



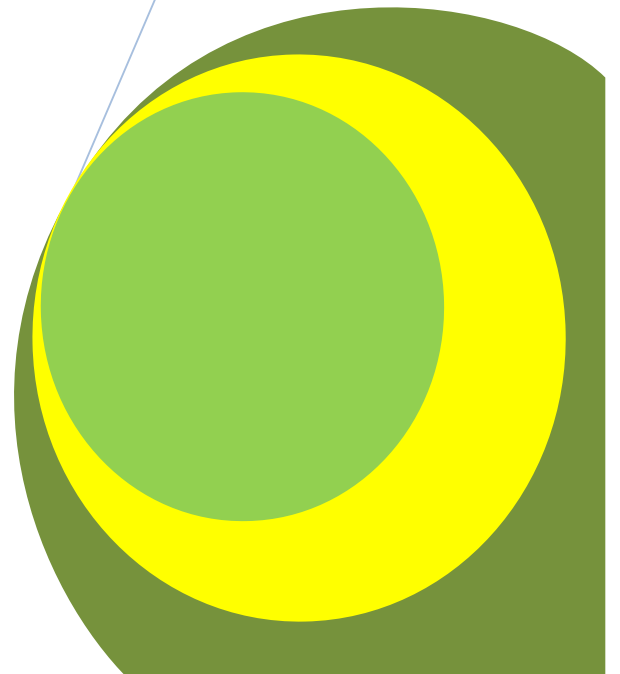
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**An Assessment of
Community
Vulnerability to Climate
Change in the Lupane
District of Matabeleland
North, Zimbabwe**

By

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Research Article

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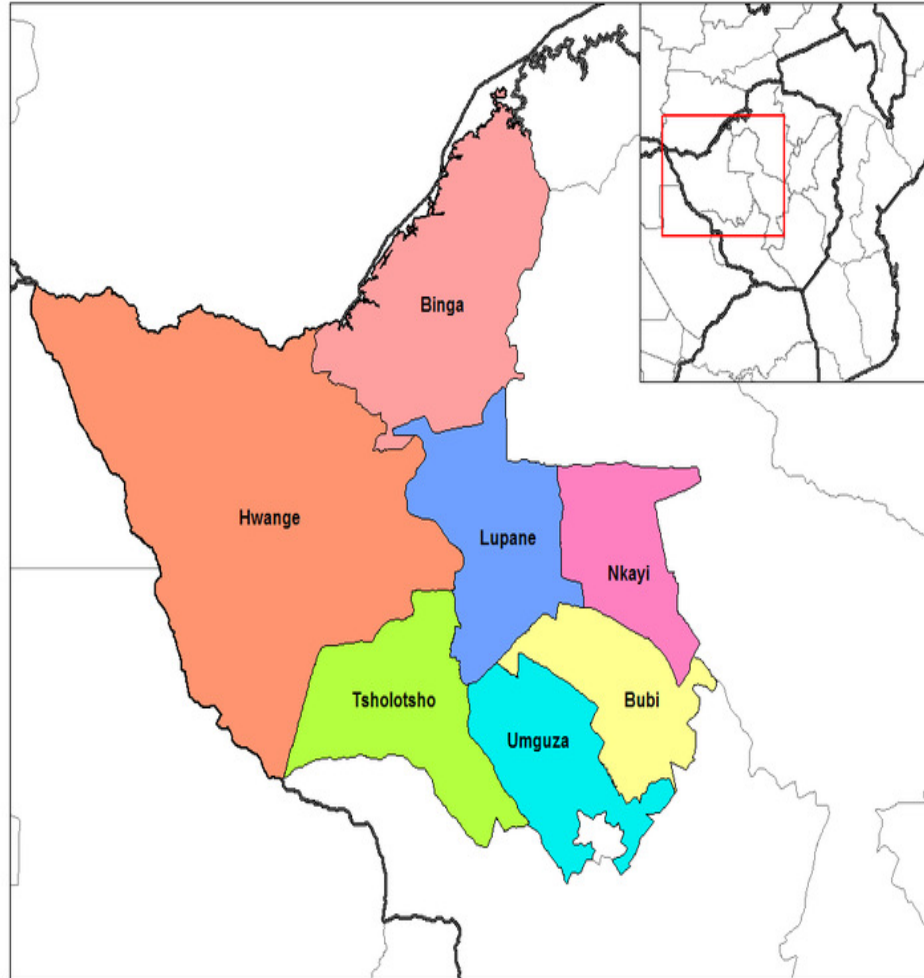
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ABSTRACT

