

**EFFECTS OF MINING ON FOOD SECURITY TO FARMING COMMUNITIES
SURROUNDING NYAMONGO GOLD MINE IN TARIME DISTRICT,
TANZANIA**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
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ABSTRACT

Food availability and supply is essential requirement for people. Household food security is the availability of food to household level which will suffice the needs all times for an active, healthy life. The food will be either produced in farms by family or purchased from other places. The aim of this study was to assess effects of mining on food security to farming communities surrounding Nyamongo Gold Mine in Tarime District, Tanzania. Specific objectives were to: (i) determine food security status in the study area; (ii) determine the amount of farm labour that moves to mining from communities surrounding the mining in the study area; (iii) determine amount of money earned by house hold farmers in study area from mining; (iv) identify items bought by money generated by farmers from mining in the study area; and (v) assess the contribution of infrastructure development to food security in the study area. Data were collected by interviewing households using interview schedule as a main tool, which comprised of closed and open ended questions. Descriptive analysis using Statistical Package for Social Sciences (SPSS) were employed as a tool of analysis to determine factors affects food security to mining surrounding communities. Results revealed that respondent's family size, farm size, sex, age (years), marital status, movement of farmers to mining area, artisanal activities, mining related activities and income generation affects food availability. It was concluded that food security will be enhanced in the study area if District Council in collaboration with mining companies, artisanal mining and farming communities surrounding North Mara Gold Mine (NMGM) will put together efforts in crop production. However small holder farmers in the study area will need a boost from Government, NMGM and other agriculture stakeholders so as to receive support in agricultural extension services because there is need to accelerate technology uptake to address declining farm production being experienced by smallholder farmers in the study area, which leads to food insecurity.

DECLARATION

I, Fredrick Kisika Juma, 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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The above declaration is confirmed

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“As time passes like vapor, fruits get ripe”.

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LIST OF ABBREVIATIONS

AGGI	Ahfo Agribusiness Growth Initiative
Ag-SWAP	Agriculture Sector-Wide Approach
ASDP	Agricultural Sector Development Programme
ASDS	Agricultural Sector Development Strategy
ASP	Agriculture Strategic Plan
BRN	Big Result Now
CAADP	Comprehensive Africa Agriculture Development Programme
CDC	Community Development Coordinator
CFSVA	Comprehensive Food Security and Vulnerability Analysis
CIA	Central Intelligence Agency
CIMMYT	Centro International de Mejoramiento de maiz Tigo (International Maize and Wheat Improvement Centre)
CMVD	Cassava Mosaic Virus Disease
DADP	District Agricultural Development Plan
DAEO	District Agriculture Extension Officer
DAICO	District Agriculture, Irrigation and Cooperative Officer
DASIP	District Agriculture Sector Investment Project
DCDO	District Community Development Officer
DED	District Executive Director
FAO	Food and Agriculture Organization
FFW	Food For Work
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GGM	Geita Gold Mine

HHs	Households
IFRCRCS	International Federation of Red Cross and Red Crescent Societies
LGFA	Local Government Finance Act
MDER	Minimum Dietary Energy Requirement
MDGs	Millennium Development Goals
NAP	National Agriculture Policy
NBS	National Bureau of Statistics
NEPAD	New Partnership for Africa's Development
NGO	Non Government Organization
NMGM	North Mara Gold Mine
NMGMSIA	North Mara Gold Mine Social Impact Assessment
NPS	National Panel Survey
PADEP	Participatory Agricultural Development and Empowerment Project
PHC	Population and Housing Census
PIDP	Participatory Irrigation Development Programme
RDPI	Resource Development Philippines Inc.
REPOA	Research on Poverty Alleviation
SPSS	Statistical Package for Social Science
TAFSIP	Tanzania Food Security Investment Plan
TASAF	Tanzania Social Action Fund
TDC	Tarime District Council
TDPR	Tarime District Plan Report
TDV	Tanzania Development Vision
TZS	Tanzanian Shilling
UNFPA	United Nations Population Fund
URT	United Republic of Tanzania

