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Preliminary study on the drivers of deforestation & potential for REDD+ in Zambia



Republic of Zambia
Ministry of Lands,
Natural Resources and
Environmental Protection



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EXECUTIVE SUMMARY

1. This study sought to answer the question: what drives deforestation and what is the potential for REDD+ in Zambia? Since deforestation and poor forest management reduce carbon storage in tropical forests, there has been increasing pressure to minimize carbon stock losses. The objectives of this study were to provide a preliminary understanding regarding drivers of deforestation and the potential for REDD+ in Zambia; to assess to what extent our current consumption, production and development patterns affect deforestation levels, as well as assessing the potential impact of future shifts in these patterns; to draw conclusions as to which actions/trends would probably have the most serious consequences in terms of additional deforestation, and analyse how these could be reduced in future. The final aim was to outline the potential for REDD+ in these circumstances.
2. In order to address these stated objectives, we used an interdisciplinary data gathering approach, integrating literature search, policy level consultancy, community level consultations, stakeholder interviews, courtesy calls and field visits.
3. According to this preliminary study, deforestation hotspots in Zambia are mainly located along the highly urbanized rail link running from Southern to Copperbelt provinces. New hotspots are also rapidly emerging in the less urbanized provinces.
4. This preliminary study has revealed that forest cover loss in deforestation hotspots has been on an upward trend since the late 1980s.
5. The direct drivers of deforestation in Zambia can be grouped into four categories. These are:
 - Agricultural expansion
 - Infrastructure development
 - Wood extraction
 - Fires



6. The ultimate drivers of forest cover loss are agricultural expansion, charcoal production, fuelwood collection, wood harvesting, settlements, fires, urbanization, industrialization, urban expansion and livestock grazing. The underlying drivers are high poverty levels, low employment opportunities, brick-making, tobacco curing, insecure tenure rights, low institutional capacity (poor funding, low staffing levels, lack of reliable transport for monitoring) and lack of synergy among policies and legislation.
7. The challenges of reducing deforestation in Zambia include improving linkages and coordination between relevant institutions in natural resource management (NRM); regularly updating information on the national status of forests; enhancing complementarity of relevant policies and institutions; making NRM policies supportive and inclusive; developing a close relationship between infrastructure development and forest conservation; eliminating or minimizing political interference in forest resource management; promoting secure land tenure systems and developing clear policies and guidelines that effectively address issues of benefit-sharing mechanisms.
8. Viable options available for halting forest cover loss in Zambia may include enhancing soil quality and erosion control, afforestation, woodland regeneration and agroforestry as conservation strategies aimed at increasing carbon stocks in degraded sites.
9. Current high levels of deforestation (between 250 000 and 300 000 ha/year) in Zambia mean there is high potential for Zambia's participation under REDD+, since degraded sites may still be managed for carbon sequestration through coppice or regeneration management. The capacity of *miombo* woodlands to recover almost completely following clearing for either charcoal production or slash-and-burn agriculture, offers very high potential for local communities to participate in carbon trading under REDD+ financing mechanisms.
10. In conclusion, deforestation is a complex matter, with many drivers operating at varying levels. The major challenge is therefore to reconcile the need to improve people's livelihoods with the urgency of achieving sustainable forest resource management. REDD+ offers an opportunity for rural dwellers to trade in forest ecosystem services that do not lead to loss in forest cover.



TABLE OF CONTENTS

EXECUTIVE SUMMARY	III
TABLE OF CONTENTS	V
LIST OF TABLES	VII
LIST OF FIGURES	VII
ACRONYMS/ ABBREVIATIONS.....	VIII
1.0 INTRODUCTION.....	1
1.1 VEGETATION TYPES OF ZAMBIA.....	2
1.2 MANAGEMENT OF FOREST RESOURCES	3
1.2.1 PAST STRATEGIES TO ENHANCE SUSTAINABLE FOREST MANAGEMENT ..	3
2.0 METHODOLOGY.....	6
2.1 SITE SELECTION	6
2.2 METHODOLOGY	6
2.2.1 DATA COLLECTION.....	6
2.2.2 DATA ANALYSIS.....	7
3.0 FINDINGS.....	8
3.1 DEFORESTATION HOTSPOTS IN ZAMBIA	8
3.2 HISTORIC, CURRENT & FUTURE TRENDS OF DEFORESTATION AND FOREST DEGRADATION	9
3.3 DRIVERS OF DEFORESTATION AND THEIR LINKAGES.....	13
3.3.1 LEGISLATIVE AND POLICY FRAMEWORK	15
3.3.2 INSTITUTIONAL FACTORS	16
3.3.3 ENVIRONMENTAL FACTORS AND THEIR LINK TO DEFORESTATION.....	17
3.3.4 SOCIO-ECONOMIC DRIVERS AND CAUSES OF DEFORESTATION	21
3.3.5 INFRASTRUCTURE DEVELOPMENT.....	25
3.4 CHALLENGES FOR REDUCING DRIVERS OF DEFORESTATION.....	27
3.4.1 POOR LINKAGE AND COORDINATION WITH OTHER RELEVANT INSTITUTIONS.....	27
3.4.2 UNAVAILABILITY OF UPDATED INFORMATION ON THE NATIONAL STATUS OF FORESTS.....	27
3.4.3 LACK OF COMPLEMENTARITY OF RELEVANT POLICIES AND INSTITUTIONS	27
3.4.4 LACK OF SUPPORTIVE AND INCLUSIVE NATURAL POLICIES	27
3.4.5 INFRASTRUCTURE DEVELOPMENT AND FOREST CONSERVATION.....	28
3.4.6 POLITICAL INTERFERENCE	28



3.4.7 INSECURE LAND TENURE SYSTEM.....	28
3.4.8 LACK OF BENEFIT-SHARING MECHANISM.....	29
3.5 OPTIONS AVAILABLE TO EFFECTIVELY REDUCE IMPACTS ON FOREST RESOURCES	29
3.5.1 REGENERATION AND COPPICE ENHANCEMENT MANAGEMENT.....	30
3.5.2 AGROFORESTRY, SOIL MANAGEMENT AND CLIMATE CHANGE MITIGATION.....	30
3.5.3 FIRE MANAGEMENT	32
3.5.4 ALTERNATIVE ENERGY SOURCES AND IMPROVED CHARCOAL USE AND PRODUCTION METHODS.....	33
3.5.5 ALTERNATIVE LIVELIHOOD SYSTEMS.....	34
3.5.6 IMPROVING STAFFING LEVELS AND COLLABORATION WITH LOCAL COMMUNITY MEMBERS.....	34
3.6 POTENTIAL FOR REDD+ IN ZAMBIA	35
3.6.1 WOODLAND RECOVERY, PRODUCTIVITY AND POTENTIAL FOR REDD+ PROJECTS.....	36
3.6.2 MECHANISMS OF CARBON STORAGE AND LOSS IN WOODLANDS	38
3.7 METHODOLOGIES AND TOOLS FOR ESTIMATING DEFORESTATION TRENDS	39
4.0 CONCLUSIONS AND RECOMMENDATIONS	42
5.0 REFERENCES	43
GLOSSARY	50
APPENDICES.....	51



LIST OF TABLES

Table 1: Major vegetation formation of Zambia	2
Table 2: provinces and districts involved in the study	6
Table 3: Annual rate of deforestation by province for the period 1965 - 2005	9
Table 4: Changes in forest area in Zambia from 1965 to 2005	10
Table 5: Long-term changes in forest cover in Zambia.....	11
Table 6: Land cover/Land use change in the Misaka National Forest from 1979 to 2010	12
Table 7: Estimates of main forest types	35
Table 8: Biomass related parameters of Southern Africa woodlands.....	36
Table 9: Total above-ground biomass and biomass density in the major land use classes in Zambia.....	37
Table 10: Estimated historical biomass and carbon stock changes from 1965-2005 in Zambia.....	38
Table 11: Present acquisition and analysis costs* of monitoring of various technologies in US\$.....	41

LIST OF FIGURES

Figure 1: Deforestation hotspots in Zambia.....	8
Figure 2: Projected deforestation as result of land use change in Zambia.....	11
Figure 3: Area under cultivation for the period 1987 to 2010	13
Figure 4: Interrelationships between proximate and underlying drivers of deforestation in Zambia.....	14
Figure 5: Hilly and rocky area with limited vegetation formation in Serenje, Central Province	20
Figure 6: Frequency of occurrence of the specific proximate drivers of deforestation.....	22
Figure 7: Frequency of occurrence of specific drivers of deforestation by province	22



ACRONYMS/ ABBREVIATIONS

CBNRM:	Community-Based Natural Resource Management
FAO:	Food & Agricultural Organization of the United Nations
FSP:	Forest Support Programme
GRZ:	Government of the Republic of Zambia
ILUA:	Integrated Land Use Assessment
JFM:	Joint Forest Management
MTENR:	Ministry of Tourism, Environment & Natural Resources
REDD:	Reducing Emissions from Deforestation and Forest Degradation
UNFCCC:	United Nations Framework Convention for Climate Change
VAG:	Village Action Group
ZAWA:	Zambia Wildlife Authority
ZFAP:	Zambia Forestry Action Plan



1.0 INTRODUCTION

Africa's *miombo* woodlands are vast, of high conservation value and important for human well-being. Forests play a crucial role in the livelihoods of the majority of resource-poor rural Zambians, who lack access to other sources of subsistence income and employment. It is, however, an unfortunate fact that agricultural production and the use of fire have constantly modified tropical woodlands over the years (Chidumayo, 1997). Livelihood factors such as the need for agricultural land, food, income and employment have all greatly contributed to degradation, and, in some cases, depletion of forest resources in Zambia (Chidumayo, 2002; Chipika & Kowero, 2000; FAO 2005). Numerous studies have shown that tropical deforestation is one of the major causes of global climate change (Henry et al., 2010). However, the question of what drives tropical deforestation at both local and global levels remains largely unanswered. It is interesting to note that over the past three decades, a significant body of evidence has revealed that factors promoting tropical deforestation are complex, and vary in scale at global, country and regional levels.

The consequences of deforestation are devastating, and may, amongst other negative impacts, result in a reduction in the provision of overall ecosystem services, and also contribute to global warming. Since deforestation and poor forest management reduce carbon storage in tropical forests, there has been increasing pressure to minimize carbon stock losses. In the UNFCCC negotiations, action on deforestation and forest degradation is considered a critical pathway for achieving the overall objective of mitigating climate change. The main purpose of this study was to generate a preliminary understanding regarding drivers of deforestation, from a Zambian perspective. The specific objectives of the study, as provided in the terms of reference (**Appendix 1**), were:

- To provide a preliminary understanding regarding drivers of deforestation and the potential for REDD+ in Zambia;
- To assess to what extent our current consumption, production and development patterns affect deforestation levels, as well as assessing the potential impact of future shifts in these patterns;



- To draw conclusions as to which actions/trends would probably have the most serious consequences in terms of additional deforestation, analyse how these could be reduced in future and outline the potential for REDD+ in these circumstances.

1.1 VEGETATION TYPES OF ZAMBIA

Zambia has three major vegetation formations (**Table 1**). The closed forests are limited in extent, covering only about 6 percent of the country. The most extensive closed forests are the *Cryptosepalum* and *Baikiaea* forests, covering parts of North-Western and Western provinces (MTENR, 2003).

Table 1: Major vegetation formation of Zambia

Vegetation type	Approximate extent, area 1000 ha	Proportion (%)
Closed Forests		
· <i>Parinari</i>	420	0.06
· <i>Marquesia</i>	430	0.06
· <i>Lake basin</i>	15 560	2.07
· <i>Cryptosepalum</i>	15 210	2.00
· <i>Baikiaea</i>	6 830	0.91
· <i>Itigi</i>	1 900	0.25
· <i>Montane</i>	40	0.01
· <i>Swamp</i>	1 530	0.20
· <i>Riparian</i>	810	0.11
Woodland (Open Forest)		
· <i>Miombo</i>	311 460	41.41
· <i>Kalahari</i>	85 460	11.36
· <i>Mopane</i>	38 700	5.15
· <i>Munga</i>	32 600	4.34
· <i>Termitaria</i>	24 260	3.23
Grassland	206 350	27.44
Open waters	10 500	1.40

(Source: MTENR, 2002)

Open forests/woodlands are the dominant vegetation formations in Zambia, covering 66 percent of the forested area (MTENR, 2002). There are four types of woodlands in the country, of which the most extensive is *miombo*. *Miombo* woodland covers 42 percent of the country and is characterized by the following genera: *Brachystegia*, *Julbernardia* and *Isoberlinia*. This is followed by the *Kalahari* woodlands, characterized by *Mopane*, *Munga* and *Termitaria* (MTENR, 2002). *Termitaria*, or anthill vegetation, covers 3 percent of land, and is present in all regions of the country, except in areas of pure stands. It is classified according to its association



with other vegetation types, as in: *Miombo Termitaria*, *Kalahari Termitaria*, *Mopane Termitaria*, *Munga Termitaria*, *Riparian Termitaria* and *Grassland Termitaria*.

