ANALYSIS OF SOCIO-ECONOMIC IMPACTS OF URANIUM EXPLORATION IN VILLAGES PARTICIPATING IN MBARANG'ANDU WILDLIFE MANAGEMENT AREA IN NAMTUMBO DISTRICT, TANZANIA

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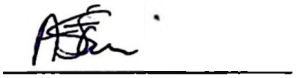
ABSTRACT

The rising demand for Uranium to produce nuclear energy has led to increasing interest on Uranium exploration activities in Tanzania. Tanzania reported on-going exploration The findings show that 60% of the household were of opinion that Uranium exploration has positive socio-economic impacts in their area and the remaining 40% indicated that it has negative impacts activities for Uranium in Wildlife Management Area. The aim of this study was to assess socio-economic impacts of Uranium exploration in three villages participating in Mbarang'andu WMA in Namtumbo District. The socio-economic activities in the study area were assessed in relation to Uranium exploration, determined the effects of Uranium exploration on the livelihoods of local community and examined the impact of Uranium exploration on conservation activities carried out in the villages participating in Mbarang'andu WMA. Random sampling procedure was employed to select a total of 90 households from the three villages. Data were collected through questionnaire, checklist, focus group discussion, field observation by the researcher and literature search. One third of the sample household realized increased in household income was due to Uranium exploration while majority are not sure whether the change in their income due to exploration as they were not directly participating in exploration activities. Findings indicate that conservation activities encounter difficulties due to Uranium exploration. The number of beekeepers have decreased at significant rate through ($r = -0.84$, $p = 0.008$) due to Uranium exploration. Similarly honey production per beehive has decreased, at non significant rate ($r = 0.321$, $p = 0.436$). The study concludes that there are both positive and negative impacts of Uranium exploration. The study recommends that the Government should involve local communities during establishment of exploration activities in their area. Companies doing exploration should develop and implement the conservation measures to sustain community and conservation activities.

DECLARATION

I, Jonas Aleningwa, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.



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DEDICATION

This work is dedicated to my parents, my father Mr. Jonas Swai and my mother Mrs. Ester Tillya who laid the groundwork of my education and dedicated much of their kind support and financial resources to sacrifice for my education.

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LIST OF ABBREVIATIONS AND ACRONYMS

ACE	Atlas Copco Exploration
ADAP	Association for Development of Protected Areas
ADBG	Africa Development Bank Group
CSR	Corporate Social Responsibility
ELAW	Environmental Law Alliance Worldwide
FGD	Focus Group Discussion
GDP	Gross Domestic Product
IRA	Institute of Research Assessment
IIED	International Institute for Environment and Development
MMSD	Mining, Mineral and Sustainable Development
MNRT	Ministry of Natural Resources and Tourism
MWC	Mining Watch Canada
NFM	Natural Forest Management
NGOs	Non- governmental Organizations
OECD	Organization for Economic Co-operation and Development Tanzania
REPOA	Research on Poverty Alleviation
SGR	Selous Game Reserve
SPSS	Statistical Package of Social Science
TANGO	Technical Assistant to Non Governmental Organizations
THDS	Tanzania Health and Demographic Survey
TZS	Tanzania shillings
U	Uranium
UBA	Uranium and Human Biomonitoring from the Commission of Germam Federal Environment Agency

UNDP	United Nations Development Programme
URT	United Republic of Tanzania
WISE	World Information Service on Energy
WMAs	Wildlife Management Areas
WRM	World Rainforest Movement

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

In Tanzania the area occupied by land as measured in 2010 was 885 800 Km^2 (World Bank, 2012). REPOA (2013) reported that a large portion of land (28.7%) is under conservation. Another portion (21%) is under scattered village settlements while agriculture and mining cover 17% (Makwariba and Ngowi, 2012). Mineral sector was reported to grow from 3.2 % in 2002 to 4.6 % GDP contribution in 2013 (World Bank, 2012).

Mineral sector is currently the second fastest growing sector in the Country after tourism (World Bank, 2012). Commonly proven mineral deposits include gold, diamonds, tanzanite, ruby, tin, copper, nickel, iron, soda, phosphate, gypsum, kaolite, coal, natural gas and Uranium (Makwariba and Ngowi, 2012). The government sees the exploitation of these mineral deposits as a significant contributor to growth and socio-economic transformation and as a catalyst for growth in other sectors such as agriculture, manufacturing, infrastructure and services.

In the last decade, Uranium exploration in Tanzania experienced fast growth and attracted various mining compamnies to invest in the Uranium exploration and mining activities. Some of these companies have on going activities in the central and southern part of the country including Bahi in Dodoma and Namtumbo District in Ruvuma (Ngowi, 2011).

The increase in demand of Uranium in the world has made the Uranium resource highly demanded, hence leading to increase in prices of this commodity that was previously not profitable. Exploration for minerals is generally the first in a series of activities towards the development of mineral resources. It usually involves low-impact geological

assessments, which determine the location of potential sites. Twenty per cent of the world's mined Uranium is produced from Africa countries such as Niger, Angola, Malawi, Namibia and South Africa. This percentage is expected to increase in the future (Scheele and Vlasblom, 2011).

Uranium in Tanzania was first discovered in Chiwiligo pegmatite in the Uluguru Mountains in 1953. The first general evaluation of Uranium potential in Tanzania was done by conducting a countrywide airborne geophysical survey for the Government between 1976 and 1979 (OECD, 2010). The places in Tanzania where Uranium is said to have commercial quantities include Namtumbo in Ruvuma, Bahi in Dodoma and Manyoni in Singida (Ngowi, 2011). Uranium is being explored in different parts of the country and it is estimated that Tanzania possesses 54 158.9 tonnes of Uranium oxide deposits, valued at 3 630 billion shillings.

According to Kidegesho *et al.* (2010). Namtumbo District has three Wildlife Management Areas (WMAs) namely Kimbanda, Kisungule and Mbarang'andu. The study further indicates different economic activities such as hunting tourism, live animal sale, photographic tourism, fish farming, lumbering, beekeeping and Uranium exploration conducted in WMAs in the District.

Feasibility studies conducted at Mkuju River project in Namtumbo confirmed mineable ore reserve base of 29 710.03 tonnes with an average annual production of 1 905.09 tonnes over a minimum of 12-year mine life (WISE, 2013). The project is believed to bring in Foreign Direct Investment of approximately 742 500 million shillings, which is 2.1% of Tanzania's GDP based on 2012 figures.

1.2 Problem Statement and Justification

The rising demand for Uranium to produce nuclear energy has led to an increasing interest in Uranium exploration activities in Tanzania in recent years. Mining has a number of common stages or activities, each of which has potentially-adverse impacts on the natural environment, society, cultural heritage, the health and safety of mine workers, and communities based in close proximity to operations (Kitula, 2005). Uranium surveys conducted in Tanzania have indicated that there are numerous deposits in different parts of the country; some of deposits are extending to reserved areas including the WMAs (Baldus, 2009). In Namtumbo, Uranium exploration gained popularity in recent years and has attracted investors and mining companies from different parts of the world (Ngowi, 2011). Over ten mining companies were given prospecting and mining licenses in Namtumbo District for up to the year 2016. Of these mining companies four have on-going activities in the area. These are Mantra Tanzania Limited, Frontier Resources Ltd, Uranium Resources and Western Metals Ltd (Noe, 2013).

Recent study by Noe (2013) in Namtumbo District reported that villagers have serious concerns over Uranium exploration in Mbarang'andu WMA. The use of heavy machines and chemicals might cause disturbances and force animals to seek refugee outside their areas, hence intensifying the already existing human-wildlife conflicts. Also they complain that some livelihood activities that are relevant to conservation are no longer possible due to the health threats from Uranium exploration in the vicinity (Noe, 2013).

The study by IRA (2007) which was focused on assessment and evaluation of WMAs discovered that it is difficult to conduct conservation activities and Uranium exploration at the same area without causing conflicts. Another study by Sengelela (2013), which focused on cost and benefit of conservation in WMAs, reported the existence of conflict of interest between conservation activities and Uranium exploration in the area.

The reviewed studies mentioned above have less quantitative and qualitative information on socio-economic impacts of Uranium exploration in the villages' participating in formation of Mbarang'andu WMA in Namtumbo.

Findings from this study will provide information about the socio-economic impacts of Uranium exploration to the villages participating in formation of Mbarang'andu WMA and reveal useful and applicable information to the policy makers, environmentalists and other stakeholders towards creating sustainable socio-economic policies guiding Uranium exploration in Tanzania. Furthermore, the findings will be useful reference to other researchers who are interested to work further in Uranium studies.

1.3 Objectives

1.3.1 Overall objective

The overall objective of this study was to analyze both positive and negative socio-economic impacts of Uranium exploration in villages participating in formation of Mbarang'andu wildlife management area in Namtumbo District.

1.3.2 Specific objectives

The specific objectives were to:

i) assess socio-economic activities impacted by Uranium exploration in the villages participating in formation of Mbarang'andu WMA

ii) determine the effects of Uranium exploration to the livelihoods of local communities in the study area

iii) examine the impact of Uranium exploration on conservation activities carried out in Mbarang'andu WMA

1.4 Hypothesis

H_1: Uranium exploration activities have significant negative impacts on the villages participating in Mbarang'andu Wildlife Management Area.

1.5 Research Questions

1. What are socio-economic activities impacted by Uranium exploration?
2. Is there any change in livelihood as results of Uranium exploration in their area?
3. Do Uranium exploration activities impact on conservation activities in WMA?

1.6 Conceptual Framework

The conceptual framework for this study (Figure 1) assumes that Uranium exploration have both direct and indirect impacts to the Wildlife Management Areas which will result to positive and negative socio-economic impacts to local communities, institutions, local and central governments which need government attention for sustainable WMAs.

