The Opportunity Costs of REDD+ in Zambia

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

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FINAL REPORT

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"Cornerstone In Integrated Consulting"

EXECUTIVE SUMMARY

INTRODUCTION

Preserving forests entails foregoing the benefits that would have been generated by alternative deforesting and forest degrading land uses (for example agriculture, charcoal burning, etc).

The difference between the benefits provided by the forest and those that would have been provided by the alternative land use is the opportunity cost of avoiding deforestation and forest degradation. Foregoing the economic benefits that come with deforestation and forest degradation will only make sense to policy makers and the general population if alternatives that are advanced under REDD+ offer sufficient sustainable benefits.

Thus, the economic context of REDD+ was assessed as part of a series of studies aimed at informing the development of the national REDD+ strategy for Zambia. During these various studies, the opportunity cost of REDD+ was assessed by looking at different predominant land use alternatives in Zambia. The framework for the assessment included desktop studies and a socio-economic survey in the Sesheke, Kapiri Mposhi, Isoka, Nakonde and Kapombo districts, thereby sampling each of Zambia's agro-ecological regions.

This publication focuses specifically on the REDD+ opportunity cost assessment undertaken during a broader technical study that focuses on the overall economic context of REDD+ in Zambia

BACKGROUND

The UN-REDD programme (FAO, UNEP and UNDP) in Zambia has been supporting government, civil society and community level stakeholders in preparation for REDD+. During the REDD+ readiness process, Zambia will have to undertake the following to benefit from the initiative:

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

Executing the above processes involves undertaking various studies to develop an in-depth understanding on the whole range of political, economic, social, technological, environmental, legal and administrative factors that underpin REDD+ implementation.

Central to all processes is due consideration of Zambia's aspiration to attain desirable social economic and environmental indicators, which include inter alia, increasing income levels, addressing better balance of payments, ensuring equitable distribution of benefits, reducing poverty levels, and attracting investment.

Achieving these socio-economic goals may require substantial exploitation of the country's natural assets (renewable and non-renewable). Thus examination and understanding of positive and negative factors that influence the relationship between the socio-economic and the natural environment goals is crucial.

STUDY METHODOLOGY

A systematic review methodology was used to identify published and unpublished studies that are relevant to assess the opportunity cost of REDD+. This framework included using desktop study, interviews with key informants (i.e. various stakeholders), and interviews with households across Zambia.

Both top-down and bottom-up approaches were considered for analyzing REDD+ opportunity costs in Zambia, and the bottom-up approach was selected as it is more widely used in emerging REDD+ countries.

Then, a five-step approach was followed to eventually calculate the Net Present Value (NPV) of land, and the following opportunity costs of REDD+ in Zambia (OppC), which were calculated using the following two equations, respectively:

$$NPV = \sum_{t=0}^{T} \frac{TR_t - TC_t}{(1+r)^T} \qquad OppC_{NF} = \left[\frac{NPV_{NF} - NPV_{LU}}{C_{LU} - C_{NF}} \right]$$

To collect data necessary for calculating REDD+ opportunity costs, five different socio-economic questionnaires were carried out among diverse stakeholders. These included the Smallholder Farmers' Questionnaire, the Households' Questionnaire, the Traditional Leaders' Questionnaire, the Charcoal Burners' Questionnaire, the Community Based Organisations' Questionnaire, and the District Government Officers' Questionnaire.

The questionnaires were also carried out in the Sesheke, Kapiri Mposhi, Isoka, Nakonde and Kapombo districts, thereby sampling each of Zambia's agro-ecological regions for demographic balance.

OPPORTUNITY COSTS FOR REDD+ IMPLEMENTATION

A comparison of findings from Zambia with selected neighbouring countries reveals that the estimated opportunity cost of alternative land uses for REDD+ are generally low, besides conversion of forest land for commercial agriculture purposes.

In Zambia, the opportunity cost of avoiding conversion of a hectare of a high dense forest to commercial agricultural use (soybean) is US$80.8/$tCO_2$ while that of small-scale agriculture (maize) is US$2.4/$tCO_2$. The opportunity costs for conversion due to low and high intensity charcoal use are US$0.5/$tCO_2$ and US$1.3/$tCO_2$ respectively. Apart from commercial agriculture whose opportunity costs are high, expansion of small scale agriculture and unsustainable charcoal production are relatively low.

Comparatively, the average opportunity cost estimate for the Africa region is US$2.22/$tCO_2$ eq. In a study of 29 opportunity cost estimates, Boucher (2008) established that most of the values were relatively low, the mean standing at US$2.51/$tCO_2$ eq. Notably, 18 of the 29 estimates were less than US$2/$tCO_2$ eq. while the overall range was from less than zero to US$13.34/$tCO_2$ eq. Of all the 29 case studies, only one was above US$10/$tCO_2$ eq.

ALTERNATIVE LIVELIHOOD OPTIONS UNDER REDD+

The study also identified alternative livelihoods which could be incentivised by REDD+ revenues and lessen the opportunity cost of REDD+ in Zambia. They include the following: Sustainable Conservation Oriented Enterprises (SCOEs) like bee keeping, diversified agriculture activities (fish farming, gardening, poultry farming, and dairy farming), and retail business and conservation farming.

Suggestions for the success of alternative livelihood options included the following:

- Increasing the provision of fertilizer to small scale farmers;
- Provision of credit facilities to small scale farmers;
- Reducing electricity tariffs in rural areas; and
- Subsidising the price of solar energy equipment.

Suggestions for alternative sources of energy also included rural electrification (49.0% of respondents), solar energy (28.6%), gas (8.2%), firewood (4.1%), bio fuel (4.1%), charcoal (2.0%), cow dung (2.0%), and kerosene (2.0%).

CONCLUDING NOTE

There is strong evidence to support the conclusion that REDD+ implementation is feasible in Zambia from its opportunity costs.

In more detail, the opportunity costs of implementation in regions with small-scale agriculture and charcoal production as the main drivers of deforestation are low, and therefore potentially ideal sites for the piloting of REDD+ projects in Zambia. For example, the cost of avoiding conversion of a hectare of natural forest to small-scale agriculture is US$2.4/$tCO_2$, high intensity charcoal use is US$1.3/$tCO_2$ and low intensity charcoal use is US$0.5/$tCO_2$.

In this report, recommendations for a way forward include undertaking additional work to produce national opportunity costs for REDD+, investigating further the economic benefits of forests and finally, further exploring the potential benefits of alternative livelihood options.

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LIST OF ABBREVIATIONS

ASB	Alternatives to Slash and Burn
BoZ	Bank of Zambia
CBA	Cost Benefit Analysis
CBO	Community Based Organisation
CSO	Central Statistical Office
FAO	Food and Agriculture Organisation of the United Nations
FD	Forestry Department
FRA	Food Reserve Agency
GDP	Gross Domestic Product
GRZ	Government of the Republic of Zambia
ICT	Information and Communication Technology
ILUA	Integrated Land Use Assessment
LCMS	Living Conditions Monitoring Survey
LU	Land Use
MTENR	Ministry of Tourism, Environmental and Natural Resources
MT	Metric Tonne
ND	No Date
NF	Natural Forest
NHCC	Heritage Conservation Commission
NPV	Net Present Value
oppC	Opportunity coststCO$_2$ Total carbon dioxide
REDD+	Reducing Emissions from Deforestation and forest Degradation, as well as conservation and enhancement of carbon stocks in forests and sustainable forest management in developing countries
SCOE	Sustainable Conservation-Oriented Enterprise
SPSS	Statistical Package for the Social Sciences
SWOT	Strengths, Weaknesses, Opportunities and Threats
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNFCC	United Nations Framework Convention on Climate Change
UN-REDD	United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation
WBI	World Bank Institute
ZAMMOD	Zambian Macroeconomic Model
ZDHS	Zambia Demographic and Health Survey

1. INTRODUCTION

1.1 General Overview

The Reducing Emissions from Deforestation and forest Degradation, as well as conservation and enhancement of carbon stocks in forests and sustainable forest management (REDD+) mechanism has gained international prominence as part of the climate change mitigation strategy within the parameters of the United Nations Framework Convention on Climate Change (UNFCCC).

As part of preparations for REDD+, the Government of the Republic of Zambia (GRZ) has been executing a national FAO/UNEP/UNDP supported REDD+ readiness programme[1]. It is expected that participating in the REDD+ readiness process will contribute to a well-designed national REDD+ strategy and framework, which will have positive effects on biodiversity, ecosystem conservation and the livelihoods of forest-dependent communities (Kokwe 2010) and subsequently the attainment of the country's sustainable development goals.

1.2 Purpose of the Study and Scope

The overall economic goal of GRZ is to create wealth and improve human wellbeing as espoused in the country's Vision 2030 and National Development Plans. At the centre of its plans is the attainment of desirable social, economic and environmental indicators and movement to middle income status by 2030 (GRZ, 2009; GRZ 2011).

Increasing income levels, addressing better balance of payments, ensuring equitable distribution of benefits, reducing poverty levels and attracting investment will require substantial exploitation of the country's natural assets (renewable and non-renewable). Therefore, it is crucial at this stage of the REDD+ process to examine and understand those positive and negative factors that influence the socio-economic-natural environment relationship and the prospects and pressures presented.

The reduction of emissions from deforestation and forest degradation will also require investments in alternative livelihood options. Foregoing the economic benefits that come with deforestation and forest degradation will only make sense to policy makers and the general population if alternatives that are advanced under REDD+ offer sustainable benefits.

Against this background, this report aims to inform policy formulation and national REDD+ strategy development by determining REDD+ opportunity costs within Zambia's socio-economic context. This is based on the understanding that while a number of REDD+ interventions are universal, their applicability and sustainability are to a large extent determined by the local policy and socio-economic contexts.

To help determine REDD+ opportunity costs, this report focuses on the (developing) interface between socio-economic aspects, the natural environment and the resultant environmental changes. The specific focus is on those socio-economic drivers influencing changes to natural assets and ecosystems and consequently on the Zambian population.

1.3 Organisation of the Study Report

The report is structured according to specific sections starting with this first section, which has provided a general overview of the study. Section two describes the methodological approaches that were used to gather economic data including the estimation of actual opportunity costs for REDD+ in Zambia. Section three covers the study's findings. Conclusions and recommendations are presented in section four and five respectively.

1 FAO/UNDP/UNEP. 2008. Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD). UN-REDD Programme Secretariat. www.un-redd.org

For the purposes of this report, the term "*environment*" includes three facets: firstly the natural environment (made up of natural and other physical resources), secondly the ecosystems and their constituent parts, including people and communities, and thirdly the social and economic aspects within which the first and second facets operate. "*Environmental change*" in this report is defined as alterations that manifest in the natural environment i.e. change in the status of natural assets, ecosystems and the socio-economic status the population.

2. METHODOLOGY

2.1 Desktop Study

A systematic review methodology was used to identify published and unpublished studies that are relevant to the economic context of REDD+. While the primary focus of the literature review was on studies that have been undertaken in Zambia, relevant reports from other countries were equally reviewed for the purposes of broadening the understanding of how socio-economic factors affect the natural environment and REDD+ implementation in other countries. This was for the purposes of gathering key lessons on methodological approaches from other countries which have undergone or are currently engaged in the REDD+ processes.