1.2 MANAGEMENT OF FOREST RESOURCES

In Zambia, the Forestry Department is responsible for implementing national forestry policies and plans for forest use and management. The Forestry Department provides the general management and control of forest resources, in order to meet national and local demand. The Department's aim is to ensure a sustainable flow of timber and non-timber forest products and services, while at the same time ensuring protection and maintenance of biodiversity for the benefit of present and future generations, through active participation of all stakeholders.

Since the inception of the Forestry Department in 1949, forest resource management in local and national forest areas has failed to facilitate meaningful involvement of other stakeholders, such as communities living near these forest areas. Although some attempts have been made to democratize forest resource management in Zambia through the 1998 forest policy, this document remains largely inactive. Furthermore, the legal aspects of forest resource management in Zambia continue to be covered by the 1973 Act, despite the subsequent formulation of the 1999 Forestry Act. The autocratic nature of both forest policy and legal frameworks, compounded by a declining national economic situation, has contributed to unprecedented loss in forest cover throughout Zambia. There has been an upward trend in deforestation since the 1990s (FAO, 2005; ILUA, 2010). As a result, the Zambian government faces the major challenge of reducing forest cover loss.

1.2.1 PAST STRATEGIES TO ENHANCE SUSTAINABLE FOREST MANAGEMENT

1.2.1.1 THE WORLD CONSERVATION STRATEGY

The World Conservation Strategy was launched in 1980 with the task of encouraging nations to develop their own national conservation strategies in order to improve the conservation of natural resources. In Zambia, the National Conservation Strategy was developed in 1984, its main goal being that of satisfying the basic needs of all the country's present and future generations through wise management of natural resources. Specifically, the objectives of the national conservation strategy were to:



- Ensure the sustainable use of Zambia’s renewable natural resources, such as forests;
- Maintain Zambia’s biological diversity;
- Maintain essential ecological processes and life support systems.

The National Conservation Strategy’s main method was to establish policies, devise plans and fully integrate conservation into Zambia’s social and economic development. It also aimed to analyse trends and current issues so as to better anticipate needs and problems.

However, the National Conservation Strategy failed to be fully integrated into national development priorities and clearly failed to reach local groups in rural communities. According to Chabala (2004), the failure of the National Conservation Strategy to achieve its set goals was attributed to the planning process, which used a top-down approach, confined to scientists and government institutions, without involving local communities in all stages of the conservation strategy. Depletion of natural resources still continued at a faster rate than had been anticipated.

1.2.1.2 ZAMBIA FORESTRY ACTION PLAN (ZFAP)

After the National Conservation Strategy, the Zambia Forestry Action Plan (ZFAP) was launched in 1998 by the Ministry of Environment and Natural Resources. The ZFAP process was intended to focus on forest–related issues such as reforestation, forest management, forest conservation and forest restoration at national level. The ZFAP process aimed to overcome political and institutional barriers in order to effectively manage Zambia’s remaining forest resources. However, unfortunately, ZFAP shared the fate of previous initiatives, since it remained a sector (Forestry Department) programme, with little influence on other sectors and the country as a whole, due to a lack of national development planning. Grassroots programmes initiated by local communities were never considered as part of the scope, and such initiatives failed to receive any meaningful policy support from the government via ZFAP.

1.2.1.3 JOINT FOREST MANAGEMENT (JFM)

The purpose of JFM is to encourage the devolution of management for protected forests in Zambia to local communities and villages through specific arrangements such as co-management agreements, village forest reserves and community



forestry. According to Bwalya (2004), the Forests Act of 1999 aimed to promote democracy in forest resource governance (local/village people participatory approach), replacing the previous top-down approach. JFM ensures active participation of villagers in forest resource management through the formation of semi-autonomous commissions. The general principle behind JFM is that power-sharing for forest conservation will instill a sense of belonging in communities living close to protected forests. Zambia aside, similar semi-autonomous forestry commissions exist in Kenya, South Africa, Tanzania and Uganda.

However, implementation of JFM in Zambia has failed to produce significant results. This is largely due to lack of proper legal backing, coupled with other factors outside the legal framework.



2.0 METHODOLOGY

2.1 Site selection

A sample selection of districts was based on a review of statistics from isolated case studies, and on an analysis of land cover maps and satellite images (MTENR, 2003). In this study, we selected Copperbelt, Central, Lusaka, Southern, North-western and Western provinces. These provinces were chosen on the basis that **1**) they represent diverse Zambian forest types (Fanshawe, 1971; White, 1983); **2**) they differ substantially in terms of key drivers of deforestation (ZFAP, 1998) and **3**) they have diverse cultural and socio-economic settings. The final districts visited during this study are given in **Table 2**.

Table 2: provinces and districts involved in the study

Central	Copperbelt	Lusaka	Southern	North-Western	Western	Northern
Kabwe	Kitwe	Kafue	Sinazongwe	Solwezi	Kaoma	Mpika
Mumbwa	Ndola	Chongwe	Choma	Kasempa	Mongu	Kasama
Chibombo	Masaiti	Lusaka	Mazabuka	Kabompo	Shesheke	Mpulungu
Kapiri-Mposhi						

2.2 Methodology

2.2.1 DATA COLLECTION

In gathering data for this study, an interdisciplinary approach was used, integrating literature search, stakeholder interviews and field visits. A number of documents, including annual reports for various organizations, government policy documents and international and local publications relating to tropical forest deforestation and forest degradation, were reviewed in order to draw from other views and experiences regarding factors that drive deforestation.

For the same reason, consultations were held with a small sample of selected key stakeholders, in order to seek their views on past and current drivers of deforestation in Zambia. These interviews targeted key stakeholders, empowered by law to manage the country's natural resources, as well as various forest users. In



addition to investigating deforestation drivers, consultations also provided an opportunity to gain an in-depth understanding of deforestation and the inherent institutional challenges for managing deforestation in Zambia.

It was also important to witness the physical nature of the problems, so field visits were conducted to assess the extent of deforestation and forest degradation for a few selected deforestation hotspots.

2.2.2 DATA ANALYSIS

The results presented in Fig. 2 are based on the simulation of land use changes using the CLUE-s model (the Conversion of Land Use and its Effects) (Veldkamp and Fresco, 1996). A nationwide application for Zambia at relatively coarse resolution CLUE-s was used. It was specifically developed for the spatially explicit simulation of land use change, based on an empirical analysis of location suitability, combined with the dynamic simulation of competition and interactions between the spatial and temporal dynamics of land use systems. The explicit focus on the spatial dynamics of land use change makes the model suitable for the purposes of this study.

The model is based on an integrated analysis of socio-economic and biophysical factors that determine the allocation of land use change in combination with the simulation of temporal dynamics (path-dependence and reversibility of changes), spatial policies and land requirements (Verburg and Veldkamp, 2003). Different scenarios of near-future developments in land use patterns were simulated, illustrating the effects of implementing spatial policies. The results in Fig. 2, from the coarse scale model with national extent, mainly serve to identify the overall pattern of land use change and hotspots of deforestation in Zambia.

In order to identify the deforestation hotspots, the Global Land Cover 2000 (GLC, 2000) was used as the baseline land use map. The simulation of deforestation was based on this baseline scenario. The four main categories of information used in the model include: *Land use requirements (demand)*, *Location characteristics*, *Spatial policies and restrictions* and *Land use type specific conversion settings*. A more detailed description of the model is provided by Verburg *et al.* (2002).



3.0 FINDINGS

3.1 DEFORESTATION HOTSPOTS IN ZAMBIA

A visible characteristic of the pattern of deforestation hotspots in Zambia is its close association with urbanization (**Fig. 1**). The close link between urbanization and deforestation is confirmed by hotspot analysis using the CLUE-S (Conversion of Land Use and its Effects) model, developed by Verburg and Veldkamp (2004).

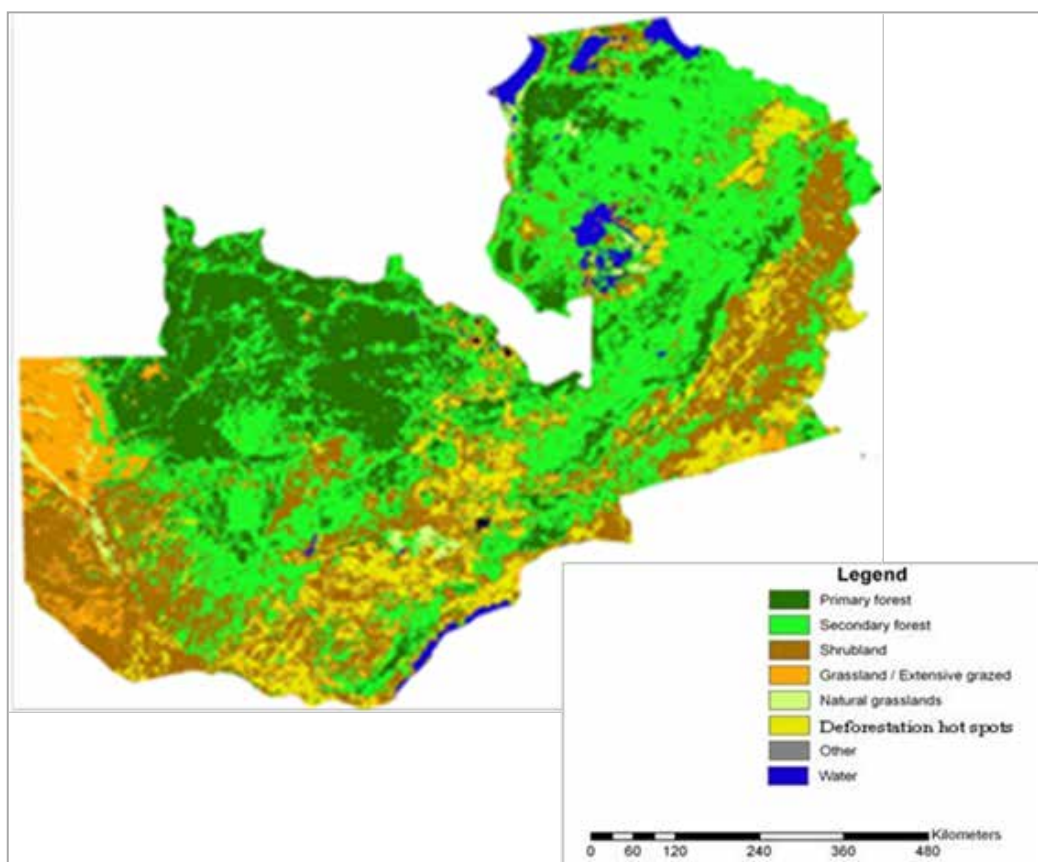


Figure 1: Deforestation hotspots in Zambia

The major corridor of deforestation hotspots is along the rail link from Livingstone to Chililabombwe. This covers four key provinces (Southern, Lusaka, Central and Copperbelt). However, there is evidence of growing numbers of hotspots in North-Western Province, driven by rapid urbanization and industrialization. The close link between urbanization and deforestation suggests that areas experiencing high population growth are likely to be more severely affected by deforestation in the near future.



3.2 HISTORIC, CURRENT & FUTURE TRENDS OF DEFORESTATION AND FOREST DEGRADATION

Trends for deforestation are variable, depending on the period (Chidumayo, 2012). For example, the average deforestation rate during 1965-2005 was 0.81 percent per province (**Table 3**). Among the provinces considered in this study, Luapula Province had the highest annual deforestation rate during the period 1965-1996, while Southern and Western had the lowest annual rate of deforestation during the period 1965-2005.

Table 3: Annual rate of deforestation by province for the period 1965 - 2005

Province	Annual deforestation (%)
	1965 - 2005
Central (including Lusaka)	-0.65
Copperbelt	-0.84
Eastern	-0.85
Luapula	-2.47
Northern	-0.47
Northwestern	-0.77
Southern	-0.20
Western	-0.20

Source: Chidumayo, 2012

According to Chidumayo (2012), the countrywide annual rate of decline in forest area increased from -0.34 percent (or -157 300 ha) for the intermediate past period of 1965 – 1996 to -0.66 percent (or -307 900 ha) for the maximum period of 1965 - 2005; the forest area decline for the minimum period of 1996 – 2005 was estimated at -1.99 percent (or -826 554 ha). Forest area in most of the country's provinces has followed a pattern of decline (**Table 4**).



