

EVIDENCE OF WATER SECURITY AS KEY TO
ECONOMIC DEVELOPMENT: A CASE OF LUUMBO
SPRING IN GWEMBE DISTRICT, SOUTHERN PROVINCE, ZAMBIA.

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requirement for the Postgraduate Diploma in
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DECLARATION

I, Beatrice Nyondo, do hereby declare that this dissertation represents my own work, and that it has not previously been submitted for a post-graduate diploma at this university or any other university.

Signature.....

Date.....

APPROVAL

This dissertation of Beatrice Nyondo has been approved as partial fulfillment of the requirement for the award of the Post-graduate Diploma in Integrated Water Resources Management (IWRM) of the University of Zambia.

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ABSTRACT

Every individual needs provision of adequate affordable safe water for a healthy and productive life. The provision of this adequate safe water should be done in a way that ensures protection and enhancing of the natural habitat.

This study investigates whether sustainable water supply is essential to achieving benefits that translate to household economic development. A community in Luumbo area, Gwembe District of Southern Zambia has steady supply of water from a developed spring. The study assesses the impacts of this development on the lives of the people who live in this drought prone area. The research involved collecting information through direct observations and semi structured interviews from the beneficiary households and key informants from the Department of Water Affairs (DWA) in Lusaka and Luumbo Rural Health Centre. Focus group discussions were also used to collect qualitative information. The Luumbo Spring water was sampled for quality analysis.

The study reveals an increase in the economic and social status of the members of the community in terms of health, education, income generation and employment creation. Nearly all the households (14 out of 15) are benefiting from the availability of the abundant spring water for agricultural activities. The crop grown and animals reared help them earn incomes that have improved their household food security. However, the water is not properly managed because of the existence of coliforms in the water.

This study concludes that availability of adequate water in Luumbo area has increased agricultural productivity and subsequently reduced the levels of poverty for the farmers and the community. There is need for regular cleaning of the mouth of the spring as well as protection of the entire spring zone. More sensitizations on water treatment methods should be done and farmer education on improved irrigation practices.

DEDICATION

To my parents Ms D. Kabwe and late Mr C. Nyondo (M.H.S.R.I.P) for all the sacrifices, love, guidance and support given to me through the years in shaping the person I am today. Mum, your prayers have been a source of great strength and inspiration. My Siblings Lidess, Charity, John, Tamara and Chileshe. You guys have been wonderful, you are my best friends. Most of all, I thank you Papa God for being there for me through it all, great is your faithfulness.

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LIST OF ABBREVIATIONS AND ACRONYMS

WWR	World Water Development Report.
SNDP	Sixth National Development plan
GDP	Gross Domestic Product
UNZA	University of Zambia
SADC	Southern African Development Community
DANIDA	Danish International Development Agency
V-WASHE	Village Water, Sanitation and Hygiene
DWA	Department of Water Affairs
ZABS	Zambia Bureau of Standards
TNTC	Too numerous to count
SSA	Sub-Saharan Africa
WHO	World Health Organisation

CHAPTER ONE

1.1 BACKGROUND

Every individual needs provision of adequate affordable safe water for a healthy and productive life. The provision of this adequate safe water should be done in a way that ensures protection and enhancing of the natural habitat. When a community is water secure, there is adequate water of acceptable quality for domestic uses, production of food, industry, energy, transportation and recreation. Water security means that the water resources are protected from degradation and used properly. It also means that the resources are developed in such a way that they provide benefits for humans for many more generations yet to come. Attaining with reasonable resilience the basic living standards of a community is what is defined as economic development. This requires measures that are able to foster growth to improve income, better education, health and protection of the environment. Water is said to support almost all aspects of all forms of life. It is said to improve health, wellbeing and peace. From water come livelihoods and improved social and economic statuses (UNESCO, 2006; Schultz and Uhlenbroo, 2008)

There is an assertion that investment in the water sector leads to water security and economic development. Water security is said to make any country's economy more resilient to rainfall variability especially for the agriculture and fisheries industries. Because of the said importance of water, many countries of the world have taken steps to achieve water security. However, some parts of the world are still struggling to be water secure. Africa is perhaps one of the continents endowed with so many water resources but can only boast of a few water secure regions (Grey and Sadoff, 2007).

This research will study the evidence of water security as key to economic development in Luumbo ward of Gwembe District, Southern Province of Zambia. Zambia is a country located in the savanna ecological zone on the great plateau of central Africa between latitude 08° and 18° south and longitude 21° and 38° east. Zambia has an area of 752,614 square km (Nyambe and Feilberg, 2009). The vegetation of the country is mainly savannah

woodlands and grasslands. The country experiences tropical climate with three seasons; cool and dry, hot and dry and hot and wet. The country is subdivided into three major agro ecological regions; Region I covers Southern and Western provinces and some parts of the Eastern province with annual rainfalls of about 500mm-700mm, Region II covering Central, Copperbelt and Lusaka provinces with annual rainfall of about 800mm-1000mm and Region III covering Northwestern, Luapula, Muchinga and Northern provinces with the highest rainfall of about 1100mm to over 1400mm. Zambia has 13,046,508 persons with an annual growth rate of 2.8% in the 2000-2010 intercensal period. Rainfall distribution in Zambia varies both within and between years. There is no part of the country which is arid. There are 5 main rivers, Zambezi, Kafue, Luapula, Luangwa and Chambeshi. The lakes are Mweru, Mweru wa ntipa, Bangweulu and the man made Kariba and itezhi tezhi. Although the country has abundant water resources, water is not evenly distributed [Central Statistical Office (CSO), 2010].

The kind of economic activities in the country are agriculture, forestry, mining, quarrying, manufacturing, electricity, gas and water, construction, wholesale and retail trade, restaurants, bars and hotels, transport, real estate and business services, community, social and personal services. Most of these activities occur in cities and towns along the line of rail. Zambia's economy is mainly based on exportation of copper and cobalt. Copper accounts for about 80% of the total export earnings (CSO, 2010).

Agriculture has been the main focus of Zambia's economic recovery according to the Fifth National Development Plan (FNDP). This is because the sector is seen to have huge potential. Despite this, the sector has not contributed significantly to the country's Gross Domestic Product (GDP) due to vulnerability to weather changes. There hasn't been any real growth in the agriculture sector due to high dependence on seasonal rainfall, reduced investments and failure to strategically position the sector according to its potential for growth relative to other sectors [Ministry of Finance & National Planning (MoFNP), 2011].

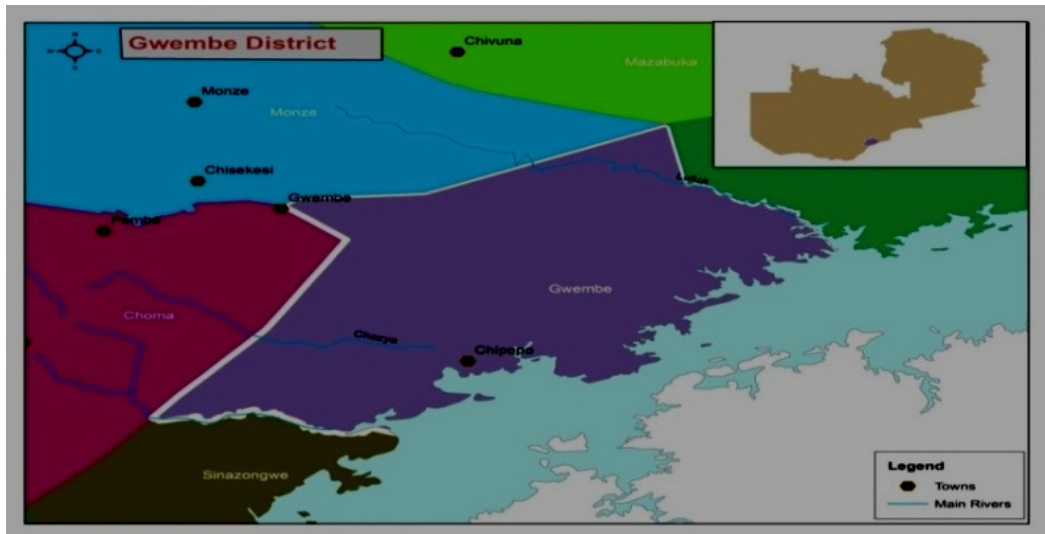
1.2 STUDY AREA

Luumbo Spring is one of the many natural springs located on the slopes of Hamunyanga Hill about 100km from Monze Town in Luumbo Ward of Gwembe District, Southern Province of Zambia (Figure 1). It is a source of water and livelihood for two villages called Hamasamu and Hamunyanga. The Gwembe valley is part of the Luangwa-Zambezi Rift Valley zone. It has the lowest lying and driest areas in the country with an elevation of 300-900m above sea level. The climate here is hot and humid and the area experiences floods and frequent dry spells in the rainy season if not droughts. This makes rain fed agriculture very difficult resulting in food insecurity and malnutrition. Access to adequate safe water was one of the challenges this area was facing until World Vision in partnership with the local communities and some government stakeholders identified and developed a spring that was considered as a shrine in the area. This was done to provide adequate safe water for domestic use as well as other activities that could improve the livelihoods and food security for the Hamasamu and Hamunyanga communities and mitigate the effects of drought (World Vision, 2011).