US\$	United State Dollar
WFP	World Food Programme
WHO	World Health Organization
WSSD	World Summit on Sustainable Development

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

For centuries, man has always been in search for food and ways to survive. It is therefore a great concern for governments and nations to focus on developing strategies and policies that will help maintain some form of food security and also to alleviate food scarcity (Ocansey, 2013). Food security is a situation in which all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active healthy life (Mwaniki, 2003). Food Security Network (2012) define food security as “a situation when all people at all times have physical and economic access to adequate amounts of nutritious, safe, and culturally appropriate foods, which are produced in an environmentally sustainable and socially just manner, and that people are able to make informed decisions about their food choices. The World Food Summit of 1996 defined food security as “a situation when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life”.

Food security is affected by a complexity of many factors. These include unstable social, political and environments that preclude sustainable economic growth, war and civil strife, macroeconomic imbalances in trade, natural resource constraints, poor human resource base, gender inequality, inadequate education, poor health, natural disasters such as floods and locust infestation, frequent drought and absence of good governance. All these factors contribute to either insufficient national food availability or insufficient access to food by households and individuals (FAOSTAT, 2013). The root cause of food insecurity in developing countries is the inability of people to gain access to food due to poverty. While

the rest of the world has made significant progress towards poverty alleviation, Africa particularly Sub-Saharan Africa continues to lag behind (FAOSTAT, 2013).

In Tanzania, the National Agriculture Policy (NAP) revolves around the goals of developing an efficient, competitive and profitable agricultural industry that contributes to the improvement of the livelihoods of Tanzanians and attainment of broad based economic growth and poverty alleviation. The Government is committed to bring about a green revolution that entails transformation of agriculture from subsistence farming towards commercialization and modernization through crop intensification, diversification, technological advancement and infrastructural development. The NAP aims at addressing challenges that continue to hinder the development of the agricultural sector. These include low productivity; over dependence on rain-fed agriculture; inadequate agriculture support services; poor infrastructure; weak agro-industries; low quality of agricultural produce; inadequate participation of the country's private sector in agriculture; environmental degradation and crop pests and diseases (URT, 2013).

Tanzania government has decided to support its agricultural sector in a more systematic way using Agriculture Sector-Wide Approach (Ag-SWAP). The initiative is being implemented under the Agricultural Sector Development Programme (ASDP). The ASDP is the sector reform programme implementing decentralization policy at local level. Tanzania's agricultural sector strategic priorities have most recently been outlined in the Tanzania Food Security Investment Plan (TAFSIP) as part of the country's Comprehensive African Agriculture Development Programme (CAADP) (URT, 2013).

CAADP is an initiative of the African Union within the context of New Partnership for Africa's Development (NEPAD). The CAADP support African countries to achieve

economic growth and food security through transformation of the agricultural sector. CAADP was endorsed by Heads of states (Tanzania included) and government in what is commonly known as Maputo Declaration of July 2003. One of the major resolutions taken by the Heads of State and government was to effect policy changes that will improve agricultural and rural development in Africa. CAADP goal is to attain an average annual agricultural sector growth rate of 6 percent for the continent.

Tanzania is implementing CAADP through the Agricultural Sector Development Programme (ASDP) for Tanzania Mainland and the Agriculture Strategic Plan (ASP) for Zanzibar (Cooksey, 2013). CAADP aims to stimulate an agricultural led development that eliminates hunger and reduces poverty and food insecurity. To achieve this goal CAADP focuses on four main pillars:

Pillar 1: Extending the area under sustainable land management and reliable water management. Pillar 2: Improving rural infrastructure and trade related capacities for improved market access. Pillar 3: Increasing food supply, reducing hunger and improving responses to food emergency crisis. Pillar 4: Improving agricultural research, technology dissemination and adoption.