Table 4: Changes in forest area in Zambia from 1965 to 2005

Forest area (km ²)										
						Forest area change (km ²)				
				2005			1965-2005		1996-2005	
	Original	1965 ¹	1996 ²	ILU A 1	Chidumayo	1965-1996	ILU A 1	Chidumayo	ILU A 1	Chidumayo
Central (including Lusaka)	99 113	77 549	69 400	58 994	57 355	-8 149	-18 555	-20 194	-10 406	-12 045
Copperbelt	28 338	21 393	17 500	18 935	14 169	-3 893	-2 458	-7 224	1 435	-3 331
Eastern	66 894	51 805	47 100	51 285	34 181	-4 705	-520	-17 624	4 185	-12 919
Luapula	37 058	25 411	25 000	31 622	258	-411	6 211	-25 153	6 622	-24 742
Northern	120 615	65 489	88 100	80 230	53 071	22 611	14 741	-12 418	-7 870	-35 029
North-Western	106 316	98 952	53 800	89 153	68 568	-45 152	-9 799	-30 384	35 353	14 768
Southern	68 244	48 093	46 600	51 012	44 159	-1 493	2 919	-3 934	4 412	-2 441
Western	87 819	76 482	68 900	84 334	70 255	-7 582	7 852	-6 227	15 434	1 355
All Provinces	61 4397	465 174	416 400	465 565	342 016	-48 774	391	-123 158	49 165	-74 384
% of country (752 600 km ²)	81.6 4	61.8 1	55.3 3	61.8 6	45.44					

Source: Chidumayo, 2012 (Based on ¹Schultz (1974); and ²ZFAP data).

The country's deforestation rate is estimated at around 1.5 percent per annum and Zambia is ranked as one of the countries with the highest rates of deforestation in the world (Henry *et al.*, 2011). In 1996, the Food and Agricultural Organization (FAO), citing Alajarvi (1996), indicated the average annual deforestation rate for Zambia to be 250 000 hectares (ha) per annum. Chidumayo (1999), reported an even higher deforestation rate of 300 000 ha per annum, suggesting that the pace at which forests were being cleared was on an upward trend. Although figures of forest recovery are never reported, there is reason to believe that the rate of recovery is outpaced by the rate of harvesting. Recent studies have shown that Zambia is among the top ten African countries experiencing significantly high rates of forest cover loss. Our trend analysis from the years 2000 to 2030 predicts an increase in the rate of deforestation, with Copperbelt being the worst affected province (**Fig. 2**).



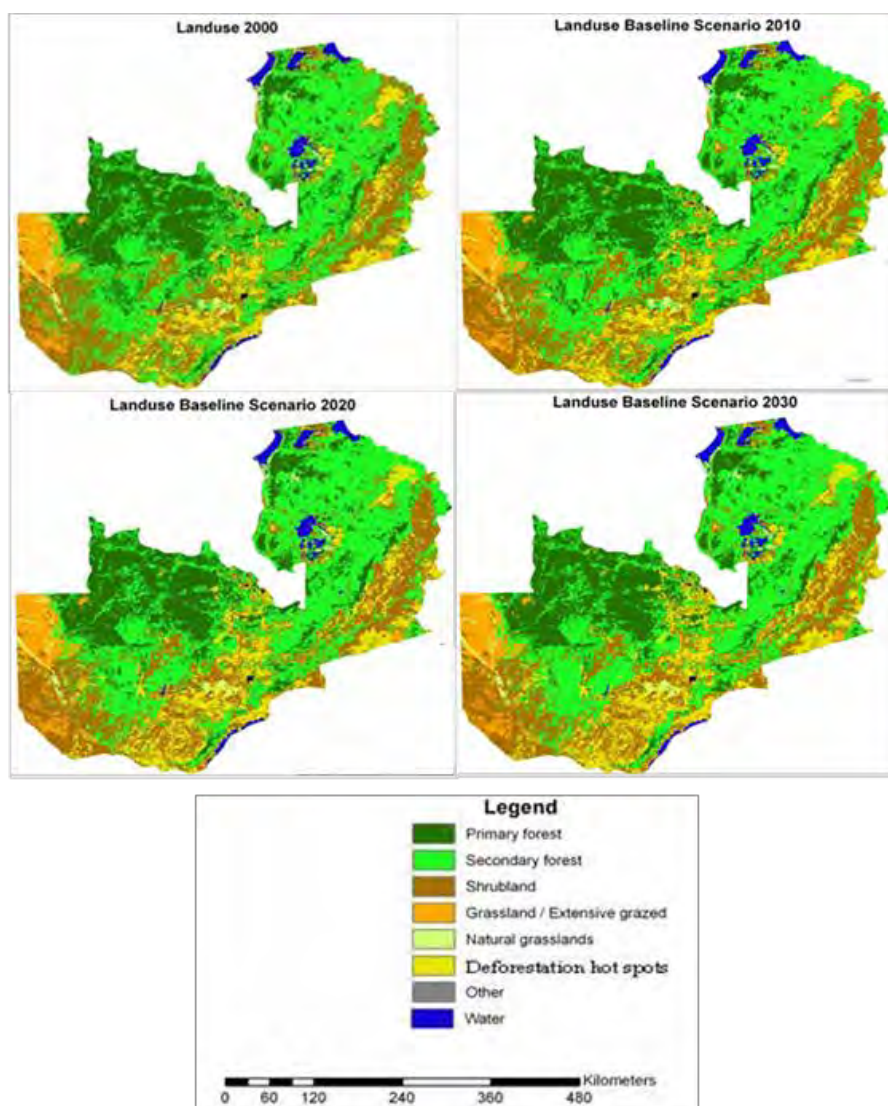


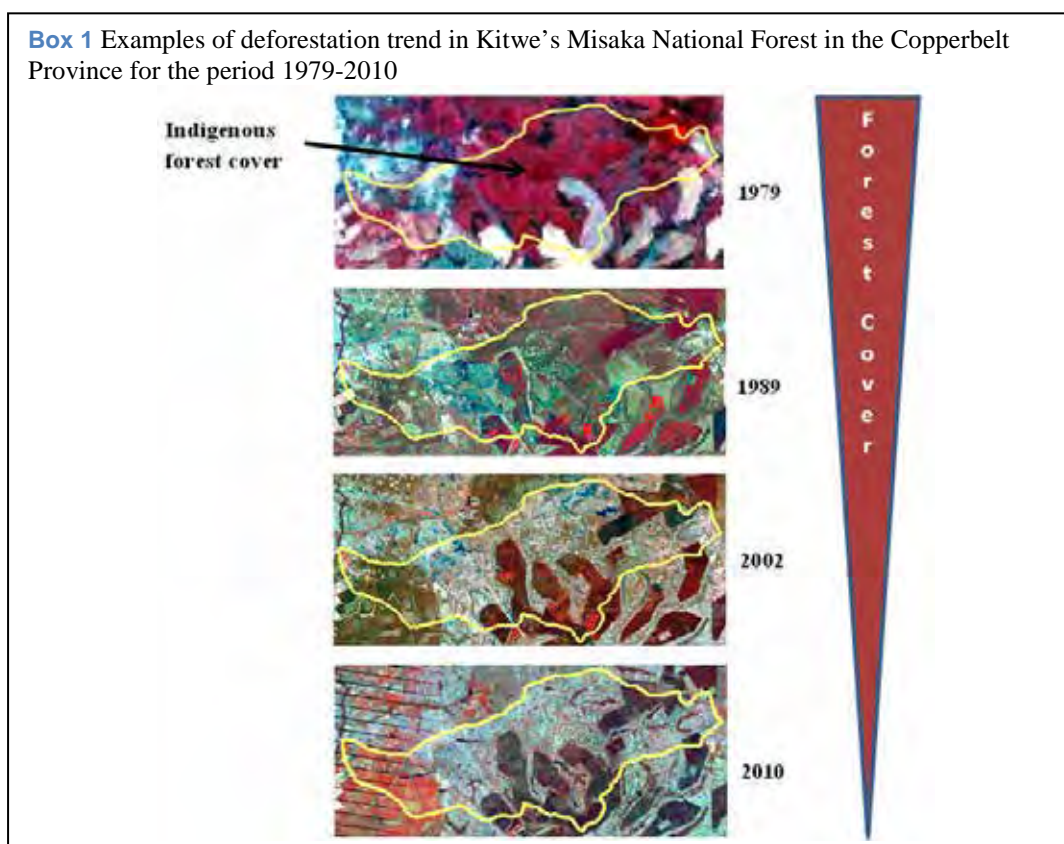
Figure 2: Projected deforestation as result of land use change in Zambia

The amount of forest cover loss is expected to vary between the different simulation periods within the deforestation hotspots. Between the baseline year 2000 and 2010, the amount of forest cover loss was 890 400 ha and is expected to increase to 1 358 200 ha in 2020. The amount of forest cover loss between 2020 and 2030 is expected to decline from 1 358 200 ha in 2020 to 1 238 800 ha in 2030 (Table 5).

Table 5: Long-term changes in forest cover in Zambia

Land use/Land cover change from 2000 to 2030				
Year	Extensive Agriculture (00 ha)	Primary forest (00 ha)	Secondary forest (00 ha)	Shrubland (00 ha)
2000	64 344	161 044	288 221	184 130
2010	73 248	158 907	284 392	181 726
2020	86 830	155 647	278 552	178 059
2030	99 218	152 674	273 225	174 714

At local level, deforestation in Kitwe’s Misaka area has been increasing (**Box 1**). The main driver of land use change in Misaka has been a combination of charcoal production, settlements, and agriculture.



Over the years, agriculture and settlements have been the main drivers of forest cover loss, particularly during the period between 1989 and 2002 (**Table 6**). This corresponds to the structural adjustment programme era, during which the country’s mines made substantial cuts in their workforce.

Table 6: Land cover/Land use change in the Misaka National Forest from 1979 to 2010

	forest cover (ha)	exotic plantation cover (ha)	settlements/ agricultural land (ha)	surface water area (ha)
1979	16 362	2 090	2 696	22
1989	7 878	5 722	7 350	22
2002	4 396	5 362	11 192	22
2010	4 712	5 313	10 859	88

Source: WRAP, 2011



Empirical data shows that land under cultivation has been steadily increasing since the late 1980s and that this trend may continue in the future (**Fig. 3**).

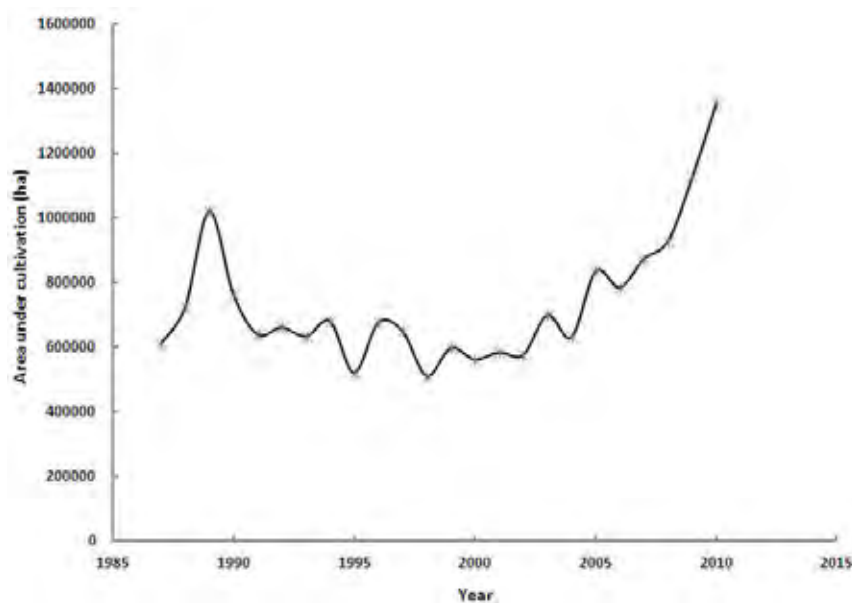


Figure 3: Area under cultivation for the period 1987 to 2010

Source: Ministry of Agriculture

The rapid rise in area under cultivation (**Fig. 3**) may be attributed to the intensification of the fertilizer support programme, launched by the Zambian government in 2000. It would have been interesting to compare this trend with forest cover loss as a result of forest-related activities, such as charcoal production and logging over the same period. However, unfortunately no empirical data could be retrieved from Forestry Department HQ, due to poor record-keeping.

3.3 DRIVERS OF DEFORESTATION AND THEIR LINKAGES

Results of this study revealed that the proximate factors driving deforestation in Zambia can be broadly grouped into four categories (**Fig. 4**):

- Agricultural expansion
- Infrastructure development
- Wood extraction
- Fires

These factors work in an interactive way to influence forest cover loss at different spatial scales.



