorontsova during the Darwin Scoping project in 2019. He designed the agricultural aspects of this project, organised forage sorghum imports to Madagascar, and delivered farming education for the current project staff in South Africa and in Kentucky, USA. The AF4RICA laboratory analysed forage nutrition.

Caroline Lehmann is an influential tropical savanna and fire ecologist with extensive research and practical experience in Australia, Africa, and Madagascar. Collaborating with Vorontsova since 2016, Lehmann became convinced of the natural origin and high forage potential of Madagascar's highland grassland flora, which evolved under prehuman fire regimes and grazing pressure from now-extinct megafauna (Solofondranohatra 2020, Silander 2023). It became apparent that outdated views of grasslands and fire were undermining both understanding and practical management of grassy ecosystems (Lehmann 2022a). Lehmann led the grassland biodiversity and biomass experiments and analyses having co-designed the GGG sampling protocol with Vorontsova (Lehmann 2022b), and oversaw ecological data collection, standardisation, and storage. Lehmann brought fire management expertise, having led Madagascar's first modern fire management workshop with Vorontsova in 2019.

Sarobidy Rakotonarivo is an interdisciplinary social scientist with extensive experience working on social issues around natural resource management. Her research interests include the social dimensions of nature-climate interventions especially in Madagascar, forest conservation, restoration, and climate-smart agriculture. She uses a mixed method approach, including field experiments and qualitative approaches to study the political and socioecological factors that increase their effectiveness. Since returning to Madagascar in 2019, she has engaged at the highest possible policy level to generate impact from her research to ensure nature-climate interventions are more effective and equitable. Rakotonarivo is a thought leader on Global North – Global South research ethics as well as broader environmental conservation issues affecting our project sites including tree planting and land tenure issues (Rakotonarivo & Andriamihaja 2023a; Rakotonarivo 2023b). Rakotonarivo designed and led the sociological aspects of this project.

John Morton (joining the project in its final year) brought a connection to the global sustainable livestock development sector. Morton is an anthropologist with 40 years of experience in applied research in developing countries, focusing on the social, institutional and policy aspects of livestock development, as well as on the impacts of climate change on different categories of the rural poor, and opportunities to strengthen climate resilience. He has been Professor of Development Anthropology in the University of Greenwich since 2010 and is currently Co-Leader of NRI's Centre for Society, Environment and Development. He has worked in over 20 countries of anglophone and francophone Africa. Relevant recent work includes an analysis of the dairy value chain in Burundi, and preparation of the European Commission document EU Support to the Livestock Sector: State of Play 2021 (European Commission 2023). In 2023 Morton visited Madagascar to observe the current project. Morton supported Rakotonarivo's sociological work, and contributed expertise on qualitative methods for investigating livestock production and pasture management systems.

Livestock production is a new area for both Kew and MBG. The project manager Livasoa Randriamanalina is a veterinary doctor qualified at the University of Antananarivo with the relevant professional connections, enabling the project to operate competently in the veterinary and livestock sphere from the start. New collaboration with the Agriculture Ministry (MINAE) started well and Lucile Razafimpamoa, Directorate of Livestock Production Support (DAPA) at MINAE, supported the project with enthusiasm because of its overlap with the MINAE target to support and increase Madagascar's livestock production. MINAE have now taken over supporting the local associations of livestock owners this project has created,

The National Centre for Applied Research on Rural Development (FOFIFA) are a key stakeholder for the grasses, forages and pasture aspects of this project. Dr Jean Augustin Randriamampianina, FOFIFA weed specialist scientist already working with Maria Vorontsova on a GCRF grass weed project and provided advice on forage and weed grass research.

Fire management in collaboration with MEDD is the greatest policy challenge of this project as concerns over recent fires are exacerbating the conflict between the need for preventative burns and historic legislation prohibiting fires. Rinah Razafindrabe, Directorate of Protected Areas, Natural Renewable Resources, and Ecosystems (DAPRNE, within MEDD) has been particularly interested in fire management, attended the project launch and put us in touch with DAPRNE regional staff. Part way through this project, Kew, KM, and MBG took on the leadership of the DEFRA UK Biodiverse Landscape Fund: *Sustainable Management for Future Generations* (FMH, https://www.kew.org/science/our-science/projects/sustainable-management-for-future-generations-in-Madagascar). The fire management work package of FMH is led by out partner Caroline Lehmann and one of the project focus sites is Itremo, enabling a close collaboration between the two projects for the challenging fire work in output 3.

Strong motivation for the project originated from the local communities, as livestock ownership holds great significance in Malagasy rural culture, a fact first noted during our Darwin Scoping workshop in 2018, and reflected in household enthusiasm to participate as well as the immediate unambiguous support from all the Malagasy organisations. The project start benefitted from pre-existing close working relationships between local communities at the three sites, Kew and MBG staff managing the Protected Areas at these sites, Environment Ministry (MEDD, see Table 1 for abbreviations) staff already supporting local Protected Area governance, and UK Embassy staff already supporting Kew operations in Madagascar. Gilbertine Rakotomahafaly, Regional Director of the Environment and Sustainable Development (DREDD, Amoron'i Mania Regional subdivision of MEDD) supported our permit applications to work in Itremo. A broad spectrum of Malagasy organisations attended the national and regional project launch and closing events (including representatives of those listed in table 1).

Table 1. List of Madagascar-based organisations engaged by this project, their respective abbreviations used in this report, and English translations. Full project partners listed in the original application are not included. Regional branches of the national government bodies are omitted for simplicity.

1. Ministry of Agriculture (MINAE) and associated bodies

1.1 Ministère de l'Agriculture et de l'Elevage, Directeur Générale de l'Agriculture (MINAE DGA); Ministry of Agriculture, General Agriculture Directorate

1.2 Ministère de l'Agriculture et de l'Elevage, Direction de la Production Végetale (MINAE DPV); Ministry of Agriculture, Plant Protection Directorate

1.3 Ministère de l'Agriculture et de l'Elevage, Direction d'Appui à la Production Animale (MINAE DAPA); Ministry of Agriculture, Animal Production Directorate

1.4 Ministère de l'Agriculture et de l'Elevage, Direction des Services Vétérinaires (MINAE DSV); Ministry of Agriculture, Veterinary Services Directorate

1.5 Centre National de Recherche Appliquée au Développement Rural, Département de Recherche Zootechniques, Vétérinaires, et Piscicoles (FOFIFA DRZVP); National Centre for Applied Research on Rural Development, Department of Zootechnological, Veterinary, and Fisheries Research

1.6 Centre National de Recherche Appliquée au Développement Rural, Département de Recherche Rizicole (FOFIFA DRZ); National Centre for Applied Research on Rural Development, Department of Rice Research

2. Ministry of Environment (MEDD) and associated bodies

2.1 Ministère de l'Environnement et du Développement Durable, Direction Générale de la Gouvernance Environnementale, Direction des Aires Protégées, des Ressources Naturelles Renouvelables et des Ecosystèmes (MEDD DGGE DAPRNE); Ministry of Environment, General Directorate of Environmental Governance, Directorate of Protected Areas, Natural Renewable Resources, and Ecosystems

3. Ministry of Higher Education and associated bodies

3.1 Université d'Antananarivo, Faculte des Sciences, Mention Biologie et Ecologie Végétales (MBEV); University of Antananarivo, Faculty of Science, Department of Plant Biology and Ecology

3.2 Université d'Antananarivo, Ecole Supérieure des Sciences Agronomiques (ESSA); University of Antananarivo, School of Agronomy

3.3 Parc Botanique et Zoologique de Tsimbazaza (PBZT); Tsimbazaza Zoo and Botanical Gardens

3.4 Silo National des Graines Forestières (SNGF); National Seedbank of Madagascar

3.5 Institut d'Enseignement Supérieur d'Antsirabe, Vakinakaratra (IESAV); University of Antananarivo in Antsirabe

4. NGOs

4.1 Fikambanana Fampivoarana ny Tantsaha (FIFATA); Association for the Progress of Farmers

4.2 Fiompina sy Fambolena Malagasy Norvéziana (FIFAMANOR); Centre of Rural and Applied Research [on livestock agriculture]

4.3 Projet d'amélioration et d'Organisation de la Filière Lait (MDB PROFI-Lait); EU and Malagasy Dairy Board Milk Production Project

4.4 California Academy of Sciences, Madagascar Biodiversity Centre (CAS MBC)

3 Project Achievements

3.1 Outputs

Output 1. *Improved preservation, understanding and more efficient exploitation of native and endemic forage grasses and forbs, in native grasslands near villages***.** By Nanjarisoa Prisca**.**

Species richness at plot and regional over time (indicator 1.1). From the combined efforts of annual surveys and the use of the GGG method (Lehmann et al. 2022b) during this research in 30 permanents sites (6 burnt sites, 6 unburnt sites and 18 communal pastures), along with careful observations under binocular microscopes and identification support from specialized botanists at Kew and Madagascar a total of **189 unique species**, belonging into **108 genera and 31 families**, were recorded in the savanna across the three regions in Ibity, Itremo, and Ankafobe, including the endemic family Sarcolaenaceae. Species richness increases about 11 to 14 species each year from the baseline in 2022 to 2024 (figure 5).

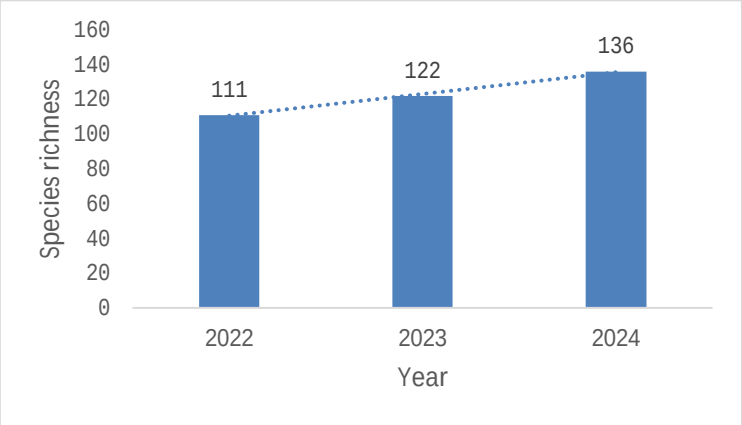

Figure 5. Pooled species richness across the three regions over the project timeline.

Within each 1m diameter circular plot, for all treatment and all regions, we can observe that **savanna species richness has increased from a baseline of 3-6 species to 8-13 species** inside of 50m x 50m sites, except for Itremo in year 3 having a species richness decreasing that we suspect due by the time of data collecting in the late dry season (May 2024). However, it should be noted that the differences are not similar for each region. For Ankafobe it varies from 7-11 species to 9-12 species, for Ibity it varies from 6-11 species to 8-13 species; 3-6 species to 5-8 species for Itremo (figure 6A).

In the burnt sites, we can observe that for all region after fire treatment in 2022, species richness decreased in 2023 and then increased in 2024. Species richness seems to accumulate across multiple years of no fire. (Figure 6B).

Five native grass and forb **frequency** (indicators 1.2 and 0.2). The most frequent grass species recorded across the regions from 2022 to 2024 (figure 7A) starting with the most frequent were *Loudetia simplex, Panicum luridum, Elionurus tristis* (endemic)*, Aristida rufescens* (endemic)*, Aristida tenuissima* (endemic)*, Schizachyrium sanguineum, Hyparrhenia rufa, Heteropogon contortus, Ctenium concinnum, Sporobolus centrifugus, Sporobolus pyramidalis*. The most frequent forb species were *Eriosema procumbens, Chamaecrista lateriticola, Antherotoma naudinii, Desmodium barbaturm var.procumbens, Emilia integrifolia, Helichrysum faradifani, Spermacoce pusilla, Bechium nudicaule, Emilia graminea, Launaea rarifolia* (endemicity not assessed here; figure 7B). The frequent species are not the same across regions, for both grasses and forbs (figure 6C-H).

