Addressing Specific Elements of REDD+ in South Africa

Component 3 Assessment of REDD+ Activities in Three Selected Pilot Project Sites

environment, forestry & fisheries

Department:
Environment, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

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FOREWORD

The process towards the National REDD+ Programme, started in July 2015 with the establishment of an Informal REDD+ Consultative Task Team (IRCTT). During the inaugural meeting the IRCTT proposed that instead of following the conventional stepwise approach (Phase 1-3) of REDD+ (as outlined in UNFCCC Decision 1/CP.16, paragraph 73), South Africa should follow a more innovative approach, by having a Phase 0 (Readiness Phase). This led to the commissioning of the South African REDD+ Readiness Study, which was funded by the GIZ, led by the DAFF in collaboration with the DEA. REDD+ was initially identified as part of the suite of eight principle climate change mitigation options in the Agriculture, Forestry and Other land use (AFOLU) sector in the National Terrestrial Carbon Sinks Assessment. However, at present, it has been included in South Africa's Land-Based mitigation programme, which is also built into the country's Nationally Determined Contribution under the United Nations Framework Convention on Climate Change and its Paris Agreement.

Since 2015, several pieces of work has been commissioned, which links to the initial set of elements of the REDD+ mechanism. This study assessed the drivers of deforestation and forest degradation for three selected sites, which are further described in the report. It also identified strategic initial prevention measures and associated costs. This data and specific case studies will contribute to the development of the overall REDD+ strategy.

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1. INTRODUCTION

South Africa has taken a progressive approach in its response to climate change. Following early ratification of the Kyoto Protocol, the Country published a National Climate Change Response White Paper in 2011 (DEA 2011) and has gradually developed a substantial foundation on which to base future policy and measures. A particular opportunity that has been identified is the implementation of a national programme aimed at reducing emissions from deforestation and forest degradation (REDD+).

Based on initial analysis in the National Terrestrial Carbon Sink Assessment (DEA 2013), an interim Interdepartmental REDD+ Consultative Task Team (IRCTT) was established between the Department of Agriculture, Forestry and Fisheries (DAFF) and the Department of Environmental Affairs (DEA), who commissioned an initial REDD+ Readiness Assessment Study (DAFF 2017). The outcomes of the study and subsequent expert consultative workshop identified the clear need to progress with the development of a number of key elements as well as pilot areas, to be able to move towards the development and implementation of a national programme in an effective, pragmatic and efficient manner.

PROJECT AIM AND OBJECTIVES - AS DESCRIBED IN THE TERMS OF REFERENCE

In order to compile the relevant information for the national context in South Africa in preparation for the REDD+ Strategy, this work addresses several elements identified within the REDD+ Readiness Study as follows:

a. To fully assess the South African Forest Scope and Definition for the development and implementation of REDD+ applying the three-tiered short, medium and long-term implementation approach developed during the REDD+ Readiness Study.

b. Explore effective and efficient institutional arrangements for the REDD+ process for South Africa on a national level. This assessment will, *inter alia* look into the appropriate institutional location for the REDD+ process as preliminary outlined in the REDD+ Readiness Study.

c. Assess the drivers of deforestation and forest degradation for three selected sites as outlined below. The service provider is further expected to identify strategic prevention measures and costs associated. This data will serve as guidance for the development of the overall REDD+ strategy through specific examples (DAFF 2017: 14 –29).

2. APPROACH AND METHODOLOGY

ASSESSMENT OF REDD+ ACTIVITIES IN THREE SELECTED PROJECT SITES

OBJECTIVES

- To specify, define and describe the selected project sites.
- To assess drivers of deforestation and forest degradation.
- To identify and cost measures to prevent deforestation and forest degradation.

CONSIDERATIONS

- The development of full, detailed REDD+ feasibility assessments will require a substantial amount of time. They require extensive mapping, protracted periods in the field and extended engagement with resident parties and regional authorities. Unfortunately, as discussed in the Proposal and Inception Meeting, this is beyond the amount of time provided in the Terms of Reference.
- A methodology is therefore proposed that seeks to assess the broad feasibility of each pilot area and provide a clear, step-wise pathway to further development and implementation at a national level. The first suggested step is to understand if there are clear deforestation and forest degradation trends and whether implementation would qualify as a REDD+ initiative. Thereafter, particular drivers and required response measures and their costs are explored in more detail.
- Field trips were organised and led to each pilot project area that was viewed as part of this broader deliverable. The site visits, conducted with members of Government, were aimed at obtaining input into the process and creating a good understanding among all parties of required future development.

METHODOLOGY

A stepwise process was followed to allow the effective and efficient identification of activities and measures required to realise REDD+ within the three pilot areas under consideration. The process followed is based on that described in the REDD+ Readiness Study and the Project Team's experience in developing project and landscape scale REDD+ projects in sub-Saharan Africa.

Definition of the spatial extent of pilot areas

An initial indication of the spatial extent of the pilot catchments is illustrated in Figure 1. Through engagement with the Department of Environmental Affairs, Forestry and Fisheries (DEFF), the Eastern Cape pilot area falling within the catchments of the Great Kei to Mtamvuna Rivers was further refined to a smaller area covering the Nstubane forest complex, situated on the Wild Coast of the Eastern Cape Province (Figure A4).

Understanding forest change and associated drivers

Once the spatial extent of the pilot areas was finalised, the next step is to understand the 'reference case' or 'baseline scenario' within the jurisdiction. A multi-faceted approach was taken, combining an analysis of historical forest cover change and an assessment of drivers of deforestation and forest degradation. The analysis of drivers was based on the initial mapping, together with a literature review and engagement with experts and parties resident in the pilot areas.

The outcome of the analysis provides an understanding of whether there is a clear long-term trend in forest cover and condition, together with an articulation of the principle direct and indirect drivers that result in the observed changes. Consideration of drivers is usually separated into an assessment of *direct drivers*, those which one can readily observe, for example, the unsustainable harvest of fuelwood, and *indirect drivers*, which are the underlying or proximate cause of the direct driver, for example, demand for energy for cooking and lighting. This separation is useful when attempting to identify pertinent response measures and especially for addressing potential *leakage*

– the displacement of a driver of deforestation from within the project area to an alternative domain that still results in associated GHG emissions.

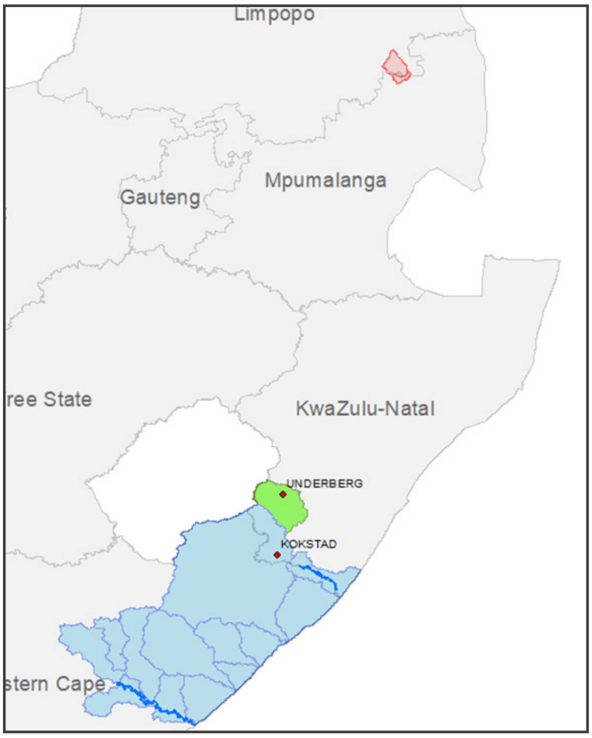

Figure 1: Proposed study catchments: Great Kai to Mtamvuna Rivers (blue), Kokstad to Underberg (green) and Mariepskop to Blyde (red). The Great Kei to Mtamvuna Rivers study area is based on Secondary Catchment boundaries and overlays the Tertiary Catchment boundaries used to describe the assumed Kokstad to Underberg extent. The Mariepskop to Blyde area is represented by two small Quaternary Catchments.