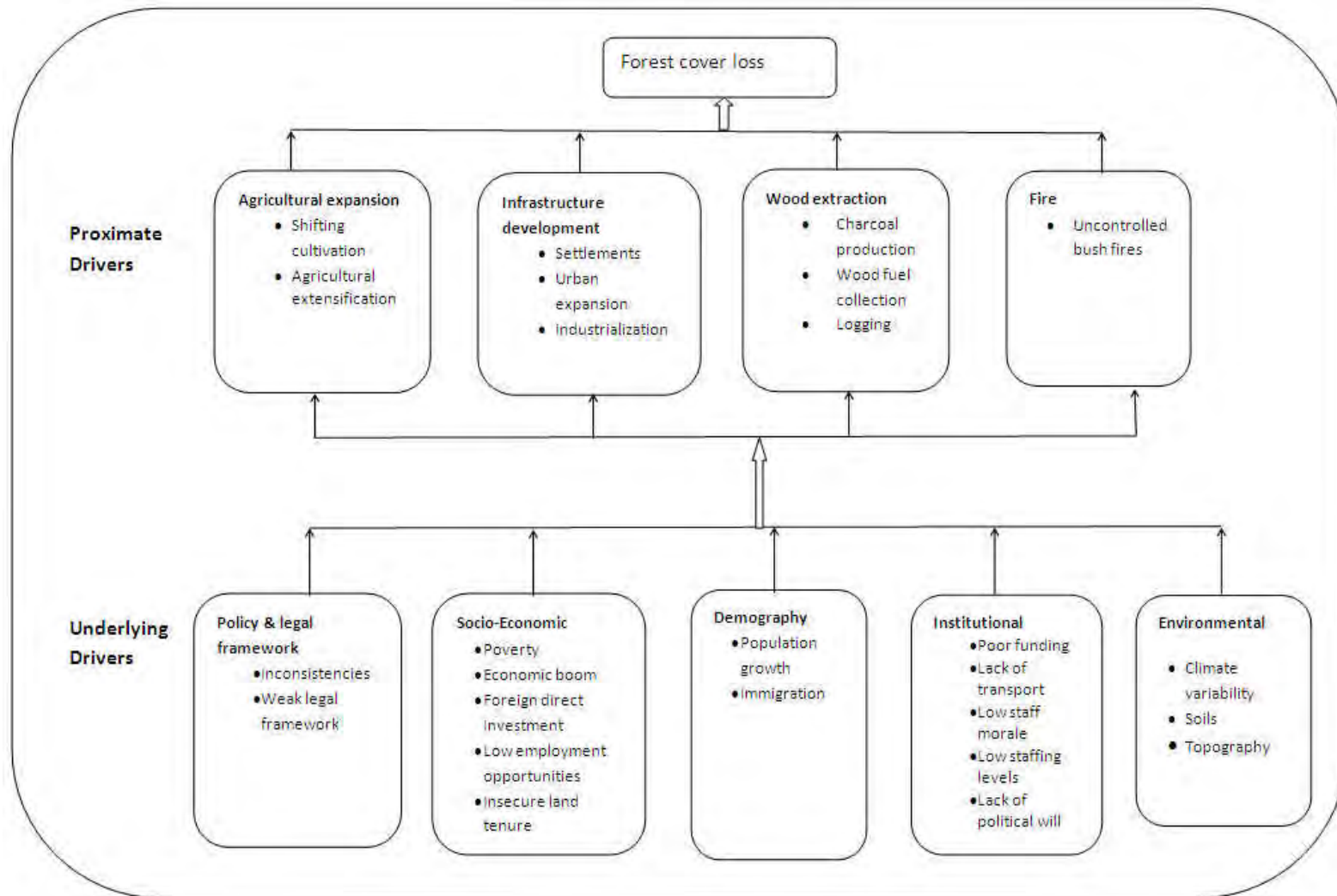


Figure 4: Interrelationships between proximate and underlying drivers of deforestation in Zambia

The proximate drivers of deforestation in Zambia are shifting agriculture, agricultural extensification, charcoal production, fuelwood collection, logging, settlements, uncontrolled fires, industrialization and urban expansion (**Fig. 4**).

The underlying drivers of deforestation can be divided into five broad groups (**Fig. 4**):

- Policy and legal framework
- Socio-economic
- Demography
- Institutional
- Environmental

However, the specific underlying drivers of deforestation are high poverty levels, low employment opportunities, brick-making, tobacco curing, insecure tenure rights, low institutional capacity (poor funding, low staffing levels, lack of reliable transport for monitoring) and lack of synergy among the various policies and acts of legislation.

3.3.1 LEGISLATIVE AND POLICY FRAMEWORK

Over the years, the Zambian government has introduced a number of policies and acts of legislation, designed to address one or more aspects of natural resource management (NRM). Some of the more effective of these measures in terms of Zambian forest resources management have included:

- **National Policy on Environment** – promotes holistic and sound environmental management in Zambia.
- **Forestry policy:** promotes involvement of local communities in sustainable forest management and conservation.
- **National Parks and Wildlife Act, no. 12 of 1998:** provides for the establishment, control and management of national parks, and the conservation and protection of wildlife resources and objects of interest.
- **National Heritage Conservation Commission Act:** promotes the protection and conservation of ancient, cultural and natural heritages.
- **Agricultural (including fisheries) policy:** promotes sustainable agriculture (agroforestry) through wise use of resources.



- **Wildlife policy:** promotes the sustainable management of wildlife resources and community participation in the management of these resources.
- **Energy policy:** promotes the use of alternative sources of energy and the adoption of energy-saving technologies.
- **Decentralization policy:** promotes local involvement in decision-making and concentration of decision-making at local rather than national level.
- **Town & Country planning Act, CAP 475:** promotes environmentally-friendly development in all towns in Zambia.

Despite their positive contribution to sustainable NRM, these policies have been characterized by widespread failure in terms of implementation and enforcement. The main factors have been lack of political will, low levels of support for implementation and inconsistencies in both policy and legislation. Generally, these policies have resulted in the forest sector being regulated in a sectoral manner, with distinct regulatory and monitoring institutions, resulting in varying degrees of overlap and conflict. The legislation also lacks provision for conflict resolution and disputes among competing concessionaires, such as those for the timber and mining sectors.

Although the Zambian government has accepted and introduced Community-Based Natural Resource Management (CBNRM) approaches, aimed at providing rural communities with secure tenure of their environmental resources, a commitment to develop appropriate supporting legislation and technical capacity appears to be lacking. Current CBNRM approaches lack clear guidelines on cost and benefit-sharing mechanisms between GRZ and participating communities (Bwalya, 2007; Phiri, 2009). Furthermore, communities have not received the required assistance to manage their activities and environmental resources in an independent manner.

3.3.2 INSTITUTIONAL FACTORS

Inadequate staffing in government departments dealing with NRM-related issues has greatly contributed to the downward trend in the sustainability of forest and natural resources in the country. For example, out of a total 544 positions made available at both technical and professional levels for the Forestry Department, 390 have yet to be filled. Inadequate staffing makes it difficult for the department to implement and monitor sustainable forest management programmes. This may be attributed to lack of investment by central government, since most natural resource-based



departments are poorly funded. During the course of this study, it emerged that district forest offices receive no funding whatsoever, despite the fact that they raise millions of kwachas in revenue (Per. Comm.). Inadequate appropriate technology to the sector has also made it difficult for these departments to perform their duties effectively.

Additionally, the institutions created by various acts of legislation governing land and natural resources tend to operate independently and with limited coordination. A good example is the demarcation of forest reserves by the Department of Land Resettlement. This responsibility comes under the Office of the Vice President, yet the forest reserves fall under the jurisdiction of the Forest Department of the Ministry of Mines and Natural Resources. Such cases highlight the need to strengthen and streamline the role of the forest sector in relation to other relevant sectors.

Political interference may have also contributed to massive forest cover loss in Zambia. Often, forests are converted into farmland for reasons of political expediency. Government attempts to provide for poverty alleviation have left natural management-based institutions such as the Forestry Department all but powerless. A number of forest reserves have been degazetted and appropriated to provide land for illegal squatters. Currently, out of 489 forest reserves in the country, 170 are heavily encroached, while 109 are partially encroached (Forestry Department, 2005). Between 6 and 12 forest reserves have been degazetted since 2000 in each of the following provinces: Copperbelt, Southern and Eastern. The degazetting of such forest reserves has probably served as an incentive to other squatters.

3.3.3 ENVIRONMENTAL FACTORS AND THEIR LINK TO DEFORESTATION

The biophysical environment of some parts of the country, namely Southern, Western, and some parts of Central province, is relatively sensitive and fragile, particularly in terms of steep slopes (escarpments), soils, climate and water. These features influence the ability of vegetation to recover once it has been disturbed. They also tend to have a strong impact on rural livelihood food security systems.



3.3.3.1 CLIMATE CHANGE AND THE PERFORMANCE OF THE AGRICULTURAL SECTOR

Higher temperatures and unpredictable rainfall (quantity and timing), frequent extreme weather events and increasing severity of pests and diseases are common phenomena not only in Zambia, but throughout Southern Africa (Lobell et al., 2008). These factors have a severe impact on smallholder farmers, exacerbating levels of poverty in the region, since local economies are largely dependent on subsistence farming. Agriculture is a crucially important sector, not just for Zambia but for the region as a whole, in terms of food security, contribution to Gross Domestic Product (35 percent), employment (contributes between 60 and 80 percent of total labour) and foreign exchange earnings (30 percent) (Abalu and Hassan, 1998).

Climate has been seen to exert an impact on agriculture through increased drought frequency and intensity over the past 20 years in Zambia. The droughts of 1991/92, 1994/95 and 1997/98 resulted in a sharp drop in maize yields, which fell from more than 500 000 metric tonnes in 1988 to about 10 000 metric tonnes in some parts (e.g. Southern Province) (de Wit, 2006). In the 2004/2005 agricultural season, two-thirds of Zambia, namely Eastern, Southern and Western provinces, experienced prolonged drought spells, resulting in irreversible damage to most crops, including drought-tolerant crops such as cotton and tobacco. These areas experienced cereal production losses of some 56 percent, and more than one million people needed food assistance up to June 2006 (de Wit, 2006). Generally, failure in the agricultural sector due to adverse weather patterns leads resource-poor rural communities to engage in off-farm activities, such as charcoal production.

Climate change may indirectly drive vegetation cover change. Its influences on the extent, severity and frequency of wildfires depends on interactions between several factors, including forest management history, drought frequency and severity and a wide range of others. One example of a vegetation type where climate change and forest management history may interact to influence change in vegetation cover is the *Baikiaea* Forest. The exploited forest areas of the *Baikiaea* Forest tend to have large quantities of woody debris on the floor, and grasses grow in open areas. With persistent drought and high temperatures, these open areas become potential fire hazards.



Furthermore, the starting of fires for all sorts of reasons is common practice among many Zambians. Driving factors include vegetation control, clearing of fields for cultivation, provision of potash (the Chitemene system), visibility improvement during hunting and pasture management. Experimental evidence has shown that, if not well managed, fire has the potential to contribute directly to forest cover loss (Bond, 2009; Lawton, 1978; Trapnell, 1959). Wild fires, especially late dry-season fires, have been observed to reduce the productivity of *miombo* woodland across the ecoregion (Grundy, 1995).

Once burnt, most *miombo* woodland trees tend to produce significantly less basal area than unburnt trees of the same age (Grundy, 1995). Fires also have a negative impact on the regeneration and survival of young plants. Fierce fires, which in most cases occur in late dry season, are the most damaging to the woodland ecosystem because of high quantities of extremely dry litter biomass (Chidumayo, 1995). According to Chidumayo et al. (1996), fierce fires are common in areas where felling has recently taken place, due to large quantities of timber debris.

3.3.3.2 SOIL AND GEOMORPHOLOGICAL SYSTEMS

Geomorphological processes that have taken place over a geological time-scale have resulted in some plateaux and hilly areas, with scattered vegetation forms (**Fig. 5**). This is particularly true for central, eastern and southern parts of the country, which are covered by hilly escarpments and complex zones that form part of the lift valley systems.





Figure 5: Hilly and rocky area with limited vegetation formation in Serenje, Central Province

These escarpments usually have steep slopes, making them highly sensitive to erosion. Any human-induced disturbance to the existing vegetation cover in such areas can cause severe land degradation, with no possibility of recovery even when the disturbance ceases. The precise rates of erosion countrywide have not been estimated, but visible evidence of this problem has been observed in localized areas of Central, Lusaka and Southern provinces. Given that in most Zambian soils, the highest nutrient concentration is found in the top 0-10 cm layer, erosion can result in considerable losses of plant nutrients (MTENR, 2002), thus making it difficult for regeneration to be sustained.

Poor land use practices such as uncontrolled slash-and-burn agriculture, continuous monocropping, cultivation on sloped areas without conservation measures, and overgrazing, easily accelerate soil erosion and hence deforestation. Soil erosion has been observed to result in low crop yields and low livestock productivity, causing food insecurity. As such, some farmers look to forest exploitation as an alternative to agriculture, in an attempt to bridge the food security gap.



3.3.4 SOCIO-ECONOMIC DRIVERS AND CAUSES OF DEFORESTATION

3.3.4.1 POVERTY AND DEFORESTATION

Poverty is perhaps the most immediate factor that undermines household capacity to contribute to environmental management and sustainability. Extreme poverty has consistently been higher in rural and peri-urban areas than in urban areas. Extreme poverty levels continue to fluctuate, due to economic instability. High poverty levels can be attributed to the national economic structure that has failed to favour Zambia's rural poor. Although the Zambian government has consistently expressed a wish to take development to rural areas, it is also true that social welfare protection has yet to be worked into the country's economic programmes. Low domestic earnings, coupled with high demand for fuelwood, have combined to exert pressure on forest resources in rural Zambia.