In Tanzania, agriculture production is subsistence in the sense that farm families are largely producing for own consumption. Subsistence farming has been defined as “farming and associated activities which together form a livelihood strategy where the main output is consumed directly, where there are few if any purchased inputs and where only a minor proportion of output is marketed” (Barnett *et al.*, 1997) cited by Morton (2007). According to Rutta (2012), Tanzania’s agriculture is dominated by small-scale subsistence farming and approximately 85% of the arable land is used by smallholder

farmers who operate between 0.2 and 2 ha using hand hoe as the main cultivating tool and low inputs.

Efforts done by Tanzania Government since 2006 to date is to conduct six main assessments. The main objectives of which are to: (a) understand clearly the general situation of the districts and identify key causes of food shortage; (b) identify the lowest geographical areas or administrative levels (ward, village or household) which are facing food shortage; (c) determine the magnitude of food shortages and characteristics of households facing food shortages in a particular areas; (d) define characteristics and number of households facing acute food shortages; (e) identify available coping strategies and their significance to the food needs of food deficit households; (f) determine and recommend appropriate interventions and support needed by affected persons to enable them cope, sustain their livelihood means and engage fully in their productive activities; and (g) recommend enhancement of short to long-term strategies to mitigate food insecurity in the country.

Programmes for initiating food security in Tanzania include Tanzania Social Action Fund (TASAF), Participatory Agriculture Development Project (PADEP), Participatory Irrigation Development Programme (PIDP) and Food for Work Programme (FFW) by World Food Programme (WFP) (URT, 2006). Other programmes are Agricultural Sector Development Programme (ASDP), Agricultural Sector Development Strategy (ASDS) and District Agriculture Sector Investment Project (DASIP).

The geographical coverage of the Agricultural Sector Development Programme (ASDP) maintained in 132 rural districts of the mainland where about 90% of the poor rural engaged in agricultural activities. The target group includes poor women and men in the

rural districts of the United Republic of Tanzania who have the potential to improve their agricultural productivity and incomes, in addition to food-insecure people. The ASDP has two objectives: (i) to improve farmers' access to and use of agricultural knowledge, technologies, marketing systems and infrastructure, all of which contribute to higher productivity, profitability and farm incomes; and (ii) to promote private investment based on an improved regulatory and policy environment (URT, 2007).

At local level ASDP aims to supporting agricultural sector activities at the village, ward and district levels. This is achieved through: (i) priority local agricultural investments made in accordance with district agricultural development plans on a cost-sharing basis, with beneficiaries contributing labour and locally available materials; (ii) a shift to contracting of agricultural services and greater control of resource allocation decisions by farmers; and (iii) building district planning capacity, agricultural reforms, farmers' empowerment and development of private-sector service provision (URT, 2007).

At national level ASDP designed to assist the agricultural sector lead ministries in implementing the policy and institutional reforms envisioned in the ASDS and to provide an enabling environment for commercial activity in the sector. This involves support to: (i) agricultural services, primarily research and extension; (ii) irrigation development; (iii) market and private-sector development; (iv) food security; and (v) coordination, monitoring and evaluation (URT, 2007).

The Government of Tanzania developed ASDS and its operational program ASDP, whose objectives are to achieve a sustained agricultural growth. ASDS focus on the preparation and implementation of District Agriculture Development Plans (DADPs). The ASDP has five key components on which it seeks improvement: (i) the policy, regulatory and

institutional arrangements; (ii) agricultural services (research, advisory, technical services, and training); (iii) investment through DADP implementation; (iv) private sector development, market development, and agricultural finance; and (v) cross-cutting and cross-sectoral issues (URT, 2007).

DASIP contributed to reduce rural poverty and food insecurity, to increase agricultural productivity and incomes of rural households in the project area, within the overall framework of the ASDS. The activities are also focused on the work of district and local extension and support services, and contract service providers. The intent is to establish favourable local conditions for small, medium and large-scale production (URT, 2004).