2.2 Socio-economic Survey

Key Informant Interviews

Government Departments: Data was collected from eighteen informants from five departments, namely Department of Forestry (5), District Administrative Office (3), District Agriculture Department (6), District Council (3), and Department of Lands (1).

Smallholder Farmers: Data was collected from 37 smallholder farmers in five districts of Zambia, namely Kabompo (12), Kapiri Mposhi (8), Sesheke (1), Isoka (8), and Nakonde (5). Three questionnaires missed the data on the districts of informants. Twenty-seven (27) were males while eight (8) were females. Two omitted to state their gender.

Charcoal Burners: Data was collected from twenty two (22) households in four districts of Zambia involved in charcoal burning or trading, namely Kabompo (5), Kapiri Mposhi (6), Isoka (5), and Nakonde (5). All the informants were individual sole traders. Fifteen (15) of the informants were charcoal burners or primary producers while the remaining seven were charcoal dealers or buyers. Seventeen (17) of the informants were males while five (5) of them were females.

Traditional Leaders: Data was collected from nineteen traditional leaders in the five districts of Zambia, namely Kabompo (6), Kapiri Mposhi (4), Sesheke (1), Isoka (5), and Nakonde (3). One informant was a chief and eighteen informants were village heads.

Community Based Organisations (CBOs) in the environmental sector: Data was collected from 18 CBOs in the five districts of Zambia, namely Kabompo (7), Kapiri Mposhi (5), Isoka (3), and Nakonde (1). Two questionnaires missed the data on the districts for two informants. Ten informants were males while six were females. Two omitted to state their gender. The oldest CBO was established in 1987, two were established in 2003, two in 2004, two in 2008, one in 2010, four in 2011, and one in 2012. Three did not state their year of establishment.

Timber Producers: Only one timber producer was interviewed in Sesheke. This was due to the non-cooperation of other timber producers, and the situation was compounded by the suspension of timber production licences during the course of data collection.

Household Interviews

Data was collected form 220 households in five districts of Zambia, namely Kabompo (58), Kapiri Mposhi (60), Sesheke (27), Isoka (35), and Nakonde (33). In terms of district representation, there were 7 questionnaires with missing data. 65% (136) of the informants were male while 35% (73) were female. 79% of the informants were married, 13% were single, 0.9% were divorced, 1.4% were separated, 4.7% were widows, and 0.9% were widowers. Eight informants did not state their marital status. The table below gives a general overview about respondents.

Table 1: Distribution of Informants by District

	Number of Respondents	%	Valid %	%
Kabompo	58	26.4	27.2	27.2
Kapiri Mposhi	60	27.3	28.2	55.4
Sesheke	27	12.3	12.7	68.1
Isoka	35	15.9	16.4	84.5
Nakonde	33	15.0	15.5	100.0
Total	213	96.8	100.0	
Not stated	7	3.2		
Total	220	100.0		

The number of persons in the households ranged from one to twenty, with an average of seven persons.

2.3 Estimation of Opportunity Costs

2.3.1 International Approaches to Estimating Opportunity Costs for REDD+

The predominant international approaches for estimating opportunity costs for REDD+ are top-down and bottom-up approaches. Top-down approaches, which are also known as global models, include global empirical and global simulation models.

Top – down approach
Global Simulation Model

Primarily, global simulation models are based on dynamic economic models[2]. Proponents for and practitioners of this approach utilise aggregate economic variables to ascertain the REDD+ economic potential. The forces of supply and demand are also factored into the analysis.

Global Empirical Model Approach (Per Area Approach)

Global-empirical models use local estimates, which are then aggregated to global per-area costs of reducing deforestation (Boucher cited in Wertz-Kanounniko, 2008). The conversion of the global area-based costs ($/ha) to emission-based costs ($/$tCO_2$ eq) tend to be based on uniform values of carbon density (ton/ha), obtaining a single, global estimate of opportunity costs ($/$tCO_2$ eq) (ibid,).

Strengths of Top-down Approaches

According to WBI (2011), the strengths of global models include**:**

- Explicit assumptions about future conditions shaping timber models (e.g., population pressure); and
- Explicit consideration of REDD+ policy effects on timber prices.

2 See The World Bank Institute (2011, Version 1.3), Estimating the Opportunity Costs of REDD+: A training Manual, p.1- 24

Weakness of Top-down Approaches

The weaknesses of global models for estimating the opportunity costs for REDD include (WBI, 2011):

- Use of aggregated average carbon stock estimates at national level. There is no differentiation of carbon stocks at regional/sub-national level and yet other regions may have higher carbon stocks than others;
- Estimates of forest extent in each region based on imprecise data;
- Simplistic modeling of land use change (e.g., one type of forest to one type of agriculture);
- Only timber production considered to determine forest value; and
- Lack of regionally specific data.

Bottom–up approach

The bottom-up approach is also referred to as the regional-empirical model. Its applicability is more suited to a local level. The bottom-up approach is a preferable option at the country level because determination of opportunity costs is based on actual country specific data, which take into account the local economic conditions and carbon stocks and land use change patterns. The local-empirical approach is thus based on detailed studies within a particular area.

Swallow, et al. (2007)[3] present sub-national opportunity cost curves for Alternatives to Slash and Burn (ASB) sites in Indonesia, Peru and Cameroon. Such studies generate detailed cost curves based on detailed field research thus requiring fewer assumptions than global models. Nevertheless, bottom-up approaches do not necessarily take into account global feedback relationships that would change prices (e.g., food and timber), and thus costs as a REDD+ system develops (Boucher, 2008b)[4].

Weakness

The disadvantage is that the area studied is often quite small. When the results from these studies are generalised to a larger area or transferred to other areas, which might have different physical and location factors, accuracy is lost. For this reason, global-empirical estimates such as those prepared for the Stern Review, and which draw on the results of local studies, can only be approximate (Bond et al. 2009, p. 18). In addition, very few of these studies address the cost of avoiding forest degradation.

Strengths

These studies have the advantage that they take into account location-specific factors that affect the returns to different land uses, such as proximity to markets, soil fertility, climate etc., and differences in carbon density. This means that their accuracy for the area studied is high (Bond et al. 2009, p.18).

Concluding Methodological Note

Even though various theoretical frameworks for estimating opportunity costs for REDD+ exist at international level, there are many complexities that are associated with their practical application. These include consensus building on methodological points and the challenges associated with generating the required data for estimation purposes.

Due to complexities and the wide variations in opportunity cost estimates that global models give, the bottom-up approach is more commonly used in many emerging REDD+ countries.

3 Ibid 2
4 Ibid

2.3.2 Approach for Estimating the Opportunity Costs of REDD+ in Zambia

Predominantly based on the UN-REDD Programme report for Vietnam (2011), these steps were followed for estimating the opportunity costs for REDD+ in Zambia:

Step 1: Identification, Classification and Description of Major Land Uses in Zambia

This involved identification of current land uses based on historical trends. After identifying current land uses, future trends in land uses were predicted. The Drivers of Deforestation and Forest Degradation consultancy team led this process.

Step 2: Land Use Characterisation and Land Use Change Analysis (Development of Alternative Land Use Scenarios)

Step 2 was also led by the Drivers of Deforestation and forest Degradation consultancy team. Essentially, land use characterization and land change analysis was done using remote sensing data and extensive ground-truthing in the selected project sites.

Step 3: Calculation of time-averaged Carbon Stocks for each of the Land Uses

Analysis of carbon stocks for each land use was based on existing data sources from relevant documents.

Step 4: Calculation of the Private and Social Profitability of Land Uses in terms of Net Present Value (NPV)

The Net Present Value (NPV) for each land use was then calculated. The NPV takes into account the time-value of money. Since waiting for profits is less desirable than obtaining profits now, the "value" of future profits is discounted by a specific percentage rate.

Step 5: Estimating Actual Opportunity Costs (Computations)

This step integrated all the information generated from the previous steps. Opportunity costs for REDD+ give a money-based figure calculated as $\$/CO_2e$.

2.4 Data Procession and Analysis Plan

2.4.1 Desktop Study

Summarising the Evidence

The findings from the studies were summarised using the following criteria:

1. Socio-economic parameters in the country of implementation;
2. International approaches used;
3. Pros and cons for each of the approaches used;
4. Steps followed in estimating opportunity costs; and
5. Applicability in the Zambian context.

Interpretation of Findings

The summary of evidence fed into the final interpretation of findings from international studies on estimating opportunity costs for REDD+.

2.4.2 Socio-economic Survey

Five questionnaires were used to collect data. These were the Smallholder Farmers' Questionnaire, the Households' Questionnaire, the Traditional Leaders' Questionnaire, the Charcoal Burners' Questionnaire, the Community Based Organisations' Questionnaire, and the District Government Officers' Questionnaire.

Data was coded and entered initially into Microsoft Excel and then later transferred into the Statistical Package for the Social Sciences (SPSS) version 16. Quantitative data was analysed using SPSS to run various statistics such as frequencies, averages, and minimum and maximum values.

Responses from open-ended questions were also entered into Microsoft Excel, standardised into emerging themes, and then later transferred into SPSS and analysed separately. Each questionnaire was treated as a separate dataset. Further, some of the charts were transferred from SPSS to Excel to make it easy to edit for reporting purposes.

2.4.3 Opportunity Cost Analysis

A bottom-up approach was adopted and this involved a review of data on actual land use changes based on historic trends. Each of the selected land uses was then subjected to Cost Benefit Analysis (CBA). After CBAs, the data including carbon stock estimates were used to do the actual computations of opportunity costs. The economic data, which was obtained from the survey, was adjusted based on expert input on productivity estimates.

For the purposes of estimations, 10% was used as a discount rate, as in nearly all the REDD+ projects this is the rate used. In addition, the inflation rate (7%) was factored in. Therefore, the cash flows for each land use were discounted by applying 10% as a discount rate and 7% as the average inflation rate in Zambia[5].

The Net Present Value (*NPV*) for each land use type was derived using the following formula:

$$NPV = \sum_{t=0}^{T} \frac{TR_t - TC_t}{(1+r)^T}$$

Where,

NPV = The net present value for each land use type, expressed in US$ ha,

TR_t = Total revenue, expressed in US$ ha,

TC_t = Total cost, expressed in US$ ha,

T = The total time (30 years) horizon for NPV analysis management cycle, and

r = The discount rate (10% was used).

After calculating NPVs for each land use type, the results were used as input data into the opportunity cost formula.

5 Zambia's inflation rate has averaged 7% (BoZ, 2011, 2012; CSO, 2010, 2011). The 10% discount rate has been adopted as the social rate, which has been widely used under the World Bank studies (World Bank Institute, 2011).