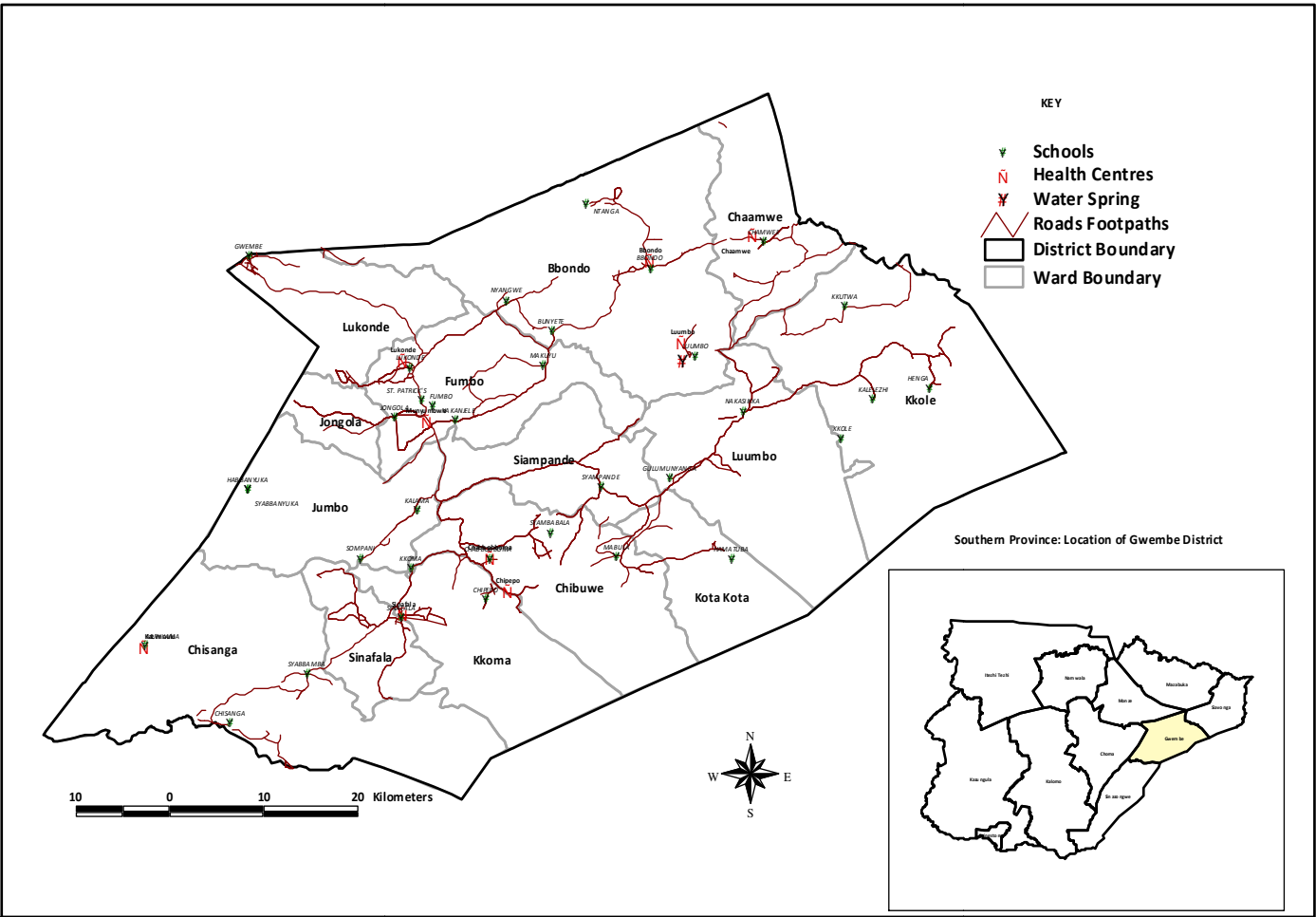
The Luumbo integrated water supply system set up is a gravity fed spring water supply scheme that comprises capping and protecting the spring and channeling the water to four storage tanks with a total capacity of 20,000 liters. From the storage tanks, the water gravitates through a pipe network of 5.4 kilometers and reticulates to 30 water points. The scheme serves about 33 households, 7 small holder farmer's gardens and 2 animal drinking troughs for cattle and goats. The spring has a discharge of 1 litre per second from the source and the average daily groundwater supply is 86,400 litres per day (Table 1).

Table 1: Characteristics of the Luumbo Integrated Water Supply, Gwembe District Southern Province, Zambia

Discharge at Source of Spring	1.0 liters/second
Average Daily Groundwater Supply	86,400liters/day
Storage Capacity	4 x 5000 liters = 20,000 liters
Population served for domestic use	33 households
Yard connections and Animal troughs	30
Domestic use	25 liters per capita
Total length of mains	5.4 kilometers



(a)



(b)

Figure 1: (a) Map of Gwembe District and Surrounding areas. (b) Map showing Luumbo and surrounding wards and Luumbo spring source in Gwembe District, Zambia

1.3 PROBLEM STATEMENT

Water resources development has been carried out in many rural communities by both government and international organizations both on small-and large-scale. Studies have indicated that a relationship exists between water security and economic development. In both the Southern African Development Community (SADC) region and the rest of Sub-Saharan Africa, many of these studies have concentrated on the relationship between water security and economic development in terms of gross domestic product/capita (GDP/capita) at regional or national level. However, few are taken to determine the rural household impacts especially that these are small-scale farmers who totally depend on this resource for their livelihood. This study therefore will investigate the household economic development which has been brought about by the development of Luumbo Spring.

1.4 AIM

The aim of the study is to establish the effects of water security on socio-economic development in Luumbo area of Southern Zambia.

1.4.1 Objectives

The objectives of this research are:

- To examine the water dependant economic activities that takes place in Luumbo area;
- To determine the impact of the water dependant economic activities on the well-being of the members of the communities in terms of health, education, income generation, employment creation and food security;
- To determine if the communities are water secure; and
- To ascertain the quality of the Luumbo spring water in terms of physical, chemical and biological parameters.

1.5 HYPOTHESIS

Availability of abundant spring water in Luumbo area has brought about socio-economic development.

1.6 SIGNIFICANCE OF STUDY

Research in the role that water security plays in society is important because it provides information about the necessity of water. It also stirs development of suitable technologies for providing good quality water in adequate quantity for various geographic locations. Studying the aspects of human life that are affected by the presence of water or the lack of it can be very important for informing policy so that the cost of providing it is analysed against the benefits in terms of health, education and income generation. This study aims to provide information on the role water security plays in rural communities. This is because unlike in urban areas where people work either in formal or informal sector and own businesses to make a living, in almost all parts of rural Zambia, agriculture is the biggest and only form of livelihood. The government of the republic of Zambia has an objective of promoting sustainable water resources development and ensure equitable provision of adequate quantity and quality of water for all (GRZ, 2005). Some areas around the country have had their natural water resources developed in order to provide people with adequate water but whether there are any real economic benefits that come with abundant water still remains to be seen.

CHAPTER TWO

2.1 LITERATURE REVIEW

There is a high awareness of the importance of water security at a global level. Many developed countries have already achieved water security owing to the fact that its importance was recognized early and appropriate steps were taken to achieve this. Although the many socio-economic benefits of safe abundant water are well recognized, Sub Saharan Africa still lags far behind. Large disparities in the distribution of rainfall and fresh water resources, high population growth rates over the past decades, ever increasing water scarcity and the lowest agricultural production, economic development seems like a farfetched dream for the majority of Africans living in abject poverty (UNESCO, 2006). According to the United Nations Environment Programme (UNEP), this low agriculture productivity is as a result of heavy dependency on rainfall. It is estimated that about 95% of all forms of agriculture on the African continent is rainfed. Low agricultural productivity continues to be experienced in Africa because rainfall is increasingly being affected by climate change. About 80% of Africans rely on agriculture for their livelihoods and the majority of these are poor living in the rural areas and cultivating crops on a subsistence and small-scale level. African countries store only about 4% of their annual flows, hence few people in Africa have access to secure water. This means there is a low water buffer and hence a high climate vulnerability (UNEP, 2010).

Climate change has greatly affected water security especially for drought prone areas. This is because in the wake of climate change, dry areas are expected to be drier whereas wet areas are expected to be wetter (Nyambe and Feilberg, 2009). The negative effects of climate change lead to crop failure and the death of animals. This causes food insecurity and high food prices especially for rural people whose livelihood is mainly agriculture (Thompson, 2010).