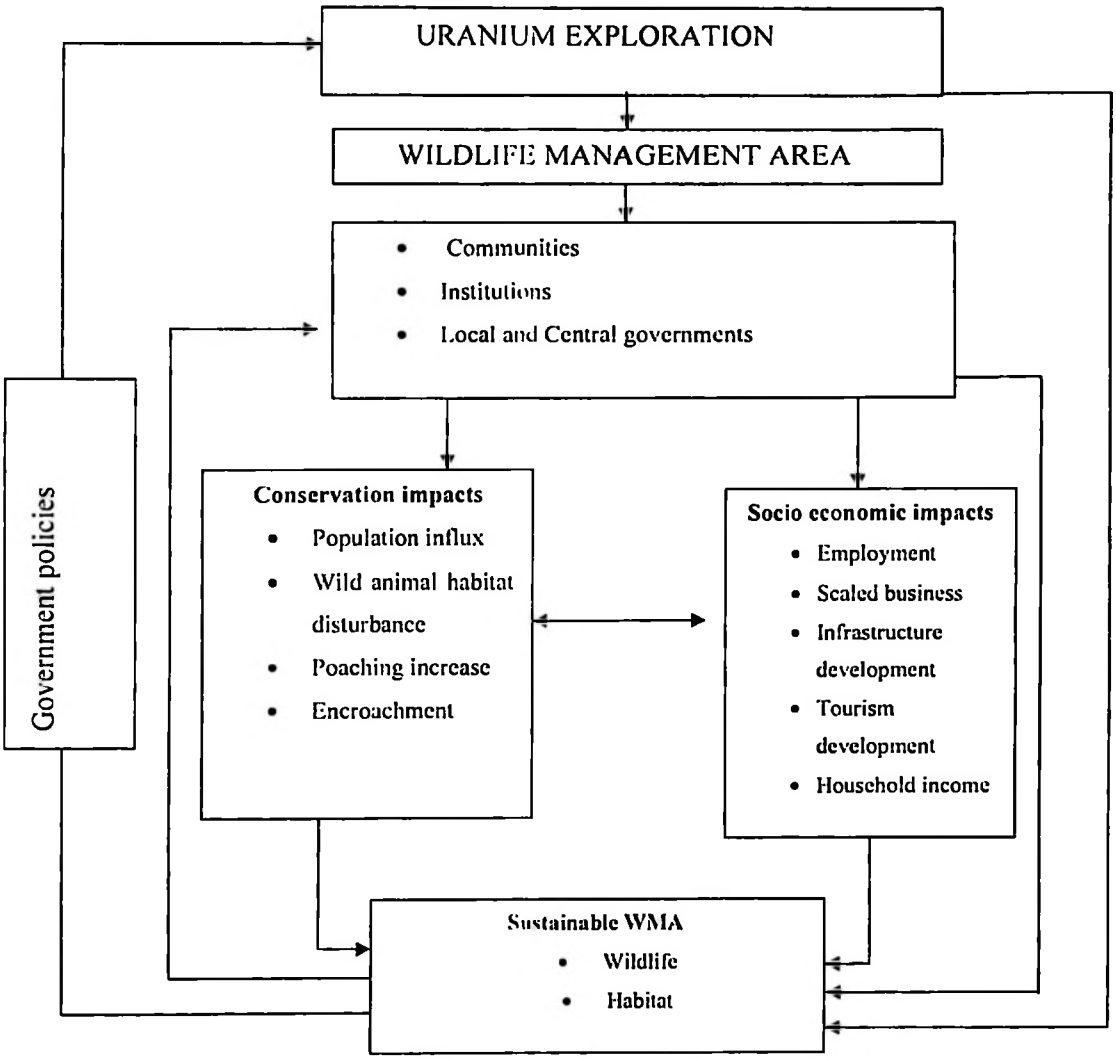

Figure 1: Positive and negative impacts of Uranium exploration in WMA

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview of Mineral Exploration

The last decade and a half has witnessed a dramatic growth in mineral activity in many developing countries. Mineral exploration and mining has also been associated with environmental and social impacts to the communities (Aspinall, 2007; Ross, 2008). Tanzania is known to have abundant mineral resources which are distributed in different places in the country. The type, quantity and distribution vary with geographical location (Kitula, 2006).

Noe (2013) mentioned over ten companies involved in mineral exploration in Tanzania. Many of these companies were interested in the Uranium Exploration. The companies with on-going exploration activities in different places in the country includes Uranex NL, Omegacorp Ltd, Mantra Resources Ltd, Uranium Resources plc, Sabre Resources Ltd, Uranium Hunter Corporation, Trimark Explorations Ltd., Mineral Evaluation Ltd., Vision Geosources Co Ltd, TanzOz Uranium Ltd, Montero Mining and Exploration Ltd.

REPOA (2013) indicated that mineral sector contributes 4.6% to GDP and this could rise considerably in future years. Gold counts proportionally large shares of revenue from the mineral sector. Other minerals including Uranium ranked Tanzania among the best producers in Africa. Thus, estimated Uranium quantity after investigation has placed Tanzania third in Africa in Uranium production after Niger and Namibia (WISE, 2014). Mineral exploration reported to have economic, social and environmental impacts which need critical analysis before commencing the activity (Korppi, 2013). Uranium (U) is a natural, radioactive and chemo toxic heavy metal, which is found in traces in rocks, soils, plants and water (Merkel and Hasche-Berger, 2008). Uranium is a heavy metal known to

be toxic in nature and it is unavoidably taken up with solid and liquid food, it is also a potential health risk and may affect all forms of life due to radiation from Uranium isotopes and its decay elements (UBA, 2005; Schnug and Haneklaus, 2008; Coetzee and VanWyk, 2008).

2.1.1 Environmental impact due to exploration

Mineral exploration is an activity that needs to be very properly planned with all possible impacts anticipated, identified, evaluated and mitigation, measures planned because it is a short-term activities with long-term effects (Abdus, 2008). At the beginning of a mineral exploration project, environmental disturbances are restricted to the momentary noise caused by airborne measurements (Korppi, 2013). Mineral exploration involves several stages which usually begin with target identification followed by investigation. Investigation stage has more impact in environment compared to other stages as it is comprised of physical land disturbance such as, site clearing, drilling, logging, trenching, pitting, and sinking shafts. Investigation for water availability, land surface, and infrastructure for buildings and roads for exploration has impact on the environment (Huang, 2008).

According to (Korppi, 2013) investigations before drilling do not significantly change the state of environment, leaving the scenery, soil, and surface or ground water intact. However, in advanced stages where heavier machinery used, the environmental impact grows and an exploration license is required (ACE, 2010; Korppi, 2013). Mining companies have typically devoted few resources during exploration for monitoring and managing, in an on-going way the impacts of their operations on the environment and surrounding communities (Brereton and Forbes, 2004).

In Australia for instance, Brereton and Forbes argues that most Australian exploration have assigned a lower priority to the environmental impacts than to workplace health and safety performance and that issues relating to environmental impacts have mainly been addressed at the project approval stage, when environmental impact assessments are being prepared (Brereton and Forbes, 2004).

In fact, environmental impacts of exploration and mining are well documented and the literature abound with environmental impacts in the form of waste management, impacts to biodiversity and habitat, deforestation of land with the consequent elimination of the vegetation, pollution (water, air, land and even noise pollution). In Ghana and many other tropical areas of mining, it is noted that exploration is among the major cause of deforestation and forest degradation, generating a large number environmental impacts (WRM, 2004).

2.1.2 Economic impact of mineral exploration

Exploration is an activity regarded as a non revenue source to the mining companies but it falls on the expenditure (MMSD, 2002). However, on the other hand mineral exploration activities help to create income to local communities through their involvement in the overall process (Hohn, 2009). Exploration is a major contributor to economic development and poverty reduction in the areas of operation (UNDP, 2003).

Kennedy (1997) observed that societies and economies depend heavily on the extractive industries in the stages of exploration, extraction, refining, recycling, transportation, and use of minerals. Companies provide direct and indirect employment, economic development, and a means of meeting basic needs. Governments often receive a good deal of income in the form of taxes and royalties, yet they are under increasing scrutiny over how they allocate revenues earned from such companies (UNDP, 2003).

2.1.3 Social impacts of mineral exploration

In terms of the social impacts of mineral exploration projects arouse two kinds of reactions locally: approval or opposition by the local community (Moon *et al.*, 2006). It is frequently emphasized that mineral exploration companies should engage with social issues and create enabling environment for the community (Moon *et al.*, 2006; Nelsen and Scoble. 2006; Deloitte 2012). So as to share relevant information as well as participate in the activities carried out by those companies. Meeting local stakeholders' expectations is often pinpointed in the literature (Hohn, 2009; Eerola, 2013). Socio-economic is defined as the interrelations of environment, social and economic dimensions that determine the patterns of development (Huisinga, 1997). It involves the social systems where people interact through roles and relationships defined by gender, age, ethnicity, and other social variables and economic strata.

Thomson and Joyce (2000) introduced four challenge implications related to the characteristics of mineral exploration. Firstly, mineral exploration is framed by technical and economic restrictions and requires setting all activities under significant economic pressure. This can lead to companies' unwillingness to invest in social projects. Secondly, the risky industry is characterized by an atmosphere of secrecy and competition, restricting mineral exploration companies' readiness to open disclosure. Thirdly, from the mineral exploration companies' point of view, the success rate of mineral exploration is very low. This may lead to mineral exploration companies' perception of not being able to promise anything to their local stakeholders. Fourthly, contributions to local employment might lead mineral exploration companies to reason that no more social investments are necessary.

According to Wilson (2004), large discrepancies exist in the literature because many studies fail to consider specific characteristics of exploration activities, therefore not

capturing many potential socio-economic consequences (Ripley *et al.*, 1996). It was estimated that over 13-year period the economic activities surrounding Uranium exploration in Bahi Swamp including farming, fishing, cattle-herding and salt production far exceeded the potential economic benefits such as taxation, employment and investment in infrastructure that a Uranium mine could bring. Interaction of these activities enhances the social economic status of the adjacent communities (Mitchell, 2013).

2.2 Uranium Exploration in Tanzania

In the 1970s radiometric survey showed several radiometric anomalies pointing to Uranium enrichments in the South of Tanzania as well as in an area around Bahi in central Tanzania. Currently more than 25 companies from different countries are exploring for Uranium in Tanzania (WISE, 2014).

During the last years these possible deposits got into the focus of the international Uranium mining industries. For example, the Australia based corporation Uranex NL WISE (2013) has managed to get rights over exploration tenements of more than 12000 km^2 since the corporation was founded in 2005. The Uranex exploration was very successful; they published a pre-feasibility study in 2008 and are ready to start mining operation in the Bahi Swamp area. Mantra Resource company recently published an initial resource description expecting 39.9 million tonnes of U3O8 in Southern Tanzania. The government already issued 70 licenses for mining Uranium to different companies while exploration activities is going on and extended to the WMA (Noe, 2013).