Although climate change models predict harsher weather conditions along the Zambezi Basin, no known micro-level assessment has been carried out on the Zimbabwe side of the Basin, including in Lupane District. Lupane is one of the Matabeleland North districts of Zimbabwe that lie within the mid-Zambezi River Basin. The purpose of this study, therefore, was to assess the vulnerability of rural communities to climate change in the Lupane District. The specific objectives of the study were to assess the following: the community understanding of climate change; its farming systems and related support services; and its food and livelihood security. It is hoped that a clearer understanding of the community agricultural production systems could contribute towards the development and infusion of technologies that enhance and stabilize the community livelihoods. The study utilized existing secondary data on the District's agricultural production systems and its agro-ecological profile. Using structured questionnaires, primary data on the community understanding of climate change; farming systems and their performance; and current food security practices; was then collected from 125 randomly selected households. Other key sources of primary data were agricultural experts resident in the District. Focused group discussions were held with opinion leaders such as traditional leaders, school headmasters, business people and leaders of farmer associations. The major findings of the study are that Lupane communities have a fair understanding of climate change and its disruptive effect on their livelihoods. They reported that there was a general decrease in average annual rainfall; decrease in crop yields over the years; and increased food insecurity within their community. This made it difficult for them to achieve food self-sufficiency as they depended on rain-fed agriculture. Their livestock numbers were also decreasing due to regular droughts. As an adaptive strategy, the study found that the Lupane communities often hedged against climate change by increasing the planted areas or encroaching onto marginal and protected lands; bridged the food insecurity gap by engaging in off-farm employment; and diversified their livelihoods by gathering firewood and collecting wild fruits, vegetables and caterpillars, among other harvests. These were for own use as well as for sale. The study also noted the significant contribution of remittances from relatives in urban areas, including South Africa. Thus, the study concluded that the livelihoods of rural communities in Lupane District have become vulnerable and insecure as climate change intensifies. On this basis, the study recommends that Government, in partnership with NGOs and the private sector, should develop and promote robust agricultural systems that increase and stabilize crop yields among these and other communities that are vulnerable to climate.

Keywords: climate change, vulnerability, production systems, community livelihoods, food security, marginal lands.



1.0 INTRODUCTION

According to the United Nations Framework Convention on Climate (1994), climate change means a change of climate which is attributed directly or indirectly to human activities that alter the composition of the global atmosphere. This is in addition to natural climate variability observed over comparable time periods. Shumba and Carlson (2011) defined climate change simply as “long term changes in average weather statistics (e.g. rainfall, temperature and wind) that differ significantly from previous averages”. It manifests itself in extreme weather conditions such as droughts and floods caused by global warming or a rise in temperatures due to Greenhouse gas (GHG) emissions such as carbon dioxide, methane and nitrous oxide. In short, it is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years.

The most common definition of climate change is a change in the statistical properties of the climate system when considered over long periods of time, regardless of the cause [Inter-governmental Panel on Climate Change (IPCC), 2001]. In this context, therefore, fluctuations over periods shorter than a few decades do not represent climate change.

The term is sometimes used to refer specifically to climate change caused by human activities, as opposed to changes in climate that may have resulted as part of Earth's natural processes. In this sense, especially from the context of the physical environment, the term climate change has become synonymous with anthropogenic global warming. Within scientific journals, *global warming* refers to surface temperature increases while climate change includes global warming and everything else that increasing greenhouse gas levels will affect (NASA, 2011).

1.1 Causes of Climate Change

Whatever the definition, climate change manifests itself in droughts and floods that are caused by global warming or increases in temperature due to greenhouse gas emissions. As stated above, the emissions include carbon

dioxide, methane and nitrous oxide resulting from human activities such as combustion of fossil fuels, industrial processes, and deforestation.