Zambia, like many other countries in southern Africa has been experiencing high rainfall variability. This has greatly affected its agricultural sector which is mainly rainfed. Studies show that in the past three decades, there has been huge decline in the economic growth of

the country during major drought years (Thurlow, 2009). Like elsewhere in Africa, most of Zambia's poor lives in rural areas and depend on agricultural incomes hence this has greatly slowed the pace of reducing poverty. Rainfall in Zambia decreases from north to south while evapotranspiration increases from north to south, hence, Southern Province where rainfall is scarce, the crop require higher amounts of water. This means that there is high risk of crop failure and yield losses. There are a number of papers that highlight the effects of climate variability in the country hence the need to invest in irrigation and water management practices to mitigate the adverse effects of both climate variability and climate change on the economic development of the country. Climate change causes the environment and people in them to experience extreme weather conditions. This coupled with increasing population growth lead to overwhelming of ecosystem services. Climate change and variability leads to change in disease patterns by increasing climate mediated spread of infections. It also changes the quantity and quality of water because of changes in temperature. High temperatures can lead to increased contamination of water courses and reduce access to fresh water leading to food insecurity. This hampers economic development (Hasselt and Chapman, 2010). The impacts of drought are considerable especially in the southern part of Zambia where the least amounts of rainfall are recorded. Southern Province of Zambia was once the country's food basket but production of food has been affected greatly because of frequent droughts and dry spells recurring over the years. Hence its vulnerability to drought is well known. This is exacerbated by government's policy of emphasizing only input distribution without ensuring water security. This encourages the growing of maize seasonally and if the crop fails due to low rainfall, many families become food insecure and remain in the vicious cycle of poverty. Different reports show that prolonged droughts and changes in rainfall patterns between years affect people's livelihoods (Thurlow, 2009; Thompson, 2010).

Many studies carried out have revealed that the benefits of water security are multiple. They include good health of the community and the subsequent improved productivity and the gains in the local economies. Socio benefits such as free time for leisure, looking after families, more time for education especially for the girl child and other productive activities whether or not they translate to economic gains (Briscoe and de Feranti, 1988). Mostly in

rural areas, subsistence and small-scale farming is the major economic activity hence abundant water increases production of food. This in turn increases the household nutritional and financial gains causing even more expansion of production and investment in other economic activities. But there is little that has been done to study the evidence of these economic activities. There are studies that argue that increased supplies of water increases the growth of food service, beverage production, and food processing in small towns and rural villages. Generally, however, the most significant impact will be on health, contributing in turn to economic growth through gains in labour supply and productivity, school attendance, and human capital formation (Churchill, 1987).

Churchill (1987), Briscoe and de Ferrati (1988) recognize the multiple benefits of water security such as health leading to increased productivity of healthy workforce, growth of the food service and food processing and beverage production in rural areas. In my opinion, a healthy workforce only increases productivity of whatever economic activities local communities are already engaged in. Development of such small industries are all a possibility especially in countries where infrastructure is already developed and policies that provide an enabling environment are in place. However, in a rural areas, infrastructure has not been developed to provide local communities such opportunities for food and beverage industries (UNESCO, 2006).

Studies investigating the factors that have made some countries in sub-Saharan Africa (SSA) more resilient to rainfall variability than others show a negative relationship between rainfall variability and economic development. They also show a positive relationship between investment in infrastructure and economic development. Good water storage is strongly related to economic growth. Countries with more internal renewable water resources and irrigated agriculture as a percentage of agricultural area are more resilient to rainfall variability (Brown, 2008). It has also been revealed that climate change has significant and negative effects on household income, agricultural productivity and economic growth in SSA. Drought (negative precipitation) has the most significant influence on economic growth. This means that buffering drought is more important for SSA in adapting to climate change (Brown, 2008). Still some studies have looked at water

security as being key for growth and development. The studies have compared the growth and development that has taken place in the developed countries as a direct result of water security and the hampered economies of countries that are not yet water secure. It also compares the costs that developed countries incurred in achieving water security and the costs that are presently there for water insecure countries. Results of this study revealed that investment in infrastructure and institutions was a means by which developed countries became water secure. Developing countries have bigger challenges to achieve water security today as compared to those countries that already have in terms of financial costs and other hidden costs such as human suffering, sustained poverty, constrained growth and socio unrest (Grey and Sadoff, 2007).

Sadoff and Grey (2007) attribute low rates of development in water insecure countries to a lack of investment in infrastructure and institutions. Brown (2008) also supports this school of thought that infrastructure and economic development have a positive relationship. He argues that infrastructure in the water sector provides a buffer for rainfall variability by increasing water storage capacity for irrigation. This study aims to verify whether this infrastructure development has a positive bearing on household livelihoods.

Musouwir (2008) also investigated the relationship between rainfall and economic development and also between investment in the water sector and economic development. The study was carried out to analyze relationships between the amount of rainfall and GDP/capita and national water supply and sanitation budget and GDP/capita. The findings show that a significant relationship exists between national budget in water supply and sanitation and GDP/capita but there is no statistical significant relationship between rainfall and GDP/capita. A very interesting finding was made that national water budgets on water supply and sanitation in all the 22 African countries including Zambia have a much larger multiplier effect on GDP/capita.

Musouwir (2008) shows that governments that invest in water sector reap a larger multiplier effect on their GDP/capita. This study is investigating if investment in the water sector has an effect on rural household livelihoods.

Many countries have developed their natural water resources such as springs to buffer the effects of rainfall variability. The springs are also protected rigorously in order to preserve the quality as well as the quantity of the water. The areas surrounding the springs are protected including the caverns, the sinkholes and the karst windows and the land above conduits that feed the springs. The vulnerable areas are identified which need intensive management. The members of the general public are limited from accessing spring protection zones. When the level of resource degradation is high, programmes are put in place for restoration and environmental education (Goulburn-Murray, 2010; SDII Global cooperation, 2004).

In many parts of the world, studies have been done in order to assess the impacts of water security on the lives of local individuals. In Kenya, Infrastructure improvements of springs have reduced fecal contamination by 66% by improving water quality. This has reduced child reported diarrhea and therefore increased the amounts of costs the government avoids for each reported diarrhea case (Kremer, Leino, Miguel and Zwane, 2011). In Luang Prabang Province of Laos in Xieng Ngeun Town, impacts on the lives of people in the area was assessed after connecting 81.7% of the households to safe piped water. Indicators such as change of social-economic status of the people, productive activities, reduction of water carrying burden on women and children, financial viability of the water project were used (UN Habitat, 2008).

In Africa, where many people in the rural areas are small-scale farmers, few studies have been undertaken to determine the relationship between water security and economic development. This is also the case in Zambia where studies of this nature have been mainly at a national level despite the many efforts being made to improve water security at community level, which this proposed study will be among the few to investigate this.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 DATA COLLECTION

Both quantitative and qualitative methods were used. For the quantitative aspect, a questionnaire was used whereas focus group discussions were used for the qualitative aspects of this study; both primary and secondary methods of collecting data were employed.

3.1.1 Primary data collection

The spring water was sampled using the UN recommended methods (Bartrum, 1996). Samples were collected both from the source at the point of harnessing and after preliminary treatment, as well as from pipes at residences and transported to the University of Zambia Geochemical Laboratory at the School of Mines for quality assessment. Direct observations and interviews were done to examine the water dependant economic activities that were taking place in Luumbo area. To evaluate the extent to which the observed economic activities were driven by the availability of spring water and the impact on wellbeing of the members of the community, a questionnaire (Appendix1) was used and 3 focus group discussions were conducted. Key informant interviews were also conducted with the Village headmen, Village Water, Sanitation and Hygiene Committee, Environmental Health Technician at Luumbo Rural Health Centre, Department of Water Affairs, and Luumbo Basic School Headteacher.

Semi structured interviews with both open and closed questions were used in order to capture the opinions, perceptions and views of the interviewees. This was done in order to probe reasons and meaning given by interviewees. Focus group discussions were used to complement information obtained through direct observation and interviews in order to obtain perceptions, attitudes and various experiences.

The sampling frame for this study was 15 households, 8 households from Hamunyanga Village and 7 households from Hamasamu Village. Hamunyanga Village had 16 households

in total whereas Hamasamu Village had 17 households. Purposive sampling technique was used as houses in the village were not built in any particular pattern. Of the 15 households which took part in this study, 7 interviewees were heads of households, 7 spouses and one child (Table 2).

Table 2: Age, Sex and Relationship to Household Heads in Luumbo area, Gwembe District, Southern Province, Zambia

RELATIONSHIP TO HOUSEHOLD HEAD			SEX		Total
			MALE	FEMALE	
HEAD	AGE	21-25YRS	1		1
		26-30YRS	1		1
		31-35yrs	2		2
		45-50yrs	1		1
		51-55yrs	1		1
		56-60yrs	1		1
		Total	7		7
SPOUSE	AGE	21-25YRS		3	3
		26-30YRS		1	1
		31-35yrs		1	1
		36-40yrs		1	1
		41-45yrs		1	1
		Total		7	7
CHILD	AGE	15-20YRS	1		1
		Total	1		1

3.1.2 Secondary data Collection

Existing records were obtained from the University of Zambia (UNZA) library and World Vision and the Department of Water Affairs in Lusaka. The information obtained was used to better understand the study area.

3.2 DATA ANALYSIS

The data was analyzed using Statistical Package for Social Sciences and Microsoft Excel Software. The data analysis helped bring statistical information to complement the qualitative data and present the information in form of charts and tables.

CHAPTER FOUR

EVIDENCE OF WATER SECURITY AS KEY TO ECONOMIC DEVELOPMENT IN LUUMBO AREA, GWEMBE, ZAMBIA.