In 2013 Tanzania Government initiate Big Results Now (BRN) transformational programme. BRN initiative aims at adopting new methods of working under specified timeframe for delivery of the step-change required or Tanzania considering the many similarities between the two nation's economies such as mining and agriculture being the initial driving forces for growth. BRN initiatives achieved through three big ideas: (i) promoting 25 commercial farming deals; (ii) enhancing 78 smallholder rice irrigation schemes; and (iii) developing 275 collective maize warehouses linking maize famers to the market. Generally BRN aims at increasing agricultural GDP growth; smallholders' income; food security and reduces poverty (URT, 2013).

1.1.1 Methods of achieving food security

Food security is achieved by increasing food availability, food access and food adequacy for all. Food insecurity is directly correlated with poverty. In order to achieve food security, it is necessary not only to alleviate poverty but also create wealth for the target population. FAO (2013) outline seven food security strategies (interventions) that when

implemented together would hold good prospects for substantially maintaining food security. These are: nutritional interventions; facilitating market access; capacity building; gender sensitive development; building on coping strategies; creating off-farm opportunities and good governance (FAOSTAT, 2013).

Nutritional interventions: The effectiveness of a nutritional intervention is increased if then you can increase in use of locally produced foods from animal products, fruits, pulses and vegetables. In addition, the intervention should increase roots and tuber production so as to reduce dependency on cereals. This reduces the risk of crop failure during droughts since tubers like cassava are relatively more drought tolerant.

Facilitating market access: There is need to remove barriers to trade. The best approach is to manage the different agricultural systems, and marketing strategies that would work best for a given group of farmers.

Rural Off-farm Opportunities: Rural off-farm opportunities will provide opportunities for both the landless rural poor and the group of non-adopters that fall out of business when the agricultural sector becomes more efficient. In addition, provision of off-farm opportunities will curb rural to urban migration and possibly induce some urban to rural migration. It would reduce the number of non-motivated farmers who took up farming just because they had no other options, thus paving the way for more efficient farming.

Capacity Building: Capacity Building should focus on education, research and development, access to capital and infrastructure development. Education not only endows one with the power to read and hence be informed, but it also allows one to communicate.

As an intervention to food security, education must go beyond the level of reading and writing to that of transfer of knowledge.

Gender Sensitive Development: There is an intrinsic gender issue where poverty is concerned. One of the ways in which this is manifested is in the shift from woman-lead leadership to man-lead leadership as one moves from subsistence farming to market driven farming. Women are important as food producers, managers of natural resources, income earners and caretakers of household food security.

Building on Coping Strategies: Poor societies need help to alleviate food insecurity and poverty, hence need meager resources to build strategies that would work for them to alleviate their food insecurity and poverty.

Good Governance: All the above interventions are part of good governance and special emphasis on the need for good governance is prudent. All the above strategies can only work in a peaceful and corruption free environment. Part of good governance is the provision of safety nets to vulnerable groups. It should also provide for the minority and be totally inclusive in its decision-making. There is need to delink political interests from the basic needs of a nation. More often than not sustainable food security measures are long-term strategies, which need to be protected from volatile political interests of leaders. This means that departments dealing with such issues need to be stable without political interference from governments and donors alike.

According to Asian Development Bank (ADB) report of 2012, other methods proposed for achieving food security are:

- i. Improve agriculture productivity for ensuring long term food security and promoting poverty reduction.

- ii. Transfer modern farm technology to increase the efficiency in which land used can produce major increase in farm yield.
- iii. Promote innovation and adoption of new technology to improve agricultural productivity and rural income.
- iv. Promote rural development to poverty reduction and rural income.
- v. Invest in human capital in health, education and basic infrastructure such as water.