2.2.1 Uranium exploration in wildlife management areas

In Tanzania the creation of WMAs serves two main and interrelated goals, these are to release communal land for nature conservation, including conservation outside formally

protected areas and as a prerequisite for realizing plans for Trans-frontier Conservation Area (Ramutsindela and Noe, 2012). Bowen (2010) commented that exploration does not always lead to mining, several exploration activities can be done but few may result to mining as mining depends on level of commercial ores identified.

Uranium exploration in the southern part of Tanzania raised attention of many people after extension of the activities in the WMA and Selous Game Reserve. Mbarang'andu is the first WMA in the Country to have Uranium exploration and prospects mining in Namtumbo district (Noe, 2013). The Government of Tanzania allows Uranium exploration in Namtumbo District with no clear resolution of the existing conflict between villagers against the benefits from the WMA (Ngowi, 2011).

The change of village land into conservation has entailed an irrevocable change of land and other resource tenure. The use of WMAs and the economic gains from investments in them are not determined by community members, but the relations of power at higher levels including the government ministries, investors and local elites (Noe, 2013). As a result, the circumstances in Mbarang'andu show the impact of Uranium exploration with the associated social economic impacts as the result of discrepancy in mining law.

2.2.2 Uranium exploration to the livelihoods of local community

Uranium exploration can create new communities and bring wealth to those already in existences, but it can also cause considerable disturbance. During exploration new projects can bring jobs, business activities, roads, schools, and health clinics to remote and previously poor areas, but the benefits may be unequally shared, and for some they may be poor recompense for the loss of existing livelihoods and the damage to their environment and culture (Heledd and Louise, 2008). Exploration increasingly occurs in remote regions with little or no development. By nature of their remoteness, the areas to

be explored are frequently ones where the title to land is in doubt and where local government lacks the capacity to provide essential services or to mediate between mining companies and local communities (MMSD, 2002).

Livelihoods are understood as a collection of activities performed on daily basis with the aim of meeting basic needs such as food, housing and securing monetary income. These activities include production of crops, rearing livestock, making handcrafts, seasonal and permanent wage labor as well as remittances (De Haan, 2000). It is emphasized that, livelihoods do not only depend on access to capitals but also on how the use of these capitals is framed in the wider social, economic, political and cultural contexts (Dreze and Sen, 1989). In this way, livelihoods are increasingly becoming diverse, as individuals and households pursue multiple occupations in multiple areas (De Haan and Zoomers, 2003). For example, Uranium exploration companies can provide employment opportunities, implementing corporate social responsibility (CSR) initiatives like enhance community access to better health services, education, safe water supply and improved infrastructures. This in turn, may improve household income and thus diversified rural livelihoods. This complex web-of assets, access, capacity and capability offer the households and local institutions layers of flexibility that would enable generation of waves of opportunities (Glavovic *et al.*, 2002).

2.3 Impact of Exploration on Conservation Activities

Since most local communities have for many years interacted with wildlife in their areas, efforts to ensure sustainability have been focusing on involving local people in conservation. Conservation of WMAs is a shared responsibility and local communities must significantly benefit from it (Buscher and Whande, 2007). Human population size and growth rates is helpful in setting conservation priorities, because population density may be used to determine resource use intensity and act as a substitute measure of the degree to which wildlife resources in WMAs are under threat (Wilfred, 2010).

For instance Mung'ong'o and Mwamfupe (2003) reported that high population density in Kilosa district has significantly contributed to devastation of natural resources and its rapid development. The demand for a better quality life has also encouraged illegal hunting of wildlife for both commercial and subsistence purposes.

Their conservation roles were run as business entities parallel to other production systems in the village land determined by the land use plans (Kulindwa *et al.*, 2003). Where exploration is in the first stage, during exploratory phase it involves clearing of wide areas of vegetation (typically in lines), to allow the entry of heavy vehicles mounted with drilling rigs (ELAW, 2010). Each step is associated with interference of biota through the removal of vegetation and top soil, the displacement of fauna, the release of pollutants, and the generation of noise.

The social impacts of Uranium exploration projects are controversial and complex. Mineral development can create wealth, but it can also cause considerable disruption (ELAW, 2010). The exploitation of mineral resources is now considered to be one of the chief causes of pollution in Tanzania, though there is growing realization that mining activities can be undertaken in a fashion where by economic contributions are maximized, social conditions are improved, and damages to the environment are minimized (Kitula, 2005).

2.4 Mineral Exploration and Socio-eeconomic Development

Literature suggests that strong economic growth and development from resource extraction activities should be properly monitored in order to sustain the community livelihood and environment (Ross, 1999; Sachs and Warner 1999; Watts, 2005; Rosser, 2006). In line with WMA objectives various activities were carried out by the community bounded by WMAs, those includes tourism and resident hunting, photo-tourism, improved beekeeping and marketing of products, and Natural Forest Management

(NFM). It was demonstrated that all four activities were financially feasible, and that government, district councils and the local community could benefit through a revenue-sharing arrangement. It is understood that all mining can be accompanied by the growth of small and micro-enterprise activities, providing supplies and related services to mining companies, miners and their families leading to generation of significant further incomes (World Bank, 2005).

Furthermore, large mining companies are expected to create employment for the adjacent communities directly through the construction and operating phases. Indirectly through input demand, and even more indirectly through multiplier effects of the demands for goods and services by their employees. After exploration stage it is expected that the mining will also provide foreign exchange earnings and tax revenues at national, regional and local levels (Holden, 2007).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

3.1.1 Location of the study area

Namtumbo District is one of the six districts of Ruvuma Region in Tanzania and it was established in 2004. The District consists of 18 wards; encompassing the eastern part of the former Songea district. It is part of the wildlife corridor linking Selous Game Reserve in Tanzania and Niassa Forest Reserves in Mozambique. It is bordered to the North by Morogoro Region, to the East by Tunduru District, to the South by Mozambique and to the West Songea Urban District and Songea Rural District. Mbarang'andu WMA is located between 9°53'-11°8'S and 35°42'-36°41'E in Namtumbo district, Ruvuma region. Mbarang'andu WMA is part of the Selous-Niassa Wildlife Corridor. The area borders Selous Game Reserve in the North and in the South with Mozambique. On the Eastern side, the WMA borders Ludewa and Mbinga Districts.

3.1.2 Reasons for selecting the study area

Figure 2 below shows three named villages Likuyu-sekamaganga, Mchomoro and Nambecha among the seven villages that form the Mbarag'andu WMA where Uranium exploration companies have ongoing activities in the area (Noe, 2013). The impacts of Uranium exploration can be seen directly and indirectly in these villages as they are close to the exploration cite compared to other villages. The government and other international organizations are interested to know the socio-economic impacts of Uranium exploration in the area.

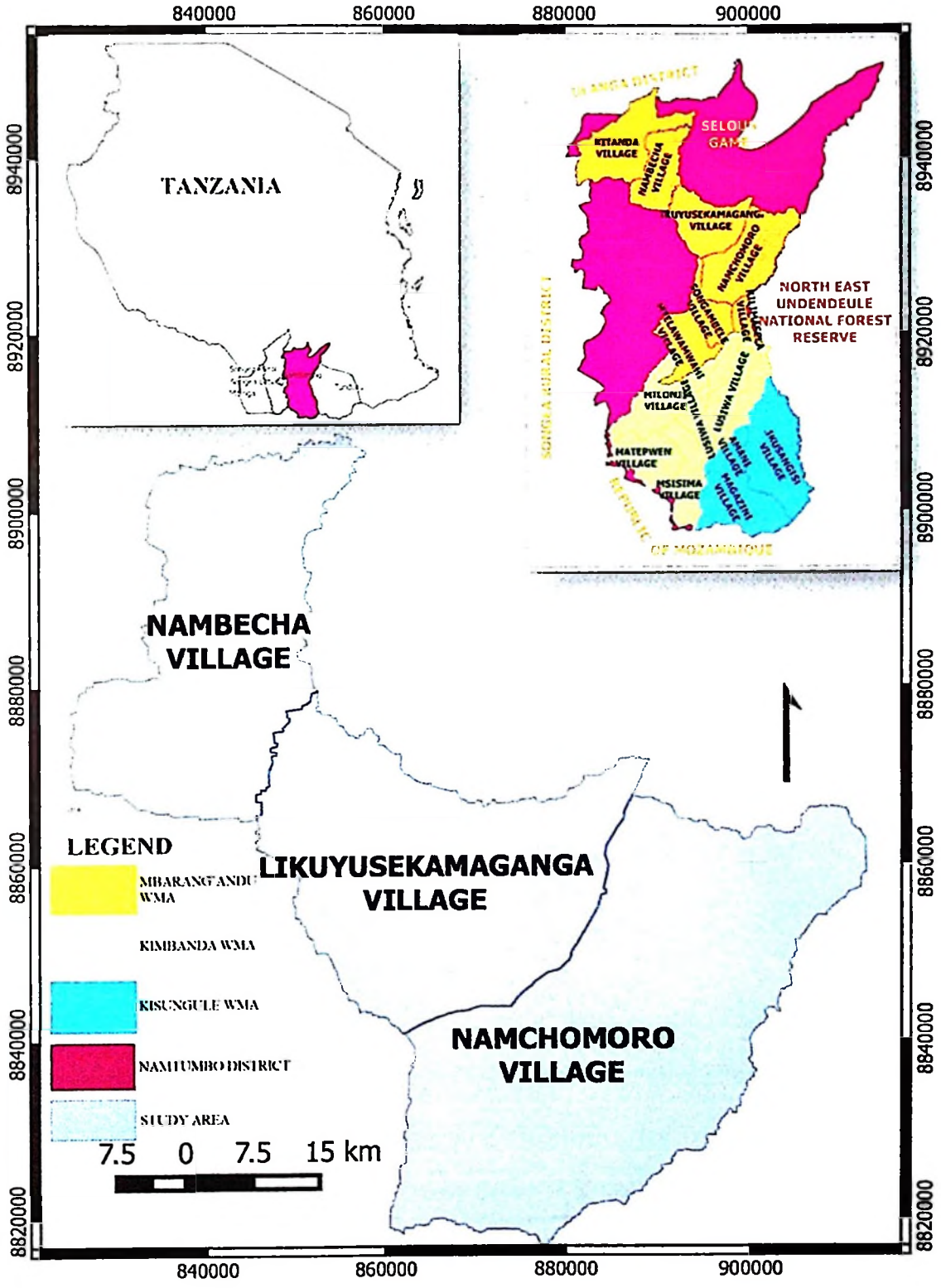

Figure 2: The Map of Namtumbo district showing study villages

3.1.3 Population size, growth rate and density

Ruvuma regional population has increased from 395 447 in 1967 and 783 327 in 1988, to 1 376 891 in 2012. According to the 2012 census Namtumbo District has a total population of 201 639 comprising of 98 335 males and 103 304 females. The average household size in the district is 5.1 which are higher than the national average of 4.8 persons per family in 2012. The average household size has increased in line with the increase in fertility rates (URT, 2013).