4.1 WATER SECURITY IN LUUMBO AREA

The Luumbo spring is located on the slopes of the Hamunyanga Hill in Chief Munyumbwe's area of Gwembe District. The Village Water, Sanitation and Hygiene committee (V-WASHE) is responsible for the care and maintenance of the water supply. This committee comprises of 8 people from the community that were trained by World Vision to collect user fees, carry out sensitizations for issues concerning the water, keeping records of meetings and maintaining the water system. Six of these are male and 2 are female. Every household that has able bodied household heads contributes K4, 500 every month towards their water supply while those households with sick or old household heads of 70 years and over who can still carry out some irrigation activities do so for monthly contributions of K2, 000.

The water runs from 06:00 hours to 18:00 hours during which people are allowed to use it for their various needs. Between 18:00 hours and 06:00 hours of the following morning, the tanks are allowed to fill and any overflow of water that is directed to the sugarcane fields through the overflow pipes. The sealed concrete boxes have been built around the source and also at what is considered as a preliminary treatment point (Figure 2). The sealed boxes protect the source of the spring and contain pipes that lead to the storage tanks. Not all the water is piped to the storage tanks; some water is left for the environment.



Figure 2: Showing the sealed boxes at the source of Luumbo Spring, Gwembe District, Southern Province, Zambia

The main source of water for about 93.3% of households in the area is spring water (Table 3). This shows how important the spring water is for the people. Only 6.7% use the borehole as their main source of water. These are people whose households are far away from the spring and those who just moved into the area.

Table 3: Showing the main sources of water in Luumbo area, Gwembe District, Southern Province, Zambia

	Frequency	Percent	Cumulative Percent
BOREHOLE	1	6.7	6.7
SPRING	14	93.3	100.0
Total	15	100.0	

Households have been using this spring for many generations even before its development. They were using it for domestic purposes, irrigation and for their livestock (Figure 3). This spring was also used as a shrine. The elders of the community would go to give prayers when there was a dry spell or drought and thanksgiving for the rain and good harvest. After the water was piped to residences of the members of the community, it became easier to access the water for various uses.

Many communities have some natural water bodies that they have used for many generations as sources of water. These need to be developed to increase water security in these areas.

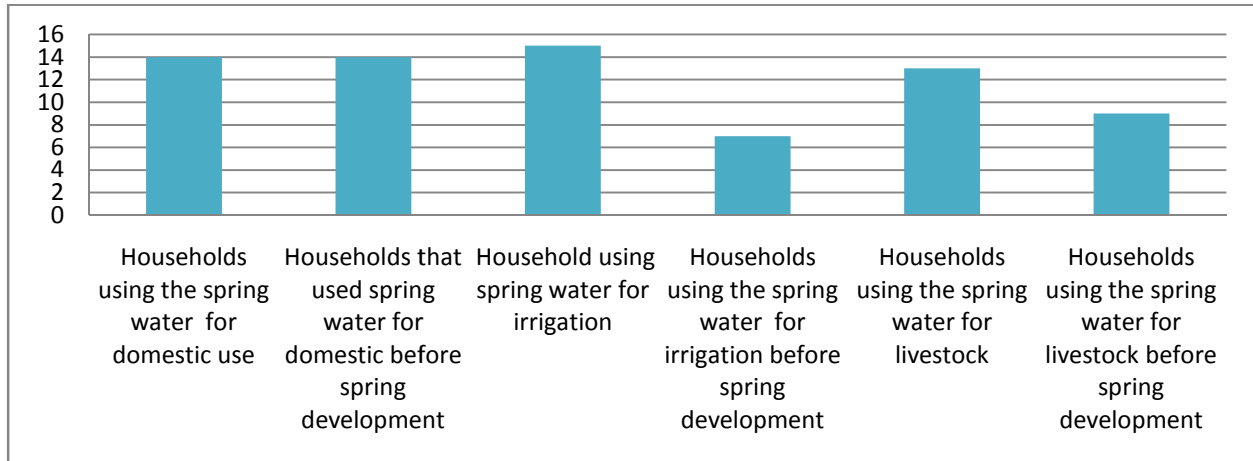


Figure 3: Households using spring water both before and after its development for various activities in Luumbo area, Gwembe District, Southern Province, Zambia

During the dry season, 8 of the 15 households that took part in this study experience water shortages whereas 7 have adequate water (Figure 4). Many of these households are located uphill and are unable to receive water when the pressure is low as the water is driven from the source to the households by gravity.

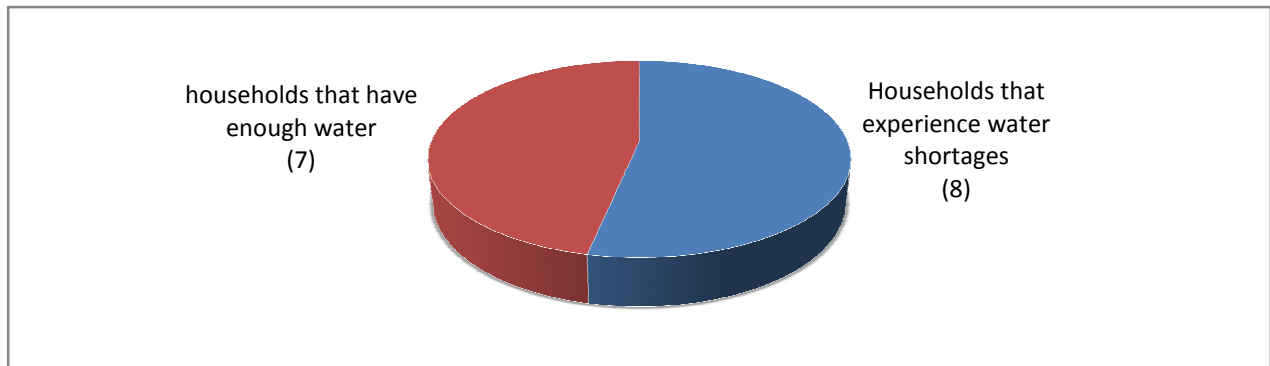


Figure 4: The number of households with water shortages and those with adequate water in Luumbo area, Gwembe District, Southern Province, Zambia

At the time of the study, one third of the households had leaking stand pipes. This means that there is a lot of unaccounted for water. The damages in the water network system are reported to any member of the V-WASHE committee. The committee then would meet to plan for repairs. However, the members of the committee had a tendency of waiting for World Vision staff to purchase for them tools and materials even for minor repairs. This significantly delayed the repairing of the system and led to increase in the damages which in turn increased the amount of water being lost and the cost of repairing. Moreover, the lending of money raised from user fee collections to any members of the community who were in need of financial assistance meant that money would sometimes not be available when needed. As a result (Table 4), 65,004 litres of water out of the 86,400 litres was available every day because 21,396 litres was lost through the leaks in the water system. There were no complaints of water shortages in the rainy season as the majority of households' dedicated themselves to planting maize, a distance away from the irrigation scheme on larger pieces of land. The spring water is mainly used for domestic purposes only hence the 65,004 litres available was more than enough for that use for both villages.

Table 4: The amount of water lost every day through water leakages in Luumbo area, Gwembe District, Southern Province, Zambia

Number of Taps leaking	Average amount of water lost/tap/day (L)	Total average water lost/day(L)
9	2,377	21,396

In the dry season however, a number of households left their taps open from 06:00 hours to 18:00 hours every day for irrigation. These households were located on lower altitude and hence always had water. This usually happened when the demand for the spring water is high. Because of this, the other households could only access the water in the morning from 06:00 hrs to about 10:00 hrs. Beyond this time the pressure is too low for the water to reach households at higher altitudes. Up to 51,903 litres was lost every day when taps were left to run the whole day (Table 5). This shows that many rural farmers do not have adequate information on how much water is need for proper irrigation of different kinds of crops. This leads to wastage of the water resource. The lack of information can be

attributed to many agricultural extension officers having huge areas to cover making them haste through all their areas without properly educating the farmer.

Table 5: The amount of water left to run in fields every day in Luumbo area, Gwembe District, Southern Province, Zambia

Number of taps running throughout the day	Average amount of water lost /tap/day(L)	Total average water lost/day(L)
11	4,718	51,903

Some households left their taps running even if no irrigation activities were taking place in their fields (Figure 5). The members of the community did not understand the value of water because every household paid fixed amount for their water regardless of how much they used. Water demand is not properly managed. The water system had stoppers that could be used to ration the water between the different locations in the area so as to accord all households an equal amount of water or an equal amount of time for irrigation. However, this was not welcomed especially by the households at lower altitudes who had abundant water all day. The difference in opinion over the water rationing was so strong that the two Village Headmen could only resolve the matter with the help of a Senior Headman who did not reside in the area. The resolution was to let the water flow naturally. More sensitization on the importance of sharing the spring water equitably is necessary. This can greatly reduce conflicts over water.



Figure 5: Showing water left to run into a field the whole day in Luumbo area, Gwembe District, Southern Province, Zambia

The types of irrigation practiced in these communities are mainly bucket and horse pipe irrigation. There are about 7 farmers who are setting up small equipment for drip irrigation. This shows that there is some consciousness by some farmers towards improved irrigation.