Required mapping and spatial analyses to inform the assessment of the three pilot areas

The adopted mapping methodology is in-line with those detailed in the GOFC-GOLD REDD+ guidelines (GOFC-GOLD 2012) and has been used successfully by GeoTerra Image in similar SADC-based REDD+ assessment projects. Conceptually, a landscape is first classified into 'forest' and 'non-forest' components, based on the definition of forests being used. The 'forest' component is then sub-divided into 'intact' and 'non-intact' based on spatial fragmentation measures. These forest modelling procedures are repeated for each assessment time-window, allowing the determination of forest cover related change between two (or more) time periods.

Two sets of 'change maps' were generated for each pair of time-window assessment dates under comparison (namely 1990–2018, 2014–2018). Land-use categories typically contain information classes such as water, natural vegetation, plantation forests, mining, urbanisation and cultivation, and assist in understanding land cover trends and patterns.

3. ASSESSMENT OF CHANGES IN FOREST COVER AND CARBON STOCK OVER TIME

The analysis of current and historical maps of each pilot area is aimed at answering a set of key questions:

1. What is the current spatial extent of each land-cover class and the magnitude of associated carbon stocks?
2. To evaluate the opportunity to reduce emissions from deforestation and forest degradation – are there clear deforestation and land cover trends over time, especially a shift from forest to non-forest land cover types?
3. To understand reforestation and forest restoration opportunities – what is the historical loss of forest, both in terms of spatial extent, type and carbon stocks?

CURRENT SPATIAL EXTENT AND CHANGES OVER TIME

In order to understand baseline, business-as-usual, reference rates of deforestation and forest degradation in a particular area, the developers of REDD+ programmes typically start by mapping historical trends in forest cover. If a clear deforestation trend is found and the drivers of degradation are likely to persist, project developers may then invest in modelling future potential changes in forest cover and the impact of additional mitigation measures to understand the magnitude of GHG emissions reductions that can be achieved. In addition, the historical mapping process provides an indication of the potential area that has been degraded to date and opportunity for future reforestation and forest restoration.

Based on availability, spatial data from three points in time was used (1990, 2014 and 2018). It should be noted that each map and reported data is robust but is influenced by the sensor used at the time, pixel size and associated processing (for example Landsat or Sentinel). Changes in land cover over time should therefore be viewed at an average percentage level, rather than at an individual pixel level. Readers are encouraged to study the spreadsheet that is attached to this report that contains the spatial data, change matrices and further carbon analysis.

Across the three pilot areas, there is both a substantial increase and decrease in the spatial extent of each land cover class (Table 1, 2, 3). The observed trends differ from that typically found in tropical countries, where there is often a unidirectional change from tall forest to more open landscapes. Over the period 1990–2018, there is a net increase in Indigenous Forest cover within the Mariepskop and Underberg pilot areas, a 0.5% and 2.3% annual increase respectively. In contrast, there has been a decrease in the extent of Indigenous Forest in the Eastern Cape at a rate of -1.2% per year. Over the more recent period (2014–2018), there is still a clear decrease in Indigenous Forest cover in the Eastern Cape pilot area (2.6% per year) and in addition, a slight decrease in Indigenous Forest in the Mariepskop pilot area (0.1% per year) and a slight increase in the Underberg pilot area (Tables 1–4, Figure A1–A3 Appendix A).

The change in the spatial extent of 'Natural Wooded Land' (herein referred to as Woodland) and 'Thicket / dense bush' (herein referred to as Dense Bush) is less clear and we encourage the reader to review the change matrices in the spreadsheet attached to this report. Reported changes are often gain and loss transitions between the three indigenous forest classes (Indigenous Forest, Woodland and Dense Bush) that would fall under South Africa's definition of forest* according to the Marrakesh Accord. In addition, the impact of both the expansion

* A vegetation type with a minimum height of 2 metres, a minimum area of 0.05 hectares of land and a minimum tree crown cover of more than 10%

and clearing of woody alien invasive plants (AIPs), bush encroachment and woodlots remains to be assessed.

Nevertheless, over the long term (1990–2018), there has been a net increase in total forest cover (including Woodlands and Dense Bush, Table 1–3). More recently (2014–2018), there has been a decrease in the extent of Woodland and Dense Bush, often due to degradation (a shift to low vegetation and bare land) and the expansion of plantations (see attached spreadsheet).

KEY MESSAGES

- Whereas there is a clear decrease in tall Indigenous Forest cover in the Eastern Cape pilot area over time (Table 3), the net spatial extent of Indigenous Forest in the Mariepskop and Underberg areas has remained the same over the long term, although there has been some clearing recently (2014-2018).
- In terms of opportunities to reduce deforestation and degradation, the Eastern Cape pilot area shows the greatest potential, while the more recent clearings in the Mariepskop and Underberg areas should not be ignored and require further investigation.
- The increases and decreases in Woodland and Dense Bush across the three pilot areas need to be further explored to understand the impact of changes in the extent of AIPs, bush encroachment, plantations and woodlots. This illustrates the complexity of implementing REDD+ in woodland and savanna areas where consideration of a broader set of land-cover changes, drivers and trends is required.
- Aside from reducing deforestation, there remains good opportunity to restore cleared Indigenous Forest, Woodland and Dense Bush across all three pilot areas, even where there has been a net increase in forest cover over time. There is an estimated 29,300 ha of degraded forest types that could either be reforested or restored (Table 1–3).

Table 1: Mariepskop Pilot Area: Change in land cover over the period 1990–2018. Total extent of pilot area: 84 198 ha.

Land cover type	Spatial extent (ha)					
	1990	2018	Change 1990-2018	Change per year	Change / year %	Potential restoration
Indigenous Forest	3 724	4 123	399	22.19	0.54	828
Thicket / dense Bush	17 251	1 878	-15 373	-854.06	-45.48	1 227
Natural Wooded Land	35 651	52 311	16 660	925.56	1.77	6 582
Sub-total "Forests"	**56 626**	**58 312**	**1 686**	**93.69**	**0.16**	**8 637**
Planted Forest	5 877	1 814	-4 062	-225.69	-12.44	
Water	161	194	33	1.84	0.95	
Other natural low veg. / bare	10 322	10 912	591	32.81	0.30	172
Cultivated	8 837	10 238	1 401	77.81	0.76	
Built-up	2 248	2 685	436	24.24	0.90	
Mines	127	43	-85	-4.7	-10.97	
TOTAL						**8 809**

Table 2: Underberg Pilot Area: Change in land cover over the period 1990–2018. Total extent of pilot area: 274 374 ha.

Land cover type	Spatial extent (ha)					
	1990	2018	Change 1990-2018	Change per year	Change / year %	Potential restoration
Indigenous Forest	2 631	4 549	1 918	106.57	2.34	186
Thicket / dense Bush	6 612	4 063	-2 549	-141.595	-3.48	4 612
Natural Wooded Land	3 182	4 687	1 504	83.56	1.78	2 259
Sub-total "Forests"	**12 425**	**13 298**	**874**	**48.535**	**0.36**	**7 058**
Planted Forest	9 440	22 153	12 712	706.23	3.19	
Water	972	1 878	905	50.285	2.68	
Other natural low veg. / bare	204 598	186 749	-17 850	-991.655	-0.53	
Cultivated	31 652	37 153	5 501	305.625	0.82	2 188
Built-up	15 262	13 097	-2 165	-120.275	-0.92	
Mines	23	46	23	1.255	2.72	
TOTAL						**9 246**

Table 3: Eastern Cape: Change in land cover over the period 1990 - 2018. Total extent of pilot area: 351 730 ha.

Land cover type	Spatial extent (ha)					
	1990	2018	Change 1990-2018	Change per year	Change / year %	Potential restoration
Indigenous Forest	21 638	17 937	-3 700	-205.565	-1.15	6 019
Thicket / dense Bush	61 180	75 679	14 499	805.51	1.06	7 073
Natural Wooded Land	7 302	51 504	44 202	2455.68	4.77	514
Sub-total "Forests"	**90 119**	**145 121**	**55 001**	**3055.625**	**2.11**	**13 606**
Planted Forest	4 813	5 254	441	24.505	0.47	
Water	45 871	47 177	1 306	72.535	0.15	
Other natural low veg. / bare	132 636	76 122	-56 513	-3139.635	-4.12	
Cultivated	31 975	33 370	1 395	77.51	0.23	1 037
Built-up	46 294	44 643	-1 651	-91.74	-0.21	
Mines	22	44	22	1.2	2.75	
TOTAL						**14 643**

Table 4: Combined total of all three pilot project areas: Change in land cover over the period 1990–2018.