3.3.4.2 WOOD EXTRACTION

The woodlands are the main source of fuelwood consumed in both rural and urban areas. At national level, fuelwood collection is the fourth leading direct driver of deforestation in Zambia (**Fig. 6**).

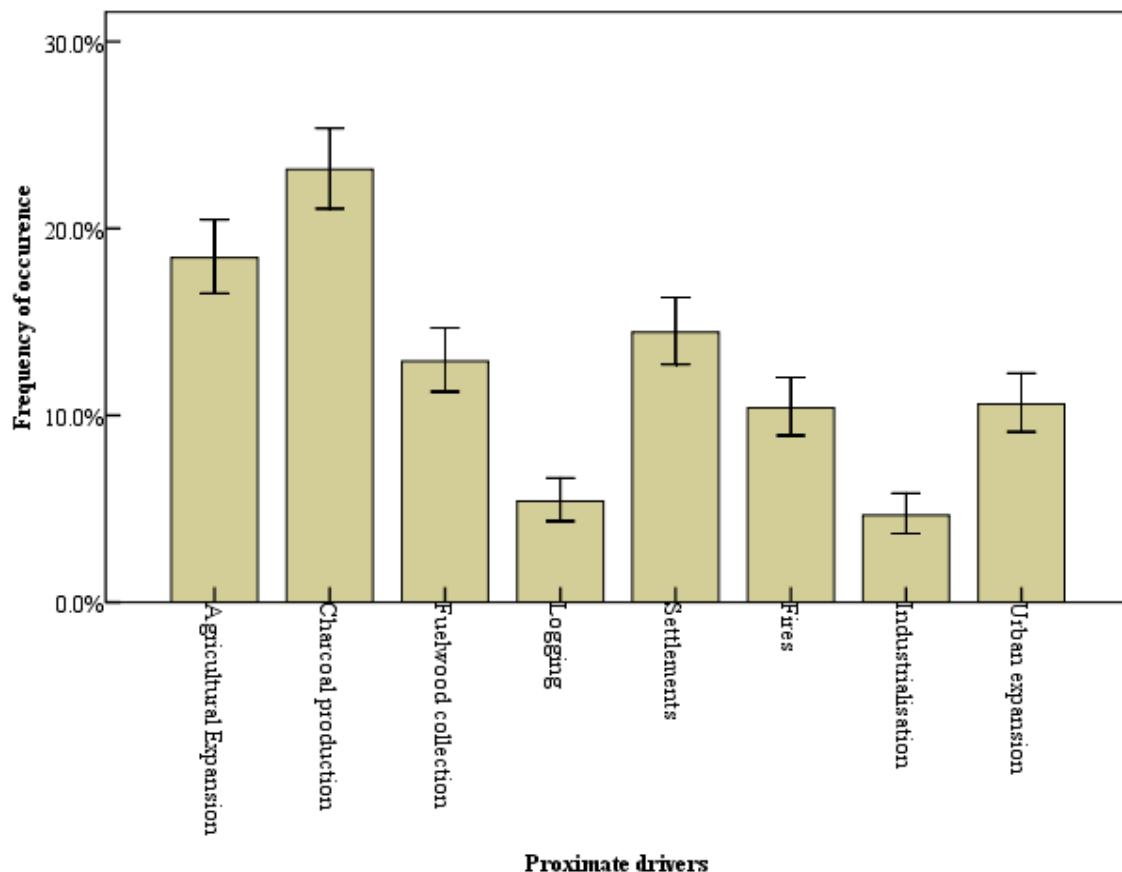


Figure 6: Frequency of occurrence of the specific proximate drivers of deforestation

While the majority of rural dwellers use fuelwood, urban dwellers mostly use charcoal. The per capita annual consumption of fuelwood in Zambia is estimated at 1 025 kg in rural areas and 240 kg in urban areas (Kalumiana, 1996). The contribution of fuelwood to deforestation varies from province to province, with Southern and North-Western provinces being the highest (**Fig. 7**). For Southern Province, tobacco curing is the main indirect driver of fuelwood collection. In North-Western Province, the baking of clay bricks is the key driver of high fuelwood consumption.

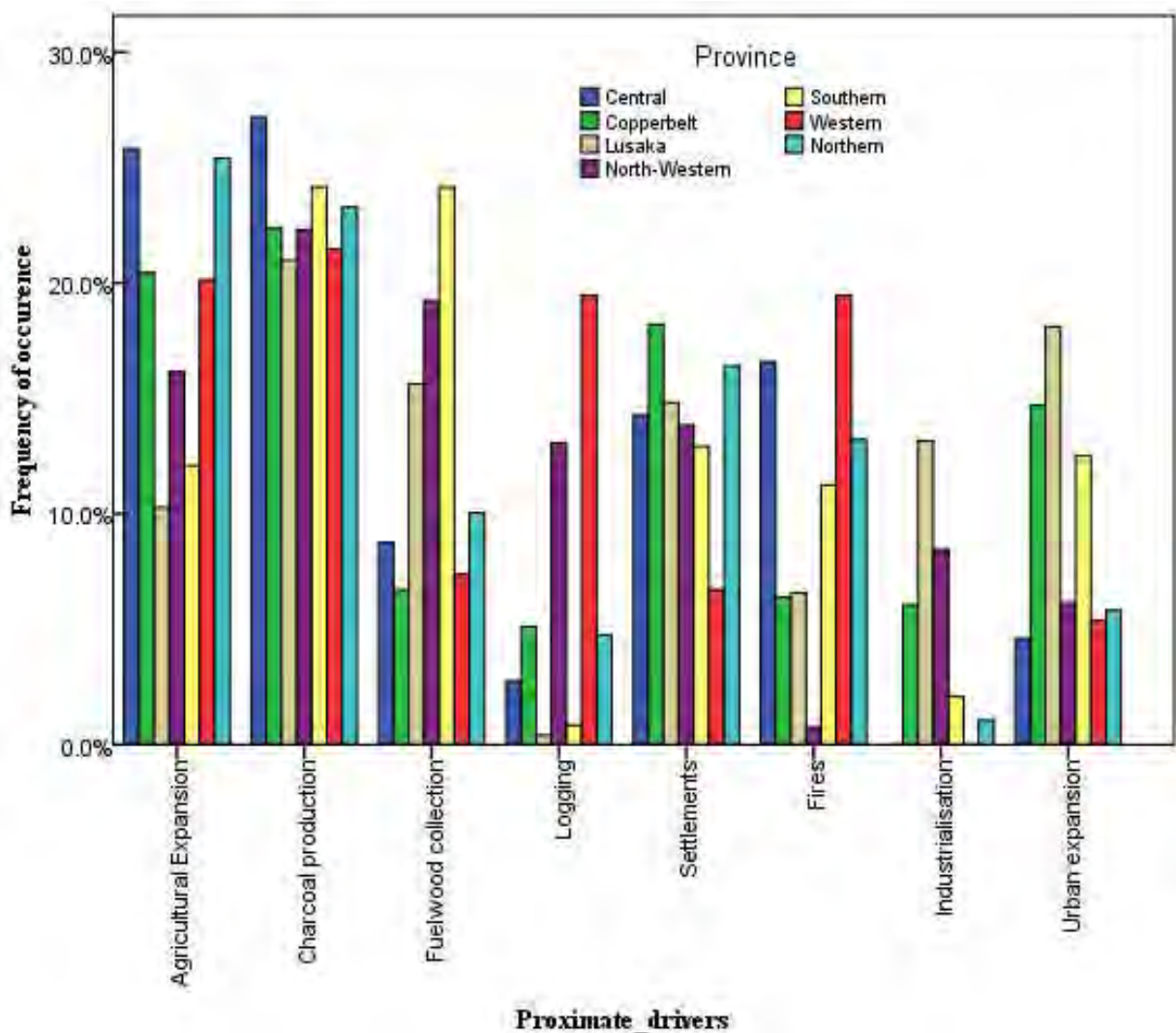


Figure 7: Frequency of occurrence of specific drivers of deforestation by province

Charcoal production is by far the most frequent driver of deforestation in nearly all of the seven provinces sampled for this study (**Fig. 7**). Although Central and Copperbelt



provinces are the main charcoal hotspots in Zambia, there are worrying signs of accelerated charcoal production in North-Western and Western provinces. Generally, the increase in charcoal production is propelled by high energy demand in the country's urban centres. Fuelwood production is estimated to contribute at least 3 percent of the country's GDP, and accounts for approximately 80 percent of the economy's total energy household balance (Kalinda et al., 2008). Charcoal use therefore has socio-economic benefits for numerous actors along the chain, from producers in rural areas to consumers in urban areas (Malimbwi et al., 2010). Production distribution and marketing employs up to 500 000 people (Kalinda et al., 2008). Low domestic earnings are forcing most rural households to intensify this non-agricultural activity, as a risk avoidance strategy. Charcoal production has been observed to have increased per capita income even when other sectors are not doing well in rural areas. For example, the study of the contribution of charcoal to income revealed that although rural per capita income from forestry and crop agriculture declined from US\$37.07 in 1990 to US\$17.33 in 2000, the contribution of charcoal increased from 65 percent to 83 percent over the same period (Chidumayo et al., 2001). The demand for charcoal continues to increase due to rises in urban populations and urban centres (e.g. Lumwana Town in North-Western Province). The proportion of city dwellers is also on the increase. Growing and persistent urban poverty in Zambia (Chiwele and Syampungani, 2011) has resulted in the dominance of charcoal use, since this is assumed to be a cheap energy source. Consequently, urbanization is also an environmental problem in Zambia. It should be emphasized that charcoal production alone does not necessarily lead to permanent loss in vegetation, but when followed by cultivation and late bushfires it may significantly delay forest regeneration (Chidumayo, 1997). A realistic solution to deforestation driven by charcoal demand may lie in promoting synergies between forest and energy policies in Zambia. While appreciating the efforts that have gone into promoting rural electrification and solar energy, the slow pace at which these initiatives are moving ahead gives considerable cause for concern.

3.3.4.3 AGRICULTURAL EXPANSION AND ASSOCIATED IMPACTS

Although the government has been promoting expanded agricultural production, the practice on the ground has been that of extensification rather than intensification. Agriculture has made a significant contribution to loss of forest resources in most



parts of Zambia. Overall, agricultural expansion ranks as the second most frequent driver of deforestation in Zambia (**Fig. 7**). Results from this study revealed that in Central, Copperbelt, Northern and Western provinces, agricultural expansion is the second most frequent driver of deforestation (**Fig. 7**). These findings are hardly surprising, given that the economy of Zambia is agro-based, with the majority of the inhabitants' practising subsistence farming. Agriculture provides the bulk of food and cash requirements for the majority of Zambians (MTENR, 2002). With the growth in population, there is mounting pressure to increase the area under agriculture to meet food requirements, even if this is at the expense of forestry in Zambia. MTENR, (2002) estimates that clearing land for agricultural production may account for some 90 percent of forest cover loss in Zambia. Large-scale agricultural systems and shifting cultivation have been seen to be the major causes of forest cover loss. Slash-and-burn, semi-shifting cultivation practices in areas where population density is high (e.g. Southern and Northern provinces) results in a slow regeneration process, thereby affecting forest cover. Rural-urban migration, coupled with low incomes received from urban employment, also result in increased pressure on forests. Recent political upheavals in Zimbabwe have seen waves of local commercial farmers migrating to Zambia, most of them to Central Province. This development carries with it the risk of reducing forest cover further, as newly settled farmers open up land for crop production.

Internal migration has contributed to deforestation in some areas. For example, movement from Southern Province into Lusaka and Copperbelt provinces, due to land shortage and persistent drought, is causing areas such as Chongwe and Masaiti Districts to be opened up for new settlements. Kalumba (1997) observed deforestation of up to 400 ha and massive encroachment of the lower Zambezi National Park arising from new settlements and immigration into the area.

Although grazing is among the least frequent drivers of deforestation, overgrazing is a common phenomenon in Southern Province and parts of Lusaka, Western and North-Western provinces (**Fig. 7**). Indirect drivers of overgrazing are poor management practices, such as non-rotational grazing, the absence of supplementary feeding systems, lack of control of livestock populations and concentrating grazing pressure in localized pastoral areas. This latter practice has



resulted in overgrazing in most of these areas (MTENR, 2002). Overgrazing is evident in Lusitu, Southern Province, Katete-Kagoro, Eastern Province and Luangwa, Lusaka Province (MTENR, 2002). In the past, the problem of overgrazing has also been observed in areas frequented by wildlife, especially in Luangwa Valley, due to the high density of elephants in the 1970s and hippos along the Luangwa River stretch (Caughley, 1975; Jachmann, 1994). High concentrations of these animals resulted in severe pressure on vegetation, particularly on *Mopane* woodland, with extensive areas left bare. Overgrazed areas are often associated with bare land and gully formations, and sometimes with compacted soils, making it difficult for any regeneration to be sustained.