4.2 WATER DEPENDANT ECONOMIC ACTIVITIES IN LUUMBO AREA

The number of households engaged in different water dependant activities has increased tremendously since the spring was developed. Figure 6 shows the number of households that were using the spring before it was developed and after its development for the various activities. Five households are farming now whereas only 2 used to farm before the spring development. After the spring development, the number of households involved in gardening has significantly increased from 6 to 14. Only 1 household is engaged in fish farming whereas no households were fish farming before the spring development. Because of the abundance of the spring water, agricultural production has increased thereby increasing the economic benefits that are spilling over to expanding production and investment in other activities such as health and education. There is a notable increase in the number of small scale agriculture activities of the two communities increasing significantly the amount of food produced per household whether it is for sale or just for consumption.

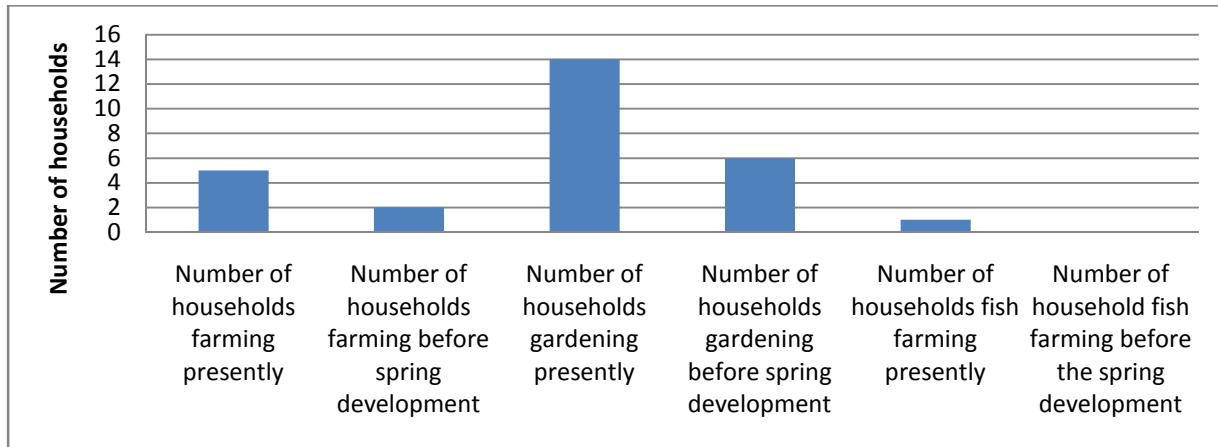


Figure 6: The number of households engaged in various activities before and after the spring development in Luumbo area, Gwembe District, Southern Province, Zambia

In farming, the main crop cultivated is maize during the dry season. Two families grow the crop to supplement the maize grown in the rainy season for consumption while 3 of families sale the extra maize. Many families do not grow maize because it is not as lucrative as vegetables. One household raises less than K150, 000 per harvest whereas 2 households raise between K150, 000 and K500, 000 per harvest (Figure 7). Growing maize in the cool dry season is a means of buffering maize shortages caused when the crop fails due to dry spells or droughts during the rainy season on larger pieces of land a distance away from the piped water system.

Before the spring development, there were no households that were engaged in growing field crops like maize in the dry season because of difficulty in collecting water from the spring. The spring was far away from some households and there were many other activities such as watering animals, bathing, washing that made the spring source to be congested. There were only three households that channeled the water to their gardens hence most of the members of the community could not access the water for farming.

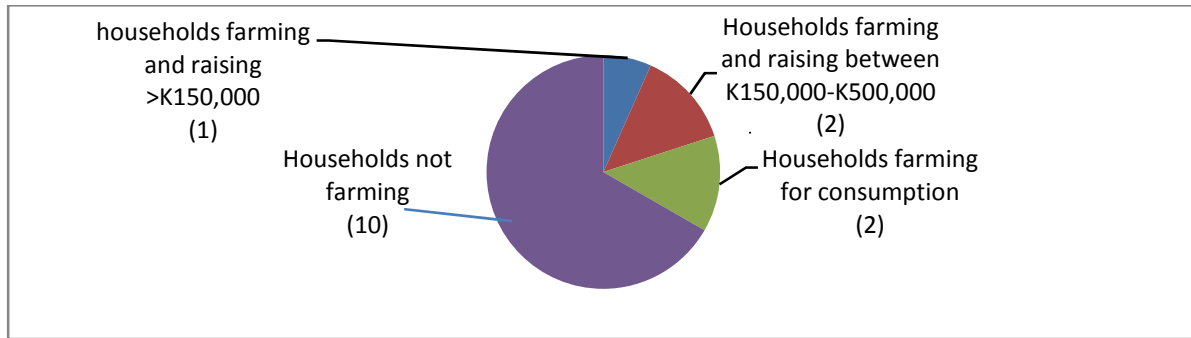


Figure 7: Showing the number of households that are engaged in farming, the amounts of money raised per harvest and those that are not farming in Luumbo area, Gwembe District, Southern Province, Zambia

The most popular activities in Luumbo area are vegetable gardening (Figure 8). The crops that are grown in gardens are rape, cabbages, sugarcane, tomatoes, onions, paprika, oranges, okra and cucumbers.



Figure 8: Showing gardens in Luumbo area, Gwembe District, Southern Province, Zambia

Only 1 household gardened for consumption, whereas the other household raises less than K150, 000 per harvest. Ten households raise between K150, 000 and K500, 000 and 3 households raise between K500, 001 and K1, 000,000 per harvest (Figure 9). Therefore, vegetable gardening is more profitable.

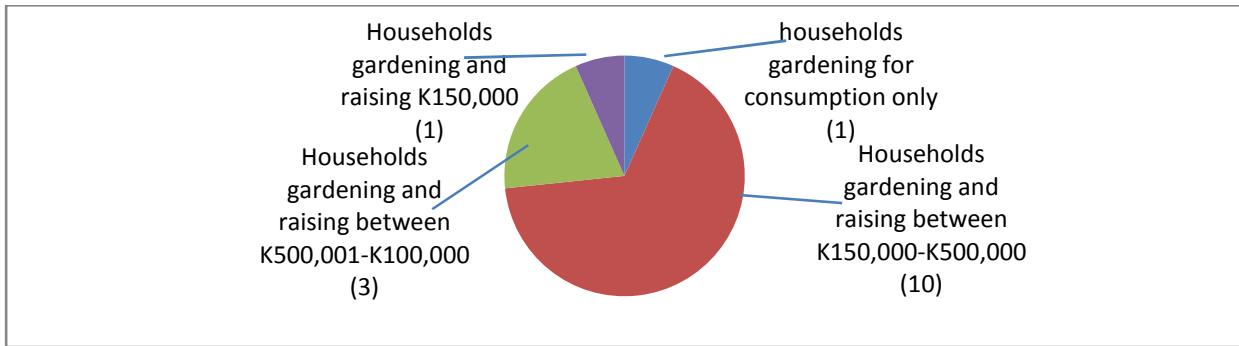


Figure 9: Showing the number of households gardening and the amounts raised per harvest in Luumbo area, Gwembe District, Southern Province, Zambia

Before the spring was developed, 11 households were not gardening. Only 4 households were involved in gardening. Of these, 2 households raised between K150, 000 and K500,000, one household raised less than K150,000 whereas the other households did not have any surplus for sell (Figure 10). This contrast between before and after the development of the spring indicates economic gains in Luumbo area as given by the analysis above. Before the spring was developed, very little farming activities were done implying that opportunities for earning incomes from crop sales were minimal. Both Figures 9 and 10 show these financial gains. Such improvements should be encouraged in many rural communities to improve crop and animal production for better livelihoods.

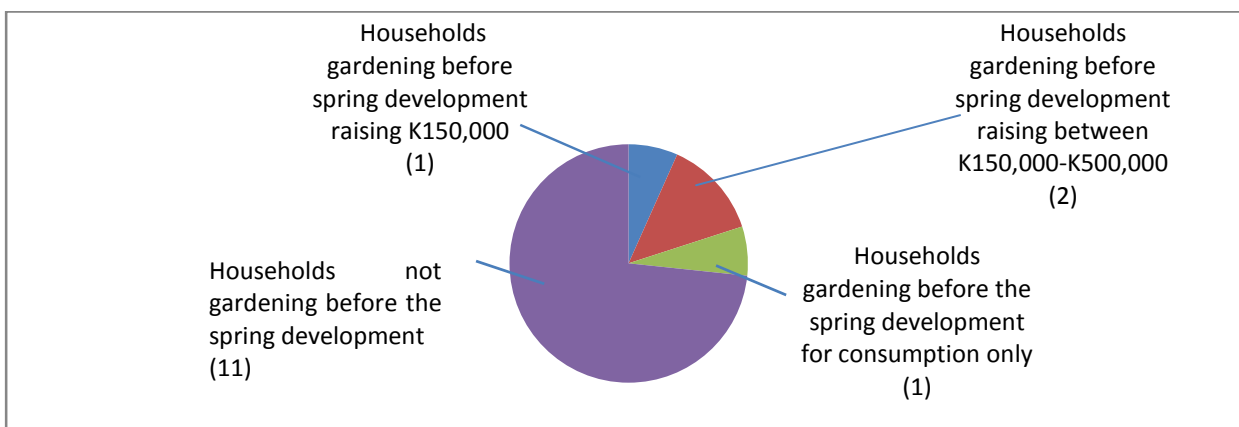


Figure 10: Showing the number of households gardening before the spring development and the amounts raised in Luumbo area, Gwembe District, Southern Province, Zambia

On fish farming, there is only one family that is engaged in fish farming and raises from between K150,000 and K500,000 (Figure 11). About 93% of the households therefore do not engage in fish farming.