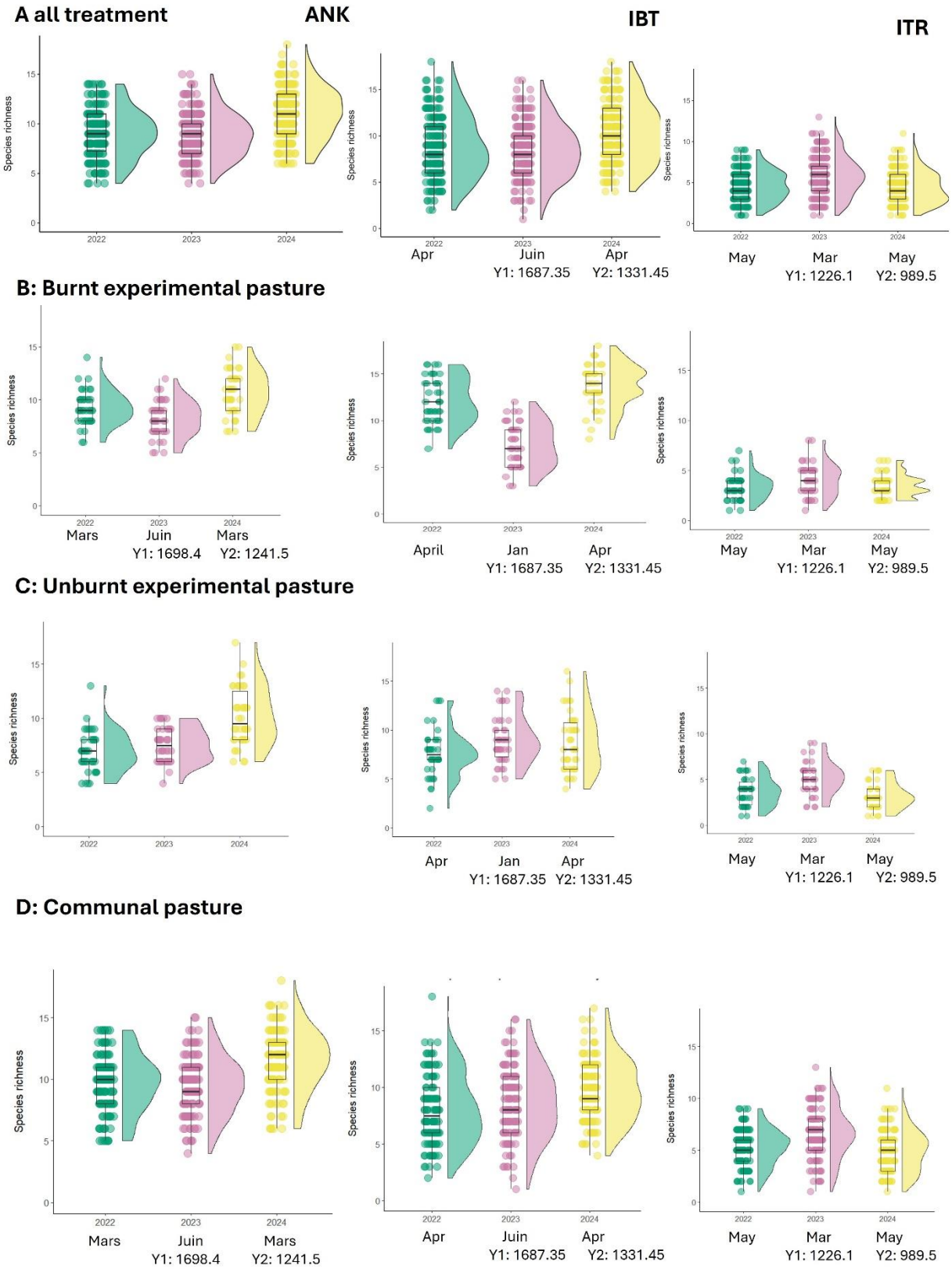

Figure 6. Average species per plot for each region across the project timeline (2022-2024) and different treatments. (A): all sites, (B): Burnt experimental sites, (C): Unburnt experimental sites, (D): Communal pastures sites.

Frequency trends in key grass species (table 2) and forb species (table 3) were calculated as change from the baseline year (2022) to the endline of the project (2024). The change over time is complex to interpret with no single clear pattern seen. *Panicum luridum* (an effective endemic perennial mat-forming broad-leaved forage grass) shows the strongest increase in frequency across all regions. The species presenting the strongest decrease in frequency are *Elionurus tristis* for Ankafobe, *Loudetia simplex, Sporobolus centrifugus* and *Trachypogon spicatus* for Ibity, and *Sporobolus pyramidalis* for Itremo. The forb species with the greatest increase in frequency are *Chamaecrista lateriticola, Spermacoce pusilla* and *Emilia itegrifolia* for Ankafobe; only *Helichrysum faradifani* for Ibity; *Chamaecrista lateriticola* and *Launaea rarifolia* for Itremo.

Grazing value indices (indicator 1.3). The selection of species for this analysis was based on the following criteria: (1) the Grazing Index (GI), represented in our case by the total number of bites recorded in each circular plot of 1m diameter between 2022-2024 across the 3 regions (figure 8), (2) the presence of the species in at least two of the studied regions and also (3) the local knowledge and perceptions collected from focus groups, particularly species recognized by local farmers as being appreciated by cattle and available throughout the year. The selected species are *Loudetia simplex* (native), *Hyparrhenia rufa* (native), *Heteropogon contortus* (native), *Aristida rufescens* (endemic), *Schizachyrium sanguineum* (native), *Imperata cylindrica* (likely native), *Sporobolus pyramidalis* (native). We added other useful forage species not always recorded in the savanna but beneficial for the local farmers: *Melinis repens, Rottboellia cochinchinensis, Digitaria ciliaris, Digitaria longiflora, Cymbopogon caesius, Panicum maximum, Leersia hexandra, Cenchrus purpureus*, Sp 14 (another variety of *Cenchrus purpureus*), *Trachypogon spicatus, Heteropogon contortus, Phragmites mauritianus*. Four analyses are made during this project: two of these carried out in the *African Forage, Fodder, Feed and Food Quality Reference Laboratory, Innovation Africa Campus, University of Pretoria* where we obtained nutrient values of some grass forage species (appendices 2-3), and two at the FOFIFA laboratory in Madagascar, including 6 forages species before and after flowering period (data not analysed yet).

All the species analysed show high levels of neutral detergent fibre (appendices 2-3, NDF), and most of them also have elevated crude fibre content, except *Leersia hexandra,* Rottboellia *cochinchinensis* and *Cymbopogon caesius*, indicating that these species have low digestibility and tend to reduce voluntary intake. This is due to the presence of high lignin and cellulose in their plant tissues. The high fibre content observed can be explained by several factors such as the maturity of the plant, most being perennial, which generally accumulate more fibre than annual species. These species are tussock grasses from savanna regularly exposed to annual fires and thus have developed higher lignin content as an adaptive trait for fire resistance and the poor soil quality (low nitrogen, water stress) also contributing to increased fibre production in these plants, as a structural and physiological response to these limiting conditions. *Leersia hexandra* is a non-savanna species and grows in the humid place is considered as a very good forage due by its crude protein content and high rate of digestibility. The values obtained from the chemical analysis help to classify species according to their suitability for different purposes: direct grazing in pasture, hay production, or silage making. Summary conclusions are presented in table 4.

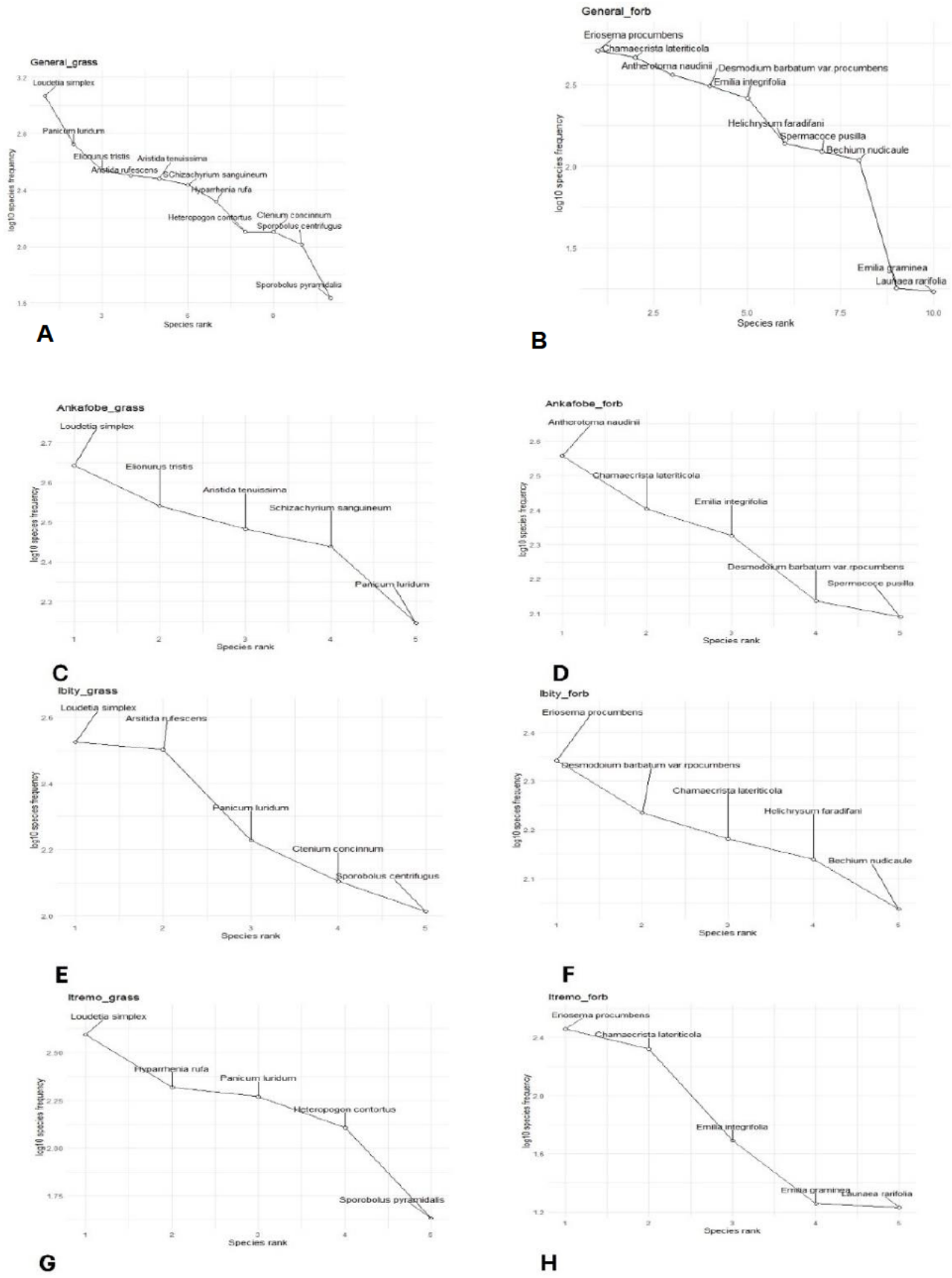

Figure 7. Rank frequency curve total per year of the ten most frequent native grass and forb species across all sites (A-B), in Ankafobe (C-D), in Ibity (E-F) and in Itremo (G-H).

Table 2. Percentage change in the frequency of six key grass species at plot level between 2022-2024 for Ibity, Itremo and Ankafobe.

ANKAFOBE				
SPECIES	2022	2024	Difference	% increasing /decreasing
Loudetia simplex	146	147	1	0.684932
Elionurus tristis	129	91	-38	-29.4574
Aristida tenuissima	97	106	9	9.278351
Schizachyrium sanguineum	91	90	-1	-1.0989
Panicum luridum	55	60	5	9.090909
Aristida rufescens	47	42	-5	-10.6383
IBITY				
SPECIES	2022	2024	Difference	% increasing /decreasing
Loudetia simplex	120	95	-25	-20.8333
Aristida rufescens	100	96	-4	-4
Sporobolus centrifugus	49	27	-22	-44.898
Trachypogon spicatus	48	31	-17	-35.4167
Panicum luridum	48	70	22	45.83333
Ctenium concinnum	47	40	-7	-14.8936
ITREMO				
SPECIES	2022	2024	Difference	% increasing /decreasing
Loudetia simplex	133	134	1	0.75188
Hyparrhenia rufa	67	69	2	2.985075
Panicum luridum	53	69	16	30.18868
Heteropogon contortus	44	42	-2	-4.54545
Sporobolus pyramidalis	17	12	-5	-29.4118

Table 3. Percentage change in the frequency of five key forb species at plot level from 2022-2024 for Ibity, Itremo and Ankafobe.