On the broadest scale, the rate at which energy is received from the sun and the rate at which it is lost to space, determine the equilibrium temperature and the climate of Earth (WWF, 2011). This energy is distributed around the globe by winds, ocean currents, and other mechanisms to affect the climates of different regions. Factors that can shape climate are sometimes called "climate forcings" or "forcing mechanisms". These include processes such as variations in solar radiation, variations in the Earth's orbit, oceanic processes such as oceanic circulation, biotic processes, and variations in solar radiation received by Earth, plate tectonics and volcanic eruptions, and human-induced alterations of the natural world (Parkington, 2007). Thus, "climate change" is often used to describe human-specific impacts because it is these latter effects that are currently causing global warming.

1.2 Research Problem

Climate change models by SADC (2011) predict a temperature increase of between 1.5 to 2.5 degrees Celsius; condensed summer rainfall seasons; and a high frequency of flood events across the Zambezi River Basin, including northern Zimbabwe, within the next forty years (Maluwa, 2011; Moyo, 2011; UNDP, 2008). If this were to happen, it would have very serious implications since agriculture is the backbone of economies in most parts of the Basin, including Zimbabwe, with at least 80% of its citizens living in rural areas and, like Lupane District, dependent on rain-fed agriculture (Kamanga, 2011; Jain, 2007). Previous experience has shown that the agriculture sector's performance is adversely affected by climate change as drought often reduces rain-fed crop yields by as much as 50% in these parts of Zimbabwe (Mika, 2011).

Although some studies have been undertaken to document crop performance and food security in Lupane District, they do not adequately incorporate community climate change vulnerability assessments in their design (Makonyere, 2011; Kuona, 2010). Vulnerability to climate change is the degree to which geophysical, biological and socio-economic systems are susceptible to and unable to cope with adverse impacts of climate change. In this context, it is used to refer to the vulnerable local communities, particularly their food supply, leading to forced migration to marginal and protected lands.

There is, therefore, a need for a research initiative that is deliberately designed to bring out a clear understanding of the vulnerability of this community's agricultural production systems and related support services, and recommend strategies that might enhance agricultural production and stabilize the community's food security. This is because the above elements are intricately linked and provide information on vulnerability of communities to climate change, as well as options that may enhance their adaptive capacities.

1.3 Research Objectives

The main objective of this study, therefore, was to assess the vulnerability to climate change of rural communities in Lupane District. Specifically, the study assessed the following elements:

- a) Key natural features of Lupane District;
- b) Community understanding of and experience with climate change;
- c) Farming systems and related support;
- d) Major agricultural products and their yields; and,
- e) The state of the community's food and livelihood security.

1.4 Significance of the Study

Vulnerability is a dynamic process whose assessment requires knowledge of the prevailing situation, problems faced by vulnerable groups, and available resource choices. Therefore, by linking the above elements, the study has potential to lay a basis for a clearer understanding of the vulnerability of communities in Lupane District to climate change, thereby providing possible options that might enhance the adaptive capacities of the affected communities.

1.5 Scope of the Study

Although a variety of land ownership systems exist in the Lupane District, the focus of this study was confined to those areas of the District that fall under the communal farming system.

2.0 RESEARCH METHODOLOGY

The study was based on both secondary and primary data sources. Secondary data were sourced from previous reports and background papers on agricultural production systems in the District. The data had been produced by agricultural, national parks, forestry experts and non-governmental organizations resident in the District. Their reports largely focused on the agro-ecological profile of the District, its socio-economic circumstances; farming systems and their performance; as well as the food security situation in the District.

Primary data were gathered through formal and informal surveys. Formal surveys were based on structured questionnaires administered to 125 randomly selected households in 25 of the pre-selected villages of the study District. The objective was to obtain a broader understanding of climate change and livelihood issues from key informants and other knowledgeable people in the study areas. Group discussions were also held with key informants and opinion leaders such as traditional leaders, agricultural, national parks and forestry experts, school headmasters, business people and lead farmers. These proved to be critical in quantifying and validating observations from the background papers and informal surveys.

3.0 RESEARCH RESULTS AND DISCUSSIONS

3.1 Natural Features of the Study District

3.1.1 Climate

Lupane District, also known as Kusile, is one of the seven rural districts of Matabeleland North Province of Zimbabwe. It lies within Natural Region IV, a generally semi-arid ecological region that is not suited to viable crop farming without irrigation. With an average maximum temperature of 37 degrees Celsius, the District lies within the Bubi, Gwayi and Mbembesi River Basins, all of which are tributaries of the mighty Zambezi River. However, the rivers are generally ephemeral, only flowing during the rainy season.