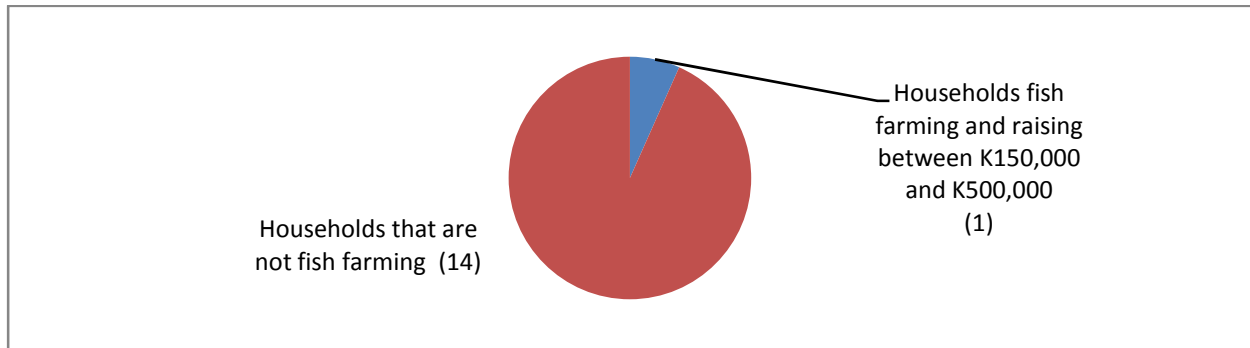


Figure 11: Showing the number of household engaged in fish farming and the amounts raised in Luumbo area, Gwembe District, Southern Province, Zambia

None of the families interviewed engaged in fish farming before the spring development. Some members of the community used to fish from the Luumbo River especially during the rainy season but this river is over 5 hours away therefore, no one has continued to fish after the spring development. Because of the availability of the water, the household decided to build a new bigger fish pond in addition to the old one (Figure 12).



Figure 12: Fish ponds in Luumbo area (a) Fish pond currently being used (b) bigger fish pond under construction, Gwembe District, Southern Province, Zambia

4.3 IMPACT OF WATER DEPENDANT ECONOMIC ACTIVITIES ON THE WELL-BEING OF THE PEOPLE OF LUUMBO AREA

The impacts of abundant availability of water in Luumbo area are employment creation, income generation, food security, improved education and Health.

4.3.1 Employment creation

There is a slight increase in the number of people being employed in agriculture activities (Table 6). The number of males and females employed were 12 and 16 respectively which brought the total to 28. Only about 4 households involved other people in their agriculture activities. The majority of households do not employ anyone during the growing season because almost everyone is busy with their own gardens. The few families that involve other people to help them cultivate bigger fields do so to maximize on their profits.

Table 6: Showing the number of households employing for farming purposes and the number of males and females employed in Luumbo area, Gwembe District, Southern Province, Zambia

Number of Households that employed for Farming Purposes	Total number of males employed	Total number of females employed	Total number of people employed
4	12	16	28

4.3.2 Income generation

Eleven families had a member of their household who had a personal income. One household has an income of over K1,000,000, five have a personal income of between K150,000 and K500,000, five have a personal income of less than K150,000 whereas 4 do not have any personal income (Figure 13). These were incomes mainly earned from the sell of vegetables irrigated using spring water and were used for buying food and other household necessities, paying school fees for children, hospital bills and buying farm implements.

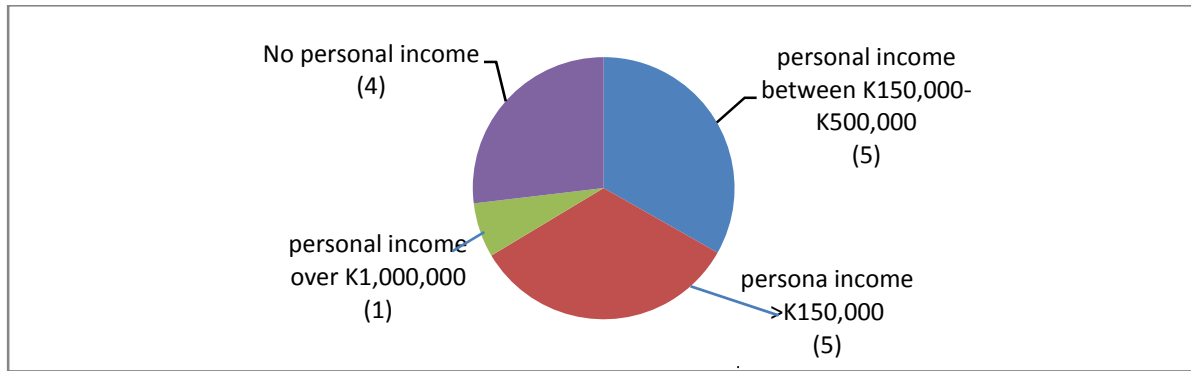


Figure 13: Showing the number of households that have members that have a personal income in Luumbo area, Gwembe District, Southern Province, Zambia

4.3.3 Food Security

Household food security has increased after the spring development in Luumbo area. Ten households usually have food throughout the year (Figure 14). Most of the households have significantly increased their access to food. Their nutrition needs are being met by the food they produce as well as the food they buy from the incomes they raise every irrigation cycle. This has greatly improved their health. Before the spring was developed, however, there were very few households that usually had food throughout the year. None of the households that took part in this study had food usually throughout the year.

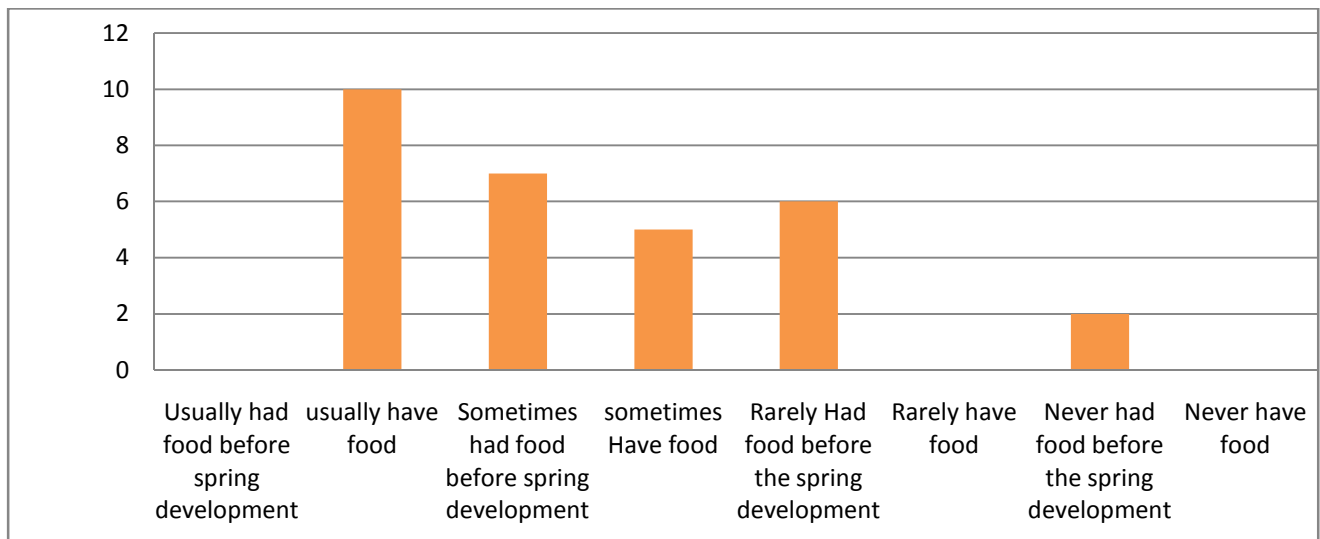


Figure 14: Showing the levels of food security before and after the spring development in Luumbo area, Gwembe District, Southern Province, Zambia

4.3.4 Education

There is no significant difference in the number of pupils enrolled to grade one in the last four years prior to the spring development and four years after its development (Figure 15), however, the difference is in the number of pupils consistently attending class. The number of pupils that were dropping out of school before Grade 7 had significantly reduced. Most of the pupils enrolled for grade one did not complete Grade 7 because they lost interest in school. They opted to help their families in looking for water for gardening and watering their animals.