3.1.4 Major economic activities

It is estimated that about 97% of the people engage in agricultural activities which is the main source of income with very little animal husbandry for natives (ADBG, 2009). The method of farming is still very traditional characterized by low yields in subsistence crops per hectare. Individual peasants undertake farming on cash and food crop production. Cash crops includes tobacco, cashew nuts, sunflower, simsim, coconuts and ground nuts whereas maize, cassava, beans, finger millets, rice, potatoes are food crops. However, nowadays maize, rice and beans are dual crops. Only 10% of all arable land is under cultivation with smallholders dominating (ADBG, 2009).

3.1.5 Geology, soils and physical features

The geology of Namtumbo District can generally be classified as sedimentary with metamorphic rocks such as limestone including travertine (ADBG, 2009). These occur as either of the following: marble, quartzite, graphitic schist, chlorite, amphibole, mica and kyalite schist, hornblende, bitite and garnet, gneiss, acid gneiss, granulate or charnokite. The soils of Namtumbo are dominated by clay loamy soils. However, patches of sandy soil can be seen (ADBG, 2009). The geology of exploration area consists of thick sequences of Karoo sediments dominated by sandstones. Secondary Uranium

mineralisation has been identified within Mkuju and the overlying Mbarangandu Series. Sandstone Uranium deposits globally occur in medium to coarse-grained sandstones deposited in a continental fluvial or marginal marine sedimentary environment. Impermeable shale/mudstone units are interbedded in the sedimentary sequence and often occur immediately above and below the mineralized sandstone. Uranium is precipitated under reducing conditions caused by a variety of reducing agents within the sandstone including: carbonaceous material (detrital plant debris, amorphous humate, marine algae), sulphides (pyrite, H_2S), hydrocarbons (petroleum), and interbedded basic volcanics with abundant ferromagnesian minerals (e.g. chlorite).

3.2 Data Collection

Purposively sampling was used to select three out of seven villages participating in formation of Mbarang'andu WMA. Respective village registers was used as a sampling frame for simple random selection of 90 households, 30 households from each selected village. Simple random sampling was favoured because each household stands an equal chance of being selected (Deaton, 1997). However according to Bailey (1994) and Yurdugul (2008) 30 respondents per village are minimum number recommended to represent a population under study.

3.2.1 Primary data

(a) Questionnaire survey

Semi-structured questionnaire both closed and open ended question (Appendix 2) was used to obtain primary data. Sampling units for the study was the household heads. According to TANGO international (2004), a household is a core analytical unit that defines regular roles, rights and responsibilities across gender and age. Questionnaires

were designed to collect socio-economic and demographic characteristics of the households.

(b) Checklist

Checklist (Appendix 1) was used to guide interviews with key informants. The key informants were Uranium mining companies, hunting company, village chair person, village elders, Mbarang'andu WMA leadership, environmental committee and natural resource officer.

(c) Focused group discussion (FGD)

Two focused group discussion with 8-10 people were conducted in each village. The participants of FGD were village elders both men and women who were familiar with village history especially on Uranium exploration issues, trend of conservation activities in the village and other income generating activities. Checklist in Appendix 1 was used to guide the interviews.

(d) Field observation

Supplementary information was collected through personal observation in the field for the purposes of cross- checking some of the information obtained through questionnaire especially on impacts of Uranium exploration.

3.2.2 Secondary data

Secondary data were collected from relevant literature reviews (published and unpublished documents). Other relevant sources used were socio economic profile of the district and Baseline information from Mantra Resources Limited, internet and Sokoine National Agriculture Library.

3.2.3 Data analysis

Data obtained from questionnaire were summarized, edited and coded. Coding involved structuring the responses from open and close ended questions and assigning numerical codes to enable analysis as suggested by Babbie (2007). Qualitative data analysis method was content analysis while quantitative data were analysed by descriptive and inferential statistics. The analysis of quantitative data was done with the help of Statistical Package for Social Science (SPSS 16) and excel.

3.2.3.1 Content analysis

Information obtained from key informants and the household heads were analysed by content analysis whereby raw data were broken down into meaningful units of information (Kothari, 2004). The information from key informants were grouped according to the study objectives and discussed to develop themes and tendencies to ascertaining values and attitudes of respondents.

3.2.3.2 Descriptive statistical analysis

Information such as socio-economic characteristics, income sources, contribution of each economic activity to household income, social services were analysed descriptively into frequencies, percentages and mean and presented in tables and graphs.

3.2.3.3 Correlation analysis

Correlation analysis was used to analyze trend data on conservation activities before and after Uranium exploration with time. It was carried out to identify possible associations between the conservation activities such as trends of beekeepers per honey production and hunting tourism from 2004 to 2013. Correlation coefficient ranges from -1 to 1 and the more the correlation coefficient approaches the extreme value -1 and 1, the stronger the association between the variables under investigation. A correlation coefficient indicates a negative relationship or positive relationship.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

4.1 Demographic Characteristics of Households

Table 1: Demographic characteristics of households

Variables	Sample villages Likuyusekamaganga (n=30)	Mchomoro (n=30)	Nambecha (n=30)	Total (n=90)
Sex				
Male	22(73.3)	22(73.3)	24(80.0)	68(75.6)
Female	8(26.7)	8(26.7)	6(20.0)	22(24.4)
Age				
18-28	9(30.0)	3(10.0)	6(20.0)	18(20.0)
29-39	12(40.0)	9(30.0)	8(26.7)	29(32.2)
40-59	9(30.0)	14(46.7)	11(36.7)	34(37.8)
Above 60	0(0.0)	4(13.3)	5(16.7)	9(10.0)
Marital status				
Married	22(73.3)	27(90.0)	17(56.7)	66(73.3)
Single	8(26.7)	2(6.7)	4(13.3)	14(15.6)
Divorce	0(0.0)	0(0.0)	1(3.3)	1(1.1)
Separated	0(0.0)	1(3.3)	3(10.0)	4(4.4)
Widow	0(0.0)	0(0.0)	5(16.7)	5(5.6)
Education level				
Never been to school	2(6.7)	2(6.7)	10(33.3)	14(15.6)
Primary education	20(66.7)	20(66.7)	14(46.7)	54(60.0)
Secondary education	5(16.7)	6(20.0)	6(20.0)	17(18.9)
College	3(10.0)	2(6.7)	0(0.0)	5(5.6)
Household size				
1 - 5	19(63.3)	17(56.7)	21(70.0)	57(63.3)
6 - 10	11(36.7)	10(33.3)	8(26.7)	29(32.2)
11 - 15	0(0.0)	2(6.7)	1(3.3)	3(3.3)
More than 15	0(0.0)	1(3.3)	0(0.0)	1(1.1)

Key: Figures in brackets are percentages

4.1.1 Age (years)

Table 1 shows demographic characteristic of the sample respondents. The total sample size of the respondents handled during the survey was 90. The findings show that majority of the households (37.8%) were in the age group ranging between 40 and 59 years. This could therefore be expected to participate more actively in the Uranium exploration and also benefit from the opportunities raised due to Uranium exploration because they range within the most productive years of labour force. According to Uddin, (2008) age of a person is a crucial determinant of the ability to perform a job.

4.1.2 Gender

Table 1 shows that of the 90 households 75% were male headed households, the rest were female headed households. This indicates that male dominate the households in the study area. These findings have an implication on the kind of economic activities that household adopt to sustain their livelihood especially to be involved in Uranium exploration activities. Katani (1999) argued that, what is done within a specific socio-group is influenced by gender. Most of the people engaged in Uranium exploration activities were male.

4.1.3 Marital status

About 73.3 % of the households in the study area were married while 26.7% was distributed among others. The findings reflect most of the grown up households are in marriage relationship. Married couples are likely to be more productive than single persons because often with marriage comes responsibility to the common good and socio economic alteration (Koso and Wilmoth, 2002).

4.1.4 Level of education

Table 1 shows that majority of respondent (60%) attended primary education followed by those with secondary education. Majority of households has a basic education level which was an important factor in assessing their skills and knowledge in exploiting the opportunities due to the impacts of Uranium exploration. As argued by Weir (1999) economic benefits of schooling include the potential to obtain paid employment from Uranium exploration activities.

4.1.5 Household size

The household size ranged between 1and 5 people which is within national average household size (4.8 per household) (URT, 2013). Thus household size would be expected to increase the probability of benefiting due to Uranium exploration opportunities.

4.2 Socio Economic Activities due to Uranium Exploration

Majority of households (74.4%) of the households were involved in crop cultivation as major economic activities. Other socio-economic activities were small business such as food vendors, transportation using motorbicycle (*Bodaboda*), tailoring, retail shop, selling fruits and vegetables and airtime business. In Likuyusekamaganga out of the twenty motorbicycle operating transportation in the study area 15 bikes belong to households with a person who works in the Uranium mining company. This implies that the income obtained from Uranium exploration has been invested in other income generating assets.

Table 2: Socio-economic activities due to Uranium exploration

	Village of respondent			
Economic activities	Likuyusekamaganga (n= 30)	Mchomoro (n=30)	Nambecha (n= 30)	Total (n=90)
Crop cultivation	23(76.7)	22(73.3)	22(73.3)	67(74.4)
Beekeeping	7(23.3)	8(26.7)	5(16.7)	20(22.2)
Exploration	5(16.7)	5(16.7)	4(13.3)	14(15.6)
Livestock keeping	9(30.0)	10(33.3)	7(23.3)	26(28.9)
Employment	3(10.0)	2(6.7)	2(6.7)	7(7.8)
Small business	12(40.0)	10(33.3)	9(30.0)	31(34.4)
Hunting	3(10.0)	4(13.3)	2(6.7)	9(10.0)

Multiple respondents Households have more than one economic activity
Key: Figures in brackets are percentages

Observation shows that there was high increase of small business hence establishments of existing business and most of these people were the immigrants and workers in the mining company. Majority of the respondent engaged in agriculture crops reported to receive a good market for their produce. Akabzaa and Darimani, (2001) observed that there are good markets for food products in the exploration area due to relatively high population. Types of crops grown in the study area are shown in Table 3.