3.1.2 Soils

Lupane District is generally characterized by sandy loam soils, prominent among which are the less fertile kgalagadi sands. Their high permeability and low fertility severely constrain their potential for crop production, especially dry-land cropping.

However, the valley soils along the drainage lines of Bubi, Gwayi, and Mbembesi Rivers, as well as their major tributaries of Gwamba and Shabula, tend to be much more varied due to differences in the parent material of the re-worked kgalagadi sands, basalts, sedimentary and alluvial deposits. Within a belt stretching approximately 2km either side of each river, rich black clay soils may be found.

3.1.3 Vegetation

Despite the climate-related limitations and infertile soils, the District of Lupane is well endowed with other natural resources, particularly the indigenous hard wood timber forests that include the Zambezi teak (*baikiaea plurijuga*), mahogany, and mukwa. The forest reserves are largely due to the moisture retention capacity of the deep kgalagadi sands that favour the regeneration of these species.

In terms of state forest reserves, Lupane District has the second highest coverage of 46% in Matabeleland North Province. The highest coverage of 66% is found in the Hwange District. Table 3.1 shows the names of the gazetted indigenous forest reserves in Lupane District, as well as the geographical area covered by each.

Table 3.1: Protected forest reserves in Lupane District

Lupane District	Forest Reserves	Area of Forest (ha)	Productive Land (ha)	Non-productive (ha)
	Gwayi/Mbembesi	144 300	105 020	39 280
	Gwamba/Lake Alice	39 000	24 360	14 640
	Ngamo	102 900	56 210	46 690
Totals		286 200	185 590	100,610

3.1.4 Wildlife resources

Because of the huge state forest reserves mentioned above, as well as the proximity of the District to the Hwange National Park, the largest National Park in Zimbabwe west of the main road from Bulawayo to Victoria Falls, the north-western part of Lupane is well endowed with a substantial variety of wildlife populations, including the big five. As a result, the District benefits from a number of tourism-related activities that include game ranching, hunting and photographic safaris. However, the District experiences regular challenges related to wildlife control, particularly elephants, lions, wild pigs and baboons which destroy their crops and livestock on a regular basis, and even human life, on some occasions.

3.1.5 Mineral resources

Although Lupane District is not well endowed with mineral resources, the District has recently been explored for the yet to be exploited coal bed methane (CBM) gas. It has been reported that a huge resource of over 370,000,000 km³ with a purity of 95% methane, does exist within the District.

Table 3.2: Summary of Key features of Lupane District

Parameter	Lupane
Altitude (meters)	1059 mm a.s.l
Average minimum temperature, C	14.0
Average max temperature, C	37
Average annual rainfall, mm	600
Average cropping season length (days)	103
Probability of mid-season drought (%)	18
Probability of a rainy season of less than 110 days (%)	63
Land area	10,107.29 sq.km
Soil type	Kgalagadi sands
Area under agriculture in hectares	185 590
Area under forest cover	286 200
Human population	100,600 (2013)
Population density	9.9 per sq. Km
% change (2002 to 2012)	0.15
Major rivers	Bubi, Gwayi, Mbembesi

3.2 Community Understanding of Climate Change

The first objective of the study was to assess level of local community understanding of climate change in the District. Specifically, the study sought to establish community understanding of the following categories of climate change indicators:

- Start of the rainy season;
- Amount of rainfall;
- Rainfall distribution;
- Extreme events such as droughts and floods; and,
- Temperatures.

The study found that 85% of the households had a fair understanding of climate change. About 100% of the households said that the District was experiencing frequent droughts; while 77% said the rainfall was now starting later than before. The common belief in the District is that rainfall should always come around the 15th of November each year. About 81% of the households said the floods were now more frequent and deadly while 78% said that temperatures had increased quite significantly.

According to Chief Mabhikwa Khumalo:

“Instead of having the first rains in October, the onset of rainfall has moved to the end November and early December. The rainfall period has become shorter and is characterized by intense falls and heat waves at the start of the rains”.

Councillor Andrew Mpala who farms in the Bubi Valley said:

“Banana, sugarcane and general horticultural production has considerably declined as a result of inadequate water from perennial wells. This has made it difficult for some households to produce vegetables from their gardens. They now buy basic products like leaf vegetables and tomatoes from those with boreholes or other sources of water.”