Land cover type	Spatial extent (ha)					
	1990	2018	Change 1990-2018	Change per year	Change / year %	Potential restoration
Indigenous Forest	27 992	26 609	-1 382	-76.805	-0.29	7 032
Thicket / dense Bush	85 043	81 621	-3 423	-190.145	-0.23	12 913
Natural Wooded Land	46 135	108 501	62 366	3464.8	3.19	9 356
Sub-total "Forests"	**159 170**	**216 731**	**57 561**	**3197.85**	**1.48**	**29 301**
Planted Forest	20 130	29 221	9 091	505.045	1.73	
Water	47 005	49 249	2 244	124.66	0.25	
Other natural low veg. / bare	347 556	273 783	-73 773	-4098.48	-1.50	
Cultivated	72 463	80 760	8 297	460.945	0.57	1 037
Built-up	63 805	60 425	-3 380	-187.775	-0.31	
Mines	173	132	-40	-2.245	-1.69	
TOTAL						**30 338**

CHANGES IN CARBON STOCKS OVER TIME

The change in carbon stocks over the historical periods 1990–2018 and 2014–2018 follow a similar pattern to the change in land-cover types (Table 5–8). Again, we suggest that one reviews the change matrices in the attached spreadsheet to better understand reported carbon stock and emission estimates.

The reported estimates are in part due to shifts between forest classes (Indigenous Forest, Woodland and Dense Bush) as well as changes between forest and non-forest classes. For example, within the Mariepskop pilot area, additional carbon has been sequestered over the past 28 years where previous areas of low vegetation and bare land have been replaced by forest. However, at the same time, a shift from tall Indigenous Forest to Woodland and Dense Bush has led to the release of sequestered carbon. A further confounding factor that needs to be considered is the replacement of plantation forestry with Woodland and Dense Bush that has led to the further release of sequestered carbon over time.


Pixabay

Although the net spatial extent of forest and woodland in the Mariepskop area has remained approximately the same over time, decreases in the extent of forest and especially recent clearing, provide the opportunity to restore up to 8,600 ha of Indigenous Forest, Woodland and Dense Bush, which in turn could sequester up to 460,000 tC over time within the biomass carbon pool (Table 5). Within the Eastern Cape pilot area, there is a clearer decrease in forest cover over time and the net release of carbon sequestered in tall Indigenous Forest (Table 7). As noted above, there could be opportunity to implement measures to reduce deforestation and forest degradation. As an indication, it is estimated that approximately 454,000 tC have been released over the past 28 years, an average of 16,220 tC per year. As an initial assessment, the calculation assumes that there will be an immediate change in both biomass and soil carbon stocks, which may over represent the actual medium-term change. If only the change in biomass carbon stocks is conservatively considered, an average of 9,000 tC has been released per year or 33,000 tCO_2e per year over the 1990–2018 period. A pilot area scale programme solely aimed at halting and reducing deforestation could potentially reduce emissions by up to this amount per year.

Aside from tall Indigenous Forest, there has been a substantial increase in spatial extent and magnitude of carbon stocks within Woodland and Dense Bushland within the Eastern Cape pilot area (Table 7). As noted, this needs to be further explored to understand the relative influence of AIPs, bush encroachment and woodlands. In addition, it highlights the impact of potential REDD+ and forest definitions being considered, as the immediate inclusion of woodland and bushland areas may confound matters and require substantial additional analysis in comparison to a programme solely focused on tall Indigenous Forest.

Nevertheless, where Indigenous Forest, Woodland and Dense Bush have been cleared or converted, there is opportunity to reforest and rehabilitate 13,600 ha of forest that could sequester approximately 1,143,000 tC in the Eastern Cape over the long term.

KEY MESSAGES

- The assessment of changes in carbon stocks illustrates that despite often multi-directional changes in forest cover within pilot areas, there may still be opportunity to reduce emissions from deforestation and forest degradation and especially restore previously degraded and deforested areas.
- In terms of the rate of carbon sequestration following reforestation and restoration activities, a conservative estimate of 2.2 tC.ha-1.yr-1 within the biomass carbon pool can be assumed. This is based on modelled growth in the aboveground woody carbon pool in similar South African forests (1.8 tC.ha-1.yr-1, Glenday 2007) and a root:shoot ratio of 0.232 (IPCC 2019). This sequestration rate within the woody carbon pool could be sustained for up to 60 years until the forests reach a mature point (Glenday 2007).
- Lastly, over the past 28 years, there has already been a substantial expansion of Woodland and Dense Bush into open and bare areas, leading to the sequestration of carbon within the biomass carbon pool. This needs to be further explored to understand the relative contribution of bush encroachment, AIPs and woodlots and how to include it in future reference case scenarios.

Table 5: Mariepskop Pilot Area: Estimated changes in terrestrial carbon stocks (tC/ha) over the period 1990–2018. Total extent of pilot area: 84 198 ha.

Land cover type	Change in carbon stocks 1990–2018 (tC/ha)		Potential C stocks that could be restored (tC/ha)
	Due to increase in land-cover type	Due to decrease in land-cover type	
Indigenous Forest	93 486	-105 563	105 030
Thicket / dense Bush	-121 321	-58 023	56 445
Natural Wooded Land	-4 250	-310 442	302 762
Sub-total "Forests"	**-32 085**	**-474 027**	
Planted Forest	46 561	-365 745	0
Water	-5 142	3 047	0
Other natural low veg. / bare	-401 455	396 671	0
Cultivated	-24 987	27 565	5 308
Built-up	3 188	-482	0
Mines	212	-736	0
TOTAL	-413 708		469 545
Mean annual net change	-22 984		

Table 6: Underberg Pilot Area: Estimated changes in terrestrial carbon stocks (tC/ha) over the period 1990–2018. Total extent of pilot area: 274 374 ha.

Land cover type	Change in carbon stocks 1990–2018 (tC/ha)		Potential C stocks that could be restored (tC/ha)
	Due to increase in land-cover type	Due to decrease in land-cover type	
Indigenous Forest	275 051	-26 106	25 591
Thicket / dense Bush	75 854	-187 197	212 171
Natural Wooded Land	135 307	-41 413	103 935
Sub-total "Forests"	**486 212**	**-254 717**	
Planted Forest	2 191 760	-257 842	0
Water	-39 375	9 973	0
Other natural low veg. / bare	-586 202	2 735 653	0
Cultivated	105 708	3 278	67 390
Built-up	47 138	-29 768	0
Mines	1 049	-286	0
TOTAL	2 206 291		409 087
Mean annual net change	122 572		

Table 7: Eastern Cape: Estimated changes in terrestrial carbon stocks (tC/ha) over the period 1990–2018. Total extent of pilot area: 351 730 ha.

Land cover type	Change in carbon stocks 1990–2018 (tC/ha)		Potential C stocks that could be restored (tC/ha)
	Due to increase in land-cover type	Due to decrease in land-cover type	
Indigenous Forest	348 613	-802 781	762 538
Thicket / dense Bush	311 675	-318 111	325 375
Natural Wooded Land	1 619 378	67 417	23 656
Sub-total "Forests"	**2 279 666**	**-1 053 474**	
Planted Forest	273 007	-154 645	0
Water	-50 738	6 567	0
Other natural low veg. / bare	-480 005	3 231 802	0
Cultivated	-5 028	-1 701	31 936
Built-up	24 183	13 901	0
Mines	1 264	-101	0
TOTAL	2 042 348		1 143 506
Mean annual net change	113 464		

Table 8: Combined total of all three pilot project areas: Estimated changes in terrestrial carbon stocks (tC/ha) over the period 1990–2018.

Land cover type	Change in carbon stocks 1990–2018 (tC/ha)		Potential C stocks that could be restored (tC/ha)
	Due to increase in land-cover type	Due to decrease in land-cover type	
Indigenous Forest	717 151	-934 450	893 159
Thicket / dense Bush	266 207	-563 331	593 991
Natural Wooded Land	1 750 435	-284 437	430 353
Sub-total "Forests"	**2 733 793**	**-1 782 218**	**0**
Planted Forest	2 511 328	-778 232	0
Water	-95 255	19 586	0
Other natural low veg. / bare	-1 467 662	6 364 126	0
Cultivated	75 693	29 141	104 635
Built-up	74 509	-16 349	0
Mines	2 525	-1 124	0
TOTAL	3 834 931	0	2 022 138
Mean annual net change	213 052		

4. ASSESSMENT OF DRIVERS OF DEFORESTATION AND FOREST DEGRADATION

While the spatial extent of Forest and Woodland has shown gains and losses across the three pilot sites over the past 28 years, there are clear areas of deforestation and forest degradation, some of which has occurred over the last five years. This is driven in general by alien invasive plant (AIP) spread, poor fire management and illegal timber logging and medicinal plant harvesting. The direct and indirect causes of both forest loss and degradation for all pilot sites is presented in Table 9.