Formula for Opportunity Cost Analysis of REDD+ (Engineering, Bottom-up Approach)

Where:

$$OppC_{NF} = \left[\frac{NPV_{NF} - NPV_{LU}}{C_{LU} - C_{NF}} \right]$$

$OppC_{NF}$ = The opportunity cost of avoiding the conversion of one ha of natural forest to an alternative Land Use (Driver of Deforestation and Forest Degradation), expressed in US$/t$CO_2$;

NPV_{NF} = Discounted cash flow from a natural forest, expressed in US$/ha;

NPV_{LU} = Discounted cash flow of an alternative land use (Driver of Deforestation and Forest Degradation), expressed in US$/ha;

C_{LU} = The mean carbon stock value (aboveground and belowground) of a particular alternative land use (driver of deforestation and forest degradation), expressed in tCO_2/ha;

C_{NF} = The mean carbon stock value (aboveground and belowground) of a natural forest, expressed in tCO_2/ha

The carbon stocks (biomass and soil) for land uses that were considered for opportunity cost analysis range from 25 tC/ha to 80 tC/ha, depending on the alternative activities considered (See Section 3 for more details). As detailed in the table below, the carbon stocks for natural forest use is 80 tC/ha, low intensity charcoal use and high intensity charcoal use have 50 tC/ha and 30 tC/ha respectively. Under expansion of commercial agriculture (soybean) and small scale agriculture (shifting cultivation) the carbon stock is the same at 25 tC/ha.

Table 2: Carbon Stocks for Land Uses

Land Uses	Details	Carbon stock (Biomass and soil) tC/ha
Natural forest use	High dense forest >80% forest cover	80
Low intensity charcoal use	Medium dense forest; 20-80% forest cover	50
High intensity charcoal use	Low dense forest; 10-20% forest cover	30
Commercial agriculture (Soybean)	Commercial agriculture	25
Small scale agriculture (Maize/Charcoal)	Small scale agriculture and charcoal in year one	25

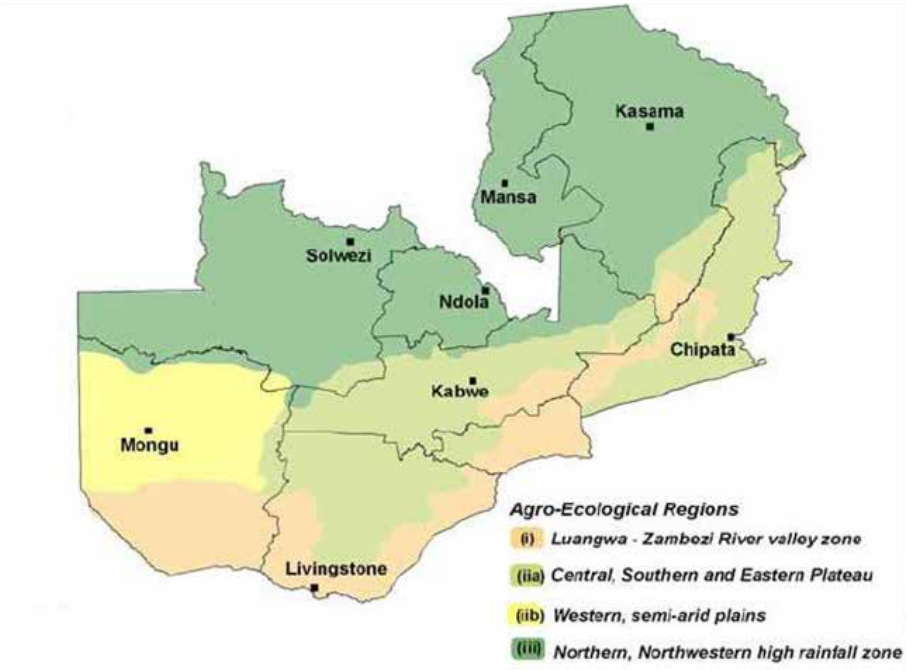
Source: Socio-economic Survey of this Study

2.5 Selection of Study Sites in Agro-ecological Regions

Selection of study sites was based on Zambia's agro-ecological zones (see figure below) as follows:

- Sesheke District: located in zone 1 (Luangwa – Zambezi River Valley Zone) and zone 2b (Western, Semi-arid Plains);
- Kapiri Mposhi District: located in zone 2b (Central, Southern and Eastern Plateau); and
- Isoka, Nakonde and Kabompo Districts: all located in zone 3 (Northern, North-western high rainfall zone).

Figure 1: Zambia's Agro-ecological Regions

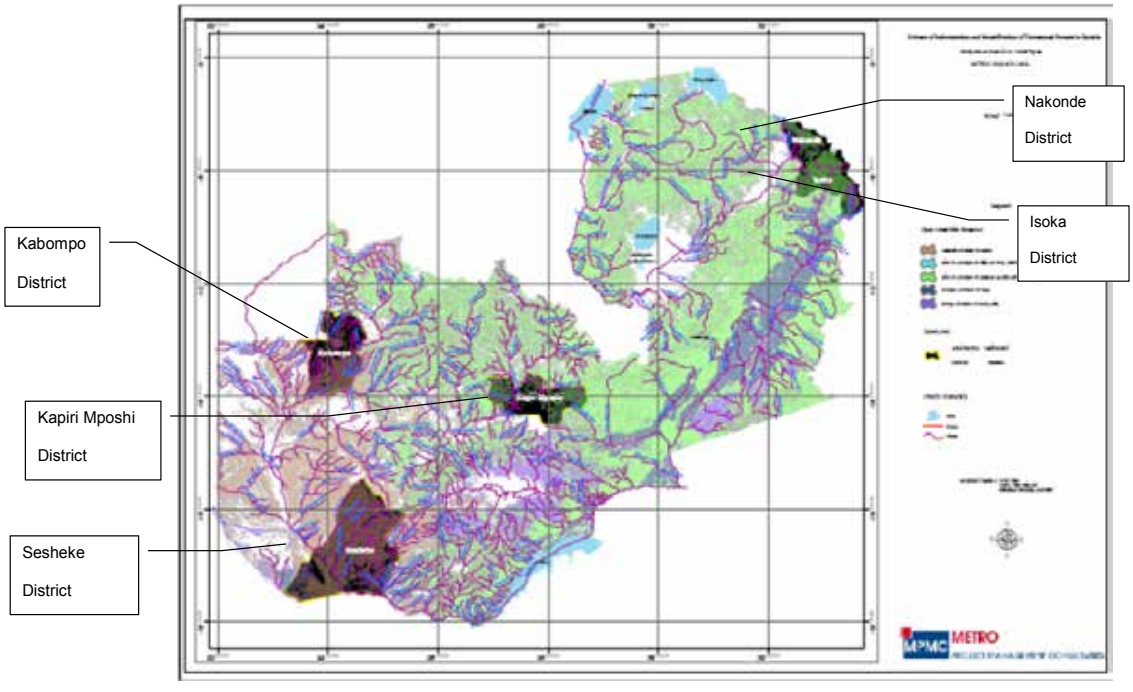


Source: FAO, 2010

The rationale for picking Sesheke was based on the literature review-based evidence that timber extraction is high in the Western Region of Zambia. Kapiri Mposhi, Isoka and Nakonde districts were selected for the purpose of sampling households that are engaged in shifting cultivation. Kabompo District was picked in North-western Province to sample households that are in the high rainfall zone.

The map below shows the geographic location of study districts.

Figure 2: Selected Study Areas



Source: *Chomba, B.M., Tembo, O., Mutandi, K., and Makano, A.,* (2012)

3. FINDINGS OF THE STUDY

3.1 District Level Socio-economic Conditions

3.1.1 Sesheke District

Generally, there is insufficient literature on the current socio-economic conditions of individual districts in Zambia. Therefore, the following socio-economic data is entirely based on the 2010 reports of the Central Statistical Office (CSO). Predominantly, the available data is at provincial level. In this context, the primary findings at district level will be compared to provincial level data by way of looking at the population of each district and the extent to which each district contributes to respective provincial economies.

Sesheke District is in the Western Province of Zambia. The population of the province as a whole is 881,524, of which 94,612 (10.7%) represents the population for Sesheke District and this makes Sesheke the fifth highest populous district in the province (2010 Census Report, CSO).

The unemployment rate in Western Province is 8% for both males and females (LCMS, CSO, 2010). Of the people who are employed, 90.6% are in the informal sector and of those in the informal sector 83% are in agriculture.

According to the Central Statistical Office (Living Conditions Monitoring Survey, 2010), Western Province as a whole has 205,000 households, of which 167,000 are agricultural, representing 81.3% of all households. Of the 167,000 agricultural households, 87.9% grow maize of all types, while 76.8% grow local maize only and 12.1% grow hybrid maize only. All households put together produced 100,000 Metric tonnes in 2010. The percentage change over time in quantity produced from 2006 to 2010 was -0.1%.

Apart from maize the province produces cassava (flour), millet (threshed), sorghum and rice (paddy). The table below shows the type of crops and quantities produced by agricultural household in 2010.

Table 3: Percentage of Agricultural Households Producing Cassava, Millet, Sorghum and Rice in Western Province

Cassava (flour)		Millet (threshed)		Sorghum		Rice (paddy)	
Percentage growing crop	Production 90 kg bags (000s)	Percentage growing crop	Production 90 kg bags (000s)	Percentage growing crop	Production 90 kg bags (000s)	Percentage growing crop	Production 90 kg bags (000s)
43.6	284	3.5	20	2.5	6	16.6	130

Data Source: CSO

For mixed beans, soya beans, sweet potatoes, Irish potatoes and groundnuts produced in 2010, details are in the following table.

Table 4: Percentage and Quantities of Other Crops Produced in Western Province

Crops		Percentage and Units
Mixed beans	Percentage growing crop	1.3
	Production 90 kg bags (000s)	6
Soya beans	Percentage growing crop	-
	Production 90 kg bags (000s)	-
Sweet potatoes	Percentage growing crop	5.2
	Production 25 kg bags (000s)	102
Irish potatoes	Percentage growing crop	-
	Production 10 kg bags (000s)	-
Groundnuts (shelled)	Percentage growing crop	6.6
	Production 00 kg bags (000s)	49

Data Source: CSO

As for livestock ownership, official data shows that out of the 167,000 agricultural households in the province, 40,000 own livestock, of which 87.1% is a percentage owning cattle, 12.4% owning goats, 14.4% owning pigs, and there is no data for sheep ownership (CSO, LCMS, 2010)

3.1.2 Kapiri Mposhi District

Kapiri Mposhi District is strategically located along the busiest line of rail in Central Province. The population of the Central Province is 1,267,803, of which 19% is the share of the population for Kapiri Mposhi, and this makes the district the second highest populous in the province (CSO, 2010 Census Report).

Generally, the unemployment rate in Central Province is 10.5% for both males and females (LCMS, CSO, 2010). Of the people who are employed, 83.9% are in the informal sector and of those who are in the informal sector, 80.1% are in agriculture.

Central province has a total of 250,000 households, of which 185,000 are agricultural representing 74.1% of all households in the province. Of the 185,000 agricultural households, 92.8% grew all types of maize in 2010 while 47.1% grew local maize and 55.8% grew hybrid maize only. The total production of maize was 411,000 metric tonnes, which represents a 0.4% percentage change over time (2006 to 2010) in quantity produced (ibid).