ANKAFOBE				
Species				
	2022	2024	Difference	%Increasing/decreasing
Antherotoma naudinii	123	127	4	3.252033
Chamaecrista lateriticola	91	98	7	7.692308
Desmodium barbatum var.procumbens	46	46	0	0
Spermacoce pusilla	41	55	14	34.14634
Emilia integrifolia	39	103	64	164.1026
IBITY				
Species	2022	2024	Difference	%Increasing/decreasing
Eriosema procumbens	86	62	-24	-27.907
Desmodium barbatum var.procumbens	62	50	-12	-19.3548
Chamaecrista lateriticola	57	58	1	1.754386
Bechium nudicaule	49	30	-19	-38.7755

Helichrysum faradifani	46	49	3	6.521739
ITREMO				
Species	2022	2024	Difference	%Increasing/decreasing
Eriosema procumbens	91	100	9	9.89011
Chamaecrista lateriticola	63	81	18	28.57143
Emilia integrifolia	21	10	-11	-52.381
Launaea rarifolia	4	6	2	50
Emilia graminea	5	5	0	0

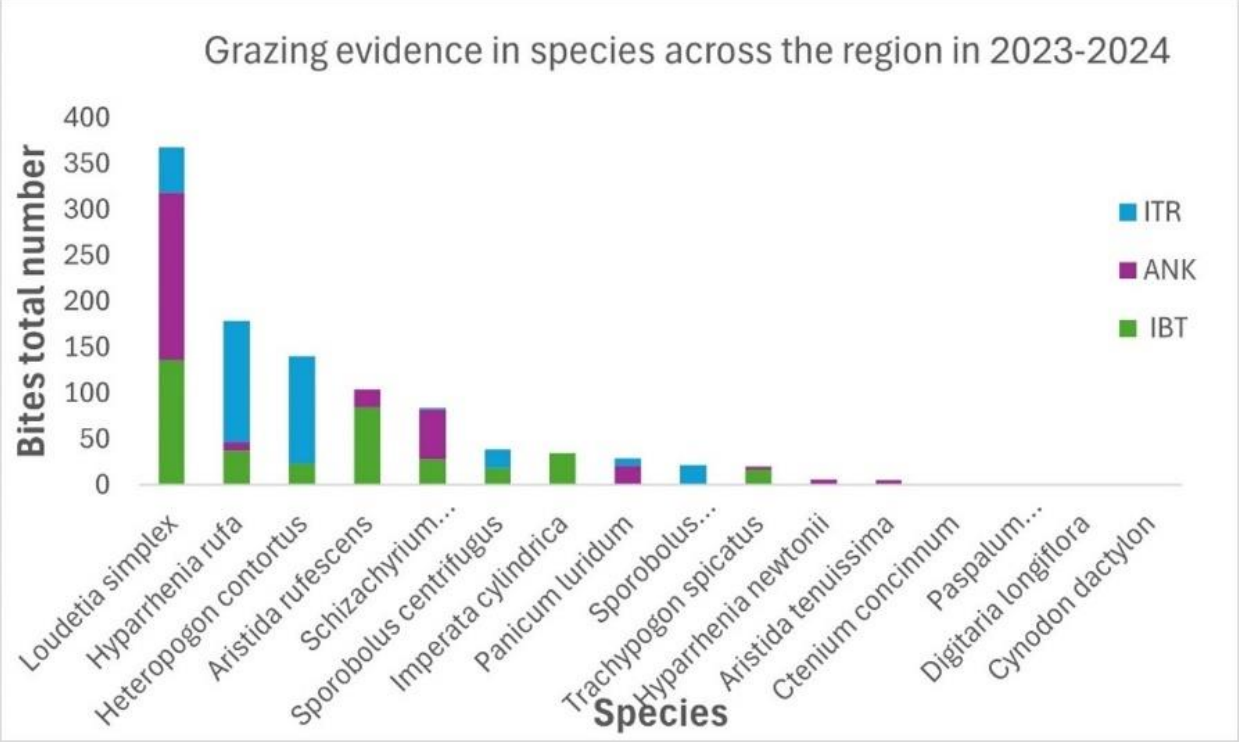

Figure 8. The most grazed grasses across the region (Ibity, Itremo, Ankafobe) in year 3 of the project, assessed for Grazing Index (total number of bites) observed on each species.

Table 4. Summary and conclusions on forage quality. Data is presented in appendices 2 and 3.

Good forage quality (High crude protein rate by dry matter,>10%	**Moderate forage quality (moderate crude protein rate by dry matter, 7-10%**	**Bad forage quality (Less crude protein rate by dry matter, <6%**
-Heteropogon contortus *-Cenchrus purpureus* -Sp14 (second variety of Cenchrus purpureus) *-Leersia hexandra* *-Cymbopogon caesius* *-Panicum maximum*	*-Aristida rufescens* *-Loudetia simplex* *-Hyparrhenia rufa* *-Phragmites mauritianus* *-Melinis repens* *-Digitaria longiflora* *-Digitaria ciliaris*	*-Trachypogon spicatus* *-Paspalum scrobiculatum* *-Schizachyrium sanguineum*
Best to be grazed directly	**Best for hay making**	

Key native grazing grass book (indicator 1.4) is discussed in section 4.3.

Biomass productivity (activity 1.5) For three years, we harvested biomass at the end of the wet season on the burnt and unburnt demonstration sites. Biomass on the burnt sites corresponds to the annual productivity of the region, whereas biomass on the unburnt sites reflects the accumulation over three consecutive years under fire exclusion. The annual biomass productivity varies from 2492-8356 kg/ha. Ankafobe and Itremo present a similar biomass productivity around 2492-3920kg/ha/year, and show a large difference compared to that of Ibity from 5319 to 8356kg/ha/year (figure 9A).

Triennial biomass productivity is roughly twice the initial weight by year 2 and up to three times the initial weight by year 3, a trend consistent across all three regions without exception. This biomass accumulation poses a **high risk to the ecosystem due to the high flammability of tall grasses**. Available data on rainfall across the 3 regions, a significant driver of productivity, are presented into figure 9B.

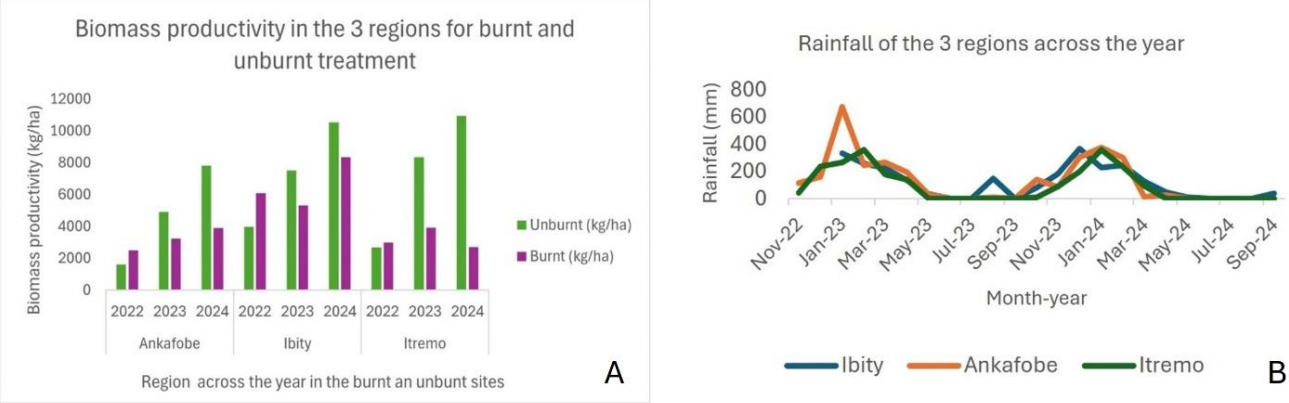

Figure 9. (A) Annual biomass productivity in kg/ha/year (burnt sites) and the triennial biomass productivity in kg/ha/year (unburnt sites) in Ibity, Itremo and Ankafobe. (B) Rainfall in project areas across the timeline of the project.

Grass training (indicator 1.5) was completed in Ibity in August 2023, and in Ankafobe and Itremo in September 2023.This training aimed to exchange scientific knowledge with local community knowledge about grass, grassland and fire management. In general, these were exchanges between the beneficiaries and the project promoters. The beneficiaries were informed about grass diversity and endemicity, as well as the services offered by grasslands to human and livestock farming. The project promoters became aware of the main threats to grasslands and the usual practices of livestock farmers on grasslands. It was noted that beneficiaries are aware that causes of malnutrition in their livestock include the poor quality of pastureland and current climate change. Reports from these focus groups are available in the appendices of previous annual reports.

Output 2. *Fodder flow supplemented by crop residue preservation and exploitation of new forage crop.* [Please note the outcome level indicators 0.3, 0.4 and 0.6 related to livestock production are included here to improve the logical flow of the narrative, following past feedback]. By Livasoa Randriamanalina with Maria Vorontsova.

Output 2: agriculture. Livestock data follows expected seasonal and metabolic patterns with animal condition and weight improving slower with some temporary drops throughout each dry season May to December and then improving faster during each wet season January to April. At the same time pregnancies and then new calves decrease or stop milk being available for variable amounts of time after the births. There is a greater population of milk breeds in Ibity and weaning decisions in Ibity tend to favour milk production while farmers in Itremo and Ankafobe prioritise calves and meat.

Overall, We are satisfied that **fodder flow** was successfully supplemented and livestock production was improved. The data on dry Sorghum harvest (indicator 2.2) and fodder bank (indicator 2.3) proved so voluminous and complex the project staff did not have the time to compile and analyse the figures fully. **Body condition** scores and animal weight (outcome

indicator 0.3, measured quarterly, appendix 4 figures 10-12) show a gradual improvement trend throughout the project, from a score of 2.75 in year 2 to a score of 3.05 in year 4, reflecting an overall improvement in animal welfare, nutrition, and feeding. Consistemtly better results in Itremo are likely to reflect greater personal attention from Livasoa, travelling there more frequently as a Kew employee. Pasture area in Ibity has been lost to crop fields throughout the project, with additional pasture is not available in this highly populated area near Antsirabe, leading to the deterioration in animal condition there.

Pregnancy and calving rates (outcome indicator 0.6, measured monthly, appendix 4 figures 5-9) showed an average calving increase from 35% in 2021 to 40% in 2023. These curves show variations approximately every 2 to 3 months, which is likely be linked to the oestrus weaning interval after the cow has given birth followed by the preparation for oestrus and then return of the next oestrus. In Itremo and Ankafobe, the beneficiaries favour reproduction over milk production, so calves are weaned early (at around two months), encouraging a rapid resumption of oestrus in the mothers. This increases the number of births but limits the possibility of milking cows after weaning. When calves are not separated from their mothers, the resumption of oestrus is delayed, limiting the reproductive cycle. This reproductive strategy is particularly prominent at Itremo, where calving rates follow a distinct trend, reflecting the local meat production-oriented zebu type and the individual farmers' objectives.

The greatest success of this project is likely the **milk production** (outcome indicator 0.4, measured monthly, appendix 4 figures 1-4) has increased from 1.3 litres per day in 2021 to 2.65 in 2024. By year 3 (April 2023 - March 2024), average production had doubled compared with the baseline level. This increase testifies to a strengthening of beneficiaries' capacities, particularly in forage stock management, especially in the dry season. In Year 4, we have been impressed that the milk production remained stable during the first months of the dry season, a considerable improvement on previous years when it had fallen between August and November. Milk production began to double from the third year of the project compared with the baseline level. Ibity beneficiaries have particularly actively invested in milk production and many have tripled their production compared with the baseline (appendix 4 figures 3-4). Our figures are in line with the beneficiary subjective perceptions.