Table 9: Direct and indirect drivers of forest loss and degradation for the pilot sites within each of the three provinces, EC = Eastern Cape, MP = Mpumalanga, KZN = KwaZulu-Natal. The degree of relative importance of each factor is scaled so that 1= major importance, 2 = minor importance, 0 = not applicable)

	Direct causes	Indirect causes	EC	MP	KZN
Forest loss	Clearing of land for small scale subsistence cropping.	Poverty, lack of alternative land options, lack of alternative livelihoods, poor agricultural extension and support. Ineffective crop rotation methods.	1	0	2
	Illegal logging for building materials, fencing, firewood (forms gaps for AIP, that burn).	Poor law enforcement, local corruption. Poor fire management.	2	0	1
	Commercial harvesting of medicinal plants and bark (forms gap in forest for AIP +fire).	Poor law enforcement, lack of alternatives, poverty	1	0	1
	Wildfires with warm dry winds.	Fires spread from neighbouring plantations and spread into forests via fire prone AIPS on forest margins. Climate change.	2	1	2
	Decommissioning and removal of plantations.	Poor or no fire management and no firebreaks. Plantations no longer a buffer for forests.	2	1	2

Table 9 continued.

	Direct causes	Indirect causes	EC	MP	KZN
Forest degradation	Alien plant invasions of margins and interior.	Climate change. Poor implementation and follow up of AIP control programmes. Decline in cultivation, increase in fallow lands.	1	0	2
	Illegal logging. Illegal hunting and poaching of forest fauna.	Poor law enforcement and corruption. Lack of alternative livelihood options.	1	0	1
	Medicinal plant collection and bark stripping.	Poor law enforcement, forest access control.	1	0	1
	Excessive burning of rangelands and loss of forest margins.	Poor agricultural extension and support for rural livelihood development. No fire management planning. Climate change.	1	1	2
	Loss of forest fauna from hunting for sport and subsistence.	Poor law enforcement. No policy to manage or regulate and traditional sport hunting (for example limited permits for problem animals). Forest fragmentation through plantations, agriculture, roads and villages.	1	0	1

Alien invasive plants are prime agents in causing forest loss and degradation in all the three sites. This is compounded by wildfires, with impacts exacerbated by poor or no fire management and the rampant spread of AIPs across all three provinces (over at least the last 30 years).

Any disturbance factors, such as old lands, has resulted in forest margins being infested with a variety of AIPs, but most importantly with *Lantana camara* and *Chromolena odorata* (triffid weed). They form dense fringes around the forest ecotones, at entrances into forests, and along paths inside forest. These species are highly flammable and when ignited will burn well into the forest from the margins. Forests with intact ecotones will have a high dominance of fire-resistant species that act as firebreaks when adjacent grasslands burn, but triffid weed and Lantana burn fiercely, providing ladders of fuel that encroach into margins and can even spread into the canopies of forest trees. Any disturbance in the forest that opens canopy gaps, such as illegal timber logging, will encourage the rapid invasion of highly flammable AIPs. In some cases, (for example Egoso forest) aggressive alien creepers such as Blue morning glory (*Ipomoea indica*), Mauritius thorn (*Caesalpinia decapetala*), and Barbados gooseberry / pereskia cactus (*Pereskia aculeata*) will rapidly climb into the canopy, causing suffocation and eventual collapse of the forest canopy.

Often overlooked in considering forest degradation is the loss of forest fauna and its impacts on forest integrity. Forest associated and dependant fauna play a key role in maintaining forest biodiversity over time (in seed dispersal, pollination, disturbance etc.). For example, Trumpeter Hornbills have been found to be important dispersers of seeds within and between Southern African forest patches, where seed removal rates decline with increasing degradation of forests and deforestation (Kirika et al. 2008). Approximately 89 forest occurring faunal (vertebrates and invertebrates) species in South Africa are listed as IUCN red data species, 11 are critically endangered 21 endangered, 32 vulnerable, with one extinction (Berliner, 2009). Key direct drivers of this loss are subsistence and recreational hunting with dogs. Indirect drivers are loss in habitat and forest fragmentation, (De Villiers and White, 2000). Recent analysis of bird atlas data show that half of South Africa's forest-dependent bird species have declining ranges, with the loss of these species most prominent in the Eastern Cape Province (Cooper et al. 2018). Reason for this seem to be associated with forest degradation, in particular the degradation of forest ecotones by the combination of fires and AIP. Woodland thickening may also be playing a role. Many forest birds make extensive use of forest ecotones.

To address the causes of forest loss and degradation, it is necessary to understand the systemic nature of the problem. This implies that there are usually multiple factors involved often with complex interactions.

For example, the loss of forest in Mariepskop can be directly attributed to at least two significant fires. That is in 2007/8 year and then again in 2016/17. In both cases the fires were exacerbated by presence of alien pines, in the first fire they had been cut and were piled to dry, in the second standing pines and remnant plantations encouraged the intensity and extent of fire spread. The decommissioning of plantations meant that efforts to control and manage fire declined, along with firebreaks. This along with climate change related impacts such as hotter and dryer conditions, has meant that fires burn hotter and further. Other changes in the Mariepskop-Salique area can be traced further back, for example, according to analysis of early aerial photographs from the 1930s (Jan Graf personal communications), the lower slopes of Mariepskop/Hebron were predominantly grasslands, with forest patches. During this time period, regular fires were a dominant feature of the landscape, probably lit by the pastoralists on the lower slopes. These local residents were then forcibly removed with

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the advent of plantation forestry in the area. This had a dramatic effect on the landscape dynamics, specifically the fire regime. Plantations were managed to remove fire from the landscape, hence the general increase in woody plants. This along with other drivers of bush encroachment and the absence of browsing herbivores such as elephant has resulted in today's dense woodland savanna, as well as a possible increase in forests. More recent time (last 20 years) has seen the decommissioning of plantations along with the decline in fire management.

The catastrophic fires in the last 15 years coming over the top of the mountain possibly originated from the grasslands on top of the escapement, as well as from more local natural lightning strikes against the mountain sides.

For each situation the drivers and associated factors should be mapped, and their dynamics understood. The diagram below provides an example of these multiple contributing factors for the Wild Coast Forest (Berliner, 2011).