Table 3: Type of crops grown by households

Types of crops	Village of respondent			
	Likuyusekamaganga (n=30)	Mchomoro (n=30)	Nambecha (n=30)	Total (n=90)
Maize	21(70.0)	20(66.7)	21(70.0)	62(68.9)
Rice	14(46.7)	15(50.0)	15(50.0)	44(48.9)
Simsim	8(26.7)	7(23.3)	6(20.0)	21(23.3)
Cassava	5(16.7)	8(26.7)	7(23.3)	20(22.2)
Millet	4(13.3)	5(16.7)	3(10.0)	12(13.3)
Tobacco	3(10.0)	4(13.3)	4(13.3)	11(12.2)
Pigeon peas	3(10.0)	3(10.0)	4(13.3)	10(11.1)
Groundnuts	2(6.7)	1(3.3)	1(3.3)	4(4.4)
Sorghum	0(0.0)	0(0.0)	1(3.3)	1(1.1)
Irish potatoes	0(0.0)	1(3.3)	0(0.0)	1(1.1)

Multiple respondents Households grow more than one crop
Key: Figures in brackets are percentages

About 68.9% of the households grew maize and the rest grew rice and simsim. The least crop grown is cassava. Most of the crops were used for subsistence. A small portion is sold when harvested in a larger amount. Commercial crops grown were tobacco, groundnuts, sorghum, pigeon peas, millet and Irish potatoes.

4.3 Effects of Uranium Exploration to the Livelihoods of Local Communities

4.3.1 Perceived effect of Uranium exploration on the household income

To determine whether there is improvement of the household income from Uranium exploration, households were asked to state their perceived effects of Uranium exploration on the household income. Findings in Table 4 indicate that, 42.2% of households in the study area perceived that they do not know whether Uranium exploration has caused any effect on the household income. It is observed that most of these households are those who are neither involved in Uranium exploration activities nor get any positive impact on livelihood from Uranium exploration. The findings further indicate that, 36.7% of the respondent in the area perceived increase in the household income as one of the effects of Uranium exploration. This is due to the fact that some of them have been employed by the Uranium mine as watchmen, machine operator, driver,

sample collection and cooks while others have established small business as well as increase of markets for selling agricultural produce. The finding is supported by Excell and Hayson, (2006) who found that exploration and mining lead to increased income levels which cause more money flowing into the community. Also the study by Manyika, (2000) in Kahama-Shinyanga shows that there was increase of household income in mine sites due to the increase in markets for their agricultural crops.

Table 4: Perceived effect of Uranium exploration on the household income

Perceived effect	Village of respondent Likuyusekamaganga (n=30)	Mchomoro (n=30)	Nambecha (n=30)	Total (n=90)
Increase	12(40.0)	11(36.7)	10(33.3)	33(36.7)
Decrease	0(0.0)	1(3.3)	1(3.3)	2(2.2)
Remain the same	4(13.3)	6(20.0)	7(23.3)	17(18.9)
Do not know	14(46.7)	12(40.0)	12(40.0)	38(42.2)
Total	30	30	30	90(100.0)

Key: Figures in brackets are percentages

4.3.2 Household income from Uranium exploration

4.3.2.1 Effect of Uranium exploration on the household income

(a) Income due to employment on Uranium exploration

Uranium exploration is normally expected to provide opportunities, among them employment to local people as a way of facilitating improvement of local people livelihoods in areas where it is practiced. It employs both the skilled people and those unskilled one. Due to lack of skills among the local people, local people have a direct way of being employed in the exploration activities as guards, cooks and machine operators.

Table 5: Annual income from Uranium exploration

Income category	Village of respondent Likuyusekamaganga (n= 30)	Mchomoro (n=30)	Nambecha (n= 30)	Total (n=90)
2 400 000.00 – 4 800 000.00	5(16.7)	4(13.3)	3(10.0)	12(50.0)
4 800 000.01 – 7 200 000.00	4(13.3)	3(10.0)	2(6.7)	9(37.5)
More than 7 200 000.00	2(6.7)	1(3.3)	0(0.0)	3(12.5)
Total	11(36.7)	8(26.6)	5(16.7)	24(100.0)

Key: Figures in brackets are percentages

Table 5 indicates that 12.5% of the household earned an annual income of more than TZS 7 200 000. Majority (50.0%) of the households earned income from TZS 2 400 000– 4 800 000 per annum from being employed to perform various activities in the Uranium exploration activities. Low annual income might be influenced by the fact that most of the local people were employed on unskilled labour such as guards, cooks which pay less due to low skills of local people and education level. Heledd and Louise (2008) observed that the exploration can bring jobs to remote and previously poor area, but the benefits may be unequally shared. Similar observations were expressed by Excell and Hayson (2006) who found that job opportunities during exploration projects may be limited and short term, the lengths of the jobs depend on prospects of the exploration.

(b) Indirect income due to Uranium exploration activities

Uranium exploration is also expected to have the indirect effect on the annual income of the local people on the study area. This is due to fact that having Uranium exploration opens up opportunities for local people such as opening small business and market to agricultural produce. Households were requested t to mention the income they generate from various economic activities since the introduction of the Uranium exploration activities in the area.

Table 6: Indirect income due to Uranium exploration activities

Income category	Village of respondent Likuyusekamaganga (n= 30)	Mchomoro (n=30)	Nambecha (n= 30)	Total (n= 90)
2 400 000.00 – 4 800 000.00	4(13.3)	4(13.3)	3(10.0)	11(23.4)
4 800 000.01 – 7 200 000.00	5(16.7)	4(13.3)	4(13.3)	13(27.7)
More than 7 200 000.00	7(23.3)	5(16.7)	7(23.3)	19(40.4)
Total	16(53.3)	13(43.3)	14(46.7)	47(100)

Key: Figures in brackets are percentages

Table 6 shows indirect annual income due to Uranium exploration in the study area. The findings show that, 23.4% of household earned an annual income between TZS 2 400 000 and 4 800 000 while (40.4%) of the households earned income more than TZS 7 200 000 per annum.

High indirect income due to Uranium exploration might be influenced by the fact that most of the households are farmers whom due to Uranium exploration there were increase of the market for their produce. According to Dixon *et al.*, (2001), the functioning of any individual farm system is strongly influenced by the external rural environment, including availability of markets.

4.3.3 The positive effects of Uranium exploration

The households were asked to mention positive impact caused by Uranium exploration. Table 7 below shows the positive impact of the Uranium exploration. Furthermore the findings show that 60% of the household were of opinion that Uranium exploration has positive impacts in their area and the remaining 40% indicated that it has negative impacts.

Table 7: Perception of households on the positive effects of Uranium exploration

Positive effect	Village of respondent			
	Likuyuseka maganga (n= 30)	Mchomoro (n= 30)	Nambecha (n= 30)	Total (n= 90)
Create jobs	27(90)	25(83.3)	20(66.6)	72(80.0)
Publicity of the area	17(56.7)	22(73.3)	15(50.0)	54(60.0)
Better education	22(73.3)	17(56.7)	0(0.0)	39(43.3)
Telephone	13(43.3)	12(40.0)	9(30.0)	34(37.8)
Made people environmental aware	17(56.7)	12(40.0)	3(10.0)	32(35.6)
Improve infrastructures	12(40)	3(10.0)	0(0.0)	15(16.7)
Tourism development	7(23.3)	2(6.7)	0(0.0)	9(10.0)
Electricity	7(23.3)	0(0.0)	0(0.0)	7(7.8)

Multiple respond Households mentioned more than one impact
Key: Figures in brackets are percentages

4.3.3.1 Creation of jobs

Findings in Table 7 shows that about 80% of the household reported that Uranium exploration has a positive impact in jobs creation whereby among 87 workers in Uranium exploration project, 40 (45.9%) of the workers are residents in the study area though most of them work in unskilled jobs. This finding is similar to Mensah, (1998) that there was poor participation of the residents people in this mineral exploration investment due their education and work skills.

Apart from those working in mining companies there are creation of jobs through establishments of other business such as "*bodaboda*" and petty business. It was found that due presence of Uranium exploration some people have engaged in "*bodaboda*" business due to increased transport demand in the villages of the study area.

Another job opportunity is improved agricultural practice to adapt to climate change. It was found that some youths at Likuyusekamaganga village have established irrigation schemes funded by Uranium mining company. The mining company so far funds three projects namely Mtonya Scheme for Irrigation, Mtonya Farmers Association which are suppliers of fruits and vegetables to the mining companies. Also they have tree nurseries which supply seedings to the company for tree replanting as environmental conservation programme. Ashanti (2005) and Barry (1996) reported that mining company spends some of its revenue to improve livelihood through funding some income generating activities.

4.3.3.2 Publicity of the area

Findings in Table 7 show that 60% of the households in the study area reported that Uranium exploration is also one of the factor which influence publicity of the area.

This has caused some people from different areas to come to the area for intention of being employed by Uranium exploration project, and others self employing in activities such as agriculture or establishment of small businesses. The finding is supported by findings from Frederick (2010) who also found an increase of the publicity of the villages due to increased number of exploration companies operating within the villages.

4.3.3.3 Better education

Findings in Table 7 show that 43.3% of the households perceived improvement of education in the study area due to Uranium exploration activities by Uranium mining

companies such as Mantra Tanzania Limited. During an interview, some of the households reported that their schools in the village receive support from Uranium Exploration Company. It was found that Uranium Mining Companies have contributed a total of 500 desks and construction of school buildings such as four class rooms and teachers' house as well as providing teaching materials in the study area. During the interview at Likuyusekamaganga, one of the households commented as follows, "*now we are free from school contribution because of the presence of mining company which provides facilities for education but before Uranium exploration it was the responsibility of parents to contribute for school facilities such as students' desks*". Hence they do not have the big burden to pay contribution for their children. Most of the students do not fail to continue with studies due to lack of paying some school contribution by their parents. Moreover, it was found that the Mantra Tanzania Limited provided solar power to Likuyusekamaganga Secondary School. Not only that, but also nine Form Four leavers were sponsored by the mining company to attend training at the National Vocation Training Centre – Moshi in mining courses. Three of them were females and the remaining six were males. The findings are in line with the study conducted by Kitula (2005) and Manyika (2000) who found improvement in education due to support by large scale mining companies.