In addition to maize, agricultural households also produce cassava (flour), millet (threshed), sorghum and rice (paddy). The table below shows the type of crops and quantities produced by agricultural households in 2010.

Table 5: Percentage of Agricultural Households Producing Cassava, Millet, Sorghum and Rice in Central Province

Cassava (flour)		Millet (threshed)		Sorghum		Rice (paddy)	
Percentage growing crop	Production 90 kg bags (000s)	Percentage growing crop	Production 90 kg bags (000s)	Percentage growing crop	Production 90 kg bags (000s)	Percentage growing crop	Production 90 kg bags (000s)
11.4	132	5.2	27	1.0	8	0.4	1

Data Source: CSO

For mixed beans, soya beans, sweet potatoes, Irish potatoes and groundnuts produced in 2010, details are in the following table.

Crops		Percentage and Units
Mixed beans	Percentage growing crop	11.4
	Production 90 kg bags (000s)	49
Soya beans	Percentage growing crop	5.5
	Production 90 kg bags (000s)	106
Sweet potatoes	Percentage growing crop	22.3
	Production 25 kg bags (000s)	1, 300
Irish potatoes	Percentage growing crop	2.0
	Production 10 kg bags (000s)	75
Groundnuts (shelled)	Percentage growing crop	28.7
	Production 00 kg bags (000s)	332

Table 6: percentage and Quantities of Other Crops Produced in Central Province
Data Source: CSO

In the area of livestock ownership, official data shows that out of the 185,000 agricultural households in the province, 79,000 own livestock, of which 61.2% own cattle, 70.3% own goats, 9% own pigs and 2% own sheep.

3.1.3 Isoka and Nakonde Districts

Isoka and Nakonde districts were taken as one study site due to their proximity and in consideration of their forests that are continuous between them.

For the purpose of this study and for statistical expediency, the secondary data that is relied upon is for the Northern Province, notwithstanding the fact that these two districts are now part of the relatively newly created province, Muchinga. Further, the new province was created after the CSO census and LCMS of 2010 were already published.

The Northern Province has a population of 1,759, 600, of which 9.3% is the population share of Isoka District, which is the fourth highest in the province. Nakonde District has a population share of 6.7% and this makes it the eighth highest in the province.

The unemployment rate in the province is 4.9% for both males and females. Of the people who are employed, 93% are in the informal sector and of those who are in the informal sector, 88.5% are in agriculture (CSO, LCMS, 2010).

Northern Province has 318,000 households, of which 274,000 were agricultural representing 86.4% of all households in the province (ibid). Of the 274,000 agricultural households, 65.2% grew all types of maize between 2006 and 2010, while 41.4% grew local maize and 26.3% grew hybrid maize only (ibid). The total production of maize was 269,000 metric tonnes, which represents a percentage change over time (2006 to 2010) in quantity produced of 36.0%.

Details for the production of cassava (flour), millet (threshed), sorghum and rice (paddy) are presented in the table below.

Table 7: percentage of Agricultural Households Producing Cassava, Millet, Sorghum and Rice in Northern Province

Cassava (flour)		Millet (threshed)		Sorghum		Rice (paddy)	
Percentage growing crop	Production 90 kg bags (000s)	Percentage growing crop	Production 90 kg bags (000s)	Percentage growing crop	Production 90 kg bags (000s)	Percentage growing crop	Production 90 kg bags (000s)
62.4	1, 517	29.8	223	2.4	30	7.2	170

Data Source: CSO

For mixed beans, soya beans, sweet potatoes, Irish potatoes and groundnuts produced in 2010, details are in the following table.

Crops		Percentage and Units
Mixed beans	Percentage growing crop	37.3
	Production 90 kg bags (000s)	260
Soya beans	Percentage growing crop	3.3
	Production 90 kg bags (000s)	17
Sweet potatoes	Percentage growing crop	27.3
	Production 25 kg bags (000s)	1, 584
Irish potatoes	Percentage growing crop	0.9
	Production 10 kg bags (000s)	74
Groundnuts (shelled)	Percentage growing crop	41.9
	Production 00 kg bags (000s)	292

Table 8: Percentage and Quantities of Other Crops Produced in Northern Province
Data Source: CSO

As far as livestock ownership is concerned, official data shows that out of the 274,000 agricultural households in the province, 75,000 own livestock, of which 22% own cattle, 70.3% own goats, 28.7% own pigs, 2.4% own sheep.

3.1.4 Kabompo District

According to the 2010 Census (CSO, 2010), the population of North-Western Province is 706,462, of which the population share of Kabompo District is at 12.9%, and this makes the district the third most populous in the province.

The unemployment rate in North-Western Province is 9.2% for both males and females. Of the people who are employed, 86.1% are in the informal sector and of those who are employed in the informal sector, 87.8% are in agriculture (CSO, LCMS, 2010).

North Western Province has 138,000 households of which 106,000 were agricultural, representing 77.2% of all households (ibid). Of the 106, 000 agricultural households, 87.3% grew all types of maize in 2010 while 69.4% grew local maize and 21.1% grew hybrid maize only (ibid). The total production of maize was 100,000 Metric tonnes, which represents a percentage change over time (2006 to 2010) in quantity produced of 3.2%.

The table below shows the type of crops and quantities produced by agricultural household in 2010.

Table 9: Percentage of Agricultural Households Producing Cassava, Millet, Sorghum and Rice in North Western Province

Cassava (flour)		Millet (threshed)		Sorghum		Rice (paddy)	
Percentage growing crop	Production 90 kg bags (000s)	Percentage growing crop	Production 90 kg bags (000s)	Percentage growing crop	Production 90 kg bags (000s)	Percentage growing crop	Production 90 kg bags (000s)
41.5	239	1.2	2	3.3	21		

Data Source: CSO

For mixed beans, soya beans, sweet potatoes, Irish potatoes and groundnuts produced in 2010, details are in the following table.

Table 10: Percentage and Quantities of Other Crops Produced in North Western Province

Crops		Percentage and Units
Mixed beans	Percentage growing crop	23.0
	Production 90 kg bags (000s)	55
Soya beans	Percentage growing crop	0.7
	Production 90 kg bags (000s)	2
Sweet potatoes	Percentage growing crop	20.7
	Production 25 kg bags (000s)	503
Irish potatoes	Percentage growing crop	7.2
	Production 10 kg bags (000s)	415
Groundnuts (shelled)	Percentage growing crop	11.7
	Production 00 kg bags (000s)	42

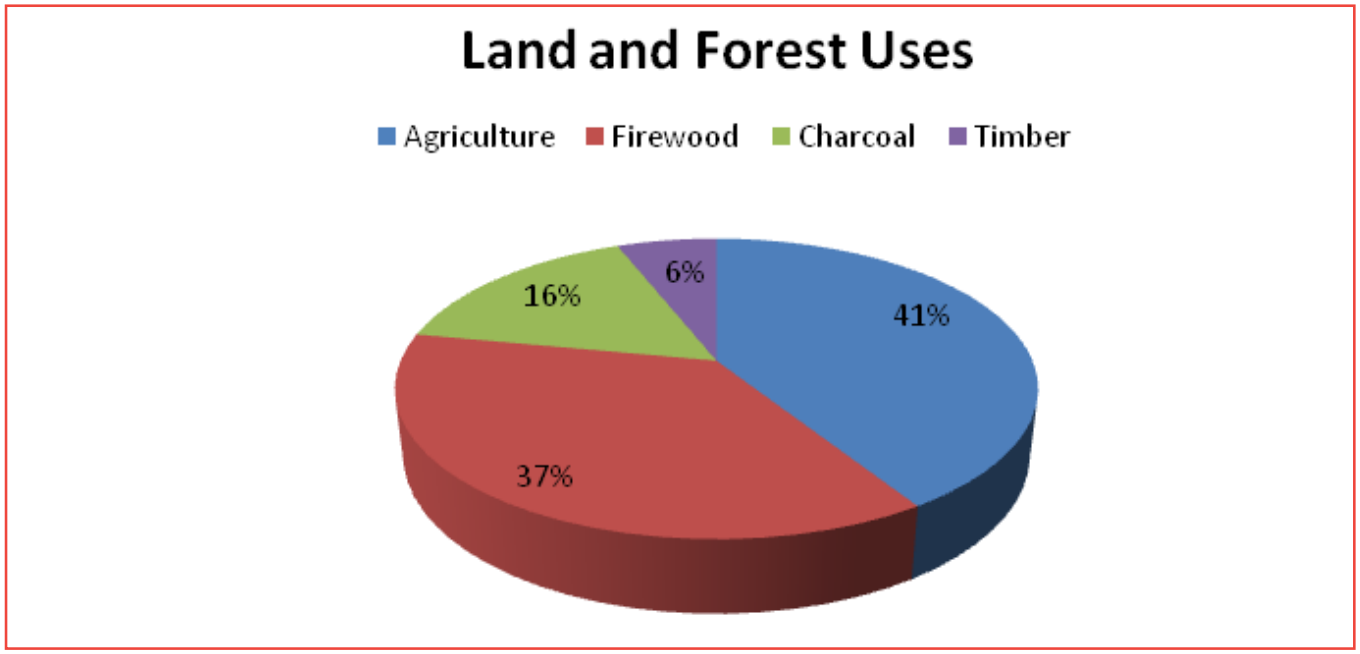
Data Source: CSO

As for livestock ownership, official data shows that out of the 106,000 agricultural households in the province, 28,000 own livestock, of which 18.8% is a percentage owning cattle, 85.7% owning goats, 8.3% owning pigs and 1.3% owning sheep.

3.2 Land Uses in the Districts

The figures below show the main uses of land and forests at household level, as stated by household respondents. Accordingly, 41% of respondents said they used land for agriculture, 37% said they used forests for firewood, 16% said they used forests for charcoal, and 7% said they used forests for timber production.