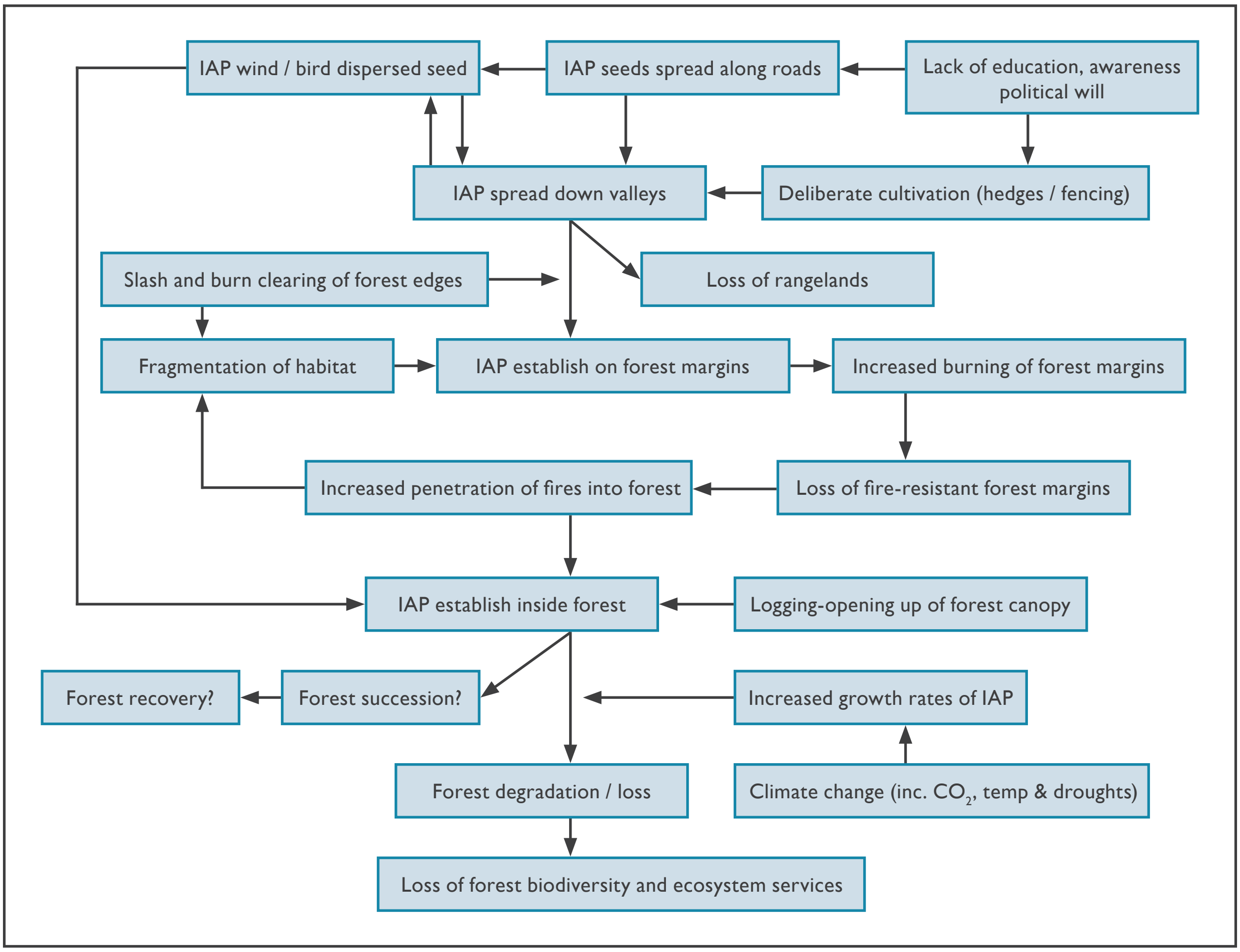

Figure 2: Forest loss and degradation on the Wild Coast involves multiple factors often with complex interactions. Each arrow illustrates the causal direction of the impact of each factor or driver (Berliner, 2011)

5. IDENTIFICATION OF REQUIRED ACTIVITIES TO ADDRESS BOTH DIRECT AND INDIRECT DRIVERS AS WELL AS THE DEVELOPMENT AND LONG-TERM MANAGEMENT OF REFORESTATION ACTIVITIES

A first step is to identify the particular activities that are required to address each driver of deforestation and restore forests over time. Thereafter, implementation models and institutional structures can be explored that facilitate the required set of activities in a cost-efficient and sustainable manner. Through the course of interviews and field visits to each pilot project area, a set of required activities were identified. This set would need to be further calibrated to a site-specific scale in future project development:

- Promote sustainable forest management and development of forests for the benefit of all, particularly by establishing and enhancing local user-group associations.
- Promote greater participation in all aspects of forestry and the forest products industry by development of forest-based enterprises (basket weaving, crafts, bee keeping, specialty products such as essential oils and tree seed oils).
- Provide special measures for the protection of representative samples of each forest type considered as high conservation value forests (Berliner, 2009).
- Promote the sustainable use of forests for environmental, economic, educational, recreational, cultural, health and spiritual purposes, according to the international best practice of Sustainable Forest Management (see for example UN Strategic Plan for Forests for 2017-2030)
- Promote community forestry in all forms, as provided for in the National Forests Act, 1998 (Act No. 84 of 1998).
- Leverage national and international funding for Forest Landscape rehabilitation, climate change mitigation and adaptation
- Where appropriate use a conceptual Agroforestry approach to Landscape rehabilitation, this will ensure the restoration of ecosystem services, carbon sequestration as well as climate change adaptation through improving food security and increased forest-based livelihood options. It is recommended that this approach be adopted for both the rehabilitation of deforested old crop lands that are no longer in use, as well as plantations that have become moribund. All reforestation projects on old crop lands near villages need to consider the future use of these lands in the context of food security climate change mitigation and adaptation.
- There is adequate policy, plans and legislation to support the approach of Participatory Forest Management (PFM). PFM highlights the important role played by rural communities in promoting sustainable forest management. South Africa sought, through the introduction of the National Forests Act, to promote, enable and regulate PFM through the conclusion of community forestry agreements (CFAs) between forestry authorities and communities. However, to date, this policy has been poorly implemented and no CFAs have been concluded (Paterson 2018).

Perhaps emphasising the last point, a recurring emerging theme of discussion with experts and field practitioners is the sheer amount of planning and development work that has happened to date, for example, the development of PFM plans for the Eastern Cape area. An appropriate first step in moving towards a full feasibility assessment for particular pilot areas, would be a comprehensive review of such work and deliverables to date.

6. IDENTIFICATION OF IMPLEMENTATION MODELS TO REALISE THE SET OF REQUIRED ACTIVITIES

The implementation models advocated will depend largely on the context (land tenure, forest value, protection status) and the kinds of activities that are required. These are described in Table 8.

In addition to on-the-ground implementation, a set of supporting functions and capacity are required to sustain implementation over time, for example:

- Management support to entities on the ground (possibly through collective action).
- Measures required to address drivers of deforestation at a regional scale (especially indirect drivers)
- Law and regulatory enforcement.
- Alignment in land-use planning and natural resource management.
- Required monitoring, reporting and verification.
- Required incentive systems.
- Required supporting policy.

Through engagement with the Directorate of Woodlands and Indigenous Forest Management and the Directorate of Forestry Regulation and Oversight, it was noted that several of these functions are currently being performed by the Department but in limited areas. Limited budgets and capacity currently inhibit their realisation at full national scale. In terms of the future development of particular pilot areas, it is suggested that a case-by-case analysis is done of the current supporting capacity within the pilot area and where it needs to be augmented and enhanced further. This step can only be done once the exact type, scale and location of required field activities is known.


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Table 10: Implementation models according to context and required activities to address forest loss and degradation.

Forest management context	Key Activities areas			
	Spatial management planning[1]	Community participation, resource use management[2]	Forest restoration[3]	Reforestation[4]
Forest in key conservation priority areas	Conservation management (fire and AIP control, reintroduction plans for species of special concern (Cape Parrot; red duiker etc).	N/A	Manage to ensure persistence of biodiversity. Specifically, removal of AIPs; reintroduction of fauna, management of ecotone (fire management plans).	May only be applicable in exceptional cases where deforestation may have occurred prior to proclamation.
High value priority forests (larger forest patches > 1000ha) on communal land e.g. Nstubane forest, Pondoland	Identifying sacred forest areas; Identify forests with unique biodiversity features (endemic species) Mapping current resource use patterns; develop management zones (core protected areas, low utilisation areas, buffer zones).	Establishment of Participatory Management Committees (PFMC); Development of non-timber forest product small enterprises; eco-tourism plans; Development of community forest ranger system (improved law enforcement and forest monitoring).	Identify and manage on-going drivers of degradation (poaching, livestock grazing, Alien invasive plants).[5] Degraded forest/ sections should receive top priority for rehabilitation of these forests.	Many high value forests in communal areas of EC and KZN have lost sections to slash and burn farming, that are no longer used. Re forestation through removal of AIP, and succession planting of pioneer forest species.
Small forest patches on communal land (headman's forest)	Identifying sacred forest as core conservation areas; Identifying important ecological connectivity (stepping- stone) patches for corridors; Identifying priority matrix areas.	Important forest for meeting resource needs (fire- wood, medicinal plants extract). Delegation of management to local PFM committees (help protect forest from poaching).	Small patches within ecological corridors should be prioritised for rehabilitation as well as surrounding matrix. Where small patches are under pressure consider woodlots as buffers.	Suitable areas for establishment of community agro-forestry and food forest projects (possibly timber).

Table 10 continued.