3.3.4.4 LAND TENURE AND PROPERTY RIGHTS

The relevance of tenure security to forest governance lies in its role in shaping incentives for forest management. History has shown how periods of insecure tenure have led to widespread over-exploitation and destruction of forests. Conversely, tenure security is known to be a necessary condition for sustainable forest management. Strong tenure security, coupled with other enabling conditions (market access, forest value, effectiveness of local institutions), can encourage local forest users to invest in long-term returns from forests, preferring these to immediate pay-offs. When systems of rights are unclear or unenforced, as is the case in Zambia, open-access regimes may result in quick resource degradation and depletion. Most of the land in Zambia is open access, without clearly defined property rights. It is therefore not surprising that the majority of the open areas visited by the study team were found to have been heavily disturbed. There can be little doubt that insecure land tenure systems represent one of the major drivers for deforestation and degradation in Zambia.

3.3.5 INFRASTRUCTURE DEVELOPMENT

Urbanization and industrialization are among the least frequent drivers of deforestation in Zambia (**Fig. 7**). However, notwithstanding the potential socio-economic benefits that come with urbanization and industrialization, these two processes are contributing to forest degradation and deforestation in a number of ways. Firstly, both are linked to land clearance, in order to pave the way for buildings and road infrastructure. The mining sector has greatly contributed to forest cover



loss. Often, huge tracts of land are cleared to provide space for mining infrastructures. At the Kalumbila Mining Concession alone, infrastructure preparations will result in the loss of more than 7 000 ha of land before the concession becomes fully operational. Secondly, infrastructure development is often followed by increased demand for construction timber, already high on both local and international markets. The result is greater pressure on both natural and plantation forest resources.



3.4 CHALLENGES FOR REDUCING DRIVERS OF DEFORESTATION

Reducing deforestation and forest degradation is faced with many daunting challenges which include:

3.4.1 POOR LINKAGE AND COORDINATION WITH OTHER RELEVANT INSTITUTIONS

Forest management efforts are still sectoral, scattered and uncoordinated, with limited institutional enforcement and support. Linkage between the Forest Department and other departments such as those of Energy and Agriculture need to be strengthened to ensure optimal intervention in the management of forest resources such as fuelwood supply and use, as well as the transition from fuelwood to sources of renewable energy.

3.4.2 UNAVAILABILITY OF UPDATED INFORMATION ON THE NATIONAL STATUS OF FORESTS

Existing information on the forests and woodlands of Zambia is outdated and incomplete. The last meaningful nationwide forest inventory was undertaken between 1952 and 1967 (ILUA, 2010). Although ILUA (2005-2008) generated some significant data sets, the methodology used was inadequate, given current demands for sustainable forest management in Zambia. In addition, field surveys at 221 sample plots spread throughout the country, were designed to capture data for global forest inventory reporting. As such, the inventory was not specific to the different forest ecosystems and structures found across the country. A major challenge therefore lies in developing a sound forest database that is of local relevance.

3.4.3 LACK OF COMPLEMENTARITY OF RELEVANT POLICIES AND INSTITUTIONS

Natural resource-based policies are in most cases at variance with each other. In order to overcome forces that degrade forest cover in Zambia, it is important to enhance synergies between the various policies, many of which do not appear to be consistent with norms of sustainable forest resource management.

3.4.4 LACK OF SUPPORTIVE AND INCLUSIVE NATURAL POLICIES

Current policies and legislation are restrictive. The regulatory system that governs the management of forest and other natural resources involves the issuance of permits by government authorities. The local regulatory systems, like the traditional

institutions, do not work closely with the government regulatory system, since this latter is considered superior to the traditional system. The independent nature of these two regulatory systems -- and to some extent, the subtle competition between them -- has resulted in both institutions performing poorly as far as natural resources management is concerned. The challenge would be to make policies supportive of one another, and ensure that they are inclusive when it comes to management of forest resources.

3.4.5 INFRASTRUCTURE DEVELOPMENT AND FOREST CONSERVATION

Increased population, urbanization and high poverty levels, especially those associated with high levels of unemployment, result in over-dependence on traditional biomass fuel and the clearing of surrounding woodlands for agriculture. There is growing pressure on natural resources (including forest resources) to meet human development needs and livelihood demands.

3.4.6 POLITICAL INTERFERENCE

In the past, high levels of political pressure have forced the Zambian government to encourage over-exploitation and conversion of woodlands to other seemingly more profitable land uses, at the expense of the environmental and ecological services that the woodlands offer. There is a compelling need to minimize political pressure on the management of forest resources. The key challenge is to raise awareness among politicians of the role played by forest resources in the national development agenda as a whole.

3.4.7 INSECURE LAND TENURE SYSTEM

Secure tenure is lacking for most of the land under traditional administration. Even local community members who live on such land cannot be sure that they will not be evicted to make way for foreign investors. Land is normally of open access and often associated with the so-called tragedy of the commons – a situation where individuals act independently in their own self interest, often to the detriment of shared resources. Tenure security is an important issue for any carbon sequestration project. Without clear and defensible rights to land, forest or sequestration services, suppliers cannot make a credible commitment to supply carbon offsets. Investors tend to have little confidence in financing carbon projects where local communities do not have secure rights to land on which forestry activities are to take place.



3.4.8 LACK OF BENEFIT-SHARING MECHANISM

Experiences in areas under participatory management of natural resources show that many of the benefits that accrue at community level are usurped by local elites, in such a way that they do not trickle down to ordinary community members. According to Tembo et al. (2009), the poor and less powerful members of the community only attend meetings with their respective Village Action Groups (VAGs), and get fewer benefits from their efforts, compared with more influential community members. Resources and opportunities related to JFM programmes tend to be skewed towards the upper caste and wealthier households, rather than benefiting disadvantaged groups. This may still prove to be a problem when it comes to implementing REDD+ programmes in Zambia.

3.5 OPTIONS AVAILABLE TO EFFECTIVELY REDUCE IMPACTS ON FOREST RESOURCES

Addressing land degradation and deforestation in Zambia presents two complementary strategies for mitigating climate change. Firstly, by reducing or halting degradation and deforestation, greenhouse gas (GHG) emissions associated with land degradation and deforestation can be reduced (Syampungani and Chirwa, 2011). Secondly, changes in land management practices can lead to greater carbon sequestration, thereby removing carbon from the atmosphere. Since carbon loss from woodlands is associated with loss of vegetation cover and soil erosion, management interventions that slow or reverse these processes can simultaneously achieve carbon sequestration (Trumper et al., 2008). There are a number of forest-based conservation strategies and initiatives designed to increase carbon stocks in degraded sites (Syampungani et al., 2010c). They include enhancing soil quality and erosion control, afforestation, woodland regeneration and agroforestry. Forest-based systems, such as agroforestry and conservation of existing carbon pools through the expansion of carbon sinks and avoided deforestation, are known to have significant potential for carbon sequestration (Syampungani and Chirwa, 2011). Agroforestry systems sequester carbon from the atmosphere and store it in both soil and their vegetation components. The amount of carbon sequestered varies from one site to another, and is also dependent on the rotational age of trees.



3.5.1 REGENERATION AND COPPICE ENHANCEMENT MANAGEMENT

Miombo woodland regrowth stands are said to be highly productive ecosystems (Geldenhuys, 2005). This implies that these ecosystems have high rates of photosynthetic processes and therefore a high uptake of carbon dioxide. Given the formidable rates of deforestation and degradation in Zambia, it follows that there are many degraded sites where carbon sequestration could be practised through coppice or regeneration management. This would call for the adaptation of management strategies that protect seedlings and shoots against fires, animal grazing or drought. For example, weeding around seedlings would result in reduced fire hazards, especially if done early. Reduction in stocking may reduce water stress. Increasing stump heights during felling for either charcoal or slash-and-burn agriculture would enhance the survival of stumps and coppicing (Grundy, 1990). Handavu et al., (2011) indicated that adhering to optimum diameter classes, within which species have high coppicing effectiveness during felling for either charcoal production or for slash-and-burn agriculture, can enhance coppicing ability and therefore recovery of woodland.

The time when trees are cut also affects coppicing vigour and production during the initial stage of development. For example, Chidumayo (1993) observed that cutting in July and November results in lower productivity than cutting in October. According to Chidumayo et al., (1996), seasonality and climatic factors, especially temperature, and phenology all appear to affect coppicing vigour and the productivity of sprouts after tree cutting. Cutting in September and October probably results in the most vigorous and productive coppice in the *Zambian miombo* woodland (Chidumayo et al., 1996). Using the above information on the response of the woodland species to cutting, there is scope for improving on existing silvicultural systems, namely i) Coppice with standards and ii) Clear felling to enhance regeneration potential.

3.5.2 AGROFORESTRY, SOIL MANAGEMENT AND CLIMATE CHANGE MITIGATION

Shifting cultivation is a major cause of deforestation and degradation in Zambia. This farming system is the result of extremely low fertility of highly weathered tropical soils (oxisols), which forces farmers to shift to nearby forests. Agroforestry is often considered as an alternative land use strategy that offers solutions to low soil fertility problems. Agroforestry trees have the potential to increase organic matter in soil and store sufficient amounts of carbon (C) woody biomass (Unrush et al., 1993).



Agroforestry helps to maximize soil fertility, thereby increasing crop yields (Akinnifesi et al., 2008). The most common agroforestry technologies for improving crop yields in Southern Africa include: traditional tree-crop and parkland systems such as the *Faidherbia albida*-based system; improved fertilizer tree systems, such as coppicing tree fallows (e.g. *Gliricidia sepium* and *Leucaena* spp.) and improved fallow with short duration species such as *Sesbania* spp., *Tephrosia* spp. These fertilizer tree-based systems have demonstrated their ability to increase crop yields in the *miombo* ecoregion. In Zambia, *Sesbania sesban* fallow was reported to have increased maize yields by 500 percent (Chirwa et al., 2003), while in Malawi, an increase of 415 percent was reported among farmers using *Sesbania sesban* (Haule et al., 2003). Different researchers have attributed the increased yields to a number of factors namely:

- Increased nutrient inputs, including biological N fixation (Kang and Akinnifesi, 2000);
- Increased nutrient availability through enhanced soil biological activity and rates of nutrient turnover (Akinnifesi et al., 2008);
- Improved micro-climate and soil physico-chemical properties (Buresh and Tian, 1997).

These systems have also been reported to reduce insect pests, such as termites, and weed problems (Sileshi and Mafongoya, 2006). The benefits of these soil enriching technologies are not limited to soil replenishment, but extend to the provision of fuelwood and other wood requirements for rural households.

Recent recognition of agroforestry as a GHG mitigation strategy under the Kyoto Protocol has earned it added attention as a strategy for biological carbon sequestration (Nair et al., 2009). Forest-based systems are known to have the largest potential to mitigate climate change through conservation of existing carbon pools and expansion of carbon sinks (e.g. agroforestry). The expansion of carbon sinks through agroforestry provides unique opportunities for mitigating GHG emissions, while addressing other more pressing livelihood concerns of the rural poor. Zambia's degraded land and low biomass land use systems can be converted into agroforestry tree C-rich systems (Syampungani et al., 2010c).



The integration of trees in agroforestry land use has potential to increase soil organic matter (SOM) and store significant amounts of carbon in the woody biomass. Carbon can be sequestered from the atmosphere and stored in soils or vegetation in agroforestry systems. The available literature indicates that smallholder systems have the potential to sequester large quantities of carbon (Montagnini and Nair, 2004). For example, a two-year rotation of non-coppicing agroforestry species in Eastern Zambia was reported to sequester 26-78 Mg ha⁻¹ carbon in the soil, while a four-year rotation sequestered 120 Mg ha⁻¹ (Makumba et al., 2006).

3.5.3 FIRE MANAGEMENT

Four groups of species are observed across the *miombo* ecoregion, based on their degree of tolerance to fire. These are:

Fire-intolerant species: Species that cannot survive fire and therefore occur only where there is complete protection against fires. Examples include *Parinari excelsa*, *Entandophragma delevoiyi* and *Syzygium guineense*

Fire-tender species: Species which decline under regular burning and increase under complete protection. These are predominantly the canopy species such as *Julbernardia paniculata*, *Isobertinia angolensis* and *Brachystegia spiciformis*

Semi-tolerant species: Species such as *Maranthes polyandra*, *Uapaca kirkiana*, *Baphia bequeartii* and *Strychnos pungens*, that are relatively unaffected by early dry-season fires but are reduced under late dry-season fires.

Fire-tolerant species: Species able to survive regular late dry-season fires either as adults, saplings or regrowth. Examples include *Pterocarpus angolensis*, *Parinari curatellifolia* and *Pericopsis angolensis*.