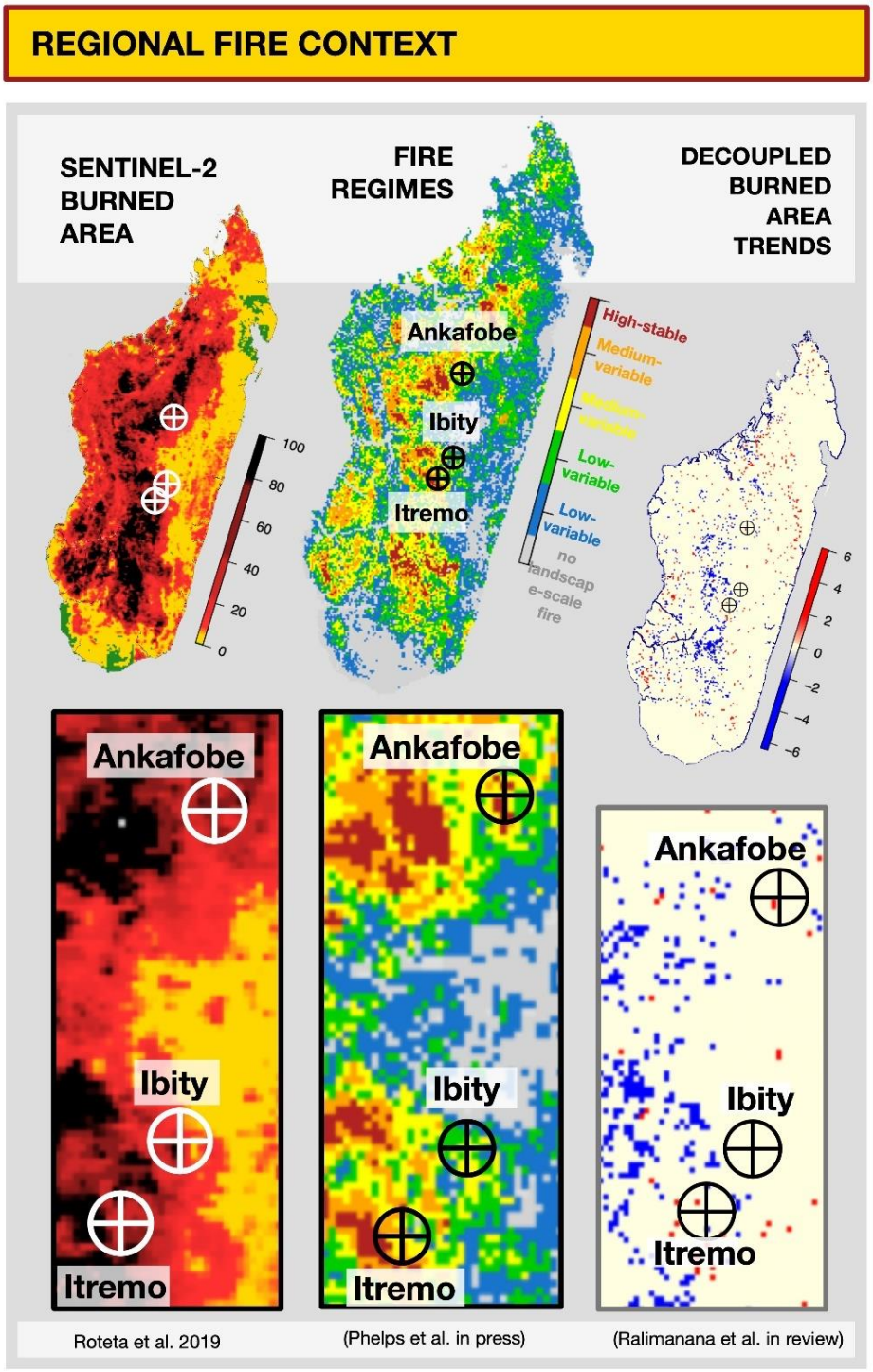

Figure 10. Analysis of the regional fire context around the three project sites carried out by Leanne Phelps (RBGE) in collaboration with Caroline Lehmann. High resolution SENTINEL-2 analysis of area burned during 2016 (left, Roteta et al. 2019; Phelps et al. 2022) shows medium-low (Ibity) to medium-high (Ankafobe and Itremo) burned area. Fire regimes (centre, definitions follow Phelps et al. in press) in Ibity are intermediate between low-variable regimes typical of tropical forest-savanna boundaries and medium-variable associated with open grassy ecosystems at higher elevations; Ankafobe and Itremo have open grassy fire regimes, from medium-variable to high-stable. Fire trends 2006-2016 (right; Phelps et al. 2022) across Madagascar as a whole show a faster than average decline in burned area compared to the similar decline observed in equivalent medium-variable and high-stable fire regimes across the tropics. Burned area is stable at all project sites, contrary to the broad decline across the Malagasy highlands.

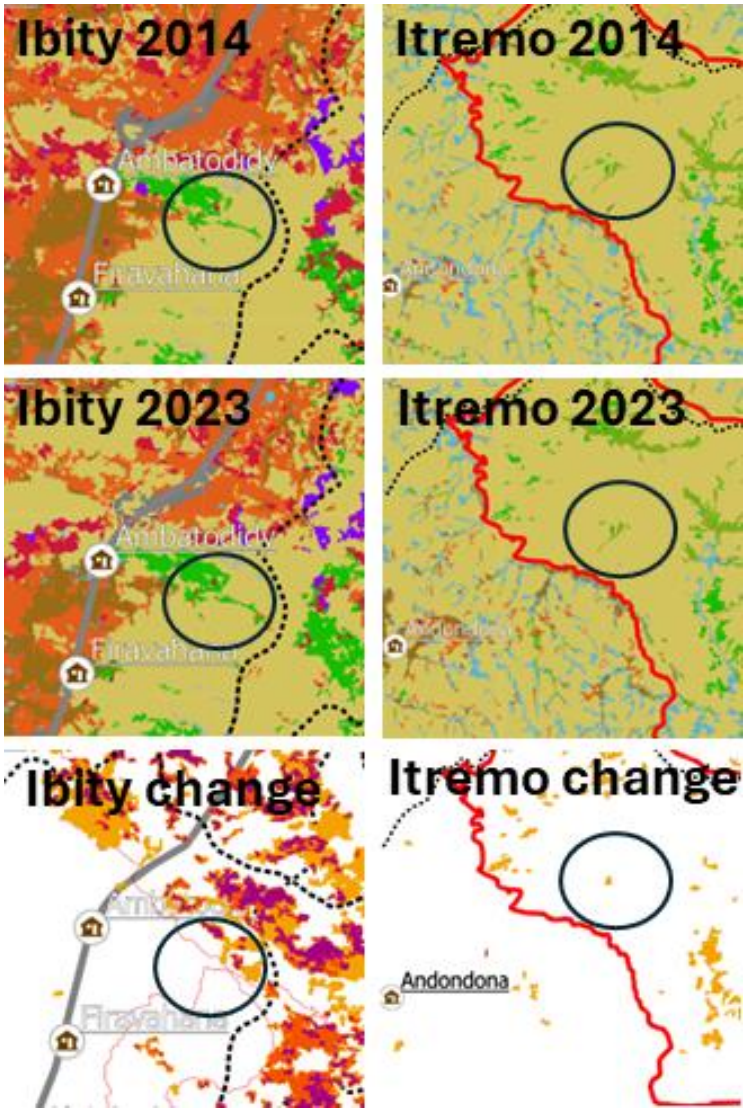

Figure 11. Ibity and Itremo gallery forest patches (centres of black circles) detected by satellites and analysed by www.space-intelligence.com. No meaningful change is seen in Ibity. The Ambazimbamena forest patch in Itremo (gallery forest in yellow-green) has not changed while areas of tapia and pine (bright green) have reduced. Maps by Adam Devenish.

Output 3. *Custom site-based fire management strategies conceived participatively and implemented to prevent late dry season forest fires.*

Our **fire management** (output 3) has been informed by a Lehmann-led methodological shift in fire analysis, away from the simple but misleading ignition counts to the far more ecologically meaningful but complex to execute analysis of burned area. Applying this modern method to Madagascar has generated controversial results suggesting Malagasy fires are declining faster than world average (Phelps et al. 2022), which seems highly counterintuitive to anti-fire in-country conservation professionals and fire fighters. Burned area is stable at our project sites, contrary to a country-wide burnt area decline (figure 10). The project was successful in **protecting the fire patches** in Ibity and Itremo (indicator 3.1, figure 11), but not in Ankafobe where the larger forest remnant was burned in 2022 (figure 12).

[confidential paragraph please] The management of Ankafobe PA has seen a high rate of staff turnover during this project, party due to the location not being attractive to professionals relocating to the area, and partly due to local community tensions which have continued since their historic resettlement from Antananarivo. The village Andranofeno Sud was established not spontaneously but by government agents and the surrounding grassland suffers from high winds, making crop production challenging, and increasing the speed of fire spread.

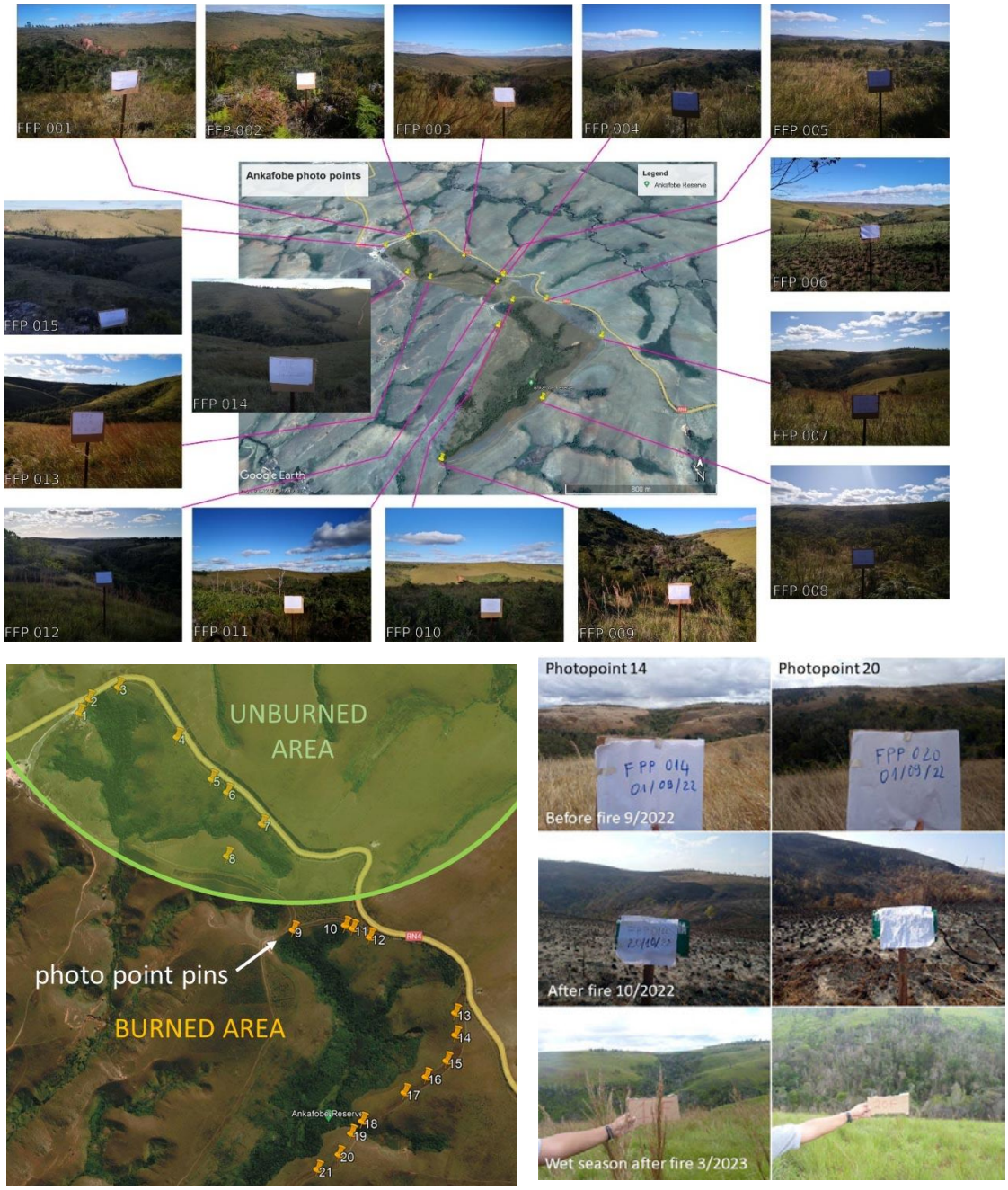

Figure 12. Ankafobe forest fire on 5-9 October 2022 and the post-fire recovery. Baseline forest map with the initial set of monitoring photo points (top); approximate extent of 2022 burned area of the southern forest (bottom left); detail before, shortly after, and five months after the burn (bottom right). For a detailed analysis see Annual Report 2 with appendices. More information is in appendix 7.

Firebreak creation and maintenance (indicator 3.2) was carried out largely through manual clearing executed by the project beneficiaries regularly brought to visit the forest patches. Hay making proved impractical far away from villages as too many calories would be used by livestock walking to the forest patches. Initially in Ibity, and then in Itremo, permits to burn in the presence of MEDD representatives were successfully obtained and some preventative burns were carried out at both locations. We are pleased to report that the cleared fire break and preventative burns very likely saved the Itremo Ambazimbamena forest fragment from the adjacent intense fires in the 2023 season (firebreak mapped in figure 13).

The newly invented **photo point method** for **monitoring forest edges** (indicator 3.2) proved successful in the areas with good staff retention where the same staff members were able to visit the same fixed photo points with images recorded monthly. Image compilations for the final year of the project for Ankafobe and Itremo are presented in appendices 5 and 6.

Photo processing is still ongoing for Ibity. We plan to publish a journal paper in the journal *Madagascar Conservation and Development* describing this as a novel method led by Lehmann.

Fire Management Plans are complete for Ibity (appendix 17) and Itremo (appendix 18), but still in draft form for Ankafobe (appendix 7).