4.3.3.4 Improving road infrastructure

Findings in the Table 7 show that 16.7% of the households reported good road network. This is small number compared to the number of households in the area. This is due to reason that only the roads running towards the industrial area were good while the rest of the roads in the villages are poor. So there is a need for all weather roads for transportation within the town and villages, particularly between mine sites and where the ore is crushed and processed.

The households indicated that the few roads that already exist have rather been worsened or destroyed because of the pressure the company has brought into the community due to the large number of migrants moving into the community who compete with the local people for few existing ones. This is contrary to the study by Ware (2010) in Ghana who found that there was improvement of the road infrastructure in the villages along the exploration project. This could create the negative attitude of the community living around the mining towards the Uranium investments. During an interview with Uranium company official, public relation officer reported that the Uranium Exploration Company has plan to construct road from Namtumbo to the exploration site, which will be more advantage to villages close to the mine including Likuyusekamaganga, village socially and economically.

4.3.3.5 Telephone and electricity

The findings in Table 7 show that 37.8% of the households reported that investment in telephone communication towers is good in such a way that most areas have different networks for mobile communication while before Uranium exploration there were few telephone communication towers. Furthermore, 7.8% of the households reported that availability of electricity in Namtumbo town is due to the presence of Uranium exploration in the area with hope that it will be spread soon to exploration sites in nearby village which will be advantageous to the communities. The finding is similar to the findings from Frederick, (2010) who reported that communities around the exploration company benefited from getting electricity due to presence of the exploration in their area. This might be due to the fact that there are power lines passing through the villages but few have received installed electricity due to lack of the transformers to supply electricity in the villages. But finally this will be solved.

4.3.3.6 Creating people's awareness environmental management

The findings in Table 7 show that 35.6% of the households reported that Uranium exploration project in the area has made people aware of good environmental management practices. Village representatives for all the seven villages which form Mbarang'andu WMA, village council and mining company conduct initiatives and programmes that the mining company intends to roll out in the community about environmental conservation and other issues. Then the representatives act as the ambassadors and trainers of the other villages along the mining area through village meetings, seminars and clubs also during the Environmental Day each year.

Moreover, mining companies encourage employees at all levels to recognize their responsibility for environmental management and ensure that adequate resources, staff, and requisite training is available to implement environmental plans. The finding is supported by Ware (2010) who found that mining companies were among the institutions which advocate the good environmental management.

4.3.3.7 Tourism development

The findings in Table 7 show that very few (10%) households experienced tourism development in the area due to the presence of Uranium exploration. These percentages are fewer compared to the number of households, because majority of them complained that the number of tourist hunters have decreased since the exploration of Uranium started in the area. The reason is that exploration activities have disturbed the habitat for wildlife hence wild animals they have run away from their habitat. The finding is supported by Betram (2010) who found that there is a decline of tourism development due to establishment of Exploration Company near the WMA.

4.3.4 Negative effects of Uranium exploration

4.3.4.1 Increased living costs

The findings in Table 8 show that 48.9 % of the households reported that there are high costs of living in the area. The finding implies that there are factors responsible for the high cost of living in the area. One of the factors is the disparity in income in favour of mining company staff that influences the pricing of goods and services such as housing, food and other amenities. Another factor is that the mining industry has withdrawn a significant percentage of the labour force from agriculture and other income-generating activities hence holding out the false promise of employment. The last is the increase of the population in the villages due to people coming from far villages looking for employment in the Uranium mining. The average price for a chicken was TZS 4 000 in 2010, but now you can get it for TZS 15 000 even the price for plate of food now sells for TZS 2 000 instead of TZS 500, a bag of rice that was selling TZS 55 000 in town is being sold for TZS 80 000 in the villages. The finding is in line with the study conducted by scholars such as Ware (2010), Akabzaa and Darimani, (2001) and Amoah (2003) who found that there was increase in living costs in the villages near the mining areas.

4.3.4.2 Creation of social classes

Findings in Table 8 further indicate that 60% of the households in the study area reported creation of social classes among negative consequences. Also indigenous people have been unable to compete for employment opportunities with the newcomers who have migrated into the area with the hope of finding employment, but have been unsuccessful in doing so. Ware (2010) found that households recognized that families who have any of their relative working at Newmont Company have had somehow alleviated their poverty.

4.3.4.3 Poaching

Findings in Table 8 further indicate that 25.6% of the households in the study area had noted increase in incidence of poaching. This implies that poaching for trophy and bush meat has increased either because roads have opened access to intact and remote areas. MWC (2001) found an increase in poaching in protected areas near the exploration sites.

4.3.4.4 Population influx

The finding shows that 75.6% of the households reported that existence of population influx in the area due to Uranium exploration activities, which was also observed by district statistics office. High migration rate in the villages near the exploration is due to increase of people seeking for employment on the mine, but also due to improved infrastructure, which might also bring an influx of settlers (Ware, 2010 and IIED, 2002).

4.3.4.5 Disturbance of wildlife animals from their habitant

The findings in Table 8 show that about 28.9% of the households explained that the habitat for wildlife was disturbed as in Plate 1 below. Furthermore 20% of the households reported disturbance to the wild animal from their natural environment. This is due to the fact that wildlife species live in communities that depend on each other. Survival of these species can depend on soil conditions, local climate, altitude, and other features of the local habitat so the presence of exploration activities in the area disturb the habitat for wildlife as exploration stage affects the environment and associated biota through the removal of vegetation and topsoil. It implies that some of wild animals go far away from their habitat which causes human wildlife conflicts to increase. Because dangerous animal such as Elephant, Buffalo, Hyena, Hippopotamus and Warthog attack human being and damage their crops in the village land. Vulnerable crops are maize, cassava, rice and banana.

Plate 1: Cleared land for Uranium exploration near WMA
Source: Mantra Tanzania Limited

The trend of crop damage increases with time since Uranium exploration activities were started in the study area. The study further found that Elephant is the major wildlife species which causes crop damage to crops hence it was evident that property damage by wild animals are the main cause of conflicts between Uranium exploration and other land uses in the area as it disturbed wild animals in their habitat. This finding is supported by World Bank (2003) which states that vegetation removal disturbs the habitat of hundreds of endemic species and alters the availability of food and shelter for wildlife.

4.3.4.6 Encroachment

Findings in Table 8 show that 41.1% of the households reported encroachment in the village land due to the presence of Uranium exploration in the area. There is conflict over the boundary of between SGR and the village land, which is used as a hunting block by Game Frontier of Tanzania. Up to now there is misunderstanding between Mbarang'andu WMA and SGR. The findings is supported by Amoasah (2010) that already, Ghana's gold mining industries particularly those in Obuasi and Tarkwa have witnessed a prolonged

period of conflict with the surrounding communities where by an encroachment of any scale would have negative consequences on biodiversity. Most of these conflicts are attributed due to the fact that the environment is destroyed at the same time as the benefits from these mines are not equitably distributed. Lillian (2011) in Zambia reported that mining communities of Obuasi and Tarkwa with vast fertile lands have been cleared. Due to the building projects for mining workers hence there is a threat of encroachment and wildlife depletion. Through observation it was found that the Map from the management of Mbarang'andu WMA (Plate 2) had minor changes in the boundary of SGR. This is the cause of conflict to the communities as they complain that the SGR encroach on their village land.

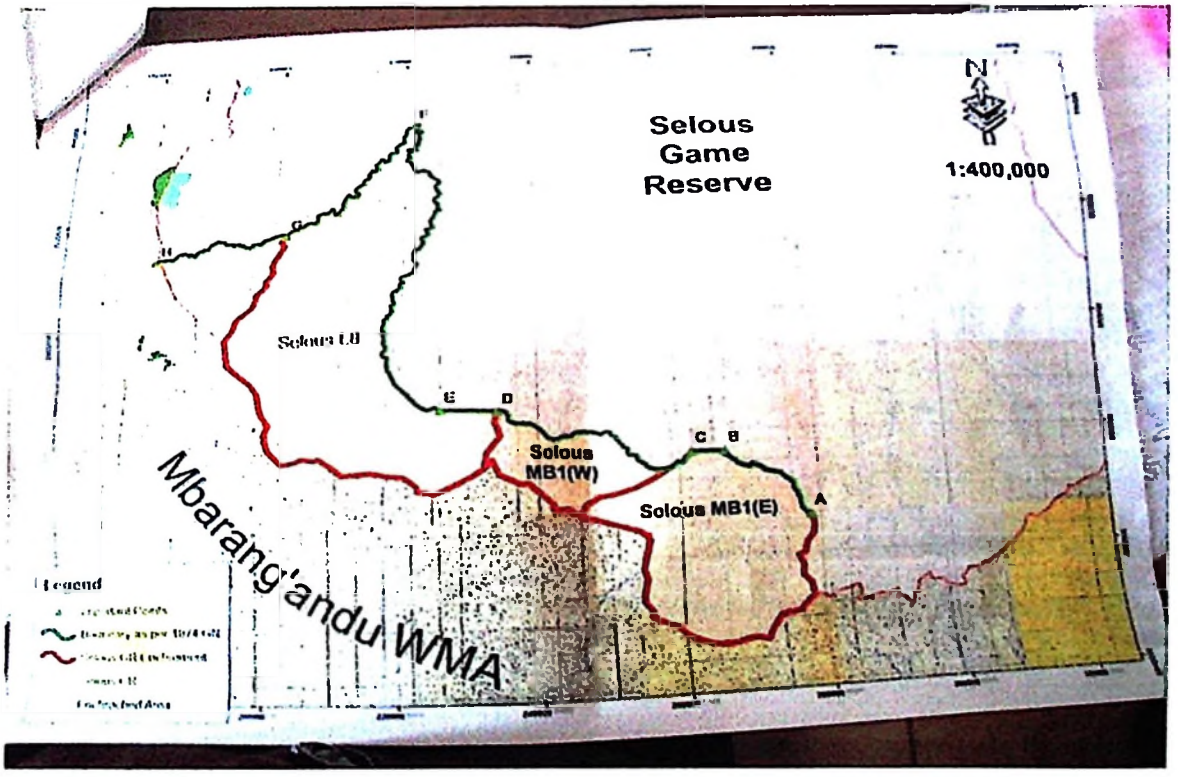

Plate 2: Selous Game Reserve enchronment

Source: Namtumbo District.