Forest management context	Key Activities areas			
	Spatial management planning[1]	Community participation, resource use management[2]	Forest restoration[3]	Reforestation[4]
Indigenous forests on private timber companies' estates	Fragmentation and ecotone management of small isolated patches, fire management to ensure ecotones reduce risk of wild-fires.	N/A	Companies obliged to clear AIPS under National Environmental Management Act (NEMA) regulation.	Where plantations are decommissioned, area should be managed to follow natural forest succession pathways.
Forests on private farms	Fragmentation and ecotone management of small isolated patches.	N/A	Extension officers to assist in forest conservation planning.	Suitable for private and NGO organised small-scale reforestation projects.

Notes applicable to the table above:

1. Forest zonation planning, mapping and biodiversity inventory: At provincial and regional scale require systematic conservation planning approach to identify representative samples of each forest type for priority conservation areas. At local scale: surveying forest patch biodiversity, zonation mapping of high value conservation areas for special forest protected areas (under the National Forests Act (NFA)), sustainable use areas, sacred forests, areas of forest loss and degradation and identifying priority degraded forests areas for restoration projects (for example, within ecological corridors according to Eastern Cape Biodiversity spatial conservation plan).

2. Community participation. The National Forests Act, 1998 (Act 84 of 1998), and the Forestry Law Amendment Act, 2005 (Act 35 of 2005) emphasise the principles of Sustainable Forest Management (SFM), and the importance of a participatory role by local communities (PFM). This involves the formation of community forest management committees with a constitution and elected members. Sustainable Forest Management has a set of principles, criteria and indicators that require ongoing monitoring. In addition, SFM requires forest management zonation, allowing for core conservation areas, low utilisation buffer areas, and sustainable use areas. It also promotes the development of non-timber forest product enterprises (crafts, bee keeping and so on) and eco-tourism, as well as community-based forest monitoring and reporting. Participatory forest management plans for sustainable harvesting rates, law enforcement, role of traditional authorities in controlling grazing in forests, and forest use (medicinal plants, firewood, structural timber and so on).

3. Forest restoration is only sustainable if the ongoing drivers of forest degradation are identified and addressed. In particular, alien plant control, livestock grazing/trampling and poaching. For community forests outside the high value priority forests, firstly the focus should be on removing AIPs and secondly, on key species enrichment planting; as well as fire and ecotone management.

4. Reforestation: only areas that held forests in the last 50 years should be considered for reforesting. A study using historical imagery is required to identify these areas. These should be prioritised with the aim of optimising social and ecosystem services in conjunction with carbon sequestration potential. Note that it is recommended that the management objectives for reforestation will differ according to the type of forest and the reforestation zones. Reforestation of sections of high value priority forests should aim to restore original forest biodiversity, while reforestation of smaller, community or head-man's forest should aim to develop forest with high utility value, focusing on establishing useful species according to the principles of agro-forestry and food forests.

5. Three forest ecological zones require different strategies: forest edges, gaps & glades and forest interior. Forest edges are vulnerable to alien plants, that should be removed by pulling/ cutting and spraying, with bi- annual follow up. Fires need to be managed to ensure periodic cool burns around forest edges. Gaps in forest are prone to livestock trampling and becoming infested with alien creepers. Creeper control requires cutting from base and spraying. Livestock need to be kept out of all forests to prevent trampling, spread of AIPs and in recovering gaps inside the forest, trampling and grazing of recovering tree saplings. Edges are prone to infestation by AIPs and benefit from periodic cool burns.

7. ANALYSIS OF IMPLEMENTATION COSTS

The goal of this component is to understand the long-term costs of halting, reducing and reversing forest degradation and deforestation across diverse landscapes. Here the costs of field implementation are considered, not the costs of supporting services (compliance, monitoring and governance), which are beyond the scope of this assessment.

A recent review of the cost of climate change mitigation activities within South Africa's Agriculture, Forestry and Other Land-Use (AFOLU) sector (DEA 2019, PAMS Assessment Report, in press), found that restoration costs can range from R10,000–38,000 per hectare in Forest ecosystems and R6,700–50,000 in sub-tropical thicket. However, these assessments only evaluate the initial cost of restoration and not the longer-term costs of replanting, addressing the drivers of deforestation and clearing AIPs.

Interviewed practitioners within the Mariepskop and Underberg areas noted that there needs to be a shift from focusing on a once-off measure to focusing on the consistent sustainable management of landscapes over the long term. For example, field implementation could be done by a team of field staff, consisting of 6-8 individuals, who would perform a range of required natural resource management tasks across the area over time. As an indicator, it is assumed that a single 8-person team would be required for the Mariepskop area, which would cost approximately R1 million per annum, including the cost of a vehicle, equipment, fuel and further overheads. In larger areas, that require more than one team, the cost per team may decrease to R800,000 due to shared overhead costs.

8. SUGGESTED IMMEDIATE COURSE OF ACTION

The analysis of the change in the spatial extent of forest types illustrates the complexity of South African landscapes where this is generally not a unidirectional loss of forest cover, but rather both increases and decreases in the extent and health of different forest, woodland and bushland types. Especially understanding the dynamics and drivers within the woodland / bushland domain, including consideration of the influence of bush encroachment and woody AIPs, will require further exploration which should start as soon as possible.

However, this should not halt the immediate implementation of opportunities to halt, reduce and reverse deforestation and forest degradation within tall Indigenous Forests. This assessment has identified opportunities to reduce deforestation in the Eastern Cape and Mariepskop Pilot Areas. In addition, there is a substantial opportunity to reforest and restore Indigenous Forest in all three pilot areas. This could be led by National Government through the Directorate of Woodlands and Indigenous Forest Management within DEFF, and where necessary, with existing private sector entities providing additional local management and implementation capacity.

The principle form of implementation should be through local Participatory Forest Management, thereby enhancing the opportunity to create local value and buy-in in the long-term management and existence of forests. Seedlings could be generated through school-run programmes following the ‘treepreneurship’ model pioneered by the WILDTRUST and successfully implemented in several provinces to date (www.wildtrust.co.za). In combination with supporting compliance and policing capacity provided by the national department, it could provide a broad range of local livelihood and income opportunities while contributing to national climate change mitigation, adaptation and land degradation neutrality goals.

9. INTERVIEWED EXPERTS AND STAKEHOLDERS

Name	Affiliation	Title	Contact details
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APPENDIX A: MAPS OF LAND COVER CHANGE IN EACH PILOT PROJECT AREA OVER THE PERIOD 1990–2018.