Also www.grida states seven methods to improve food security. These methods are:

- i. Decrease the risk of highly volatile prices, price regulations on commodities and large cereal stocks should be created to bugger the tight market of food commodities and the subsequent risks of speculations in markets.
- ii. Encourage removal of subsidies and blending ratio of first generation bio fuels which would promote a shift to higher generation bio fuels based on wastes.
- iii. Reduce use of cereals and food fish in animal feeds and develop alternatives to animal and fish feeds.
- iv. Support farmers in developing diversified and resilient eco-agriculture systems that provide critical ecosystem services.
- v. Increase trade and improve access to market access by improving infrastructure and reducing trade barriers.
- vi. Limit global warming including the promotion of climate-friendly agriculture production systems and land use policies at scale to help mitigate climate change.
- vii. Raise awareness of the pressure of increasing population growth and consumption patterns on sustainable ecosystem functioning.

1.1.2 The link between poverty and food security

In the attempt to define poverty, many authors feel secure to associate it with the causes of or manifestations of poverty. This is because of the complexity and multidimensional nature of poverty. Thus one can hardly find it defined uniquely (Likwelile, 2000). Indeed

there are variations and or different views on how poverty should be defined and what it means to be poor. Poverty is caused by lack of adequate basic needs. This problem has tended to increase food insecurity including malnutrition, ignorance and prevalence of diseases, dirty surroundings, high infant mortality, child and maternal mortality among the effects. However, the most commonly used definitions emphasizes the income dimension of poverty because all the manifestations listed earlier, for instance food insecurity and malnutrition are translated through inadequate income flow. In other words income is regarded as a relevant welfare indicator and therefore poverty occurs when one is unable to attain a minimum standard of living (Msambichaka *et al.*, 2003).

Poverty is the state of human beings who are poor. That is, they have little or no material means of surviving, little or no food, shelter, clothes, healthcare, education, and other physical means of living and improving one's life ([http://en.wikipedia.org/wiki/Poverty reduction](http://en.wikipedia.org/wiki/Poverty_reduction)). Food security and poverty reduction are inseparable. Food security alone does not eradicate poverty, and strategies to fight poverty must be integrated with policies to ensure food security and to offer the best chance of reducing mass poverty and hunger. Poverty is multifaceted and intensified through such factors as an even distribution and quality of land, poor access to education and health facilities, low level of infrastructure development and lack of employment, climate stress and prone to natural disasters (www.icimod.org/?q=1394). Attaining food security is integral part of poverty reduction. Without it, poverty becomes a viscous cycle (ADB, 2012).

1.1.3 The link between poverty and food security in Tanzania

Poverty deprives people of access to good quality and enough amount of food, denying them the nutrition they need to be healthy. Apart from availability, stability and utilization, the issue is access, which refers to the ability of people to physically obtain and

economically procure the food they need. Having food in town centers is meaningless to people who cannot get there and having food on market shelves is meaningless to people who cannot afford to purchase it (ADB, 2012). Individual food security depend on income, purchasing power, sufficient labour and resources such as cattle or land (Kavishe and Mushi, 1993).

Since food insecurity is part of poverty, many households in Tanzania which are poor lack income, purchasing power, sufficient labour and resources such as cattle or land tend to be food insecure. According to Comprehensive Food Security and Vulnerability Analysis (CFSVA, 2012) household food insecure indicators are classified along the four dimensions of food security (availability, access, stability and utilization). Indicators of household food insecurity in Tanzania include: lack of/no food to eat; undernourished/malnutrition; reduced meals i.e. eating single meal per day due to inability of household to afford three meals. In order to cope with food insecurity at household level in Tanzania, households exercise a set of coping strategies to manage food insecurity. Specifically households resorted to: relying on less preferred foods; limiting portion size at meal times; reducing the number of meals eaten in a day; restricting consumption by adults for small children to eat; borrowing food, or relying on help from a friend or relative (CFSVA, 2012).

1.1.4 Food security and mining

According to Weber-Fahr *et al.* (2001) mining can contribute to poverty reduction in community through a variety of ways, mostly directly, through generating income and through creating opportunities for growth for lateral or downstream businesses. It also contributes indirectly through investments that enable better social services and it catalyze improvements in physical infrastructures. This is supported by CIA (2011) that in

Argentina, the amount of land under cultivation in communities near Barrick's Veladero mine increased between 2001 and 2007 despite mine construction and operation.