Table 8: Perception of households on the negative effect of Uranium exploration

Negative effects	Village respondent Likuyusekamaganga (n= 30)	Mchomoro (n= 30)	Nambecha (n= 30)	Total (n= 90)
Increase living costs	20(66.7)	16(53.3)	8(26.7)	44(48.9)
Poaching	8(26.7)	14(46.7)	1(3.3)	23(25.6)
Population influx	28(93.3)	23(76.7)	17(56.7)	68(75.6)
Habitat disturbance	8(26.7)	11(36.7)	7(23.3)	26(28.9)
Encroachment	21(70.0)	16(53.3)	0(0.0)	37(41.7)
Creation of social class	10(33.3)	4(13.3)	4(13.3)	18(20.0)
Disturb wildlife	10(33.3)	4(13.3)	4(13.3)	18(20.0)

Multiple respondent households have more one effects
Key: Figures in brackets are percentages

4.4 Impact of Uranium Exploration on Conservation Activities

4.4.1 Awareness of WMA in the village

First the study aimed to seek whether the households were aware of the WMA. The findings show that about 86% of the households are aware of WMA in the study area with different economic activities conducted in the area while the remaining 14% are not aware of WMA in the area. This observation reveals that most of households can be able to measure up the impacts of Uranium exploration on conservation activities carried out in WMA as they are aware of WMA in the area.

4.4.2 Income generating activities due to WMA

The findings in Table 9 show that 83.3% of the households considered hunting tourism one of income generating activities for Mbarang'andu WMA in the study area. Further results indicate that 75.6% of households mentioned beekeeping as another income generating activity in the WMA. Plate 3 shows beekeepers harvesting honey from the modern beehive in Mchomoro. During the interview with focus group discussion and WMA management, it was fond those two activities: i.e. Fishing and selling live animal are not yet conducted in the area rather than beekeeping and hunting tourism of which are the sources of income in the WMA.

Table 9: Income generating activities due to WMA

Income generating act.	Village of respondent Likuyusekamaganga (n= 30)	Mchomoro (n= 30)	Nambecha (n= 30)	Total (n= 90)
Beekeeping	23(76.7)	23(76.7)	22(73.3)	68(75.6)
Hunting tourism	26(86.7)	25(83.3)	24(80.0)	75(83.3)
Fishing	0(0.0)	1(3.3)	2(6.7)	3(3.3)
Selling live animal	1(3.3)	0(0.0)	1(3.3)	2(2.2)

Households have more than one income generating activities
Key: Figures in brackets are percentages

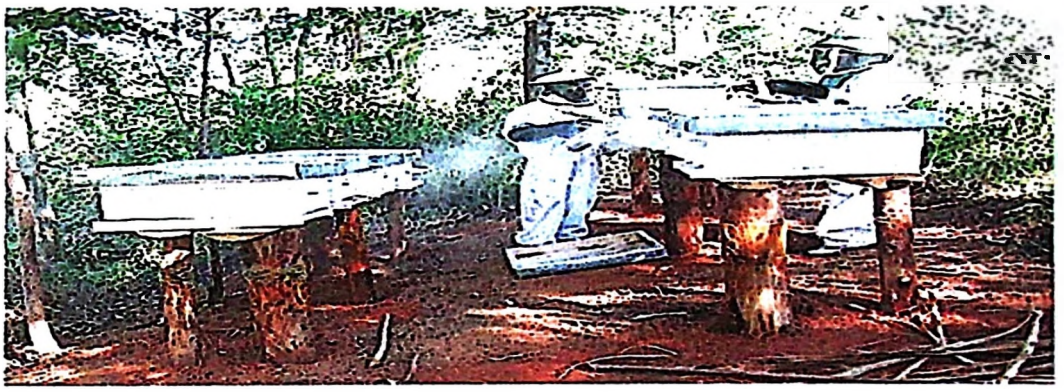

Plate 3: Beekeepers harvesting honey from the modern beehive in Mchomoro
Source: Mantra Tanzania Limited

4.4.3 Decrease in the trend of beekeepers and honey production

The correlation analysis was carried out to determine whether there is any relationship between the trend beekeepers with time before and after Uranium exploration since 2006 to 2013. Data in figure 3 indicate in 16 groups from the selected villages which were involved with beekeeping. In 2006 however the number of groups has decreased at a significant rate through ($r = -0.84$, $p = 0.008$). Similarly honey production per bee hive has decreased, at non significant rate ($r = 0.321$, $p = 0.436$). This decrease is related to dispute over access and resource use in the WMA from the fact that local people supported by Association for Development of Protected Areas needed areas for bee keeping while Uranium exploration activities need huge areas for Uranium exploration and thereafter mining activities.

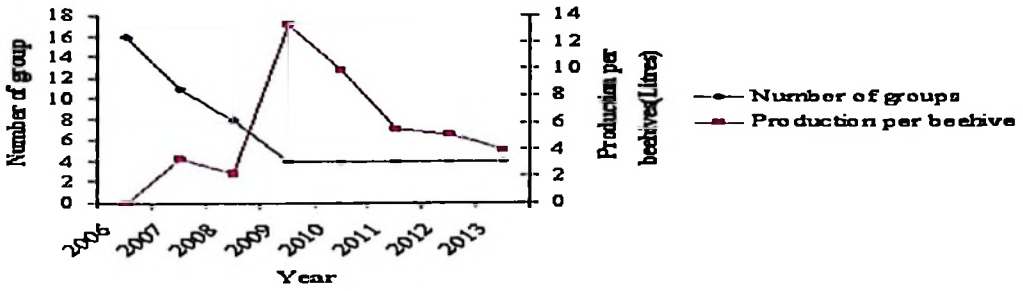

Figure 3: Trend of beekeepers and honey production

Source: Ministry of Natural Resource and Tourism

As a result, ADAP as an NGO that supported local people livelihoods by helping local people to develop alternative income generation activities in the Mbarang'andu WMA through development of modern beekeeping refused to do so in 2010. So once ADAP stopped training programmes on beekeeping and assistance in marketing of bee products, the groups of beekeepers also decreased. The study further established that ADAP was against Uranium exploration because dangers of Uranium exploration would interfere with the quality of beekeeping products to be sold. As a result in 2009 the beekeepers were required to send their products first to laboratories at Dar es salaam before bringing to the market in order to test whether there is Uranium content in the honey. This caused most of beekeepers threatening to pull out. So the approval of Uranium exploration activities to take place implied that local people lose access to the land for honey production.

4.4.4 Decrease in the trend of tourist and hunted wild animals

Findings on the number of tourist visiting in the study area from 2004 to 2013 are presented in figure 4 below. The number of tourist patterns appear to decrease at non significant rate of ($r = -0.222$, $p = 0.538$). The finding shows that, the number of tourists

been fluctuating overtime at decreasing trend. Similarly these findings are further supported by information collected through the household questionnaire. About 18.9% of the households reported that the number of tourist has been decreasing over time. The trend shows that the high number of tourist visiting the wildlife conservation in Mbara ng'andu was 20 in the year 2006 since then the number has been decreasing. It is possible that in certain particular cases a mine might directly eliminate an existing or potential tourism opportunity by eliminating a valued landscape feature or blocking access to high value area which attract the tourist (Betram, 2010). Also the mining activities may have some negative impact on tourism attractions making those nearby a mining site earn less income; it is very clear some factors tie the two industries together such as investing capacity of and policy support from local government, and convenient accessibility to roads (Huang, 2008). However failure to have appropriate implementation of the policy and regulation can lead exploration to have the negative impacts on the tourist industry.

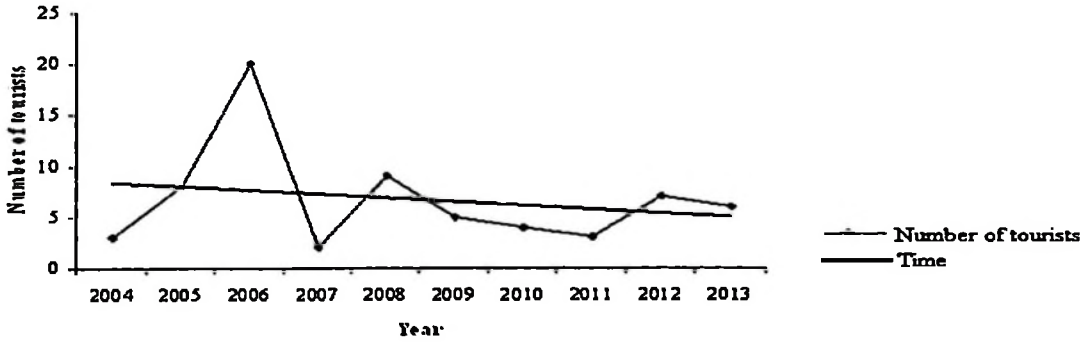

Figure 4: Trend of tourist in Mbarang'andu wildlife management area
Source: Ministry of Natural Resource and Tourism

Figure 5 shows the number of most animals hunted in Mbarang'andu wildlife management area. It was found that wild animals hunted in Mbarang'andu wildlife management area were Buffalo, Waterbuck, Impala, Reedbuck, Wildebeest, Zebra,

Waterbuck, Warthog, Bushbuck, Lion, Leopard, Hippopotamus, Elephant, Hyena, Sable, Greater kudu, Baboon, Crocodile, Porcupine, Jackal, Eland, However some of these were less hunted but the most hunted wild animals were buffalos, waterbuck and warthog. The findings of the most hunted wild animals in the study area from 2004 to 2013 are presented in figure 5 below.