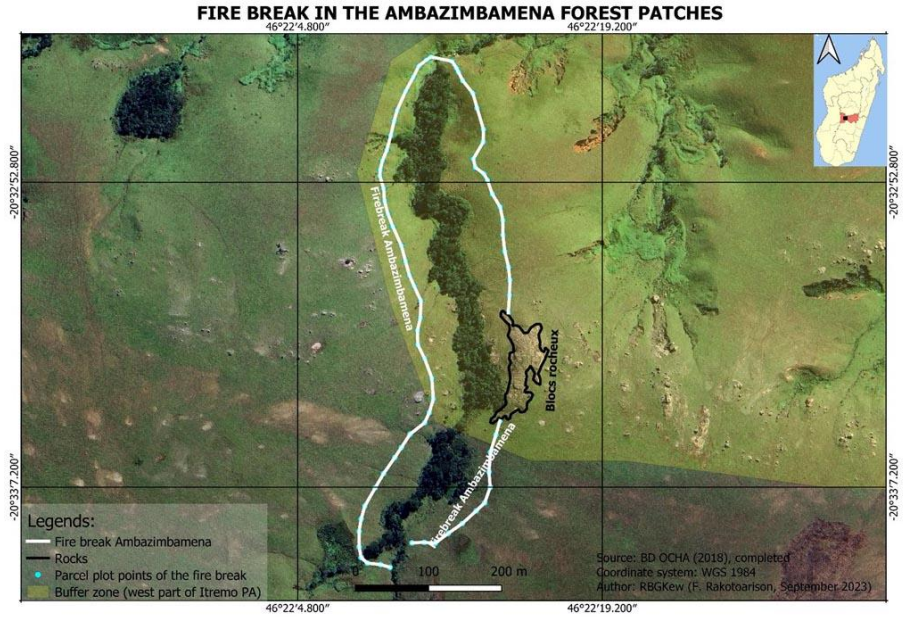

Figure 13. Map of the manually cleared fire break established by the project around the Ambazimbamena forest patch, Itremo. Lemurs are frequently seen in this forest. Map by Fenonirina Rakotoarison.

3.2 Outcome

The outcome of *Improved grazing system management capacity among 90 pastoral farming households in Ankafobe, Ibity and Itremo leading to healthier cattle, sustainable grassland exploitation, and reduced loss of grassland and forest biodiversity* has been partly achieved. Successful delivery of agricultural improvements in the outcome indicators 0.3, 0.4, and 0.6 evidence improved grazing system management capacity leading to healthier cattle. In spite of the loss of one forest fragment to fire, it is likely that we did reduce the loss of forest biodiversity (indicator 0.5) by preventing the loss of the second Ankafobe forest patch and successfully preventing fires from entering the Itremo Ambazimbamena forest.

Sarobidy Rakotonarivo' s statistical analysis of her controlled before and after counterfactual study using *difference in difference* regressions to estimate the impact of the project on standardized poverty measures (indicator 0.1) controlled for the effects of time-invariant variables including beneficiary age, gender, education and whether the respondent had previously benefitted from development projects (appendix 4, table 3; the full dataset is presented in appendix 8). This is a statistically sophisticated approach designed for larger datasets, possibly giving us smaller significance values because of only 145 households contributing to the endline survey after 3% midline and 7% endline attrition rates (appendix 8, table 1). When responses from all beneficiaries are pooled, a significant positive relationship between project activities and improvement in poverty (an improvement in poverty is a negative change in the Multidimensional Poverty Index, MPI values) is found. When control households (selected households in the same communities with similar characteristics to the beneficiaries) are compared to project beneficiaries, no significant relationship is observed. More educated participants, male participants, and previous recipients of development project assistance were wealthier. Beneficiary age was not significant. It is possible that the project timeframe is too short for positive significant effect on the MPI to take place**.** These results broadly correspond to the overall informal impressions of the project staff, with one exception of the endline Itremo survey where both beneficiary and control households appear suddenly inexplicably wealthier when no such change was observed by others (appendix 8, figures 1 and 2). As the surveys

were carried out by staff based at another project site (to prevent bias as well as promote exchange between the sites), with some staff turnover, it is possible that the surprising endline Itremo data reflect one person's error. We are investigating these data in order to correct them prior to journal submission.

Within the qualitative part of the analysis, **90% of the beneficiary sample said they had grown their cattle faster, and their calving rate had increased considerably. The majority of households felt that the benefits of the project met or exceeded their expectations** (appendices 4, 8). These results also correspond to the overall informal impressions of the project staff.

Sustainable exploitation of native grasslands is perhaps the part of the outcome statement addressed the least directly, since in addition to the pasture research, and training on the use of forage grasses, our project design did not include grazing trials, a fault of the initial project design we had no capacity to correct (section 5).

Our concluding technical recommendations for similar projects are presented in Appendix 15.

3.3 Monitoring of assumptions

We are satisfied that the expected pathway to change held true. Assumptions were mostly straightforward to monitor as part of the overall Kew operations in Madagascar. Most of our assumptions held true, with the following exceptions:

Coronavirus situation permits travel at least within central Madagascar for the project duration and *Rainfall patterns remain within local average ranges* did not hold fully true during the first year of the project, leading to multiple travel cancellations and flood damage in Itremo, but the negative effect was not long lasting as the situation returned to norm. Details in the first annual report.

Land used for the production of Sorghum does not compete with food crops seems to have not been fully true as some conflict in the available working hours was reported by some beneficiaries (appendices 4, 8). The cultivation of sorghum and production of silage proved labour intensive also because of insufficient time saving farm equipment (such as ploughs) was provided by the project. This was exacerbated by the poor silage outcomes from the imported South African sorghum on the poorer soils of Ankafobe and Itremo. Unfortunately, this information only emerged in the endline report making it difficult to address. The best solution would have been for the affected households to focus on basic agricultural techniques, not attempting sorghum cultivation or silage.

3.4 Impact

The impact statement is *Conservation of biodiversity and improved welfare of communities in the Central Highlands of Madagascar through optimal grazing of cattle and management of grasslands.*

The uncharacteristically (for botanical projects) strong level of community enthusiasm expressed at all stages of this project process provided the first indication of both effect and durability. Tapping into Madagascar's history and living tradition of zebu rearing and pasture grazing, and giving it the opportunity to be significant for the country's future, are powerful tools. The project closing event and interviews were filmed by the MINAE communications team and featured on the MINAE YouTube Channel at https://www.youtube.com/watch?v=4g37GYshN5w; version with English subtitles available at https://www.youtube.com/watch?v=yTIfmv2jU9c . MINAE and MEDD representatives have expressed enthusiasm throughout the project and at the closing event in September 2024, where the project final recommendations (appendix 15) were discussed. International impact was made by the film produced by Lydia Shellien-Walker, a professional film maker and Kew staff member, available at https://youtu.be/uofIwC887ok?si=NihaveF_3gDDKUvj.

During the project, the greatest contribution was made to improved welfare, through poverty alleviation by increasing food production. Improved production of livestock and milk will over time increase the grazing pressure on grasslands, decreasing dry grass material available to fires, and therefore decreasing fires. Optimal management of tropical grassland requires a more open-minded approach to fires within MEDD, which we did not succeed in changing, although perspectives have broadened (discussion on structural long-term challenges post-project in section 9).

In the longer term, we are satisfied that a positive contribution has been made and will continue being made through influencing opinions and policy (appendices 9-11). We plan to publish an updated version of appendix 11 in an influential journal as priority.

4 Contribution to Darwin Initiative Programme Objectives

4.1 Project support to the Conventions, Treaties or Agreements

Agriculture and poverty. Poverty has been reduced through the improvement of livestock production by introduction of locally new agricultural methodology (section 3). Healthier and more productive cattle also giving more milk have improved food security, and grazing practice on native grassy ecosystems is promoting sustainable agriculture, contributing to SDG 2. More diverse native pastures under a sustainable grazing regime are gaining greater recognition, contributing to SDG 15.

We supported the *Plan Émergence Madagascar* (PEM 2019), Program 9.2, objectives and priorities *Achieve protein self-sufficiency* and *Develop the beef sector* by successfully supporting project beneficiary farmers to improve livestock body condition scores and produce more calves. We contributed to the *National Adaptation Plan of Madagascar* (Government of Madagascar 2021), working with traditional zebu breeds to *Prioritise and safeguard local breeds thus increasing the number of animals adapted to climate stress and resistant to diseases* by including 144 zebu (and only 23 milk cows) in the project activities and improving their health and calving rates. Additional contribution was made through our support to DAPA and MINAE towards rangeland advocacy and policy review (appendices 9-11).

Biodiversity and traditional knowledge. The demonstration of the livelihood value of native and endemic Malagasy grassland plants during this project is contributing to CBD Articles 7 and 13. The improvement of livestock nutrition while conserving native grasses is contributing to CBD Article 10.

We supported the ITPGRFA to *access plant genetic materials* by researching the value of native forage grasses and utilising them alongside only one imported forage crop.

Within Madagascar's *National Biodiversity Strategy and Action Plans* 2015-2025 strategic goals 1-5 (Rabarison 2016 pages 18-19), we contributed to goal 1: *awareness about the value of biodiversity* by researching native nutritious forage grass diversity and making this knowledge available to the livestock sector. We contributed to goal 4: *Strengthening the benefits of biodiversity under sustainable management* by making progress towards building productive and sustainable rangeland management. We contributed to goal 5: *a system to protect traditional practices and knowledge* by co-creating this project with farming communities to integrate traditional knowledge with modern pasture science, supporting and safeguarding Madagascar's zebu rangeland traditions, and compiling Malagasy names of grasses as part of the production of our field guide (appendix 16).

Fire. Establishing and demonstrating a flexible locally responsive fuel load and fire management system around humid forest patches through a mixture of cutting fire breaks and controlled burns and supporting specialist skills development by community members and in country professionals, and protected area fire management plans, has contributed to CBD Article 8: *Develop guidelines for the management of protected areas*. A Madagascar website being developed to serve burnt area to policy makers, led by the FMH project:

https://researchers.cdu.edu.au/en/projects/burnt-area-reporting-tool-for-madagascar-protected-areas.

Climate. Madagascar's commitments to UNFCCC have been supported by building grassland carbon stocks below ground through our collaboration with the new *Global Centre on Biodiversity for Climate* (GCBC) project mapping grassland carbon and convening the new Madagascar Open Ecosystems Group connecting Madagascar to the global community.

Stakeholder discussion of the Conventions, Treaties or Agreements relevant to grasslands and rangelands in Madagascar led by John Morton in March 2024 generated lively debate; his presentation is attached in appendix 9.

4.2 Gender Equality and Social Inclusion (GESI)

GESI Scale	Description	Put X where you think your project is on the scale
Not yet sensitive	The GESI context may have been considered but the project isn't quite meeting the requirements of a 'sensitive' approach	
Sensitive	The GESI context has been considered and project activities take this into account in their design and implementation. The project addresses basic needs and vulnerabilities of women and marginalised groups and the project will not contribute to or create further inequalities.	X
Empowering	The project has all the characteristics of a 'sensitive' approach whilst also increasing equal access to assets, resources and capabilities for women and marginalised groups	
Transformative	The project has all the characteristics of an 'empowering' approach whilst also addressing unequal power relationships and seeking institutional and societal change	

Traditional gender roles remain the norm in rural society in Madagascar. The primary responsibility for looking after and working with cattle lies with men, who are usually the heads of households. In Itremo, women were said to perform any cattle-related tasks when few men are available, with the exception of trampling, which is seen as a high-energy task only suited to men (and during which they are liable to use bad language, "scandalising any women present"). Women can plough, if insufficient men are available. In Ibity, women are mainly restricted to handling manure and cleaning cattle enclosures. Men are mostly responsible for milking (using cattle for work is much less prevalent in Ibity, so this was not raised during the discussion). Men and women consult together on major decisions such as selling or killing animals: in Itremo this was qualified by a statement that the final decision was the man's, in Ibity that the couple decide jointly "even on killing a chicken". In Itremo women keep money from sales and spend it following discussion. In Ibity decisions on spending income are made jointly, but women are said to complain about men taking money to buy alcohol (appendix 10).

Our approach to GESI has been cautious in its nature after community pushback experienced by an MBG-led Darwin project in southern Madagascar some years ago. Gender is statistically significant in our social survey, with women poorer than men on average (appendix 4 table 3). Out of the 90 beneficiary households, 15 were formally represented by women (appendix 8 table 1), and the wives of the male beneficiaries also participated in project activities. It does not seem likely that the project fundamentally shifted any gender roles, but we are reasonably confident that we did empower female participants, especially through them

gaining largely exclusive knowledge of forage grasses and crop residue preservation during project training and mentoring.

Anecdotally, a female beneficiary in Betsiarika (Itremo) gained a new calf, the sale of which enabled her to buy a rice field (informal communication made to Nanjarisoa).