The communities' perceptions are summarized in table 3.3 below.

Table 3.3: Farmer perceptions on climate change (n=125)

In what way is climate changing?	Not changing (%)	Changing (%)
Less overall rainfall	15	85
Uneven rainfall distribution	48	52
Frequent droughts	0	100
Frequent floods	19	81
Higher temperatures	22	78
Late start of rainy season	23	77
Other	2	98

The conclusion of the study, therefore, was that there was an overwhelming majority who felt that climate was indeed changing. The study found that the most popular source of this information was the radio which was widely accessible to most farmers. Other information sources included friends, relatives and neighbours, as well as government agricultural officers.

3.3 Farming systems

The second objective of the study was to understand the farming systems of communal farmers in the District. The study found that Lupane District was predominantly composed of smallholder communal farmers who depended on rain-fed cropping. Their farming systems involved individually owned plots and free-range livestock rearing. Therefore, any adverse weather changes negatively impacted on the livelihoods of populations in this semi-arid District, resulting in the District being always in need of food aid. The key characteristics of the farmers in the District can be seen in table 1.4 below.

Table 3.4: Key Characteristics of the Households in Lupane District (n=125)

Parameter	% of parameter
% of male-headed households,	81
No of average family size	6.3
% of household heads with no formal education	8
% of household heads with primary education (7yrs)	64
% of household heads with secondary plus education	39
Average arable land size per household (hectares)	2.95
% of households owning cattle	82
% of households owning goats	91
% of households with chickens	100

The study found that 81% of households were male-headed and that 64% had at least basic/primary-level education. However, most males were often away in Bulawayo or even South Africa.

The study found also that there were very few households (18%) who did not own cattle. However, those with fewer cattle said that intermittent droughts were partly to blame as they resulted in inadequate grazing, sometimes leading to a complete wipe-out among those who already had fewer. Other reasons for lack of livestock were predators from the nearby Hwange National Park and state forests, and occasional disease outbreaks such as foot and mouth.

Because cattle are a critical source of draught power and manure, they are an integral part of the general farming system in this District. Thus, lack of cattle can have adverse implications for land preparation and

planting, particularly among the poorer farmers. However, the study found that most households (81%) kept goats and (100%) kept chickens. These species were easily convertible into cash during food insecure periods.

The study also found that demand for land caused by low crop yields and increasing human population often led to more encroachment onto marginal as well as protected lands (See table 1.5 below).

Table 3.5: Expansion of crop lands (n-125)

Expansion of areas under key crops	% of Households
Maize	32
Finger millet	21
Sorghum	17
Groundnuts	-
Cotton	10
Reduction of areas under key crops	
Maize	6
Finger millet	-
Sorghum	-
Groundnuts	-
Cotton	-

Source: Sukume (2012)

While demand for land was increasing, however, land clearing for agricultural expansion and tree cutting for firewood were causing serious environmental degradation as well as human-wildlife conflicts. This was evidenced by an increase in reported cases of crop damage by elephants, as well as human and livestock attacks by lions and hyenas.

According to officials from both the Zimbabwe Parks and Wildlife Management Authority and the Forestry Commission, several conservancies and gazetted forest reserves had fallen victim to rampant poaching and illegal settlements. One senior Park official said: "A number of conservancies no longer exist in their original form because Government directives to spare these conservancies have not been adhered to, hence rampant poaching continues unabated". He also revealed that, between January 2012 and March 2013, 16 poachers had been killed in stand-offs with Park authorities, 2, 572 people had been arrested, while 52 rhinos had been killed on both protected lands and private conservancies. He attributed all this to "insufficient political will to remove the illegal settlers".

The study also found that illegal settlements on forest land made forest management very difficult. There was rampant timber poaching, charcoal production, and uncontrolled bush fires.