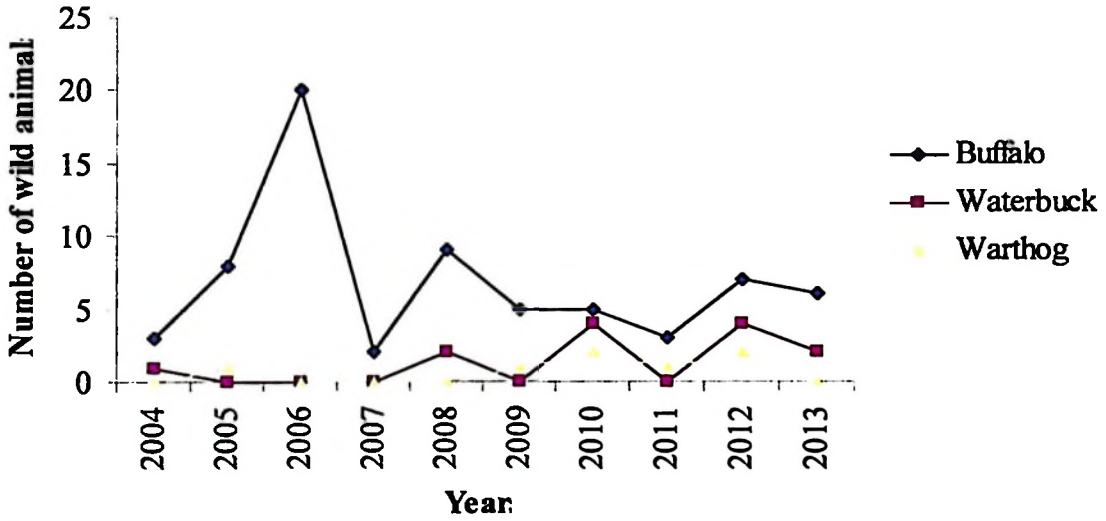

Figure 5: Trend of wild animals hunted in Mbarang'andu wildlife management area
Source: Ministry of Natural Resource and Tourism

The findings show that the number of animals hunted has been fluctuating overtime at decreasing trend. The implication of this finding is that Uranium exploration has negative impact in hunting tourism activities. It is supported by findings from Betram (2010) who found that the decrease on the trend of the hunted wild animals might be attributed to the number of poachers visiting the wild area, but also eliminating the habitat for the wild animals due to the presence of Uranium exploration.

CHAPTER FIVE

5.0 CONCLUTIONS AND RECOMMENDATIONS

5.1 Conclusions

From the study findings, it can be concluded that Uranium exploration has both positive and negative impacts on socio-economic activities in the villages participating in Mbarang'andu WMA. Provisions of alternative means of income such as employment to the communities, establishment of small business that has more impact to low-income people regarded as positive impact of Uranium exploration.

It is further concluded that positive effects of Uranium exploration to the livelihoods of local communities outweigh negative effects as communities perceive that mining company provided support to local communities as they have extra sources of income, and enable them expand their financial capital base, attain viable livelihoods and reduce livelihood vulnerability. Local people appreciate contributions of WMA through revenue income to the villages from conservation activities, but established that managing their livelihoods needs more than just to wait for revenues from WMA. To them Uranium exploration and other small activities like beekeeping, small businesses including food vending, retail shop, *bodaboda*, tailoring and agriculture have more contribution in their livelihoods. So the study concludes that, there is direct contribution of Uranium exploration on the local people in form of their livelihoods.

The findings from this study conclude that procedures exist for mining projects beyond exploration stage are well documented on paper but are confronted with problems of implementation on the ground as conservation activities encountered difficulties to ensure economic and social sustainability.

5.2 Recommendations

Based on the conclusion of the study, the following recommendations are made in order to improve livelihoods and relations between communities and Uranium exploration.

i. Local community should be involved in conducting exploration activities due to its impacts on socio-economic activities on their villages.

ii. Exploration companies should accomplish their role by giving some of their revenue to the community around the mine such as support in education, improve road infrastructure for improvement of livelihoods of local communities.

iii. Companies doing exploration should develop and implement the conservation measures to sustain community and conservation activities.

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APPENDICES

Appendix 1: Checklist for key informants

Environmental officer and natural resource officer

1. What are social economic activities provided by Uranium mining companies during exploration phase.
2. Relationship of Uranium mining companies with communities.
3. How many households and WMAs displaced by Uranium exploration project.
4. Contribution of Uranium exploration to communities in the area of the mines.
5. The effects of Uranium exploration to the livelihood of local community.
6. Measures taken to control the environmental impact of Uranium exploration.
7. Any health hazards and measures in the Uranium exploration in the area and environmental protection.
8. Available statistics data on the above questions.

Wildlife officer

1. Impacts of Uranium exploration to other natural resources' and economic activities such as beekeeping, hunting tourism and other.
2. Are there any changes in Population influx, Wild animal habitat disturbance, Poaching increase, Encroachment as a result of Uranium exploration?
3. Measures taken to protect the nature.
4. Available statistics of positive and negative adverse impacts.
5. Is there any improved natural resource conservation such as wildlife?
6. Are the hunting companies increasing or decreasing in number?
7. If decreasing why?
8. If increasing why?

9. Can you tell me the status of hunting companies?
10. Do you associate this status with Uranium exploration activities?

Hunting companies

1. The effects of Uranium exploration in hunting tourism activities
2. Any changes before and after Uranium exploration
3. Statistics of hunting tourism (species of animal, number of tourist revenue collection and its distribution.
4. Contribution of Uranium exploration to hunting companies and communities.
5. Are the hunting companies increasing or decreasing in number?
6. If decreasing why?
7. If increasing why?
8. Can you tell me the status of hunting companies?
9. Do you associate this status with Uranium exploration activities?

Village representatives (village government leaders, natural resource committee leaders and influential people or elders)

1. What are the main income generating activities in your area if possible group them in gender and rank
2. How do you comment on level of benefit obtained in these income generating activities after the investment of Uranium exploration in your area.
3. Does Uranium companies' operating at your area give support to livelihoods? How
4. How is the relationship between Uranium companies and the villages?
5. What could be done by Uranium companies to strength exploration activities so that they can improve people's livelihoods?
6. What is importance of Uranium companies in your area?

7. Are Uranium exploration activities having impacts on your conservation activities at your area such as Population influx, Wild animal habitat disturbance, Poaching increase Chemical contamination, Encroachment How? Reason for the answers

Mining companies

1. Available statistics of benefits provided to local communities and WMAs.
2. Compensation to WMAs and local communities.
3. Contribution of Uranium exploration to communities in WMAs.
4. Any health hazards and measures in the Uranium exploration in the area and environmental protection.

Appendix 2: Questionnaires for the household

A. General Information

District .....ward.....

Location/village.....sub village.....

B. PERSONAL PARTICULARS OF HOUSEHOLDS

1. Name of respondent.....
2. Age .....
3. Sex ..... (1) Male (2) Female
4. Marital status

    1. Married
    2 Single
    3 Divorced
    4 Separated
    5 Widow

5. Level of education

    1 Never been to school
    2 Primary education
    3 Adult education
    4 Secondary education
    5 College
    6 Other .....(specify)

6. Are you native to this area or migrants from different place

    1. Native to the area
    2. Migrant from different place

7. If Migrant, when did you move in and what motivated you to come and live in this place?

   1.....

   2.....

8. I would like to know total number of people living in your household and sex

   1. Male ..... 2. Female .....

9. Do you have children attending school?

   1. Yes/No

10. How many children are attending school? ..... indicate level of education in the table below

S/n	Age	Sex		Level of education
		Male	Female	
1				
2				
3				
4				
5				
6				

11. Please explain why your children do not attending school?

    .....

C. Information on Economic Activities

12. What are the major economic activities of your family.....

(1) Agriculture crops; (2) Mining(Exploration) (3) Hunting tourism

(4) Beekeeping (5) Livestock farming (6) Mixed farming

(7) Wage employment specify... (8)Entrepreneur (9) other specify .....

13. For agricultural crops what crops did you grow last season?

s/ no.	Type of crop	No. of bags/kg	price	cash

14. Are you aware of Uranium exploration activities in this area?

1. Yes 2. No

15. Did you get involved in Uranium exploration activities?

1. Yes 2. No

16. If yes in QN15 Would you describe your household income as a result of Uranium exploration activities undertaken? Is your income has

1. Increased
2. Decreased
3. Remain the same
4. Don't know

17. Do you think Uranium exploration is important to your household?

1. Yes / 2. No

If yes explain why .....

18. How much did your household get from mining company as a result of Uranium exploration activities in calendar year 2012
19. Are you or your household satisfied with the way you are or it is being involved? Yes / No
20. If No how would you like to participate in Uranium exploration
21. If No how would you like to benefit from Uranium exploration
22. Which of the following benefits have Uranium exploration brought to your village?

1. Jobs
2. Publicity of the area
3. Better education
4. Tarmac roads
5. Telephone
6. Electricity
7. Made people more environmental aware
8. Tourism development
9. Other specify

23. Which of the following has been caused by Uranium exploration in your community?

1. Increased living costs
2. Creation of social classes
3. Poaching
4. Population influx
5. Habitat disturbance
6. encroachment

24 Indicate in the table below on how you think the Uranium exploration have impacted the following

Item	**Impacts**		**Reason for the answer**
	negative	**positive**	
Education services			
Road network			
Household income			
Settlement			
Land acquisition			
environment			
Other specify			

25 Among the following, what is/are your source of income and how much did you get from each source annual

s/no.	Source of income	Amount TAS
1.	Employed	
2.	Casual labour	
3.	Business	
4.	Agriculture	
5.	Livestock	
6.	Tourism	
7.	Other specify	

26. Do you own the land? 1. Yes 2. No

27. If yes what size of the land do you own

28. In the table below, please mention the business you conduct and how much you earned from each annual

s/no.	Type of business	Amount TAS
1.		
2.		
3.		
4.		

29. Do you know anything about WMA in this village?

1. Yes 2. No 3. Somehow

30. What are the income generating activities generated due to WMA of your area?

1. Bee keeping
2. Hunting and tourism
3. Fishing
4. Others specify

31. What is the status of income generating activities after Uranium exploration in your area?

32. Can you tell me the link between IGS and Uranium activities?

33. What is your total annual income generated from crop production in TZS?
    1. Less than 500 000
    2. Between 500 000-1 000 000
    3. More than 1 000 000
34. If you're involved in small business, how do you judge your business growth as far as your capital investment is concerned and your expectation?
    1. The business is growing bigger and bigger each year with increasing profit and customers
    2. The business has remain constant that it never grows or declines
    3. The business is declining every year and the profit has declined
    4. Other .....
35. Is there any land conflict experienced in this area due to Uranium exploration?
    1. Yes
    2. No
36. If yes in Qn 35 Whenever conflict arises between community members and government, how do they solve such a conflict?
    1. Normally listen to members
    2. Normally listen to government
    3. Listen to both of them and analyze before decision
37. Can you tell me the status of the roads in your area.....?
    (1) Very good (2) Good (3)worse (4) wise
38. If is good who assisted maintenance of road.....
39. Please mention mining companies which are operating in this area?
40. Are you aware of hunting activities in this area?
41. Can you tell me the status of hunting companies

    .....

    Do you associate this status with Uranium exploration activities?