Malagasy staff empowerment has been a strength of our project. 50% of the Project Board members were female: 3 out of 6, including 2 out of 3 Malagasy board members. 60% of the partners were led by women: 3 out of 5, including 1 out of 2 Malagasy partners. Community participants were also exposed to both Malagasy and foreign visible senior female leadership during workshops and project meetings. See also section 4.4. for Nanjarisoa' s career progression.

4.3 Transfer of knowledge

We are satisfied that agricultural technique training and grass training for livestock farmers was largely successful. Training in fire management is inevitably more difficult to assess due to the ongoing contradiction between Madagascar's punitive laws versus local received perceived practices in setting fires. All the national and international experts listed in section 2 actively worked to transfer their knowledge to both project staff and communities.

Agricultural staff and PA managers travelled to South Africa to complete livestock farming training with the University of Pretoria. Mamy Tiana Rajaonah, Tiana Randriamboavonjy, and PA managers travelled to South Africa to receive fire management training at the Kruger National Park. Livasoa Randriamanalina and Nanjarisoa Prisca travelled to the USA to present project work to the *International Grassland Congress in Kentucky 2023* (evidence attached to previous annual reports). Livasoa was also due to travel to the *International Rangeland Congress 2025* in Australia but failed to secure a visa in spite of repeated attempts.

The photographic field guide to the common grasses of Madagascar (second proofs in appendix 16) is being co-delivered by the botanical part of this project. This product is likely to have the greatest longevity of all the project outputs. Madagascar's grass knowledge has lagged behind many other countries partly due to the lack of easy-to-use reference materials. After the classic Bosser (1969) black and white book requiring considerable technical expertise to use, our group published a more appealing picture guide to genera (Vorontsova et al. 2018). Now, this far more extensive guide to species will be the first to print intuitively recognisable field photographs of every common species. Kew Publishing will be making the pdf available for free online and we hope this book will dramatically increase the identifications of grasses as well as the level of interest in them in Madagascar. The other two projects contributing to this output are the *GCRF Royal Society International Collaboration Award* to Vorontsova and Rakotonarivo, and the ongoing GCBC TANETI project (section 12). Further information is provided within Appendix 16.

4.4 Capacity building

We are proud of our Grassland Botanist Nanjarisoa Prisca, a female Malagasy scientist who has appeared on Malagasy national television presenting this project (MINAE YouTube Channel at https://www.youtube.com/watch?v=4g37GYshN5w; version with English subtitles available at https://www.youtube.com/watch?v=yTIfmv2jU9c). Having grown up in a farming family in Ambositra, she was particularly effective in the training of farmers. She is now a recipient of a *Kew Global PhD Programme* scholarship for a doctoral project *Grassland diversity and productivity in central Madagascar*. This PhD supervised co-supervised by project staff with the University of Antananarivo will further analyse the data collected in output 1. This research is described in section 3.

Gender disaggregated figures on project beneficiaries and staff are in section 4.2.

5 Monitoring and evaluation

At initial application stage, the project leaders certainly underestimated the amount of agricultural work that would be required, and overestimated the data we would have capacity to collect and analyse. For this reason, we are not showing detailed datasets for indicators 2.1-2.3. This challenge was first noted in the first annual report and in response we attempted to make a series of adjustments to the overall project extent as well as the logframe to reduce staff workload. Unfortunately, by this time a commitment to our beneficiary households had already been made, and we did not feel able to reduce either the household number or the interventions attempted for fear of damaging our reputation. An alternative solution was to remove the fire management output 3 in its entirety since the FMH project was making a greater simultaneous investment in fire management work; this was rejected by the KM and MBG PA mangers to prevent PA investment withdrawal and to continue the new connections being built between the beneficiaries and their nearby forest fragments (as beneficiary families were taken to the forest fragments by bus to help with firebreak clearing).

As visiting experts worked on different parts of this project independently, Wayne Truter suggested additional activities on forage nutrition and grazing capacity, Caroline Lehmann was keen to add grassland biomass productivity measurements as well as the photo point methodology for monitoring forest fragment edges, while John Morton added further anthropological analysis on the role of zebu in the Amborompotsy village in Itremo (appendix 10) as well as rangeland policy work (appendices 9 and 11). These specialist leaders of the separate strands of the project were not kept fully aware of each other's activities as none had time to attend full project meetings. The project leadership admit that that our attempt to reduce the project to a manageable size largely failed and the final logframe presented here after a series of changes made annually actually required more work than the original project design. Staff unfortunately worked a significant amount of unpaid overtime, and several continue to do so at the time of writing.

The sociological assessment was a great success largely due to the tireless training, support, and mentoring put in by Sarobidy Rakotonarivo, including during her maternity leave. It is described in detail in section 3.2 and appendices 4 and 8.

We remain keen to identify funding for a post project assessment, but this has not yet been successful.

6 Lessons learnt

Project success was a direct consequence of our successful interdisciplinary recruitment of the registered veterinary doctor Dr Livasoa Randriamanalina (https://www.kew.org/science/our-science/people/livasoa-randriamanalina) as project manager. Working with multiple botanists and conservation professionals in KM and MBG, he was the only Madagascar-based project staff member with a professional knowledge of livestock development and with personal connections to MINAE, DAPA, and FOFIFA. In addition to his core role, he was able to not only organise and provide veterinary care to livestock, but expand the knowledge and outlook of multiple other staff. This has made it apparent that our professional community is less outward looking than we realised and needs closer much connections to agriculture and policy professionals. There can be no grassy ecosystem conservation without pastoralist poverty alleviation.

The Malagasy project staff and the Malagasy NGOs and government agencies have been central to the success of this project, providing consistent input and mutual support throughout. It is interesting to note that all of the foreign partners have at some point failed to deliver on their commitments, for a variety of unforeseen reasons. Activities have been moved in-country as the project progressed: obtaining forage Sorghum seeds from FOFIFA rather than South Africa, carrying out more of the forage nutrition analysis at FOFIFA in addition to South Africa, obtaining fire management training from Madagascar-based US projects instead of Africa or UK, and Nanjarisoa delivering grass forage training instead of Maria Vorontsova. We conclude that greater financial support and great agency should be given directly to Malagasy professionals. As it also becomes increasingly difficult to export material, more research should be carried out in Madagascar.

7 Actions taken in response to Annual Report reviews

Issues raised in the evaluation of our 2024 third annual report:

This is an important project, which is undertaking work of a high quality. However, the annual report is disappointing because the project has not fully addressed many of the questions in the template, in contrast to previous years.

We acknowledge the insufficient time invested into the third annual report. The same leadership team was concurrently launching our new GCBC project (see section 12.2) leading to a scarcity of time at the same time as health challenges in April 2024. Lehmann was on an extended leave of absence due family caring requirements and wasn't able to participate in the report.

The project states at the outset that the present report is focussed around legacy planning and project closure planning, noting that over the past year, it has invested a significant proportion of staff time in two funding bids, one of which was successful, resulting in a substantial grant from GCBC, for which the project should be congratulated. However, the project also comments that there is a very real possibility that it will lose its project staff as a direct result of their employment contract termination in October 2024. It is not clear whether any of the funding raised can support its existing staff beyond the Darwin project lifetime, and the implications of the likely loss of staff for the project's sustainability and legacy.

The project was originally designed to terminate project staff contracts in 2024 while leaving a successful legacy after termination, and we are broadly satisfied that this has been successful. The new local associations created at each site (appendices 12-14) are now being supported by KM and MBG (section 9). All Kew Madagascar project staff have stayed in the organisation except one Itremo animator and agricultural specialist, Romain, now using the same skills as at *Conservation International*. The project manager and veterinary doctor Livasoa Randriamanalina now manages the Madagascar part of the REPAIR project (section 9); the grass botanist Nanjarisoa Prisca is studying towards a PhD (section 4.3). In the future there is unfortunately a possibility of all these staff no longer being available to support the local associations if Kew and MBG are not successful at raising further income after the next series of projects are completed in 2026-2027.

It would be helpful to include the draft fire management plans and the draft grassland guide with the next annual report.

Ibity and Itremo fire management plans are provided as appendices 17 and 18. The Ankafobe fire management plan is not yet fully drafted due to the difficulties of retaining a PA manager in post; a draft is provided in appendix 7. The guide to grasses is currently in production with the second proofs at 319 pages long; the 116MB file is shared confidentially as appendix 16.

8 Risk Management

The greatest risk to the project was undoubtedly security, reasonably safe in Ibity, episodically challenging in Ankafobe, and disruptive in Itremo. Security incidents in Itremo have continued over the past year. Effective adaptations were made by KM with the recruitment of a dedicated logistics and security specialist based in Antananarivo. Through sharing resources with the FMH project, a permanent satellite internet connection was installed in Amborompotsy.

The lack of desk space and overloaded internet connection in the KM Antananarivo office emerged as an additional challenge following the expansion in staff 2022 – 2023. This was addressed through the hire of a new office and move in 2024.

9 Scalability and Durability

At the project sites, the new local associations created at each site (appendices 12-14) are now being supported by KM and MBG. Demonstration farms and project property at each site has been transferred to each local association. Project owned livestock was sold to support associations. The training in simple and well-established farming skills which do not require

specialist materials seems to be the most likely to endure: using manure for compost and fertilisation instead of throwing it away; ensuring livestock never eat plastic rubbish; preserving crop residue to feed to livestock; making hay. Longer term support was also sought from MINAE but this was not possible in the absence of post-project funding. **Scalability** is currently less certain following our repeated failure to identify funding to expand our approach.

Our contribution to policy is described in section 4.1

Multiple **follow-on and related research and practical projects** are ongoing and in development. The follow-on projects FMH, TANETI, and REPAIR are all incorporating aspects of this work. Malagasy grassy ecosystems are being better defined by TANETI with is also working towards policy briefs (https://www.gcbc.org.uk/project/resource-management-of-madagascars-grasslands/, https://www.facebook.com/profile.php?id=61562367566960). As a result of this project, Maria Vorontsova and Livasoa were invited to participate in the grant application to NERC for the Resilient and Equitable Nature-based Pathways in Southern African Rangelands (REPAIR) project (https://www.ids.ac.uk/projects/resilient-and-equitable-nature-based-pathways-in-southern-african-rangelands-repair/). In addition to those listed in section 12.2, associated research student projects are supervised through the University of Antananarivo and Lehmann's lab. At the University of Antananarivo two MScs were awarded: *The grass that built the Central Highland of Madagascar: environmental niches and morphological diversity of Loudetia simplex* by Tchana Almary, and *The Diversity of Poaceae along the altitudinal gradient of the high mountains of Madagascar* by Diana Rabeharison. A PhD project *Evolution, status, and conservation of the Poaceae in Madagascar's grassy ecosystems* is underway caried out by Fenitra Randrianarimanana. At Kew UK an MSc project *Factors shaping reforestation outcomes in Madagascar* was completed by Louisa Leach and a PhD *Lawn and Order: The influence of top-down and bottom-up drivers on grass functional traits* has been submitted by Susan Eshelman at RBGE. A new PhD project on the zebu will shortly be advertised with the Royal Veterinary College through the LIDO DTP.

Structural long-term challenges post-project remain in the governance of Madagascar's open habitats, driven by a continued lack of recognition of their value, and the ongoing challenge of the perception of fires. In 2025, the standard MEDD management contract for the Itremo New Protected Area still expects PA managers to keep burned area under 5%, in spite the compelling evidence of the pre-human normal nature of many fires presented to MEDD by this project and others. We do feel disappointed that the twentieth century myth of a fully forested pre-human Madagascar (McConnell & Kull 2014) seems to persist in the in-country environmental governance community, newly evidenced by *Madagascar Protected Area Outlook* "categorically dismissing" native grassland in the centre of the country (Madagascar Protected Area Consortium Partners 2024: 67). The new 2025 carbon decree includes only forest carbon, failing to open the pathway to carbon projects outside closed canopy forests, and further undermining perceived value of grassland (MEDD 2025). Much stronger evidence base and in-country support still needs to be built to shift public opinion (for our current paper draft see appendix 11).

10 Darwin Initiative identity

This project has a particularly distinctive identity in Madagascar, being the first piece of work with livestock executed by the plant-focused environmental conservation organisations Kew and MBG. Our impression is that the close-knit community of Madagascar's environmental conservation organisations already recognises the UK government contribution and the Darwin brand, and this project extended that reach further to MINAE, FOFIFA, and the much larger network of agriculture professionals.

The Darwin logo has been printed project t-shirts, caps, stand-up signs at the project sites, and formal project communications (accidentally omitted in appendix 16 and will be added).