Plate 3.1: Charcoal on its way to market



Plate 3.2: Firewood poaching and uncontrolled bush fires on the Gwayi/Mbembesi Forest

A forest ranger revealed that 35,000 families had settled themselves on 26,000 hectares of indigenous forests in Matabeleland North and that there was a population of more than 117,000 cattle, 8,400 goats and 12,000 donkeys in the demarcated forests. He raised concern over people legally settled on conservancies as they continued to convert forest lands into crop lands, thereby threatening the ecological balance of this particularly fragile ecosystem. He said: "They are converting the land to cropping yet the forests were meant to stop the spread of the Kalahari Desert into Zimbabwe." He further said "When the powers that be begin to speak in tongues, it is difficult for us to enforce forest conservation programmes."

3.4 Crop production

As shown in table 1.5 above, the study found that Lupane District farmers grew a wide range of crops. Cropping patterns were biased towards food self-sufficiency, although there were significant pockets of cash cropping, particularly in the fertile river valleys of the District. The limited focus on cash crops partly reflects on the absence of ready markets for some cash crops. Poor feeder-road infrastructure also raised transaction costs of bringing inputs to farmers and transporting produce to markets. Consequently, most food crop sales in the District were between local communities largely through cash sales and barter deals.

The study viewed the issue of poor external market access as a major disincentive to agricultural intensification and cash cropping in Lupane District. On the basis of the number of households who grow particular crops, and the areas planted thereto, the study concluded that the top five crops were maize, sorghum, finger millet, groundnuts and cotton.

3.5 Land, soil and water management practices

The study observed varying extents of conservation agriculture practices in Lupane District, albeit to varying degrees (See table 1.6).

Table 1.6: Land management practices (n-125)

Strategy	% of Households
Intercropping	100
Mulching	31
Contour planting	65
Crop rotation	17
Manure/compost use	20
Artificial fertilizer	23
Pesticides/herbicides	37

Of the 125 households interviewed, the study found that 100% practised inter-cropping. The common practice was to intercrop maize and cereals with groundnuts, beans, and other creeping crops that were not in competition with taller crops. It was revealed to the researcher that inter-cropping and ploughing along the contours were long standing traditions within the community. On the other hand, the study found that monocropping and mulching were confined to vegetable gardening. In the case of mulching, it was found necessary in summer when temperatures could reach up to 37 degrees Celsius. There was also greater use of improved maize varieties while the use of inorganic fertilizer was confined to vegetable growing. The study further found

that some farmers (17%) practised limited crop rotation while the use of manure was more prevalent (20%) among farmers whose fields were in sandy soils.

However, the conservation impact of such practices at landscape level was not assessed. Pesticide use was highest among vegetable and cotton farmers. The study concluded that the use or non-use of improved crop inputs in the study district was generally associated with availability of markets and expected economic returns.

3.6 Food and livelihood security

The study observed that both crop yield and rainfall figures in Lupane varied over time in that there has been a general decrease in the two parameters. This scenario confirms the notion that crop yields decline with climate change, thus exposing affected communities to food and livelihood insecurity. The food security situation of the communities is given in Table 3.7.

Table 3.7: Crop yields in Lupane District (n-125)

Crop	Area planted (ha)	Yield, t/hectare
Maize	79,417	0.65
Finger millet	91,142	0.93
Sorghum	85,081	0.87
Groundnuts	64,826	0.67
Cotton	4,565	0.55

The following inferences can be made from the table:

- Most households experience food shortages between November and March after grain from the previous harvest would generally have run out and before the current crop has been harvested.
- However, most households are food secure between March and October once the new crop has been harvested.

Table 3.8 below shows that most communities in Lupane District often bridged the November to March food insecurity gap by engaging in off-farm employment (to raise cash to buy food) and natural resource utilization.

Table 3.8: Food security situation

Crop	% of Households
Households experiencing food shortages between April and October	4
Households experiencing food shortages between November and March	33
Source of livelihood during food insecurity	
- Off farm income	80
- Off farm remittances	49

Table 3.8 also shows that about 80% of Lupane communities engage in off-farm employment within and outside the District. According to Village Head Mpala, however, off-farm employment creates its own social problems such as marriage break-ups. He said: *"Husbands migrate to areas where they can get casual labour; in the long run they marry other women there and become reluctant to return to their former wives. Sometimes the man gets married to a wife who has a rich father and refuses to go back to his village where there is hunger!"*

Some 49% of Lupane households received remittances from relatives working in various places, including Bulawayo, Harare and even South Africa.

A wide range of natural resources and their products are used to diversify livelihoods and hedge against climate change in the study district (See table 1.9 below).