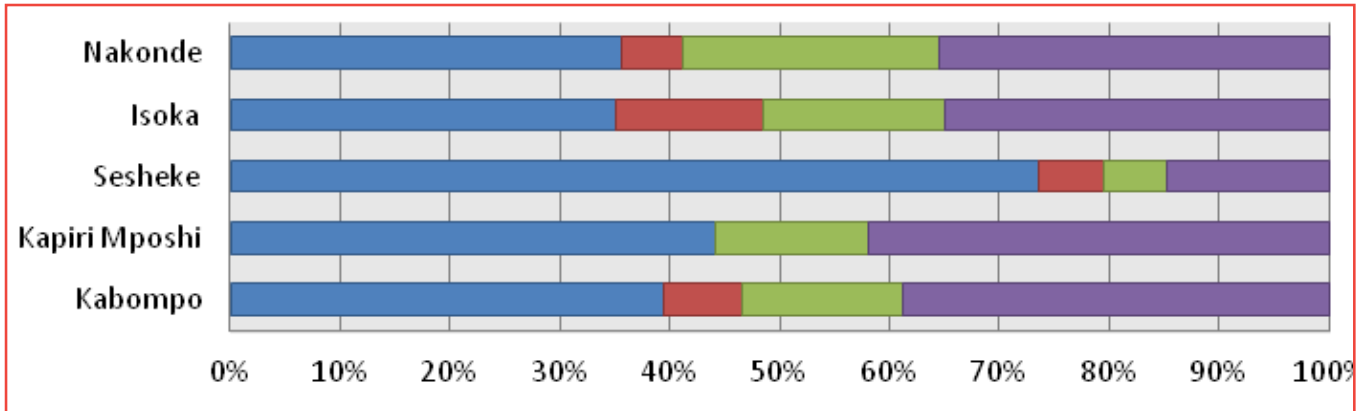
Figure 3: Main Uses of Land & Forests at Household Level



Source: Socio-economic Survey of this study

In terms of the most common land use, the figure below shows that agriculture was a predominant land use across all districts, more especially in Sesheke, Kapiri Mposhi and Kabompo. The second predominant land use was firewood, particularly in Kapiri Mposhi, Kabompo, Isoka and Nakonde, while it was least predominant in Sesheke. Charcoal was more pronounced in Nakonde, Isoka, Kabompo and Kapiri Mposhi, in that order.

Figure 4: Main Uses of Land & Forests at Household Level by District

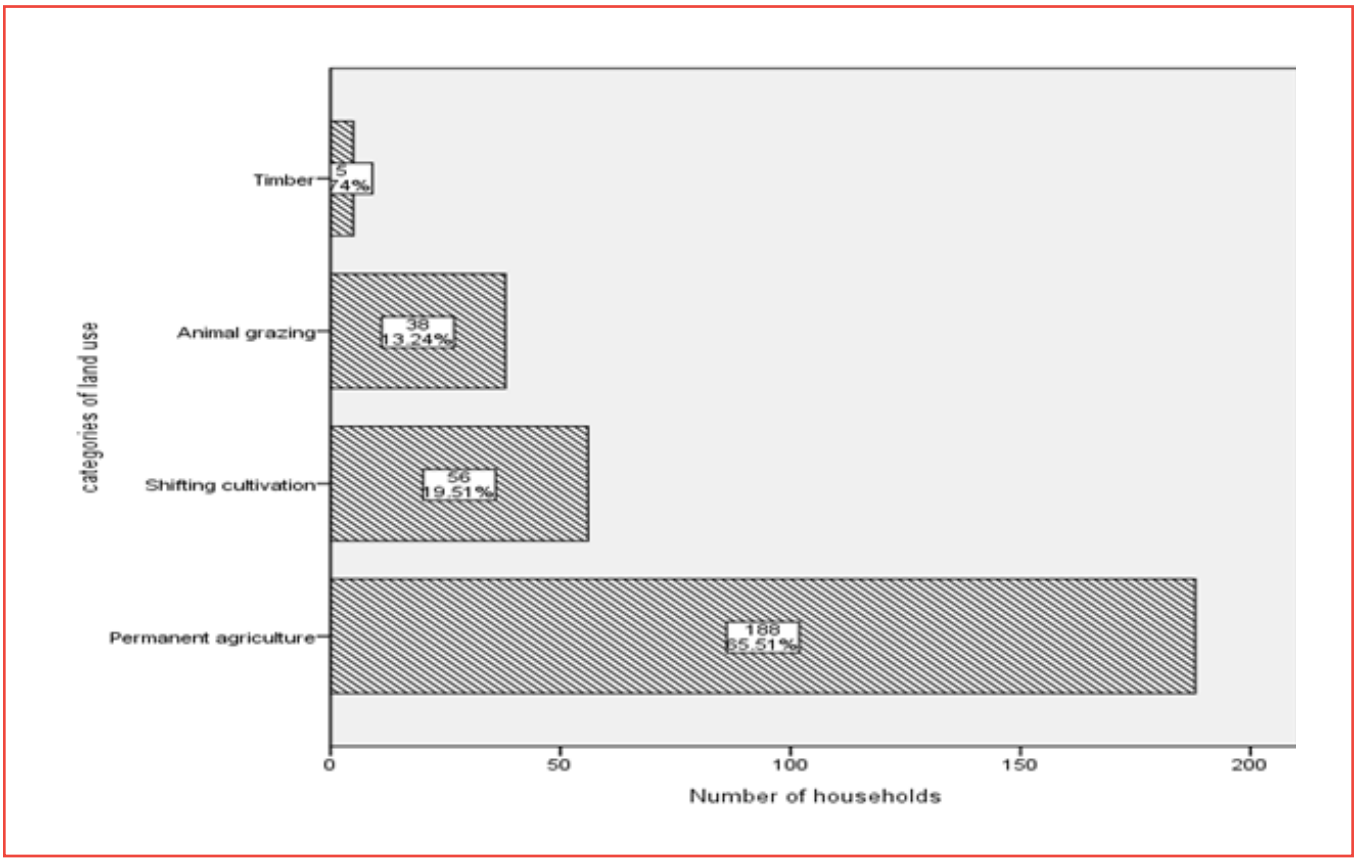


	Kabompo	Kapiri Mposhi	Sesheke	Isoka	Nakonde
Agriculture	56	57	25	34	32
Timber	10	0	2	13	5
Charcoal	21	18	2	16	21
Firewood	55	54	5	34	32

Source: Socio-economic Survey of this study

Furthermore, the major type of land use category in 65.5% of households surveyed was permanent agriculture, followed by shifting cultivation (19.5% of households), animal grazing (13.2% of households), and timber production (1.7% of the households) (see figure below).

Figure 5: Types of Land Use Categories at Household Level (Aggregate for All Districts)



Source: Socio-economic Survey of this study

For ranking purposes, agriculture was sub-divided into shifting cultivation and permanent agriculture. Other major land and forest uses were included on the scale. The table below shows the results of the ranking of the land use categories starting with the most common; and these included agriculture (permanent), firewood, charcoal, animal grazing, timber extraction, shifting cultivation, grass cutting and mushroom collection.

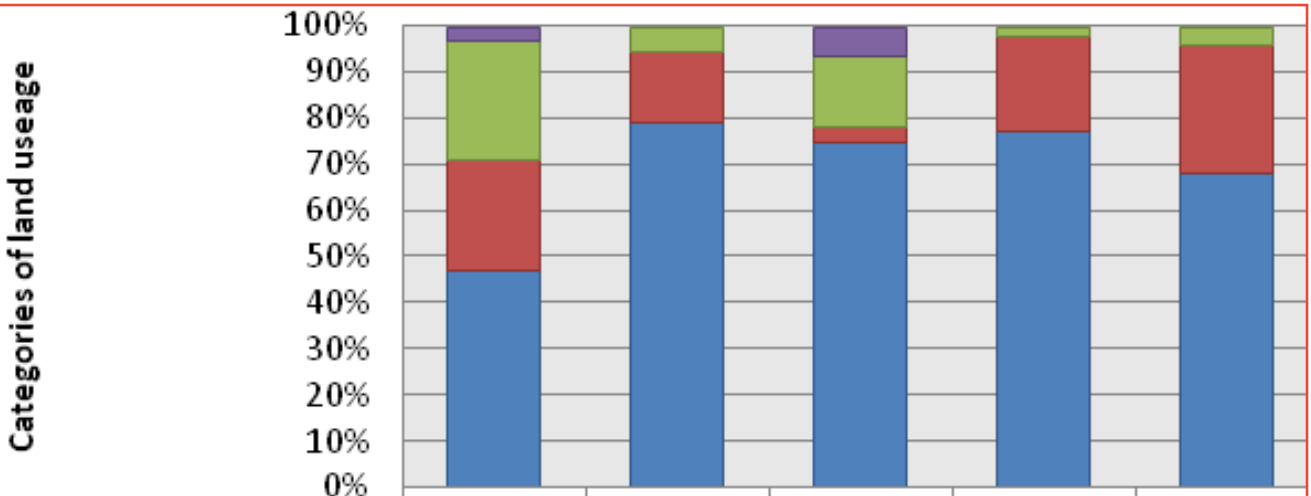
Table 11: Ranking of Land Use Categories

Land use category	Rank
Agriculture (Permanent)	1
Firewood	2
Charcoal	3
Animal grazing	4
Timber	5
Shifting cultivation	6
Grass collection	7
Mushroom collection.	8

Source: Socio-economic Survey of this study

The geographic distribution of land uses shows that shifting cultivation was more predominant in Nakonde, Kabompo, Isoka, and Kapiri Mposhi (see figure below).

Figure 6: Types of Land Use Categories at Household Level



	Kabompo	Kapiri Mposhi	Sesheke	Isoka	Nakonde
Timber	3	0	2	0	0
Animal grazing	27	3	5	1	2
Shifting cultivation	25	8	1	9	13
Permanent agriculture	49	42	24	34	32

Source: Socio-economic Survey of this study

The types of crop grown under subsistence agriculture and shifting cultivation land uses include maize, (29.7%), groundnuts (16.7%), cassava (14.8%), sweet potatoes (10.6%), beans (10.2%), millet (3.3%), sorghum (3.1), vegetables (onion, green pepper, cabbage, tomato) (28%), soya beans (2.4%), cotton (1.4%), popcorn (1.4%), pumpkins (1.0%), bambara nuts (0.9%), cowpeas (0.9%), rice (0.3%), sunflowers (0.3%), and mushrooms (0.2%).

Table 12: Types of Crops Grown

Type of Crop	Frequency	%	Cumulative %
Maize	171	29.7	29.7
Groundnuts	96	16.7	46.4
Cassava	85	14.8	61.1
Sweet potatoes	61	10.6	71.7
Beans	59	10.2	81.9
Millet	19	3.3	85.2
Sorghum	18	3.1	88.4
Vegetables	16	2.8	91.1
Soya beans	14	2.4	93.6
Cotton	8	1.4	95.0
Popcorn	8	1.4	96.4
Pumpkins	6	1.0	97.4
Bambara nuts	5	.9	98.3
Cowpeas	5	.9	99.1
Rice	2	.3	99.5
Sunflowers	2	.3	99.8

Mushrooms	1	.2	100.0
Total	**576**	**100.0**	

Source: Socio-economic Survey of this study

The above findings from households on land use was not markedly different from those identified by key informants. According to key informants, the following were the major land and forest use categories in all the districts put together:

- **Land Use 1:** Agriculture (permanent)
- **Land Use 2:** Shifting cultivation (small scale or subsistence agriculture)
- **Land Use 3:** Timber production
- **Land Use 4:** Charcoal burning
- **Land Use 5:** Firewood
- **Land Use 6:** Animal grazing

While some of the land uses that key informants reported were similar to the ones itemised by households, there were small variations including the order in which they (land uses) were ranked, as can be seen above.

Land Tenure
Estimated land with title ranged from 3 to 158 hectares, with an average of 49.83 hectares. This is land allocated to individuals who acquire land under customary tenure and then they get the titled deeds in due course.