Our chosen primary communication channel targeted at the Malagasy professional community and social networks is the project Facebook page ran primarily in Malagasy, *Harena Voajanahary sy Kijana Mamokatra* at https://www.facebook.com/KMCCMBG , chosen because Facebook does not charge for mobile data accessed through several in-country mobile internet

providers, and has therefore become Madagascar's primary social media website. The Facebook page has accumulated 997 likes and 1049 followers, 56% male and 44% female, largely within the 25-34 age bracket, predominantly from the Antananarivo area of Madagascar, reflecting the primarily professional audience of biodiversity, conservation, development, and policy workers. Detailed audience statistics are attached to the first annual report. Please note that since the end of this project the Facebook page has been re-branded for the follow-on project, *Resilient and Equitable Nature-based Pathways in Southern African Rangelands* (REPAiR).

[Confidential paragraph please] Following the recent political events in the USA, RBG Kew has implemented an organisation-wide policy to stop using X (Twitter). Our project updates published there through @vorontsovams and #kijanamaharitra (sustainable pasture) and linking to BCF media channels have unfortunately also been accidentally deleted when @vorontsovams was incorrectly suspended with no replies to support requests. Project communications were unfortunately lost.

11 Safeguarding

[redacted]

[redacted]

12 Finance and administration

12.1 Project expenditure

Project spend (indicative) since last Annual Report	2024/25 Grant (£)	2024/25 Total actual Darwin Initiative Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs (see below)	[redacted]			
Consultancy costs				

				staff budget to fund the cost of consultant.
Overhead Costs	[redacted]			
Travel and subsistence				
Operating Costs				
Capital items (see below)				
Others (see below)				
TOTAL	**£89,311.00**	[redacted]		

Staff employed **(Name and position)**	**Cost** **(£)**
Maria Vorontsova, Project Leader and expert on grasses	[redacted]
Hélène Ralimanana, KMCC coordination; M&E; steering group member	
Mamy Tiana Rajaonah, Co-Leader; coordination with ministries	
Tiana Randriamboavonjy, Coordination with ministries and for Itremo	
Nanja Nanjarisoa, Grass and forb botanist	
Roger Rajaonarison, Driver/mechanic	
Livasoa Randriamanalina, Project manager, M&E	
Romain Ratovoarinjaka, Animator, M&E Itremo	
Feno Rakotoarison, PA manager Itremo	
Mampiharitra Rabenindrina, Technician for cattle, Itremo	
Lucien Rakotonirina, Technician for grasses, Itremo	
Zoherinjina Minosoa Nombanjhanahary, PA manager Ankafobe	
Simplice Razafindranaivo, PA manager Ankafobe	
Brice Rakotozafy, PA manager Ibity	
Dina Miarinjanahary, Animator, M&E Ibity	
Aubri Bendrainy, Technician for cattle, Ankafobe	
Landry Raharinirina, Technician for grasses, Ankafobe	
Jean Christian Rijaniaina, Technician for cattle, Ibity	
Randriamahavita Mamihasina, Technician for grasses, Ibity	
Casual, Fire patrols and fire break clearing, Ankafobe	
Casual, Fire patrols and fire break clearing, Ibity	
Caroline Lehmann, Expert on fire	

TOTAL	[redacted]

Capital items – description	Capital items – cost (£)
none	none
TOTAL	none

Other items – description	Other items – cost (£)
Consumables, printing t-shirts, booklets, posters	[redacted]
Sorghum seeds, quarantine and importation	
Vehicle and motorbike maintenance	
Banking and shipping charges	
Communications costs	
Association creation	
Capacity building for associations	
Veterinary training in Itremo for beneficiaries	
Ministry visit during the workshop in Tana and in the sites	
Sample analysis	
Audit	
TOTAL	

12.2 Additional funds or in-kind contributions secured

Matched funding leveraged by the partners to deliver the project	Total (£)
Royal Botanic Gardens Kew	[redacted]
University of Pretoria, South Africa	
TOTAL	

Total additional finance mobilised for new activities occurring outside of the project, building on evidence, best practices and the project	Total (£)
DEFRA UK Biodiverse Landscape Fund: Sustainable Management for Future Generations (FMH)	[redacted]

Global Centre on Biodiversity for Climate: Malagasy Grasslands for Maintaining and Enhancing the Environment (TANETI)	[redacted]
NERC: Resilient and Equitable Nature-based Pathways in Southern African Rangelands (REPAiR)	
Kew Global PhD Programme: Grassland diversity and productivity in central Madagascar	
TOTAL	

12.3 Value for Money

We believe the project provided excellent value for money largely due to the comparatively low cost of salaries in Madagascar following currency conversion. The use of existing KM, MBG, and PA infrastructure in Madagascar as well as close collaborations with numerous organisations and other projects enabled a lot to be achieved within sensible financial investment.

13 Other comments on progress not covered elsewhere

None.

14 OPTIONAL: Outstanding achievements of your project (300-400 words maximum). This section may be used for publicity purposes.

I agree for the Biodiversity Challenge Funds to edit and use the following for various promotional purposes (please leave this line in to indicate your agreement to use any material you provide here).

File Type (Image / Video / Graphic)	File Name or File Location	Caption, country and credit	Online accounts to be tagged (leave blank if none)	Consent of subjects received (delete as necessary)
video	https://youtu.be/uofIwC887ok?si=Il1v2btHwkjcbI2t	Native grass forage management to feed people and protect forests, RBG Kew, 2023	https://www.youtube.com/@grasstube7407	Yes
video	https://www.youtube.com/watch?v=yTIfmv2jU9c	Productive Pasture Partner	https://www.youtube.com/@grasstube7407	Yes

		ship, Madagascar, MINAE 2024		
photographs	https://www.flickr.com/photos/36803481@N06/albums/	Project photographs	https://www.flickr.com/people/36803481@N06/	Yes
				Yes / No
				Yes / No

Annex 1 Report of progress and achievements against logframe for the life of the project

Project summary	Progress and achievements
Impact **Conservation of biodiversity and improved welfare of communities in the Central Highlands of Madagascar through optimal grazing of cattle and management of grasslands**	
Outcome **Improved grazing system management capacity among 90 pastoral farming households in Ankafobe, Ibity and Itremo leading to healthier cattle, sustainable grassland exploitation, and reduced loss of grassland and forest biodiversity**	
Outcome indicator 0.1 *Global Person Generated Index* data and Likert scale questionnaire surveys show a positive cause and effect relationship between the project interventions and **perceived wealth and well-being** among the 90 project household members in September 2024	Significant positive relationship between project activities and improvement in poverty, but no significant difference between beneficiary versus control households. Appendix 4.
Outcome indicator 0.2 Five key native forage grasses (chosen from *Aristida rufescens, Aristida tenuissima, Brachiaria subrostrata, Cynodon dactylon, Cyrtococcum deltoideum, Digitaria longiflora, Eragrostis lateritica, Panicum luridum, Panicum umbellatum, Paspalum scrobiculatum*) and five native forbs increase in frequency in 30 project demonstration farm and communal pasture plots in Ankafobe, Ibity and Itremo by 20% from measured baseline in February 2022 to February 2024	Complex results with both positive and negative trends. Evidence in tables 2 and 3.
Outcome indicator 0.3 Average cattle condition in 90 – 400 cattle owned by 90 project households in Ankafobe, Ibity and Itremo improved from the estimated baseline condition score of 2 – 2.5 units to condition score of 3 – 3.5 units between December 2021 and September 2024	Average cattle condition score increased from 2.75 in 2022 to 3.05 in 2024. Appendix 4.
Outcome indicator 0.4 Milk production in 30 – 150 milk cows owned by 90 project households in Ankafobe, Ibity and Itremo improved from the estimated baseline of 3 – 4 litres per day per cow to 4.5 – 5 litres per day per cow between December 2021 and September 2024	Average milk production has increased from 1.3 litres per day in 2021 to 2.65 in 2024. Appendix 4.
Outcome indicator 0.5 Plant and animal diversity within 3 patches of forest within Ankafobe, Ibity and Itremo Protected Areas preserved at current levels through fires not increasing between January 2022 – January 2024	Successful in Ibity and Itremo, but only partly in Ankafobe. Figures 11 and 12.

Outcome indicator 0.6 Post project annual calving rate reaches 70% in the cattle owned by the 90 project households in Ankafobe, Ibity and Itremo, improved from the estimated baseline annual calving rate of 40%, between September 2024 and September 2039	Average calving increased from 35% in 2021 to 40% in 2023. Appendix 4.
Output 1 Improved preservation, understanding and more efficient exploitation of native and endemic forage grasses and forbs, in native grasslands near villages	
Output indicator 1.1 **Native grass and forb diversity increase** from an estimated baseline of 4 – 5 species to 6 – 7 species per 50 × 50m plot in 30 plots in project demonstration farms and communal pastures in Ankafobe, Ibity and Itremo between February 2022 to February 2024	Overall biodiversity increased from a baseline of 3-6 species to an average of 8-13 species. Evidence in figures 5-6.
Output indicator 1.2 Five native key forage grasses and five native forbs **increase in frequency** in 30 project demonstration farm and communal pasture grazing plots in Ankafobe, Ibity and Itremo by 20% from measured baseline in February 2022 to February 2024	Complex results with both positive and negative trends. Evidence in tables 2 and 3.
Output indicator 1.3. Grazing value indices measured for ten key native and endemic grazing grass species candidates (*Aristida rufescens, Aristida tenuissima, Brachiaria subrostrata, Cynodon dactylon, Cyrtococcum deltoideum, Digitaria longiflora, Eragrostis lateritica, Panicum luridum, Panicum umbellatum, Paspalum scrobiculatum*) using Truter standard methodology by October 2022	Data in appendices 2 and 3, analysis in table 4. Full analysis is not yet complete.
Output indicator 1.4 Key native grazing grass **book** (in English and Malagasy), **poster** (in Malagasy), and a community-led short film (in Malagasy) produced by April 2024 in draft form, and July 2024 in final form, guided by Vorontsova and Truter.	Second proofs of the bilingual book in appendix 16. Film at https://youtu.be/uoflwC887ok .
Output indicator 1.5 **Grass training** in years 2 and 3 for 90 project household members	Completed in Ibity in August 2023; Ankafobe and Itremo in September 2023. Reports attached to past annual reports.
Output 2. Fodder flow supplemented by crop residue preservation and exploitation of new forage crop	
Output indicator 2.1. ***Sorghum* fodder crop plants** established on three 1-hectare demonstration farm plots between August 2023 and May 2024	Completed. Documents attached to past annual reports.
Output indicator 2.2. **Dry matter *Sorghum* harvest** production established on three 1-hectare demonstration farm plots to produce yield above an estimated natural grassland baseline of 4 tonnes of dry matter per hectare, achieving 6 tonnes of dry matter per hectare between April 2023 and April 2024	Roughly completed; insufficient resource to analyse the data fully.
Output indicator 2.3 **Fodder bank** created by project households including hay and silage improved from an estimated baseline of 1 – 2 tonnes of dry matter per	Roughly completed; insufficient resource to analyse the data fully.

hectare to an estimated 4 tonnes of dry matter per hectare between April 2022 and April 2024	
Output indicator 2.4 **Fodder training** in years 2 and 3 and **veterinary training** in year 2 for 90 project household members	Completed in Ibity in August 2023; Ankafobe and Itremo in September 2023. Reports attached to past annual reports.
Output 3. Custom site-based fire management strategies conceived participatively and implemented to prevent late dry season forest fires	
Output indicator 3.1 Burned area within 3 patches of forest within Ankafobe, Ibity and Itremo Protected Areas not increased from the baseline measured for January 2022 to January 2023 and 2024	Successful in Ibity and Itremo, but only partly in Ankafobe. Figures 11 and 12.
Output indicator 3.2 Firebreaks created and maintained for 3 patches of forest using manual clearing and hay making at a minimum of 5m wide with vegetation kept under 15cm tall, within project dry season months May – November during 2022 – 2024	Completed largely through manual clearing. Preventative burns successfully caried out in Ibity and Itremo. Figure 13, appendices 5 -7, 17, 18.
Output indicator 3.3 **Fire Management Plans** co-created with communities driven by the PA managers, with a focus around establishing safe burn days and times, weather adaptation and no-fire zones. Plans added to the Protected Area management plans by June 2024 in draft form and by September 2024 in the final form, guided by Lehmann	Fire Management Plans complete for Ibity and Itremo; in draft form for Ankafobe (appendices 7, 17, 18). Protected Area Management Plans were not due to be renewed so the integration has not taken place.
Output indicator 3.4 Fire training in years 2 and 3 for 90 project household members	Completed in Ibity in August 2023; Ankafobe and Itremo in September 2023. Reports attached to past annual reports.