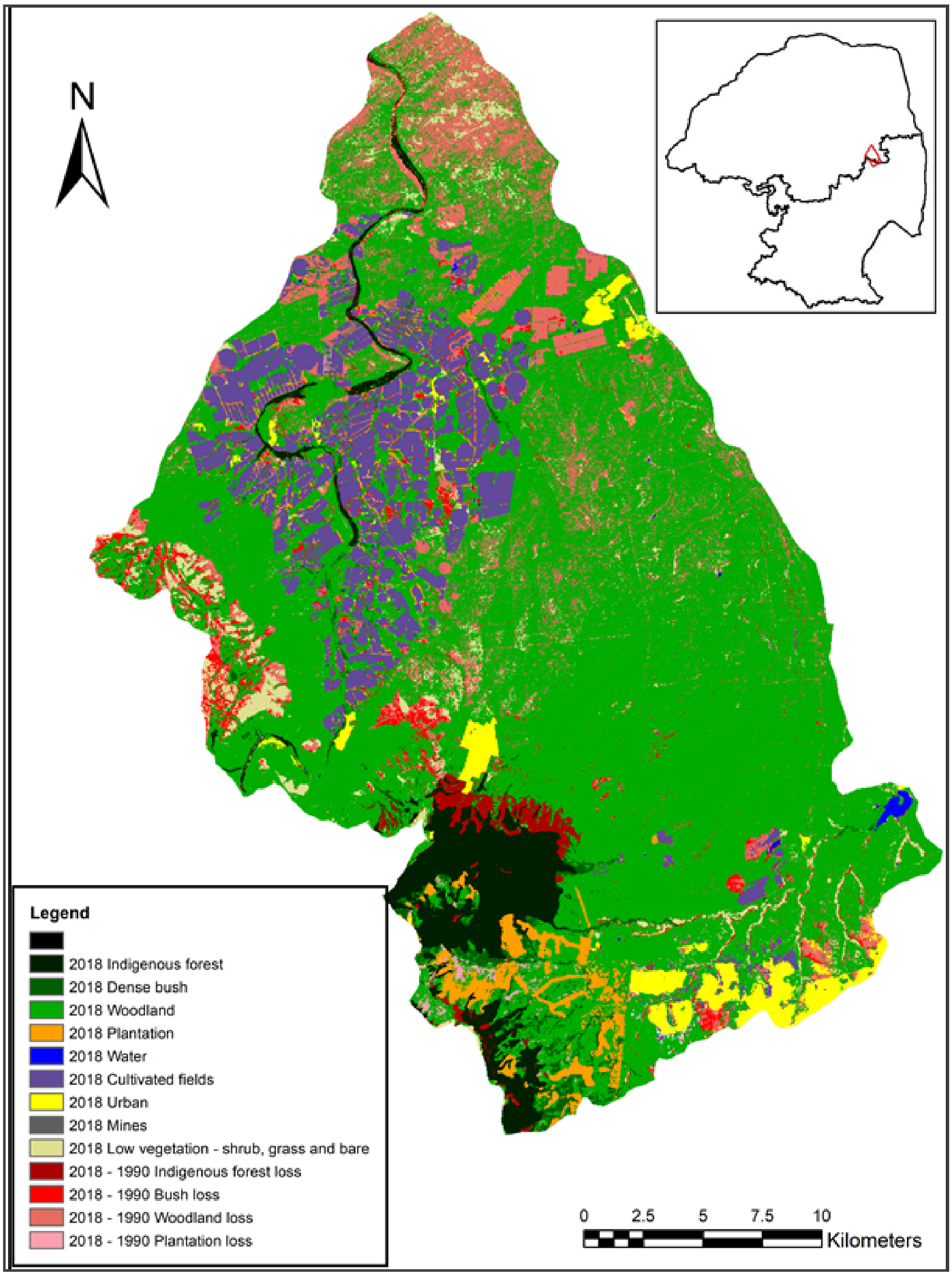

Figure A1: Mariepskop Pilot Area: Change in land cover over the period 1990–2018. Total extent of pilot area: 84 198 ha.

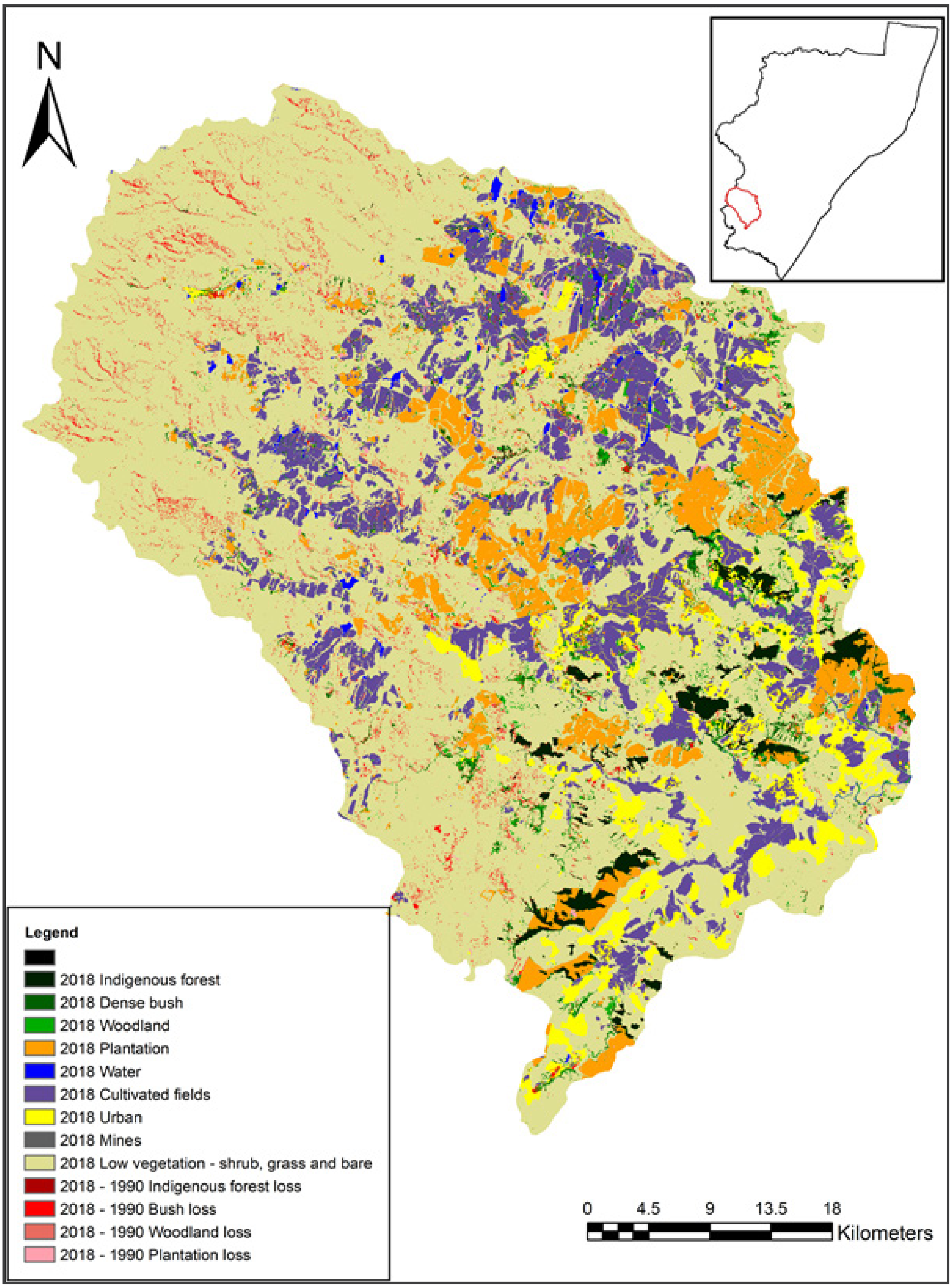

Figure A2: Underberg Pilot Area: Change in land cover over the period 1990–2018. Total extent of pilot area: 274 374 ha.