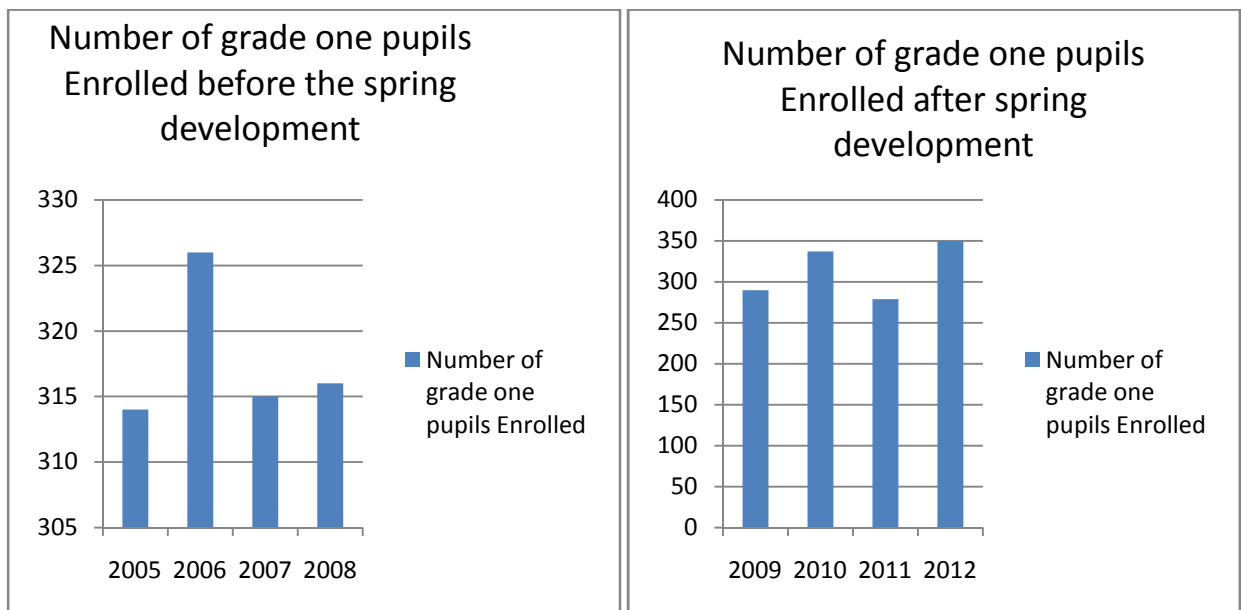


Figure 15: Graphs showing number of grade one pupils enrolled before and after the spring development in Luumbo area, Gwembe District, Southern Province, Zambia

4.3.5 Health

The health of the Luumbo people has improved since the spring developed. Nutrition has increased for almost all beneficiaries' households including in under 5 children due to abundance of food and mother's milk. This has led to improved health due to reduction in exposure to illness and disease. The number of diarrheal cases have also been reducing generally since the introduction of safer water from a borehole in 2005 and also from the development of the spring in 2009 in the area (Figure 16). This has resulted in improvements of household livelihood because healthy people are productive.

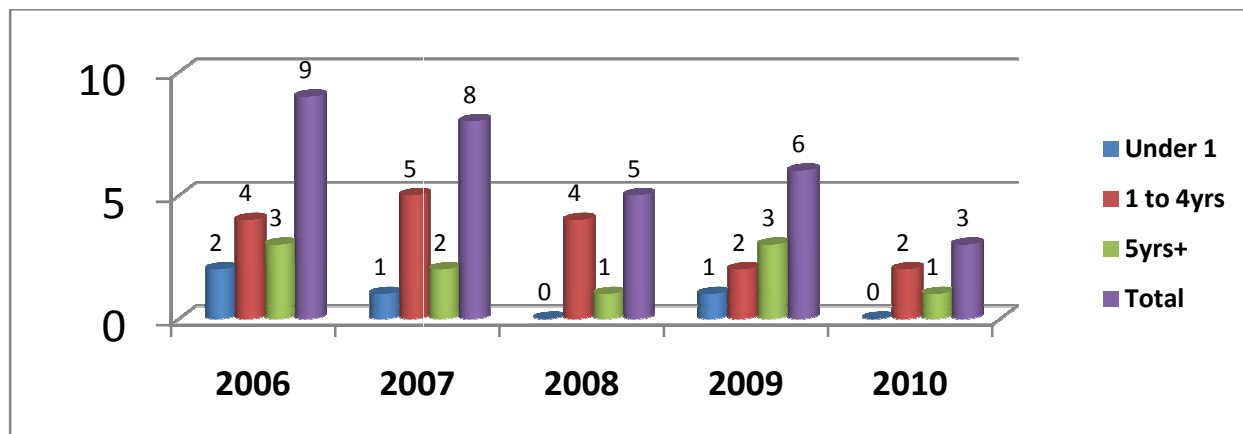


Figure 16: Showing the number of diarrheal cases between 2006 and 2010 in Luumbo area, Gwembe District, Southern Province, Zambia

4.4 QUALITY OF THE LUUMBO SPRING WATER

The bacteriological quality of the spring water at the time of sampling was found to have unacceptable amounts of coliforms whereas the physical and chemical qualities were good (Table 7). The amounts of total and fecal coliforms exceeded the World Health Organization (WHO) and the Zambia Bureau of Standards (ZABS) guidelines for maximum permissible value for drinking water. The values were between 6-38 coliforms with the source having the highest contamination of Too Numerous To Count (TNTC). It is recommended that no coliforms should be found in drinking water giving the acceptable number of coliforms to be zero. Therefore, even one coliform in drinking water makes it unacceptable. The possible source of contamination could have been from the animal droppings as there were a lot of goats and cows in the area. The water was sampled in the rainy season hence there was a possibility of groundwater/surface water interaction which caused the contamination.

The physical parameters of pH (average 7.57), Conductivity (average 310), Total Dissolved Solids (average 155.3), and Total Hardness (average 80) are all within the acceptable WHO and ZABS standards. On the chemical parameters, the Sulphates (average 13.2), Chlorides (average 21.5), Nitrates (average 0.81) and Iron (average <0.01mg/l) are all within the acceptable standards of WHO and ZABS (Table 7).

Table 7: Shows the quality of the Luumbo Spring water, Gwembe District, Southern Province, Zambia

Sample Number:	120377	120378	120379	120380	WHO Guideline	ZABS Guideline
Parameter	Point1 HH	Point2 HH	Source	Source After pre-Treatment	(Maximum Permissible value for drinking water)	(Maximum permissible value for drinking water)
pH	7.48	7.69	7.50	7.61	6.5- 8.5	6.5-8.5
Turbidity (NTU)	0.36	0.33	0.37	0.32	5.0	5 NTU
Conductivity (mMhos/cm)	305	308	313	314	1500	1500
Total Dissolved Solids (mg/l)	159	149	157	156	1000	1000
Total Suspended Solids (mg/l)	<1.0	<1.0	<1.0	<1.0	-	-
Total hardness (as mg CaCO ₃ /l)	76	70	86	88	500	500
Calcium hardness (as mgCaCO ₃ /l)	52	62	62	70	500	500
Alkalinity (as mg CaCO ₃ /l)	71	64	77	79	500	500
Iron (mg/l)	<0.01	<0.01	<0.01	<0.01	0.30	0.30
Ammonia (as NH ₄ -Nmg/l)	<0.01	<0.01	<0.01	<0.01	1.50	-
Sulphates (mg/l)	11.50	14.75	13.70	12.85	250	-
Chlorides (mg/l)	23.0	22.0	19.0	22.0	250	250
Nitrites (as NO ₂ -Nmg/l)	<0.001	<0.001	<0.001	<0.001	0.100	1
Nitrates (as NO ₃ -Nmg/l)	0.36	<0.01	1.22	0.84	10.0	10
Acidity (as mg CaCO ₃ /l)	Nil	Nil	Nil	Nil	500	500
Total phosphates (mg/l)	<0.01	<0.01	<0.01	<0.01	5.0	5.0
Magnesium (mg/l)	5.76	1.92	5.76	4.32	-	-
Calcium (mg/l)	20.8	24.8	24.8	28.0	200	200
Fluorides (mg/l)	0.14	0.15	0.11	0.14	1.50	1.5
Potassium (mg/l)	4.20	5.02	3.74	5.04	-	-
Sodium (mg/l)	20.10	22.04	12.75	18.50	200	200
Manganese (mg/l)	<0.01	<0.01	<0.01	<0.01	0.50	0.1
Bacteriological Results						
Total coliforms (#/100ml)	11	38	TNTC	16	0	0
Feacal coliforms (#/100ml)	6	20	TNTC	8	0	0

In order to maintain the water quality of the spring, during its development, treatment points were installed. The sealed box that receives water from the source is a preliminary treatment point containing stone media (Figure 17). However, it is unlikely that the intended purpose of filtration is done because the media used is not suitable for filtration. Filtration of water is usually done using sand which is arranged according to grain size. The bigger sand grains being at the beginning where the water to be filtered is entering from.



Figure 17: Showing the preliminary treatment point containing stone media in Luumbo area, Gwembe District, Southern Province, Zambia

The water system was fitted with a filter as shown in Figure 18. However, it was removed because it was observed as an inconvenience as it filled with debris quickly. The filter needed to be cleaned every 2 hours. This shows that the importance of having safe water was not fully understood by the community.



Figure 18: Showing a filter between storage tanks in Luumbo area, Gwembe District, Southern Province, Zambia

CHAPTER FIVE

DISCUSSION

Access to water is critical to both the social and economic well being of men, women and children (GRZ, 2007; GRZ, 2005). This study has revealed a number of benefits of water security in the lives of the people of Luumbo area in Gwembe District, Southern Province, Zambia. The benefits are similar to those that have been recognized in many studies at national as well as regional level (Sadoff and Grey, 2007). In fact, they start at local level. Rainfed agriculture has limitations because nature can be unpredictable but when natural resources are sufficiently developed to improve irrigation, returns on investment are tremendous on the quality of the lives of beneficiaries (GRZ, 2005).