A successful fire management strategy in *miombo* woodland should therefore take into account the age of the woodland, the phenology of the dominant and desired species, the type of land use and the management objective of the area. However, some of the general fire management practices in the *miombo* woodland are as follows:

- Piling all the discarded wood away from stumps and patches of dense sapling and then burnt;



- Protection of young regrowth stands against late dry-season fires by early-season burning;
- Grazing to maintain low grass levels while maximizing woody production;
- Planned and management use of fires for clearing fields.

3.5.4 ALTERNATIVE ENERGY SOURCES AND IMPROVED CHARCOAL USE AND PRODUCTION METHODS

Fuelwood is the primary energy source for the majority of Zambians, for both domestic use and processing (curing tobacco, drying fish). The high levels of fuelwood used in Zambia point to the need to replan and manage the country's energy sector. Bioenergy presents an alternative modern, and more efficient use of biomass energy. It involves converting the sugary and starchy part of a given plant, or the oil in fruit, into liquid. Zambia has various types of bioenergy material (plant materials, twigs, leaf litter, agricultural residues and dung) that may be exploited for bioenergy production. This may call for strengthening the linkage between the Forestry Department and other government offices, such as the Department of Energy, so as ensure optimal intervention in the supply, management and use of fuelwood in the transition to renewable energy sources.

Reducing the impact of charcoal production and consumption on woodland cover would also require the use of improved stoves such as *Jiko* and *Rocket* models. These stoves have high combustion and heat transfer efficiency. They can be purchased at low and affordable prices. There is also a need to improve charcoal production methods. Currently, the efficiency of traditional earth kiln methods is very low, at up to just 25 percent (Chaposa, 2002). Other methods such as Casamance and the Retort kiln, offer production efficiency rates of 35 percent (Seidal, 2008). However, using these kilns for charcoal production involves overcoming a number of challenges:

- i) The sophisticated skills needed to construct them present obstacles for the rural poor.
- ii) High initial capital investment, ranging from US\$300-400 (Falcão, 2008).

Overcoming these challenges requires supportive and coherent policies and institutional structures. There is a need to have programmes in place that provide assistance to rural communities, so that they can acquire the skills needed to build and manage such kilns.



3.5.5 ALTERNATIVE LIVELIHOOD SYSTEMS

Poverty forces the majority of Zambians into indiscriminate exploitation of most woodland resources. Reducing the impact of rural communities on woodlands therefore requires developing other livelihood strategies that will be less damaging. Woodlands play an important role in the livelihoods of many people by providing a range of non-timber forest products (NTFPs) for subsistence consumption and trade. The growing international trade in NTFPs, including medicinal plants, has increased demand (FAO, 2005). Although there are many NTFPs with scope for poverty alleviation, medicinal plants, honey and beeswax are believed to offer the greatest potential.

Medicinal plants: Increased urbanization and the inadequacy of conventional medicinal facilities have resulted in growing demand for traditional healing methods. This has in turn led to a rise in demand for medicinal plants. Trade in medicinal products can greatly enhance the economic well-being of communities at local, national and international levels. For example, FAO (2000) estimated an annual trade in medicinal plants of about US\$4.4 million for Zambia. At regional level, the market in raw materials for medicinal or therapeutic plants and products is estimated at US\$150 million. Trade in medicinal plants therefore offers an alternative livelihood strategy, with potential for poverty alleviation among the country's rural communities.

Honey and beeswax trade: Honey and beeswax are the main products harvested from the honey bee, *Apis mellifera*; other products include pollen and brood comb. Among woodland countries, Zambia is a leading exporter of honey. In 2005 the country exported 219 tonnes of honey, valued at US\$491,000 (ITC, 2006). Demand for honey has increased by 30 percent over the past few years (Chidumayo & Gumbo, 2010). Trade in honey and beeswax is therefore a real possibility for resource-poor rural communities, and can have a significant impact on poverty alleviation.

3.5.6 IMPROVING STAFFING LEVELS AND COLLABORATION WITH LOCAL COMMUNITY MEMBERS

If the Forestry Department is to monitor and manage forest resources effectively, steps must be taken to improve staffing levels. There is also a need for the department to motivate its employees through training and improved office



infrastructure and equipment. Forest Stations should be provided with reliable transport for patrols and other forest management programmes.

The Forestry Department also needs to improve collaboration with local community members. It is important that transparency prevails between the department and local communities for the implementation of forest-related programmes. Clear benefit-sharing mechanisms need to be set up between the government and local communities. These mechanisms should clearly stipulate the distribution of benefits between community members to avoid the problem of members of the elite taking more than their fair share.

3.6 POTENTIAL FOR REDD+ IN ZAMBIA

There is much potential for REDD+ in Zambia. ILUA (2010) reports that the country still has close to 50 million ha of forested land, which offers considerable potential to increase carbon stocks if properly managed (**Table 7**).

Table 7: Estimates of main forest types

Forest type	Total area (ha)
Evergreen forest	819
Semi-evergreen forests	34 145
Deciduous forests	14 865
Other Natural forests	139
Broad-leaved forest plantations	0
Coniferous forest plantations	0
Total	49 968

Source: ILUA (2010)

The availability of huge expanses of forested land raises the possibility of Zambia's effective participation in the REDD+ mechanism. Deforestation that is not accompanied by infrastructure development presents another path through which the country could benefit from REDD+, through management of regeneration and degraded lands.



3.6.1 WOODLAND RECOVERY, PRODUCTIVITY AND POTENTIAL FOR REDD+ PROJECTS

The Southern African woodland savannas are capable of almost total recovery from clearing for either charcoal production or slash-and-burn agriculture (Fanshawe, 1971). Several studies have reported rapid development of regrowth in many parts of the Southern African savannas (Syampungani & Chirwa, 2011). The regrowth stands have been reported to be of higher stocking levels than mature woodlands (Syampungani, 2008: Table 6). Additionally, higher values of stand basal areas of between 30 and 50 m² ha⁻¹ have been recorded in the wet *miombo* and dry *miombo* of Zambia and Zimbabwe respectively, in small-sized plots (Grundy, 1995; Chidumayo, 1985) compared with up to just 22 m² in old even stands (**Table 8**). The recovery of woodland savannah after clearing is possible because most woodland species have both vertical and extensive root systems, that facilitate recuperation after cutting (Mistry, 2000).

Table 8: Biomass related parameters of Southern Africa woodlands

Range of variables		Land use type	Authors
Density (stems/ha)	1 121-6 685	Regrowth (<i>miombo</i>)	Syampungani et al., 2010a; Campbell et al., 1995; Strang, 1974
	2 434-2 773	Uneven aged mature woodland (<i>miombo</i>)	Syampungani, 2008
	837-1 131	Uneven aged mature woodland (Kalahari)	Timberlake et al., 2010
	7 264-9 700	Regrowth (Kalahari)	Timberlake et al., 2010
Basal area (m²)	7-22	Uneven aged mature woodland	Lowore <i>et al.</i> , 1994; Freson <i>et al.</i> , 1994
	30-50	Regrowth	Grundy, 1995
Mean biomass (Mg ha⁻¹)	21.8-81.03	Uneven aged mature woodland	Chidumayo, 1991
	22-44.47	Uneven aged mature woodland	Guy, 1981; Martin, 1974
Growth rate (Mean annual ring width, mm)	4.4-5.6	Regrowth	Syampungani, et al., 2010b
	2.3-4.8	Uneven aged mature woodland	Shackleton, 2002; Rathogwa, 1999; Chidumayo, 1988

Adopted from Chirwa *et al.* (in prep)



Growth rates have also been observed to be high (4.4-5.6 mm) in regrowth stands, compared with 2.3-4.8 mm in uneven aged stands. The regrowth stands are said to be part of highly productive ecosystems. These highly productive ecosystems tend to have high rates of photosynthetic processes and hence a high uptake of carbon dioxide. It therefore follows that even with high levels of deforestation in Zambia, degraded sites may still be managed for carbon sequestration through coppice or regeneration management. Data on primary production and soil carbon availability specific to *miombo* woodland indicate that 900-1 600 gm⁻² yr⁻¹ is sequestered (Frost, 1996). In principle, if *miombo* woodland is to be managed for maximizing carbon storage, a similar amount of carbon could be sequestered and stored over the same area.

3.6.1.1 CARBON STOCK LEVELS

Zambian forests hold a considerable amount (90 percent) of the country's total above-ground biomass (**Table 9**). This makes up a total of approximately 4.7 billion metric tonnes. Below-ground biomass is estimated at 932 million tonnes, while deadwood accounts for an additional 434 million metric tonnes of biomass (ILUA, 2005-2008). In terms of carbon storage, these figures would translate into a total of 2.8 billion tonnes of carbon stored in trees. Carbon storage varies widely from one vegetation/land use type to another, depending on the extent of the tree cover. For example, the ILUA 2005-2008 report indicated that the bulk of carbon, 1.9 billion tonnes (69 percent), is found within semi-green forest types, dominated by *miombo* woodland.

Table 9: Total above-ground biomass and biomass density in the major land use classes in Zambia

Land Use class	Above-ground Biomass (tonnes/ha)	Density	Total Biomass (million tonnes)	% of total above-ground biomass
Forest	83.8		4 185	89.8
Other wooded land	29.7		180	3.9
Other Land	18.5		292	6.3
Inland water	0.2		.79	0.0
Total	61.9		4 658	100

Source: ILUA 2005-2008 report



Changes in land cover have a significant influence on the biomass stock of any vegetation type. Land use type, together with vegetation type, has an impact on the amount of biomass stock of a particular region, and hence the carbon stock levels. For example, Luapula Province, when compared with North-Western Province, experienced a higher rate of change in both biomass and carbon stocks between 1965 and 2005 (**Table 10**). This may be attributed to the fact wood extraction, especially for fish drying, was higher in Luapula Province than in North-Western Province, where the demand for fuelwood is low due to less economic activity in that period.

Table 10: Estimated historical biomass and carbon stock changes from 1965-2005 in Zambia

Province	Biomass stocks (million tonnes)		Annual biomass change (1965-2005)		Carbon stocks (million tonnes)		Annual change in carbon stocks	
	1965	2005	Million tonnes	%	1965	2005	Million tonnes	%
Central	450.56	266.59	4.6	1.02	211.76	125.3	2.16	1.02
Copperbelt	149.54	89.14	1.51	1.01	70.28	41.89	0.71	1.01
Eastern	274.57	181.16	2.34	0.85	129.05	85.14	1.1	0.85
Luapula	215.99	1.58	5.36	2.48	101.52	0.74	2.52	2.48
Northern	486.58	283.91	5.07	1.04	228.69	133.44	2.38	1.04
North- Western	868.8	481.62	9.68	1.11	408.34	226.36	4.55	1.11
Southern	279.42	256.56	0.57	0.2	131.33	120.59	0.27	0.2
Western	339.58	249.55	2.25	0.01	159.6	117.29	1.06	0.01
Zambia	3065.04	1810.11	31.38	1.02	1440.57	850.75	14.75	1.02

Source: Chidumayo, 2012

3.6.2 MECHANISMS OF CARBON STORAGE AND LOSS IN WOODLANDS

Land use change and degradation are important sources of GHGs. Land degradation leads to increased carbon emissions in two ways: i) through loss of biomass due to vegetation destruction and ii) increased soil erosion.



Zambian woodlands, like many other vegetation formations, take up CO₂ from the atmosphere by the process of photosynthesis and incorporate it into plant biomass. Although plant biomass per unit area of the Zambian vegetation may be low (6 Kg/m²), as in many dryland ecosystems, the country's large surface area of vegetation gives the potential for carbon sequestration an international significance. Deforestation, through conversion to farmland, slash-and-burn agriculture, charcoal production, bushfires and wood harvesting, are modifying and transforming Zambian woodlands into a degraded landscape (Chilufya and Tengäs, 1996). Conversion of land into other uses leads to soil erosion, continuous loss of nutrients and degradation of woodlands. In terms of carbon content, a comparative study between agricultural fields and natural woodlands in Malawi indicated that degraded sites contain 40 percent less carbon than natural woodlands (Walker and Desanker, 2004). This implies that the degraded sites are far from being saturated with carbon, and their potential to sequester carbon could therefore be high. That is because in addition to erosion, the conversion of forests influences soil properties, such as the chemical composition of organic matter and its matrix capacity to act as storage for carbon (FAO, 2004; Lal, 2004).

3.7 METHODOLOGIES AND TOOLS FOR ESTIMATING DEFORESTATION TRENDS

Remote sensing remains an essential tool for establishing baselines and monitoring progress in reducing emissions from deforestation. However, in many developing countries, capacity will need to be strengthened considerably if such methodologies are to be used (Böttcher *et al.*, 2009). The assessment of emissions from deforestation and degradation requires data on both change in forest cover and estimates of carbon stock changes associated with transition between land use types.