Table 1.9: Food and Income from Natural Resources

Natural resource	% of HH Harvesting	% of HH Selling
Timber/poles	87	17
Firewood	100	14
Charcoal	27	8
Honey	31	11
Mushroom	91	10
Wild fruits	90	5
Wild vegetables	78	19
Caterpillars	100	69

Table 1.9 shows that firewood (100%), caterpillars (100%), mushroom (91%), wild fruits (90%), timber/poles (87%) and vegetables (78%) were the most prominent natural resources harvested for both own use and for sale (Shumba and Carlson, 2011; Sukume (2012).

**Plate 3.3: Illegal tree cutting for timber**

The former is the major energy source as alternative and conventional sources such as electricity and petroleum are beyond the reach of the District's predominantly poor households. On the other hand, charcoal was the least harvested because it has traditionally not been a source of energy among these communities.

Most wild fruits and vegetables often ripen during the food deficit period, that is, as soon as the rains start. They are, therefore, an important food and cash source in the study district. The fruits are sold either at the local markets, bus stops or to middlemen/women for re-sale in urban markets. At the time of the study, honey production for household use and sale was emerging as an important non-destructive non-timber forest product in Lupane District. This was a very encouraging development because, in areas with opportunities for local value addition and good external market access, profitable honey production can encourage good forest stewardship while providing positive economic returns to households.

According to WWF (2011), some beekeepers in the Bangweulu Basin, Zambia, have set aside over 600 hectares of communally owned forest land for deliberate community level management as bee forage areas. Another important activity in the Lupane District was caterpillar harvesting for both subsistence and for sale. However, conflict was simmering between local communities and people from other districts and even urban centres because their methods of harvesting caterpillars were associated with tree destruction (Sukume (2012). To reduce such destruction and conflict, the Lupane District Council had employed community forest scouts to monitor caterpillar harvesting in the forage areas. This could be an interesting case for future studies to assess the impact of the monitoring exercise.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusion

The major conclusion of this study is that most households in Lupane District become food insecure from November to March each year. The intensity of this phenomenon has increased with climate change which reduces crop yields. To hedge against starvation, communities were adapting by increasing the area planted to both food and cash crops; increasing dependence on natural resources for subsistence and income; and engaging in off-farm employment.

The study has observed that over reliance on wood energy has contributed to deforestation and reduced the capacity of forests to sequester carbon dioxide and to reduce greenhouse gas emissions in Lupane District. In addition, households, especially women, now travel longer distances in search of firewood.

Most climate change adaptation work in southern Africa has been in the agricultural sector where various assessment tools have been developed and made operational. This influenced the strong agricultural focus of the study.

4.2 Recommendations

On the basis of the above climate change vulnerability, there is a need to develop and promote robust agricultural systems that increase and stabilize crop yields. Thus, national and local authorities should consider using information generated by this study to identify, develop and promote high yielding and resilient agricultural technologies that suit the study district. In addition, the positive soil and water conservation impact of current initiatives should be closely assessed at landscape/village level to confirm the contribution of these farmers a "global good". This would justify the need for them to be financially supported by the national government and/or international community. For example, crop intensification and yield stabilization initiatives could be accompanied by improvements in non-climate change related factors such as markets and social services.

In addition, the study recommends the need to maintain as much forest cover as possible. This could be done by:

- Promoting and/or up-scaling natural resource based value addition business ventures such as commercial honey production;
- Identifying and promoting sustainable and affordable soil nutrient sources such as agro-forestry practices; and,
- Designing and piloting forest carbon trading projects through the Reduced Emissions from Deforestation and forest Degradation (REDD+) mechanism. As stated by Sukume, (2012), this mechanism recognizes that tropical forest destruction accounts for 20% of global carbon emissions. REDD+ can, therefore, create economic value for carbon locked up in standing trees and provide incentives to rural communities and other forest land owners to practice good natural resource stewardship.

There is therefore need to reduce community reliance on wood energy source. There is, therefore, need to identify and promote appropriate renewable energy solutions by:

- a) Mapping the use of natural resources by communities (e.g. wood, water, non-timber forest products, etc.);
- b) Assessing the impact of climate change on natural resources; and,
- c) Developing strategies that reduce the vulnerability of communities and their natural resources to climate change.

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