3.3 Cost Benefit Analysis of Land Uses in the Districts

3.3.1 Overview

Key informants were asked to estimate the productivity of land uses with regard to commodity productivity, product unit price, establishment cost, production cost, employment creation, and target buyers/markets. Notably, while key informants and household respondents were able to identify various land uses they were not able to give cost benefit estimates for a number of land uses like grass cutting, mushroom collection, firewood, etc. Therefore, this report has concentrated on agriculture (permanent and shifting cultivation), timber and charcoal burning. The tables and figures that are presented in this section show summaries of the productivity statistics of these selected land uses.

3.3.2 Cost Benefit Analysis

Land Use 1: Permanent Agriculture
The table below shows estimates from key informants. The figures below are presented in the rebased Zambian Kwacha and the current exchange rate of one United States of America Dollar to Kwacha is K5.4.

Table 13: Productivity and Cost-Benefit Estimates for Subsistence Agriculture

Land Use 1: Permanent Agriculture (maize)	Estimates
Commodity productivity (unit/ha/year)	70 X 50 kg bags per hectare per year
Product unit price (ZMK/unit)	K65.00 per 50 kg bag
Establishment cost (ZMK/ha)	K950.00 per hectare
Production cost (ZMK/ha/year)	K3, 000.00 per hectare per year
Employment creation in the local community (jobs/ha)	14 people per hectare

Source: Socio-economic Survey of this study

The sizes of the smallholders' farms ranged from 2 hectares to 62 hectares, giving an average of 10.47 hectares. The average number of hectares normally farmed was 3.93 hectares. Of the smallholder farmers surveyed, 47.2% practised permanent agriculture while 51.8% practised mixed (shifting and permanent) farming.

Inputs and Technologies Used in Production

The major inputs used included fertilizers (including ashes and compost manure), seed, pesticides, and water. Other inputs included land and labour. The major technologies used included hand tools (hoes, axes and sprayers), ploughs, and tractors. The table below shows a summary of these details.

Table 14: Inputs and Technologies Normally Used

Input	Number of Respondents	%
Fertilizer	31	19.5
Hoes	29	18.2
Seed	22	13.8
Axes	18	11.3
Ploughs	17	10.7
Labour	17	10.7
Pesticides	10	6.3
Sprayers	5	3.1
Oxen	4	2.5
Land	2	1.3
Ash	1	.6
Compost manure	1	.6
Tractor	1	.6
Water	1	.6
Total	159	100.0

Source: Socio-economic Survey of this study

Land Use 2: Small Scale Agriculture (Shifting Cultivation)

According to households, the average commodity productivity was approximately 47.68 bags per hectare per year; the average product unit price was K290.44 per bag; the average establishment cost was K237.14 per hectare; the average production cost was K437.50 per hectare per year; and the average employment creation to the local community was 5 persons per hectare.

Table 15: Summary Statistics on Shifting Cultivation

Shifting Cultivation (millet)	N	Mean
Commodity productivity (no. bags/ha/year)	22	47.68
Product unit price (ZMK/bag)	23	290.44
Establishment cost (ZMK/ha)	14	237.14
Production cost (ZMK/ha/year)	18	437.50
Employment creation (jobs/ha)	16	5

Source: Socio-economic Survey of this study

Other Sources of Household Revenues

Other sources of household revenues were retailing, selling agriculture produce, charcoal burning, gardening, fishing and fish trading, poultry, beer brewing, trading in forest products (grass, caterpillars, mushrooms, etc.), bricklaying, bee keeping, piece work, carpentry, timber cutting, canoe making, dairy milk, moulding bricks, piggery, selling manure, auto repair, craft work, fish farming, grain milling, metal fabrication, real estate, sewing, thatching, tobacco trading and traditional medicine.

Land Use 3: Timber Production

There was only one key informant for timber due to the ban on timber that government imposed during the course of the study. Therefore, estimates from one producer could not be relied upon.

Land Use 4: Charcoal Burning

The table below shows a summary of statistics on the charcoal business. The length of period the informants had been in the charcoal business ranged from one month to 288 months (24 years), with an average of 61.3 months (5 years). The average commodity productivity ranged from 50 bags to 600 bags per year, giving an average of 198.60 bags per year.

Five to five hundred (500) trees were being cut per year, giving an average of 152.75 trees per year. Five to a hundred bags were being produced per kiln, giving an average of 25.87 bags per kiln. The product unit price ranged from K10.00 to K30.00 per bag, giving an average of K20.93750 per bag of charcoal. The establishment costs ranged from K20.00 to K310.00 per hectare, giving an average establishment cost of K85.00 per hectare. Production costs ranged from K10.00 to K2,500.00 per year, giving an average production cost of K307.73 per year. The number of persons employed in the charcoal business ranged from one to six, giving an average of three persons.

Table 16: Summary Descriptive Statistics on Charcoal Business

Charcoal	N	Minimum	Maximum	Mean
Length of time in the charcoal business (months)	19	1	288	61.32
Commodity productivity (bags per year)	15	50	600	198.60
Number of trees cut per year	16	5	500	152.75
Quantity of charcoal per kiln (50 kg bags)	15	5	100	25.87
Product unit price (ZMK/ 50 kg bag)	16	10.00	30.00	20.94
Establishment cost (ZMK/ha)	8	20.00	310.00	85.00
Production cost (ZMK/year)	11	10.00	2,500.00	307.73
Employment creation to the local community (jobs)	12	1	6	3.00

Source: Socio-economic Survey of this study

On average K64.79 is paid to the Government in form of tax and other fees. Other taxes and levies ranged from K16.20 to K81.00. The cost of rent ranged from K2.50 to K10.00.

Labour costs ranged from K30.00 to K60.00. Transport costs ranged from K15.00 to K75.00, giving an average transport cost of K46.67. Other production costs included the purchase of empty bags and axes and the repair of axes.

The table below provides a summary of other costs and revenues in the charcoal business. The other revenues raised from the charcoal business ranged from K1,040.00 to K1,746.67 per year. The other charcoal business related revenues are from the selling of firewood, i.e., the branches of trees that are cut off from the main trunks of trees that are burnt for charcoal.

Table 17: Other Costs and Revenues in Charcoal Business

Costs and Revenues	N	Minimum	Maximum	Mean
Other revenues (ZMK/year) e.g. firewood	3	1,040.00	3,000.00	1,746.67
Tax or other fees payable to Government (ZMK)	14	2.00	162.00	64.79
Quantities/purchases per year (bags) (ZMK)	5	30	600	294.00
Purchase price (per bag) (ZMK)	7	10.00	25.00	17.86
Transport costs (ZMK)	6	15.00	75.00	46.67
Taxes/levies (ZMK)	6	16.20	81.00	42.57
Space (rental) (ZMK)	5	2.50	10.00	5.90
Labour (ZMK)	2	30.00	60.00	45.00

Quantities sold per year (bags)	6	40	650	285.00
Income/revenue per year (ZMK)	6	600.00	5,400.00	2,350.0

Source: Socio-economic Survey of this study

Crop Marketing

According to key informants, growing maize was the main land use and the target market/buyer was the Food Reserve Agency.

According to households, the target market/buyers of various agriculture produce were, in their order of importance, the Food Reserve Agency (FRA), local markets, small scale traders, local millers, urban markets, home consumption, government institutions (e.g. schools, hospitals, and prisons), local breweries, and cotton companies (see the table below).

Table 18: Target Buyers/Markets

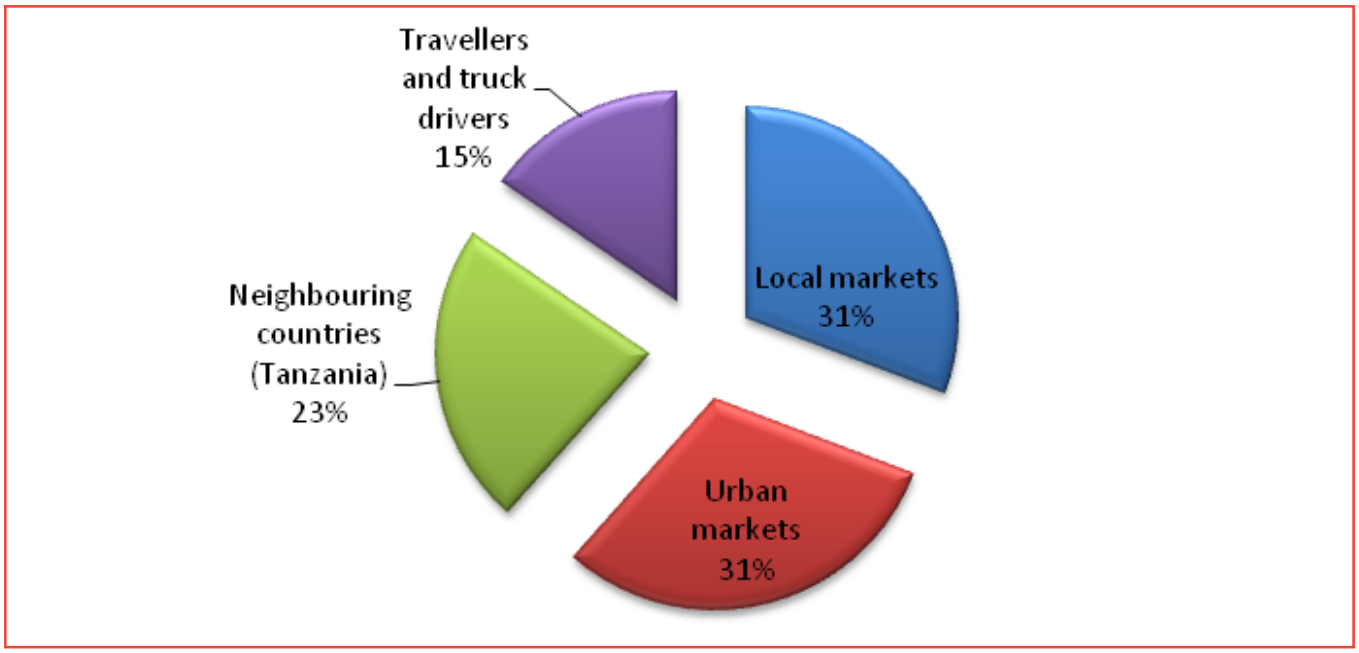
Input	Number of Respondents	%	Cumulative %
Food Reserve Agency	114	55.9	55.9
Local markets	31	15.2	71.1
Small scale traders	20	9.8	80.9
Local millers	11	5.4	86.3
Urban markets	9	4.4	90.7
Home consumption	7	3.4	94.1
Government institutions	5	2.5	96.6
Local breweries	5	2.5	99.0
Cotton companies	2	1.0	100.0
Total	204	100.0	

Source: Socio-economic Survey of this study

Charcoal Marketing

The target markets for charcoal include urban markets (31.0%), local markets (31.0%), neighbouring countries (23.0%), and travellers and truck drivers (15.0%).

Table 19: Target Charcoal Markets/Buyers



Source: Socio-economic Survey of this study

Adjusted Cost Benefit Analyses (CBAs)

After further literature review (Ministry of Agriculture and Cooperatives database) and expert input on productivity estimates, the field study CBA figures were adjusted and the tables from sub-section (a) to (d) present the summary of findings.