A number of new and innovative technologies have recently approached operational feasibility. These include light detection and ranging (LiDAR) (Defries *et al.*, 2007). LiDAR techniques involve large amounts of data. The IPCC compiled methods and good practice guidance (IPCC, 2003) to move from two-dimensional (forest area) to three-dimensional (carbon stock) evaluation changes. IPCC suggests



the use of remote sensing technologies only to assess forest area changes, while there are no indications for the use for direct biomass estimates (Böttcher *et al.*, 2009). Usually, this methodology should be consistent at repeated intervals, and results need verification with ground-based or very high resolution remote observations.

The existing technologies and their associated costs for acquisition and analysis are listed in **Table 11** (Böttcher *et al.*, 2009). Though remote sensing-related methodologies have been identified as key technologies for successfully implementing and monitoring the REDD mechanism (Herold and John, 2007), they are expensive and beyond the reach of most developing countries. Remote sensing assessments of deforestation and degradation involve the cost of obtaining suitable satellite data, processing hardware and software, training and capacity building, to name but a few.

Zambia may continue to rely on ground-based national forest inventories as the main tool for monitoring deforestation and degradation. Recognizing the availability of cheap reliable remote sensing tools, we recommend that Zambia combine both ground inventories and some remote sensing. In terms of sustainability, traditional national inventories would provide data of the growing stock, timber volume per unit area, by tree diameter or age classes and species composition. In order to implement remote sensing technologies for estimating deforestation and forest degradation, Zambia, like any other developing country, will face capacity building costs which may include costs for establishing research capacity, technological transfer and legal support. However, if commitment is made, we feel that the country has enough human capacity to manage a well functioning remote sensing unit.



Table 11: Present acquisition and analysis costs* of monitoring of various technologies in US\$

Satellite Sensor	Resolution and coverage or project area	Cost for data acquisition (US\$/km ²)	Cost for analysis (US\$/km ²)	Total monitoring costs (US\$/km ²)
Optical, medium resolution sensors				
Landsat-5, TM	30 m, 180x180 km	0.02-free	Classification 0.12-0.31 Change detection 0.4-0.6	0.50-1.21
SPOT 4	20 m	0.31		
Terra ASTER	15 m, 60x60 km	0.02		
CBERS-2, HRCCD	20 m	Free in Brazil		
DMC	32 m, 160x 660 km	0.04		
IRS-P6-LISS III	23.5 m	0.07	Human resources and equipment 0.5	0.57
Optical, high resolution sensors				
Quickbird	3 m	25	Classification 2.2-2.5 Change detection 4.7-7.9	7.50-35.40
Ikonos	4 m	25		
RapidEye	5 m	2.8		
SPOT-5, HRVIR	5-20 m, 60x60 km	0.6		
Optical, very high resolution sensors				
Quickbird	0.6 m	16-22	Classification 100-125	116-272
WorldView-1	0.5 m	16-22	Change detection 160-250	116-272
Radar, SAR				
ALOS PALSAR	10-15 m	0.04	Classification 2.2-2.5	6.94-10.44
Satellite or Shuttle		0.14	Change detection 4.7-7.9	7.04-10.54
Airborne SAR		345		>345
LiDAR				
UK, forest monitoring, national average	28 000 km ²			415
US, forest inventory at project level	40 km ²			455
US, project area	180 km ²			388
Indonesia, forest inventory at project level	136 km ²	400-550	169 hours processing time	>400-550
Ground-based inventories and national/project examples				
US, project example	180 km ² , 1 000 sample plots			167
UK, ground survey	28 000 km ²			172
Bolivia, Noel Kempff	6 340km ² , 625 sample plots	17-0.16		55
Costa Rica, Private forestry project monitoring	570 km ²			100
Indian National Forest Inventory and additional biomass assessment	677 088 km ² ; ca. 7 000 NFI plots + 1 400 additional plots			<10
National Forest Monitoring and Assessment	Total forest monitoring costs of five examples (Zambia, Honduras, Nicaragua, Bangladesh, Cameroon)			1.2-8.2
Indonesia, Ulu Masen Project	7 500 km ²			81
RS monitoring and management				200
Airborne monitoring (ultra light aircraft)				

Source: Böttcher *et al.*, 2009

4.0 CONCLUSIONS AND RECOMMENDATIONS

Evidence from this preliminary study suggests that deforestation is on the rise and may continue to be so for many years to come. The key deforestation hotspots still lie along the main rail link. However, an upward trend can be seen in most parts of rural Zambia. The drivers of deforestation in Zambia are numerous and at any one site, the main ones are closely interlinked. These drivers vary from province to province. The top four leading drivers of deforestation are charcoal production, agricultural expansion, fuelwood collection and settlements. The major indirect drivers of deforestation are low institutional capacity, declining economic gains, high poverty levels and environmental factors. The interaction between these drivers is complex. Addressing these factors requires an integrated approach, ranging from improved livelihood systems to an enhanced supportive policy framework. Improving rural livelihood systems would greatly contribute to rural poverty alleviation, thereby reducing over-dependence on forest resources by rural communities. The study has also shown that most Zambian woodland has high recovery potential once disturbances cease. This high recovery potential is indicative of the carbon sequestration potential for these woodlands.

Although the original objective of this work was to carry out a nationwide survey, the time and resources available did not permit such a wide-ranging study to be undertaken. For this reason, the results of the present study must be interpreted with some caution. In general terms, it was not easy to reach major conclusions regarding the drivers of deforestation and the potential for REDD+, based on 21 towns in a space of five weeks. We believe that more detailed and longer-term studies, focusing on all the major vegetation types, would be required to answer pertinent questions such as: i) What are the biomass stocks of the major vegetation types of Zambia, and how are they changing? ii) How does primary production vary across the major vegetation types in Zambia? iii) What are drivers of land use change across the major vegetation types, and how do they influence biomass accumulation over time? The above recommendations are intended to provide a stronger scientific database on biomass accumulation and carbon sequestration for the major vegetation types found in the country.



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GLOSSARY

- Afforestation:** Conversion from other land uses into forest, or the increase of the canopy cover to above the 10 percent threshold.
- Deforestation:** The conversion of forest to another land use *or* the long-term reduction of tree canopy cover below the 10 percent threshold.
- Forest degradation:** Reduction of the canopy cover or stocking within a forest (provided that the canopy cover stays above 10 percent).
- Forests:** Lands of more than 0.5 ha, with a tree canopy cover of more than 10 percent, which are not primarily under agricultural or urban land use.
- Industrialization:** The process of social and economic change that transforms a human group from an agrarian society into an industrial one (closely related with technological innovation, particularly with the development of large-scale energy and metallurgy production).
- Reforestation:** Re-establishment of forest formations after a temporary condition with less than 10 percent canopy cover due to human-induced or natural perturbations.
- Urban expansion:** The spreading outwards of a city and its suburbs to its outskirts to low-density and auto-dependent development on rural land.
- Urbanization:** Process by which there is an increase in proportion of a population living in places classified as urban (the movement from a rural to urban area).



APPENDIX I: Terms of reference

TERMS OF AGREEMENT

1. Introduction

In accordance with the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation (UN-REDD+) in Zambia work plan, the programme invited eligible consultants to undertake the following consultancy:

‘Preliminary Study on Drivers of Deforestation and Forest Degradation and Potential for REDD+ in Zambia’

The School of Natural Sciences of the Copperbelt University accordingly applied and was awarded the consultancy.

2.0 BACKGROUND

The Inter-governmental Panel on Climate Change (IPCC) report indicated that about 20 percent of GHG emissions was as a result of land use changes, mainly deforestation and forest degradation. Consequently, the REDD+ mechanism was conceived and entered international climate change negotiations. Zambia is among the first nine pilot countries of the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD Programme) (<http://www.un-redd.org/>). The UN-REDD programme for Zambia is a United Nations support to Government, civil society and community level stakeholders to assist with the preparation for the REDD+ mechanism in the country. It fits within the framework of the Environment and Natural Resource Management and Mainstreaming Programme (ENRMMP), ensuring that the country, in view of the post-Kyoto protocol climate change regime, is ready for the REDD+ initiative. It is expected that REDD+ will be an internationally

agreed and recognized climate change mitigation instrument in the post-Kyoto context.

The UN-REDD programme for Zambia intends “to prepare Zambian institutions and stakeholders for effective nationwide implementation of the REDD+ mechanism”, and was allocated a budget of US\$4.5 million for a period of 3 years (2011-2013). It will be implemented by the Government of Zambia, with support from the three U.N. agencies that are part of the partnership (namely FAO, UNDP and UNEP), and with intense stakeholder engagement.

REDD+ is an international initiative aimed at enhancing the value of standing forests and offering incentives for sustainable forest management through a multi-stakeholder approach. During the REDD+ readiness process (UN-REDD Programme), in order to benefit from the initiative, Zambia will have to undertake the following actions:

- Develop a National Strategy or Action Plan to reduce deforestation;
- Develop a national forest reference emission level and/or forest reference level (interim measure, sub-national);
- Develop a robust and transparent national forest monitoring system for the monitoring and reporting of REDD + activities (interim measure, sub-national);
- Establish a system for providing information on how safeguards for local community and forest biodiversity are being addressed and respected throughout the implementation of REDD+ activities, while respecting sovereignty.

The readiness process for Zambia involves the development of a national strategy to reduce deforestation and forest degradation.

The Zambian National Joint Programme Document goals, objectives and outcomes are outlined below:

Programme Goal: To prepare Zambian institutions and stakeholders for effective nationwide implementation of the REDD+ mechanism.

Programme Objectives:

- a. Build institutional and stakeholder capacity to implement REDD+



- b. Develop an enabling policy environment for REDD+
- c. Develop REDD+ benefit-sharing model
- d. Develop Monitoring, Reporting and Verification (MRV) systems for REDD+.

Joint Programme Outcomes:

Outcome 1: Capacity to manage REDD+ Readiness strengthened

Outcome 2: Broad-based stakeholder support for REDD+ established

Outcome 3: National governance framework and institutional capacities for the implementation of REDD+ strengthened

Outcome 4: National REDD+ strategies identified

Outcome 5: MRV capacity to implement REDD+ strengthened

Outcome 6: Assessment of Reference Emission Level (REL) and Reference Level (RL) undertaken.

2.1 Context

The objective of this particular study is:

- To provide a preliminary understanding regarding drivers of deforestation and the potential for REDD+ in Zambia;
- To assess to what extent our current consumption, production and development patterns affect deforestation levels, as well as assessing the potential impact of future shifts in these patterns;
- To draw conclusions as to which actions/trends would probably have the most serious consequences in terms of additional deforestation, analyse how these could be reduced in future and to outline the potential for REDD+ in these circumstances.



2.2 TASKS AND SCOPE OF THE STUDY

Scope of work

- a) This study will mainly involve desk research, interviews with key informants and field visits in order to identify the key drivers of deforestation in Zambia;
- b) The scope of the assignment is to better understand the linkages between different deforestation drivers, and their significance, taking into account past and current trends in economic and environmental policy. The study will further estimate the general effects of changes in drivers (with various scenarios to be defined) for deforestation levels and assess challenges for reducing deforestation in order to contribute to mitigating climate change and preserve biodiversity;
- c) In recognizing the drivers and trends in deforestation and forest degradation, the study will outline the potential for REDD+ in Zambia, taking into account various options/scenarios;
- d) The study will undertake an in-depth review of existing and promising new methodologies and tools to generate scientifically sound estimates of historical rates or levels of deforestation in Zambia;
- e) The consultant will collate and critically review case studies, articles, guidelines, manuals and other documents describing methodologies for assessing historical rates of deforestation and will compare and contrast different methodologies. Aspects to be considered include the following:
 - i. Soundness of approach;
 - ii. Advantages and disadvantages (strengths and weaknesses);
 - iii. Feasibility (replicability, possibility of scaling up/down, skills and equipment needs, suitability for different forest types/conditions.)
 - iv. Cost effectiveness;
 - v. Applicability to developing countries.
- f) Present findings to a working group for comments before the stakeholders' workshop as a validation process.



Specific Tasks

- i. Carry out desk research on deforestation drivers in Zambia, using various reports and assessments;
- ii. Identify deforestation hotspots in Zambia and their causes, conduct interviews with a wide range of stakeholders, including government, civil society, and traditional leadership;
- iii. Document current and historical trends of deforestation and forest degradation in different forest types, under different forest management categories and approaches;
- iv. Identify the different drivers of deforestation and their linkages, using past and present scenarios/trends, assessing the effects of such changes on these drivers;
- v. Identify the challenges of reducing the identified drivers of deforestation and the options available to effectively reduce their impacts on forest resources;
- vi. Outline the potential for REDD+ in Zambia, giving carbon stock levels in the identified scenarios, based on current and potential carbon markets.

MAIN OUTPUTS

- i. Inception report
- ii. Final Report outlining drivers of deforestation
- iii. Maps of the most threatened forests (Maps of deforestation hotspots in Zambia and their causes).