Annex 2: Project's full current logframe as presented in the application form (unless changes have been agreed)

Project summary	SMART Indicators	Means of verification	Important Assumptions
Impact: **Conservation of biodiversity and improved welfare of communities in the Central Highlands of Madagascar through optimal grazing of cattle and management of grasslands**			
Outcome: Improved grazing system management capacity among 90 pastoral farming households in Ankafobe, Ibity and Itremo leading to healthier cattle, sustainable grassland exploitation, and reduced loss of grassland and forest biodiversity	0.1 *Global Person Generated Index* data and Likert scale questionnaire surveys show a positive cause and effect relationship between the project interventions and **perceived wealth and well-being** among the 90 project household members in September 2024 0.2 Five **key native forage grasses** (chosen from *Aristida rufescens, Aristida tenuissima, Brachiaria subrostrata, Cynodon dactylon, Cyrtococcum deltoideum, Digitaria longiflora, Eragrostis lateritica, Panicum luridum, Panicum umbellatum, Paspalum scrobiculatum*) and five native forbs increase in frequency in 30 project demonstration farm and communal pasture plots in Ankafobe, Ibity and Itremo by 20% from measured baseline in February 2022 to February 2024 0.3 **Average cattle condition** in 90 – 400 cattle owned by 90 project households in Ankafobe, Ibity and Itremo improved from the estimated baseline condition score of 2 – 2.5 units to condition score of 3 – 3.5 units between December 2021 and September 2024	0.1 Copies of gender disaggregated social survey results 0.2 Grass and forb species frequency records in 50 × 50m standard grassland plot spreadsheets made by the grass and forb botanist using the grassland monitoring method already established for ecological research 0.3 Cattle body condition photographs for each animal taken quarterly by community technicians for cattle using smartphones, animal rear and side 0.4 Measurements of milk production in 30 – 150 project milk cows made by community project technicians for cattle weekly and recorded in project spreadsheets 0.5 Photographs of forest edges made by monthly Protected Area fire patrols May - December, photographs at set photo points spaced 50 – 200 m apart in each Protected Area	Political situation stable with no significant civil unrest in Antananarivo or nearby (risk mitigated by our close links with the British Embassy in Antananarivo and multiple long-term trusted local contacts at the sites so we are kept aware of any changes and receive timely advice) Cattle remain central to rice production and income from meat and milk, no successful simultaneous technological improvements introduced (risk mitigated by advice obtained from the Agriculture Ministry and their involvement throughout the project) Cattle rustling is low and does not affect more than 10% of participating households (risk mitigated by animators living at or near the demonstration farms, and employing community members as technicians and fire patrol members, to monitor the security situation and discourage theft) Improved cattle productivity may lead to overgrazing (risk mitigated by close monitoring of the rangeland plots throughout project)

	0.4 **Milk production** in 30 – 150 milk cows owned by 90 project households in Ankafobe, Ibity and Itremo improved from the estimated baseline of 3 – 4 litres per day per cow to 4.5 – 5 litres per day per cow between December 2021 and September 2024 0.5 **Plant and animal diversity within 3 patches of forest** within Ankafobe, Ibity and Itremo Protected Areas preserved at current levels through fires not increasing between January 2022 – January 2024 0.6 **Post project annual calving rate** reaches 70% in the cattle owned by the 90 project households in Ankafobe, Ibity and Itremo, improved from the estimated baseline annual calving rate of 40%, between September 2024 and September 2039	Calving date records for 60 – 300 project cows	Coronavirus situation permits travel at least within central Madagascar for the project duration (risk mitigated by project founded in local communities with less reliance on central and foreign staff; budget for faster internet subscriptions to improve online communications as an alternative to travel)
Output 1 Improved preservation, understanding and more efficient exploitation of native and endemic forage grasses and forbs, in native grasslands near villages	**1.1 Native grass and forb diversity increase** from an estimated baseline of 4 – 5 species to 6 – 7 species per 50 × 50m plot in 30 plots in project demonstration farms and communal pastures in Ankafobe, Ibity and Itremo between February 2022 to February 2024 **1.2** Five native key forage grasses and five native forbs **increase in frequency** in 30 project demonstration farm and communal pasture grazing plots in Ankafobe, Ibity and Itremo by 20% from	1.1 Grass and forb species diversity records in standard grassland plot spreadsheets made by the grass and forb botanist using the grassland monitoring method already established for ecological research 1.2 Grass and forb species frequency records in 50 × 50m standard grassland plot spreadsheets made by the grass and forb botanist using the grassland monitoring method already established for ecological research	Continued community trust and engagement; most management associations choose to participate in the project (risk mitigated by 17 years of trusting relationships already built in Ankafobe, Ibity and Itremo, enthusiasm expressed at the scoping workshop, and investment to ensure full community engagement in project) Rainfall patterns remain within local average ranges (risk mitigated through monitoring and adjustment of plot design)

	measured baseline in February 2022 to February 2024 **1.3 Grazing value indices** measured for ten key native and endemic grazing grass species candidates (*Aristida rufescens, Aristida tenuissima, Brachiaria subrostrata, Cynodon dactylon, Cyrtococcum deltoideum, Digitaria longiflora, Eragrostis lateritica, Panicum luridum, Panicum umbellatum, Paspalum scrobiculatum*) using Truter standard methodology by October 2022 **1.4** Key native grazing grass **book** (in English and Malagasy), **poster** (in Malagasy), and a community-led short film (in Malagasy) produced by April 2024 in draft form, and July 2024 in final form, guided by Vorontsova and Truter. Grazing grass booklet material submitted to Kew Publishing in July 2023. **1.5 Grass training** in years 2 and 3 for 90 project household members judged useful by majority of project household participants	1.3 Grazing value index reports produced by Truter's *African Forage, Fodder, Feed and Food Quality* (AF^{4}RICA) *Laboratory* at the University of Pretoria 1.4 Copies of key native grazing grass book and poster, draft and final version pdfs and the community-led short film made available via the project webpage 1.5 Gender disaggregated training attendance sheets and records of verbal feedback	Invasions of alien grasses and forbs do not significantly increase (risk mitigated through monitoring and adjustment of plot design by the grass and forb botanist, and cultivating *Sorghum* cultivars which have proven non-invasive) Coronavirus situation permits travel at least within central Madagascar for the project duration (risk mitigated by budget for faster internet subscriptions to improve video and other online communications as an alternative to travel)
Output 2 Fodder flow supplemented by crop residue preservation and exploitation of new forage crop	2.1 ***Sorghum* fodder crop plants** established on three 1-hectare demonstration farm plots between August 2023 and May 2024 **1.2 Dry matter *Sorghum* harvest** production established on three	2.1 Photographs of the plantings 2.2 Forage production yield weight measurements made by community technicians for grasses quarterly	Continued community trust and engagement; most management associations choose to participate in the project (risk mitigated by 17 years of trusting relationships already built in Ankafobe, Ibity and Itremo, enthusiasm expressed at the scoping workshop,

	1-hectare demonstration farm plots to produce yield above an estimated natural grassland baseline of 4 tonnes of dry matter per hectare, achieving 6 tonnes of dry matter per hectare between April 2023 and April 2024 **1.3 Fodder bank** created by project households including hay and silage improved from an estimated baseline of 1 – 2 tonnes of dry matter per hectare to an estimated 4 tonnes of dry matter per hectare between April 2022 and April 2024 **1.4 Fodder training** in years 2 and 3 and **veterinary training** in year 2 for 90 project household members judged useful by majority of project household participants	2.3 Hay and crop residue yield dry weight measurements made by community technicians quarterly 2.4 Gender disaggregated training attendance sheets and records of verbal feedback	and investment to ensure full community engagement in project) Land used for the production of *Sorghum* does not compete with food crops (risk mitigated by community decision making on land use and specific questions on land use consequences in project perception questionnaires) Healthy project cattle are available for purchase (risk mitigated by reassuring results of informal enquiries already made by Sedera Ramaromanana) Cattle illness does not increase above current local average (risk mitigated by specialist advice availability from the *National Diagnostic Veterinary Laboratory* accessed through the Agriculture Ministry) Rainfall patterns remain within local average ranges (risk mitigated through climate-responsive approach to all interventions) Coronavirus situation permits travel at least within central Madagascar for the project duration (risk mitigated by budget for faster internet subscriptions to improve video and other online communications as an alternative to travel)

Output 3 Custom site-based fire management strategies conceived participatively and implemented to prevent late dry season forest fires	3.1 **Burned area** within 3 patches of forest within Ankafobe, Ibity and Itremo Protected Areas not increased from the baseline measured for January 2022 to January 2023 and 2024 3.2 **Firebreaks** created and maintained for 3 patches of forest using manual clearing and hay making at a minimum of 5m wide with vegetation kept under 15cm tall, within project dry season months May – November during 2022 – 2024 3.3 **Fire Management Plans** co-created with communities driven by the PA managers, with a focus around establishing safe burn days and times, weather adaptation and no-fire zones. Plans added to the Protected Area management plans by June 2024 in draft form and by September 2024 in the final form, guided by Lehmann 3.4 **Fire training** in years 2 and 3 for 90 project household members judged useful by majority of project household participants	3.1 Regional assessment of fire regimes in the Ankafobe, Ibity and Itremo areas completed in March 2022, by Lehmann's team 3.2 Photographs of forest edges made by monthly Protected Area fire patrols using the SMART-Mobile app, including monthly photographs at 10 set photo points in each Protected Area 3.3 Copies of Fire Management Plans, draft and final version pdfs made available via the project webpage 3.4 Gender disaggregated training attendance sheets and records of verbal feedback In July 2024 this will include testing perceptions of the draft Fire Management Plan.	Continued community trust and engagement; most management associations choose to participate in the project (risk mitigated by 17 years of trusting relationships already built in Ankafobe, Ibity and Itremo, enthusiasm expressed at the scoping workshop, and investment to ensure full community engagement in project) No sudden change in fire regime e.g. following drought (risk mitigated through monitoring and adjustment of firebreak design and preventative burns) No fires deliberately started in the forest (risk mitigated by decreasing community need for fires through improved dry season livestock nutrition supply by outputs 1 and 2, and increased community control over fires) Rainfall patterns remain within local average ranges (risk mitigated through wider firebreaks and higher frequency of patrols in dry years) Coronavirus situation permits travel at least within central Madagascar for the project duration (risk mitigated by budget for faster internet subscriptions to improve video and other online communications as an alternative to travel)

Annex 3 Standard Indicators

Table 1 Project Standard Indicators

DI Indicator number	Name of indicator	Units	Disaggregation	Year 1 Total	Year 2 Total	Year 3 Total	Total to date	Total planned during the project
DI-A01	Number of project beneficiaries and project staff who received training on sociology, grasses, agriculture, and fire	People	90 beneficiary men, 90 beneficiary women, 11 male staff, 5 female staff	196	196	196	196	196
DI-A03	Number of Malagasy state bodies and NGOs (as defined in Table 1, plus KMCC and MBG Madagascar) with improved capability and capacity as a result of project	Number	None	2	9	10	10	10
DI-B01	Protected Area Fire Management Plans written	Number	Place	0	1	2	2	3
DI-B05	Number of project beneficiaries becoming members of the new pasture and livestock raising associations	Households	90 beneficiary men, 90 beneficiary women	0	0	180	180	180
DI-C09	Grass and forb (species known to science) herbarium and silica gel reference collections made	Number of collections	Species of plant	150	600	1500	1500	1500
DI-C12	Number of followers on the project Facebook page	People	53% male and 47% female	481	680	1049	1049	1000
DI-C18	Number of papers published in peer reviewed journals and conference proceedings	Number	None	0	7	10	10	5
DI-D02	Number of project beneficiaries whose disaster/climate resilience has been improved	Households	90 beneficiary men, 90 beneficiary women	0	180	180	180	180

Checklist for submission

	Check
Different reporting templates have different questions, and it is important you use the correct one. Have you checked you have used the **correct template** (checking fund, scheme, type of report (i.e. Annual or Final), and year) and **deleted the blue guidance text** before submission?	yes
Is the report less than 10MB? If so, please email to BCF-Reports@niras.com putting the project number in the Subject line.	no
Is your report more than 10MB? If so, please consider the best way to submit. One zipped file, or a download option, is recommended. We can work with most online options and will be in touch if we have a problem accessing material. If unsure, please discuss with BCF-Reports@niras.com about the best way to deliver the report, putting the project number in the Subject line.	yes
If you are submitting photos for publicity purposes, **do these meet the outlined requirements** (see section 14)?	n/a
Have you included means of verification? You should not submit every project document, but the main outputs and a selection of the others would strengthen the report.	yes
Have you provided an updated risk register? If you have an existing risk register you should provide an updated version alongside your report. If your project was funded prior to this being a requirement, you are encouraged to develop a risk register.	no
Have you involved your partners in preparation of the report and named the main contributors	yes
Have you completed the Project Expenditure table fully?	yes
Do not include claim forms or other communications with this report.	