In the adjusted CBAs, commercial agriculture was included to ascertain economic benefits considering the fact that commercial agriculture is rapidly expanding.

(a) Permanent Agriculture (Commercial, Soybeans)

Table 20: Cost Benefit Analysis for Commercial Agriculture (Adjusted)

Permanent agriculture (Commercial, Soybeans)	US $ or unit
Establishment year 1	500
Inputs (per hectare)	
Soybeans (25kg)	240
Fertilizer (50kg) x 2 (inoculant)	86
Pesticides / herbicides	14
Labour (land preparation, harvesting and spraying)	420
Transport	462
Costs Total	1222
Expected yields per hectare (50 kg bags)	3 tons (60 bags)
Market price (soybeans)	35
Benefits Total	**2100**

Source: Socio-economic Survey of this study

(b) Small Scale Agriculture (maize)

Table 21: Cost Benefit Analysis for Small Scale Agriculture (Adjusted)

Small scale agriculture	US$ or unit
Establishment year 1	500
Inputs (per ha)	
Maize (10kg)	30
Fertilizer (50kg) x 4	160
Labour (land preparation, weeding and harvesting)	360
Transport (to and from the farm)	30
Costs Total	580
Expected yield per hectare	2.5
Market prices (Maize)	13
Benefits Total	650
Net Benefits	**70**

Source: Socio-economic Survey of this study

(c) Charcoal

Table 22: Cost Benefit Analysis for Charcoal Production (Adjusted)

Charcoal Production	$ or unit
Inputs charcoal (per ha)	
Labour	47.44
Licence	2.98
Council levy	74.79
Packaging (bags)	60.00
Transport (local)	113.18
TOTAL INPUTS	298.39
Revenues charcoal (per ha)	
Product yields	134
Sales prices	498.60
Net profit	**200.21**

Source: Socio-economic Survey of this study

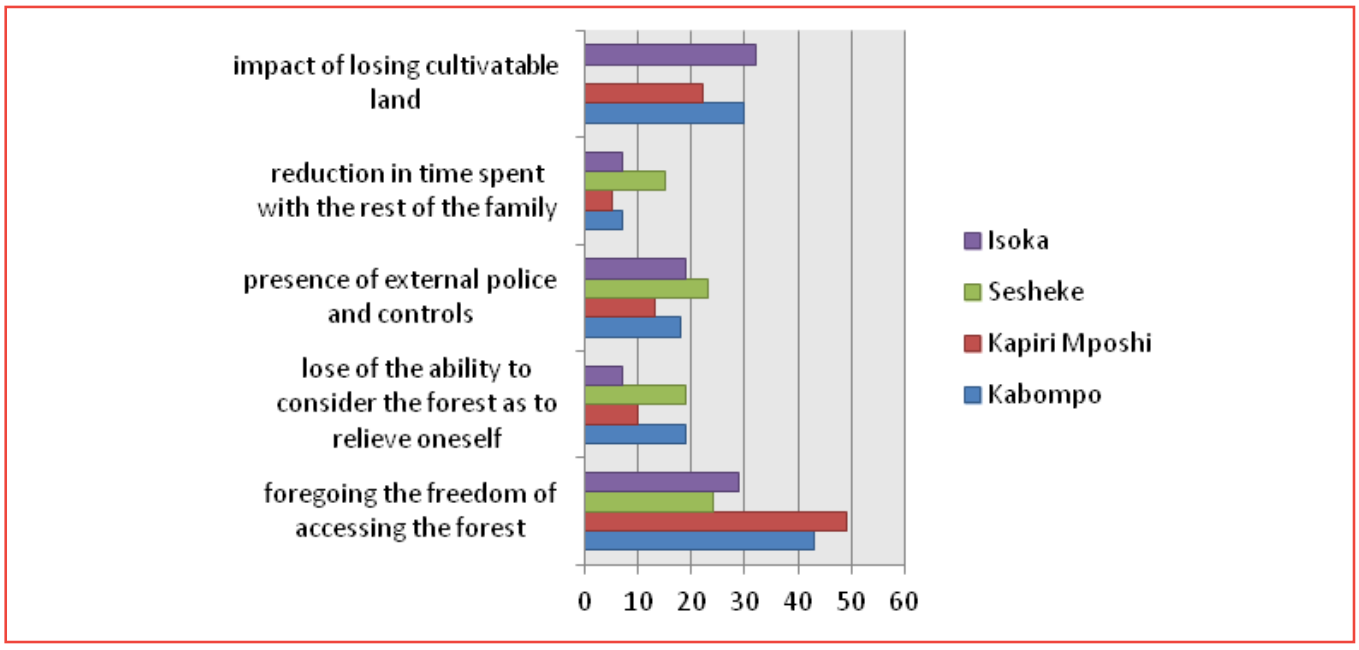
3.4 Implications of REDD+ Implementation in Zambia

3.4.1 Non Market-Based Opportunity Costs

Informants identified the following impacts on the community emanating from the perceived restrictions on the use of the forests once REDD+ interventions are implemented: foregoing the freedom of accessing the forest (35%), impact of losing cultivatable land (22.6%), presence of external police and controls (18.8%), loss of the ability to consider the forest for relieving oneself (13.8%), and reduction in the time spent with the rest of the family (9.2%).

The figure below shows the impacts of not using the forests on a per district basis. The greatest impact of losing acess to the forest is recorded in Kapiri Mposhi (48%). The impact of losing cultivable land ranks highest in Isoka followed by Kabompo.

Figure 7: Impacts on the Community for not Using Forests (per District Basis)



Source: Socio-economic Survey of this study

3.4.2 Market-Based Opportunity Costs

As undesirable as deforestation and forest degradation may be, people engage in environmentally unsustainable economic activities through both tradition and the need to satisfy their socio-economic needs often with no knowledge that their daily activities and way of life might be threatening the preservation of forests, the enhancement of carbon stocks and in time their own survival. Thus, the economic analysis of REDD+ primarily focuses on highlighting the foregone benefits from alternative land uses with a view to, inter alia, determining fair compensation.

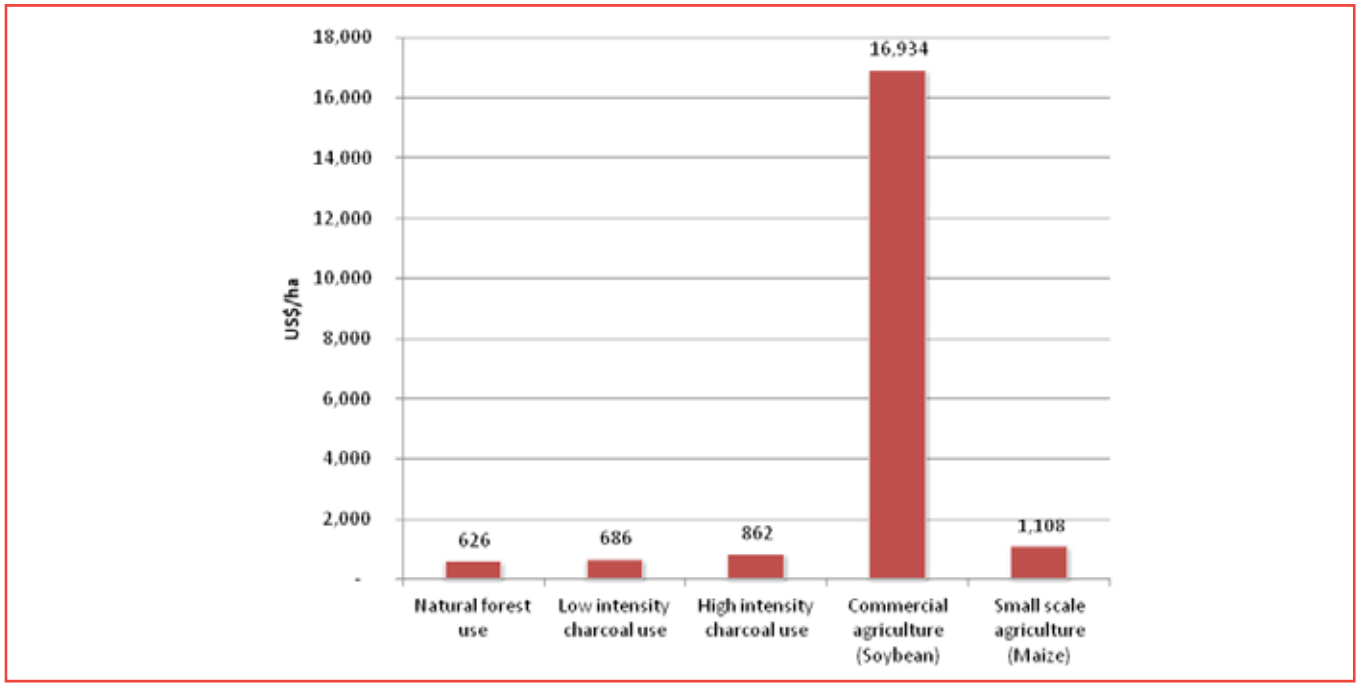
Generally, the study identified six land and forest uses: agriculture (permanent), small-scale agriculture (shifting cultivation), timber extraction, charcoal burning, firewood use and animal grazing.

Out of these six, four were prioritised and these include expansion of permanent and small-scale agriculture (shifting cultivation), unsustainable timber extraction and charcoal production. However, unsustainable timber extraction has not been included in opportunity cost calculations because only one timber producer provided the necessary data[6].

Determination of carbon stocks and calculation of Net Present Values (NPVs) for land uses including natural forest use, preceded the actual computation of the opportunity costs of avoiding the convertion of a hectare of natural forest to each of the selected alternative land uses. Details of the methodology used can be found in Section 2.4.3.

The NPVs for natural forest use, low intensity charcoal use, high intensity charcoal use, expansion of commercial agriculture and small scale agriculture are 626 US$/ha, 686 US$/ha, 862 US$/ha, 16, 934 US$/ha and 1,108 US$/ha respectively (see the figure below for details).