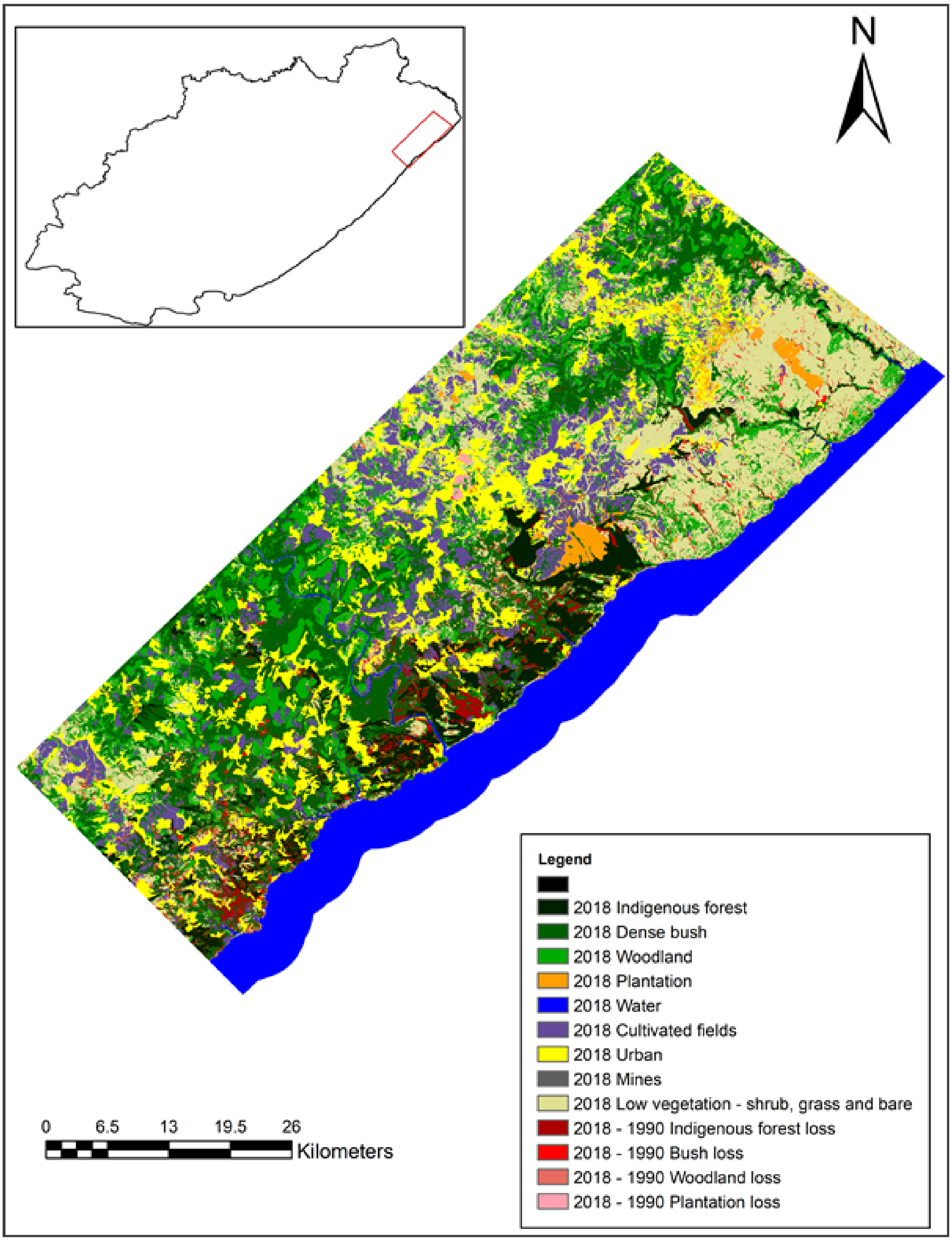

Figure A3: Eastern Cape: Change in land cover over the period 1990–2018. Total extent of pilot area: 351 730 ha.

APPENDIX B: POTENTIAL PROJECT FOCAL SIGHTS

While it is suggested here that the whole of the Ntsubane forest complex be considered as a climate change adaptation, mitigation and landscape restoration programme. Several key focal areas have been identified. These are shown in the maps below.

Mthambalala/Khaleni forest (31 31' 13.66"S ; 29 32' 41.08E)

GOSO forest (31 24' 27.14"S ; 29 37' 44.16"E)

Part of this focal are has been the location of Wildlife of Southern Africa (WESSA) reforestation sites). Note extensive forest cover loss and degradation in Goso forest in image below.

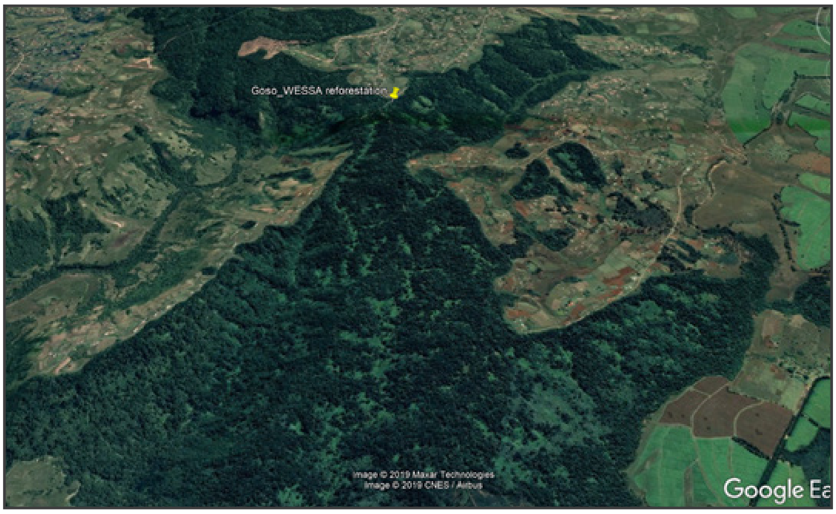

Figure A4: Large scale forest cover loss and degradation, evident from the satellite imagery for Goso forest just West of Magwa tea plantation.

Mt Sulivan: Dedeni (31 35' 04.38"S ;29 32' 15.12"E)

Figure A5: An example of heavily degraded forest on Noqhekwana hill, Dedeni area. Red arrow on the satellite image indicates where the pictures were taken (left summer of 2010, right winter of 2014).

APPENDIX C: PILOT PROJECT AREA LAND COVER CHANGE DATA

Table C1: The change in land cover in the Mariepskop Pilot Project Area: 1990–2018. Metric: Hectares.

Marieskop: Change in land cover over the period 1990 - 2018. Total extent of pilot area: 84 198 ha.

2018 \ 1990	Indigenous Forest	Thicket / dense Bush	Natural Wooded Land	Planted Forest	Water	Other natural low veg. / bare	Cultivated	Built-up	Mines	Total 2018	
Indigenous Forest	2 892	5	84	767	1	369	3	2	0	4 123	*Horizontal numbers,*
Thicket / dense Bush	354	325	47	878	4	236	28	6	0	1 878	*Increase since 1990*
Natural Wooded Land	434	15 048	26 639	2 578	30	6 337	969	204	71	52 311	
Planted Forest	2	73	128	1 401	0	60	151	0	0	1 814	
Water	1	31	23	0	116	17	5	0	0	194	
Other natural low veg. / bare	38	1 227	6 582	191	9	2 625	172	37	31	10 912	
Cultivated	2	423	1 757	39	1	441	7 493	82	0	10 238	
Built-up	0	117	385	23	0	229	17	1 912	1	2 685	
Mines	0	2	6	0	0	7	0	4	24	43	
Total 1990	3 724	17 251	35 651	5 877	161	10 322	8 837	2 248	127		
	Vertical numbers, decrease since 1990							Total	84 198		
	Numbers on the diagonal no change between assessment years										

Table C2: The change in land cover in the Underberg Pilot Project Area: 1990–2018. Metric: Hectares.

Underberg: Change in land cover over the period 1990 - 2018. Total extent of pilot area: 274 374 ha.

2018 \ 1990	Indigenous Forest	Thicket / dense Bush	Natural Wooded Land	Planted Forest	Water	Other natural low veg. / bare	Cultivated	Built-up	Mines	Total 2018	
Indigenous Forest	2 441	4	217	485	1	1 298	14	88	0	4549	*Horizontal numbers,*
Thicket / dense Bush	55	719	94	371	6	2 516	223	80	0	4063	*Increase since 1990*
Natural Wooded Land	23	601	164	219	27	3 356	220	77	0	4687	
Planted Forest	18	320	372	6 872	12	13 966	576	16	1	22153	
Water	0	52	17	6	760	949	92	2	0	1878	
Other natural low veg. / bare	91	4 612	2 259	1 199	154	175 851	2 188	385	10	186749	
Cultivated	1	227	54	186	13	5 138	28 286	3 248	1	37153	
Built-up	3	77	6	102	0	1 498	48	11 361	2	13097	
Mines	0	1	0	0	0	26	4	6	10	46	
Total 1990	2 631	6 612	3 182	9 440	972	204 598	31 652	15 262	23		
	Vertical numbers, decrease since 1990							Total	274 374		
	Numbers on the diagonal no change between assessment years										

Table C3: The change in land cover in the Eastern Cape Project Area: 1990–2018. Metric: Hectares.

Eastern Cape: Change in land cover over the period 1990 - 2018. Total extent of pilot area: 351 730 ha.

	Indigenous Forest	Thicket / dense Bush	Natural Wooded Land	Planted Forest	Water	Other natural low veg. / bare	Cultivated	Built-up	Mines	1990 Total 2018	
Indigenous Forest	15 330	118	729	323	3	1 152	11	271	0	17 937	*Horizontal numbers,*
Thicket / dense Bush	5 542	40 750	4 175	555	28	22 570	724	1 336	0	75 679	*Increase since 1990*
Natural Wooded Land	222	11 680	1 761	98	25	35 474	961	1 282	1	51 504	
Planted Forest	10	154	33	3 025	0	1 694	26	309	3	5 254	
Water	6	128	38	0	45 752	1 233	5	14	0	47 177	
Other natural low veg. / bare	244	7 073	514	208	60	66 260	1 037	716	9	76 122	
Cultivated	210	564	30	83	1	1 810	29 168	1 503	0	33 370	
Built-up	73	711	21	521	2	2 410	42	40 862	0	44 643	
Mines	0	2	0	0	0	33	0	1	8	44	
Total 1990	21 638	61 180	7 302	4 813	45 871	132 636	31 975	46 294	22		
	Vertical numbers, decrease since 1990							Total	351 730		
	Numbers on the diagonal no change between assessment years										

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