It is true that about 80% of Africans rely on agriculture as a means for livelihood (UNEP, 2010). According to this study, the number of people in rural areas depending on agriculture is even higher (About 95%). Luumbo Spring has increased people's access to abundant water for agricultural activities. About 93% of people in the area have access to the spring water. Increased irrigation has brought about opportunities to earn incomes from crop sales. Nearly all the households (14 households out of 15) that were sampled for this study use the spring water for irrigation. Improved access to water has also brought about increased opportunity to water animals and rear even more animals. Fish farming that started after the spring was developed has also improved. The rearing of more animals and fish farming has given the people of Luumbo access to more protein in their diets. At least 14 households from the 15 that took part in this study had improved their generation of income from sale of their agricultural produce. Employment creation in the area had slightly improved by households' engaging other people in their agricultural activities. Similar studies by Churchill (1987) had also observed that one of the major benefits to increased access to abundance water is the improved health of the community which increases productivity through labour supply. Briscoe and de Ferrati (1988) also observed from studies that abundant water increases production of food leading to increased nutritional as well as financial gains.

The Luumbo Spring water has also contributed to improved attendance of school going pupils, reduced drop out cases and increased level of participation in class. This is due to reduced distance of collection of water and increased incomes which have enabled parents to take their children to school (World Vision, 2011). Other factors such as increased sensitization on the importance of education and government free primary education policy, however, have also played a role in this improvement. The Luumbo spring water has also helped improve the people's health (World Vision, 2011). This has been by way of reducing the number of diarrheal cases and improving nutrition through improved food production. This is in line with the government of the Republic of Zambia's goals of improving its citizen's health through improved rural water supply and sanitation (GRZ, 2007). Improved feeding has reduced exposure to illness and diseases. Churchill (1987), Briscoe and de Ferrati (1988) observed these socio benefits such as free time for leisure, caring for families and for education especially for the girl child. A study in Kenya showed that infrastructure improvements on springs brought about reduced child reported diarrhea cases due to low fecal contamination reducing health care costs on the government (Kremer et al, 2011).

The indicators of socio-economic benefits of water security that have been observed in this study have also been observed in other parts of the world where similar studies have been carried out (UN-HABITAT, 2008). These indicators include increased agriculture productivity and income generation, economic empowerment, improvements in the areas of health and education and general improvements of the socio wellbeing of the people especially women and children. The people of Luumbo area are now more water secure since investment was made to improve the infrastructure. This has reduced human suffering in terms of disease, hunger, sustained poverty and constrained growth. This is similar to observations of Sadoff and Grey (2007) in their study on Water Security for Growth and Development in selected sub-Saharan Africa where Zambia is located.

Notwithstanding the social economic benefits realized from the water supply in the study area, the chemical and physical qualities of the water that is within the WHO and ZABS permissible limits, the microbiological quality of the water in Luumbo could not meet the

WHO (2008) and (ZABS, 2008) minimum requirements of nill faecal and total coliforms per 100ml of water meant for drinking (Table 7). Hence like elsewhere in the world as noted by Goulburn-Murray, 2010 and SDII Global Corporation, 2004, there is need for rigorous protection of the water resource. It is in this regard that resource protection should be an integral part of the management of the spring to insure sustained benefits. There is need to establish the boundaries of the spring protection zone, study of the hydrogeology in order for the most vulnerable areas of the spring to be identified for proper management measures and limit access to the public.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

From the findings of this research, it is clear that water security brings about economic development. The economic benefits of water security in Luumbo area include increased agricultural productivity, good health, improved education and improved food security.

This is indicated by the increased number of households that are engaged in production of different crops (14 out of 15 households). This has increased income generation from crop sales (between K150,000 and about K1,100,000) every irrigation cycle and improved household food security. This has empowered farmers to buy inputs such as fertilizers and drip irrigation equipment to improve irrigation and crop yields. The health of the people in the area has been improved due to reduced diarrheal diseases and improved nutrition. There is improved socio wellbeing especially for women and children as the burden of looking for and collecting water has been removed. There is more time for families to do more gardening, house chores and leisure due to reduced distance to water points. The chemical and physical water qualities in Luumbo satisfies the WHO/ZABS permissible limits but does not meet the nil faecal and total coliforms per 100ml of water meant for drinking.

6.2 RECOMMENDATIONS

Based on the findings of this research, the following are the recommendations:

- The Ministry of Agriculture through the Agriculture Extension Officers to carry out more sensitizations on the irrigation techniques that conserve water but meet the crop water requirements for the crops grown in such communities.
- The Ministry of Agriculture to encourage growing of drought resistance crops in areas like Gwembe where crop failure is caused by lack of adequate water coupled

by high rates of evapotranspiration due to the high temperatures as opposed to just providing farming inputs that encourage the growing of maize.

- That World Vision as the NGO that has installed this water system to provide more education and training to the Village Committee on the importance of cleaning of the source without contaminating it. There is also need for more sensitization on the importance of treatment of the water either by chlorination or/ a filtration system that is simple enough to be handled by the community.
- There is also need for sensitization of the community about conflict management and the importance of owning the water system by World Vision and the Department of Water affairs.
- That in the rural areas, Government should find solutions that are suitable for indigenous geographic areas in terms of cost, technology and practicality for water from sources that have been used by communities for many generations.
- Regular cleaning of the mouth of the spring to avoid algae growth by the community.
- The area immediately upstream of the spring should be protected from animal as well as human defecation by the members of the community.

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Appendix 1: Evidence of water security as key to economic development: A case of Luumbo Spring, Gwembe District, Southern Province, Zambia

A. Demographic Information

1. Sex
(I)Male (II) Female
2. Age.....
3. Relationship to household owner.....
4. How many people live in the household?

B. Water security

5. What is the main source of water for the members of this household?
(I)Borehole (II) well (III) spring (IV) other (specify).....
6. Do you have any other source? (I) yes (II) no
If yes, explain.....
7. How long does it take you to go to the source(s), get water and come back?
(If one of the sources is spring water)
8. Did you use the spring as a source of water before it was developed and why?
(I) Yes (II) No Why?
9. If yes, how long did it take you to reach the spring, collect water and come back?
.....
10. What did you use the spring water for and why?
(I)Domestic use (II) Irrigation (III) for livestock (IV) other
(specify).....
Why.....
11. What do you use the spring water for and why?
(I)Domestic use (II) irrigation (III) for livestock (IV) other
(specify).....
Why.....
12. Do you experience water shortages? (I) yes (II) no
13. If yes when? (I)During the dry season (II) throughout the year
14. Is the water enough for all the activities that you need it for? (I) Yes (II) No
If no, explain.....

15. Who manages the spring?

- (I)Community members (II) Nongovernmental organization (NGO) (III) Government

16. Do you pay to access the water? (I)Yes (II) No

17. If yes, how much do you pay?

18. Is what you pay used to maintain the spring? (I)Yes (II) No

C. Economic development

19. **Income** What are the income generating activities related to water this household engages in and how much is realized per harvest?

Activity	Amount	Activity	Amount
.....
.....
.....
.....
.....
.....

20. Who runs these activities?

21. Have you employed anyone to help with these activities? I)Yes (II) No

22. If Yes, how many? (I) female..... (II) Male.....

23. What do you use this income for? (Probe if business creation or expansion is one use).....

.....

.....

24. What income generating activities related to water were you involved in before the spring development and how much was being realized per harvest?

Activity	Income	Activity	Income
.....
.....

.....
.....

25. Did you employ people to help you? (I) yes (II) no

26. If yes, how many? (I) female..... (II) male.....

27. Do you have a personal income? (I) yes (II) no

28. If yes, how much is it?

29. What do you use it for?

.....

30. Have you acquired more animals since the spring development? (I) yes (II) no

31. Have you seen any changes since the development of the spring? (I)Yes (II) No

32. If yes, what is the difference in terms of?

a. **Health**-Since the spring development, do you usually have cases of diarrheal diseases in the household, sometimes have diarrhea cases, rarely have diarrhea diseases or never have diarrhea diseases? (I) usually (II) sometimes (III) rarely (IV) never

b. What was the situation before the spring development? (I) usually (II) sometimes (III) rarely (IV) never

c. **Time**-do you have more time for other things since the spring development? (I) yes (II) no

d. What do use it for?

e. **Education**-Do the children from this household go to school? (I) yes (II) no

What was the situation before the spring development?

.....

f. Has any member of this household acquired skill to better use water for your advantage?.....

g. **Food security** these days, would you say that this household usually has enough food to eat, sometimes has enough food to eat, rarely has enough food to eat, or never has enough food to eat? (I) usually (II) sometimes (III) rarely (IV) never

H. When does this happen? (I) throughout the year (II) part of the year
(specify).....

I. What about before the spring development? (I) usually (II) sometimes (III) rarely (IV)
never

J. When did that happen? (I) throughout the year (II) part of the year (specify).....
.....