Figure 8: NPVs of Land Uses



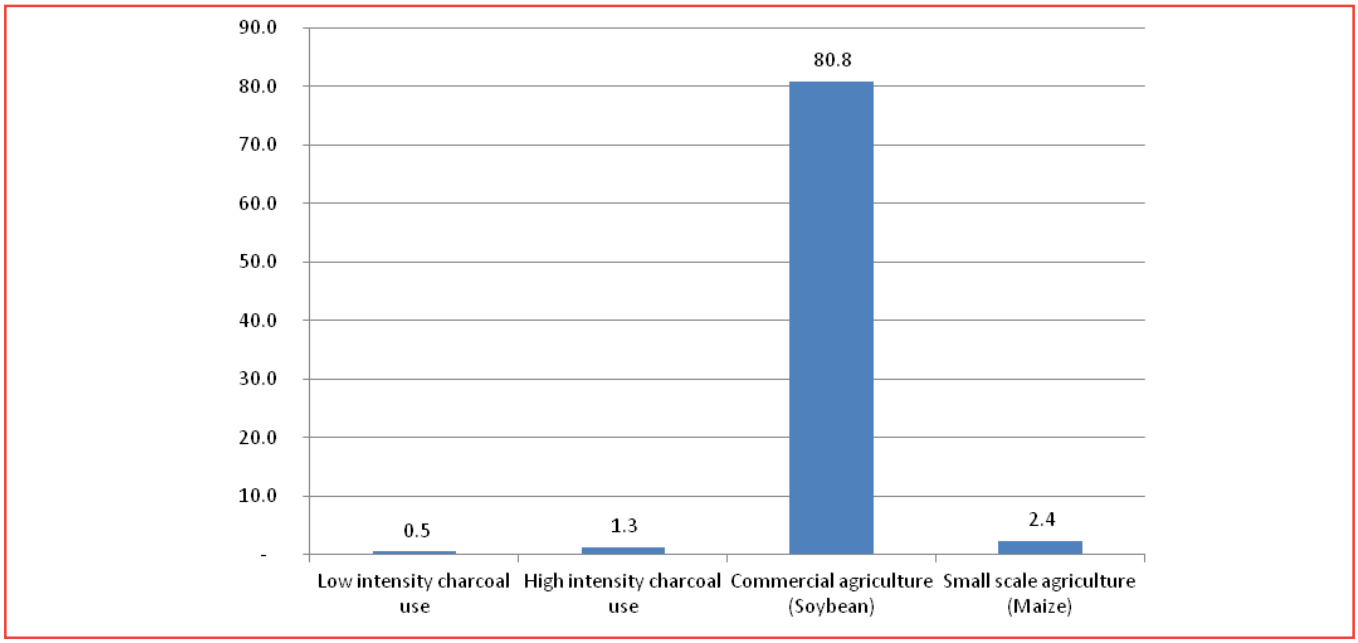
Source: Socio-economic Survey of this study

Taking into account the aforementioned carbon stocks under the selected land uses and the economic data that was collected during the study, which also includes data from the Ministry of Agriculture and Cooperatives, the opportunity costs were computed and the figure below presents a summary of findings for avoiding the conversion of a hectare

6 As already noted in the report, there was only one timber producer who participated in the study due to the ban on timber extraction that the government imposed when the study was underway. Therefore, the submission of one producer cannot be generalised.

of natural forest to the selected alternative land uses, i.e. expansion of commercial agriculture (soybeans)[7], small scale agriculture (maize)[8], and low and high intensity charcoal use.

Figure 9: Opportunity Costs of Natural Forest Conversion to Alternative Land Uses (USD/tCO2)



Source: Socio-economic Survey of this study

From the above figure, it can be deduced that the opportunity cost for avoiding conversion of a hectare of a high dense forest to commercial agricultural use (soybean) is US$80.8/$tCO_2$ while that of small-scale agriculture (maize) is US$2.4/$tCO_2$. The opportunity costs for conversion due to low and high intensity charcoal use are US$0.5/$tCO_2$ and US$1.3/$tCO_2$ respectively. Apart from commercial agriculture whose opportunity costs are high, expansion of small scale agriculture and unsustainable charcoal production are relatively low.

Comparatively, the average opportunity cost estimate for the Africa region is US$2.22/$tCO_2$ eq. In a study of 29 opportunity cost estimates, Boucher (2008) established that most of the values were relatively low, the mean standing at US$2.51/$tCO_2$ eq. Notably, 18 of the 29 estimates were less than US$2/$tCO_2$ eq. while the overall range was from less than zero to US$13.34/$tCO_2$ eq. Of all the 29 case studies, only one was above US$10/$tCO_2$ eq.

3.5 Alternative Livelihood Options under REDD+

Key informants suggested a wide range of alternative livelihood options, which included the following: Sustainable Conservation Oriented Enterprises (SCOEs) like bee keeping, diversified agriculture activities (fish farming, gardening, poultry farming, and dairy farming), retail business and conservation farming. Suggestions for the success of alternative livelihood options included the following:

- Increasing the provision of fertilizer to small scale farmers;
- Provision of credit facilities to small scale farmers;

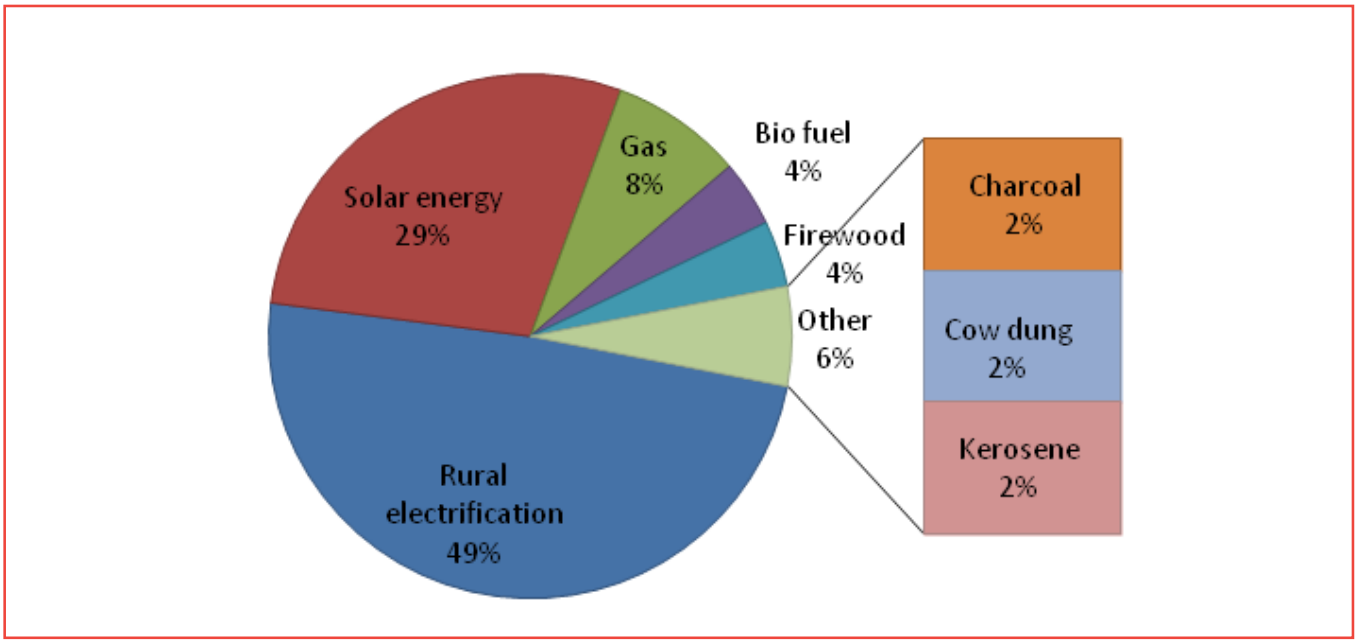
7 Soybean is the main crop of choice for most commercial farmers due to the high profitability that it has.

8 Maize is the staple food in Zambia and as such it was selected as the crop of choice for the purpose of calculating opportunity costs for small-scale agriculture, which occupies over 80% of Zambians who survive on subsistence agriculture.

- Reducing electricity tariffs in rural areas; and
- Subsidising the price of solar energy equipment.

Suggestions for alternative sources of energy included rural electrification (49.0% of respondents), solar energy (28.6%), gas (8.2%), firewood (4.1%), bio fuel (4.1%), charcoal (2.0%), cow dung (2.0%), and kerosene (2.0%) (see figure below).

Figure 10: Alternative Energy Sources



Source: Socio-economic Survey of this study

4.0 CONCLUSIONS

The opportunity costs for REDD+ implementation in regions where there is commercial agriculture with high value crops like soybeans were greater. Out of the study districts, Kapiri Mposhi has more commercial farmers than others.

The opportunity costs for REDD+ implementation in regions with small-scale agriculture and charcoal production as the main drivers of deforestation are lwo, and therefore potentially ideal sites for the piloting of REDD+ projects due to the low opportunity costs. When the five study districts are considered, Kapiri Mposhi, Isoka and Nakonde ranked highest in charcoal production. Small-scale agriculture was dominant in all the districts and it remains a very important economic activity among households.

A comparison of findings from Zambia with selected neighbouring countries reveals that the estimated opportunity costs are generally low. In the Democratic Republic of Congo (DRC), the opportunity costs for avoiding smallholder agriculture are estimated to be in the range of US$4.8/$tCO_2$ to US$5.0/$tCO_2$ (Simula M, 2010).

In the Tanzania studies, it was established that the opportunity costs for agriculture, fuel wood production, unsustainable timber exploitation and pasture expansion were between US$-7.8/$tCO_2$ and US$28.8/$tCO_2$ (Merger et al, 2012). These estimates were project-specific and the mean opportunity costs for the three projects ranged between US$10.1/$tCO_2$ and US$12.5/$tCO_2$ (ibid.) In an earlier 2011 study in 53 districts, the opportunity costs for avoiding charcoal and agriculture expansion were between US$1.90/$tCO_2$ and US$13.40/$tCO_2$ with a median of US$3.90/$tCO_2$ (ibid.). From the case for Tanzania, the high variability of opportunity costs for various districts in Zambia may exist, but these estimates could only be made once land use change matrices are compiled for Zambia including the total economic value of natural forests. This would also require more detailed economic studies in all the potential districts.

Further, it must be noted that opportunity costs are the key component of abatement (or mitigation) costs which include all the costs of activities needed to achieve emission reduction. According to Gregersen *et al.* (2010), in a well-functioning market economy opportunity cost can provide an indicator of the minimum amount to be paid to forest owners or users to ensure the forests are not used for purposes based solely on economic factors. In the case of REDD+ the additional non-leakage criteria may also be met (ibid.).

5. RECOMMENDATIONS

Given that Zambia is progressing in the development of its REDD+ national strategy and in assessing the opportunity cost of REDD+, the following recommendations emerged from the study:

(a) There is need to commission additional REDD+ work on economics for the purposes of producing national opportunity costs for REDD+. Detailed land use change matrices at sub-national and national levels will be required including the Total Economic Value of Forests in Zambia. Once all the detailed data is generated, the REDD Abacus software can be used to produce opportunity cost curves.

(b) It is recommended that the opportunity cost study be followed up by a study on the economic benefits of forests. Notably, the success of a REDD+ programme is partly embedded in incentivising environmental protection, which includes maintaining natural forests in Zambia. From the economics standpoint of REDD+, the question that must be addressed at every stage of REDD+ readiness has to do with the foregone socio-economic benefits to households and local economies. On account of this, the strategy must clearly show the multiple socio-economic and environmental benefits that accrue under REDD+.

(c) Finally, GRZ should commission a detailed economic study on selected livelihood options that will be advanced during the pilot implementation of the national REDD+ programme. This study will help to determine levels of investment that will be required for the successful promotion of such options, including support for local communities. Furthermore, a detailed study on livelihood options is helpful in the determination of trade-offs between benefits (profitability) from forest products and those from REDD+ programme actions (interventions/options).

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