But, a study by Mishra and Pujari (2008) on mining in villages in India found that agricultural productivity decreased due to mining activities. Mishra and Pujari (2009) argue that mining activities contributes to transfer of labour from agriculture, which causes loss in agricultural production, thus leading to food insecurity. This is supported by <http://en.wikipedia.org/wiki/Poverty> which states that: "due to mining activities, shift of livelihood from agriculture to mining activity work tends to change agriculture productivity into negative".

In Tanzania, food production has been failing to meet demand and the country has been importing food and receiving food aid so as to meet the demand due to its production shortfalls. There is a tendency for able-bodied young people to leave the villages to seek work or business opportunities in mining, leaving the disabled, elderly, ill and young children in the villages to carry out farming activities (Rukonge *et al.*, 2008). Due to the argued contribution of mining to the farming communities as stated by Weber-Fahr *et al.* (2001) contrary to Mishra and Pujari (2009), I expected communities surrounding mining to be food secure due to opportunities created by mining such as income and infrastructures, as well as available resources such as agricultural extension workers, agricultural extension services, fertile land, draught animals, agricultural inputs subsidy and bimodal rainfall. So there was a need to find out if the mining contributes to positive or negative food security to farming communities surrounding North Mara Gold Mine (NMGM) locally known as Nyamongo Gold Mine.

1.2 Problem Statement and Justification

Although the government of Tanzania has been putting effort towards attaining food security, food insecurity is still a major constraint for poor farming families in many areas of Tanzania, which some time force the government to send relief food to such areas. Research have been done on conflicts, violence, bloodshed, land and environment degradation in farming communities surrounding mining areas which in fact contributes to negative food security. However little is known on food production in those areas, including communities surrounding NMGM. Therefore, this study focused on effects of mining on food security to farming communities surrounding NMGM because per capital income of majority people in the study area depends on farming and related mining activities (activities present due to presence of mining e.g. food vendors, restaurants, bars, transport), while food scarcity is persisting.

Findings in this study will be used to develop strategies for addressing effects of mining on food security to surrounding communities of NMGM. The research results will help to inform government and stakeholders on key issues of food security in the study area, then suggest on better solutions. Challenges will assist policy makers, planners, academicians, other researchers, development partners and stakeholders to make decisions on what interventions do the mining company can make to improve food security in the study area also in other related parts of Tanzania. This study comes at the right time for Tanzania where the government is advocating and initiating Agriculture Revolution Campaign locally known as *KILIMO KWANZA* initiative (*Agriculture First*), as well as to meet Millennium Development Goal (MDG) 1 target 1C which is to eradicate extreme poverty and hunger with its 2 targets of halving between 1990 and 2015.

1.3 Objectives of the Research

1.3.1 Overall objective

To assess effects of mining on food security to farming communities surrounding Nyamongo Gold Mine in Tarime District, Tanzania.

1.3.2 Specific objectives

- (i) To determine food security status in the study area.
- (ii) To determine the amount of farm labour that moves to mining from communities surrounding the mining in the study area.
- (iii) To determine amount of money earned by house hold farmers in study area from mining.
- (iv) To identify items expenditure for money generated by farmers from mining in the study area.
- (v) To assess the contribution of infrastructure development to food security in the study area.

1.4 Research Questions

1. What is food security status in the study area?
2. What is the amount of farm labour that moves to mining from communities surrounding the mining in the study area?
3. What is amount of money earned by house hold farmers in study area from mining?
4. How money generated by farmers from mining is used in the study area?
5. How infrastructure development contributes to food security in the study area?

1.5 Conceptual Framework

A conceptual framework binds together and provides guidelines towards collection of appropriate data or information (Katani, 1999). For this study conceptual framework consist of Institution, Independent and Dependent variables. Independent variables involve negative effects and positive effects caused by presence of mining in communities surrounding the mine. More explanation of the variables used to construct the conceptual framework is summarized in Fig. 1 and the variables are shown in Appendix1.

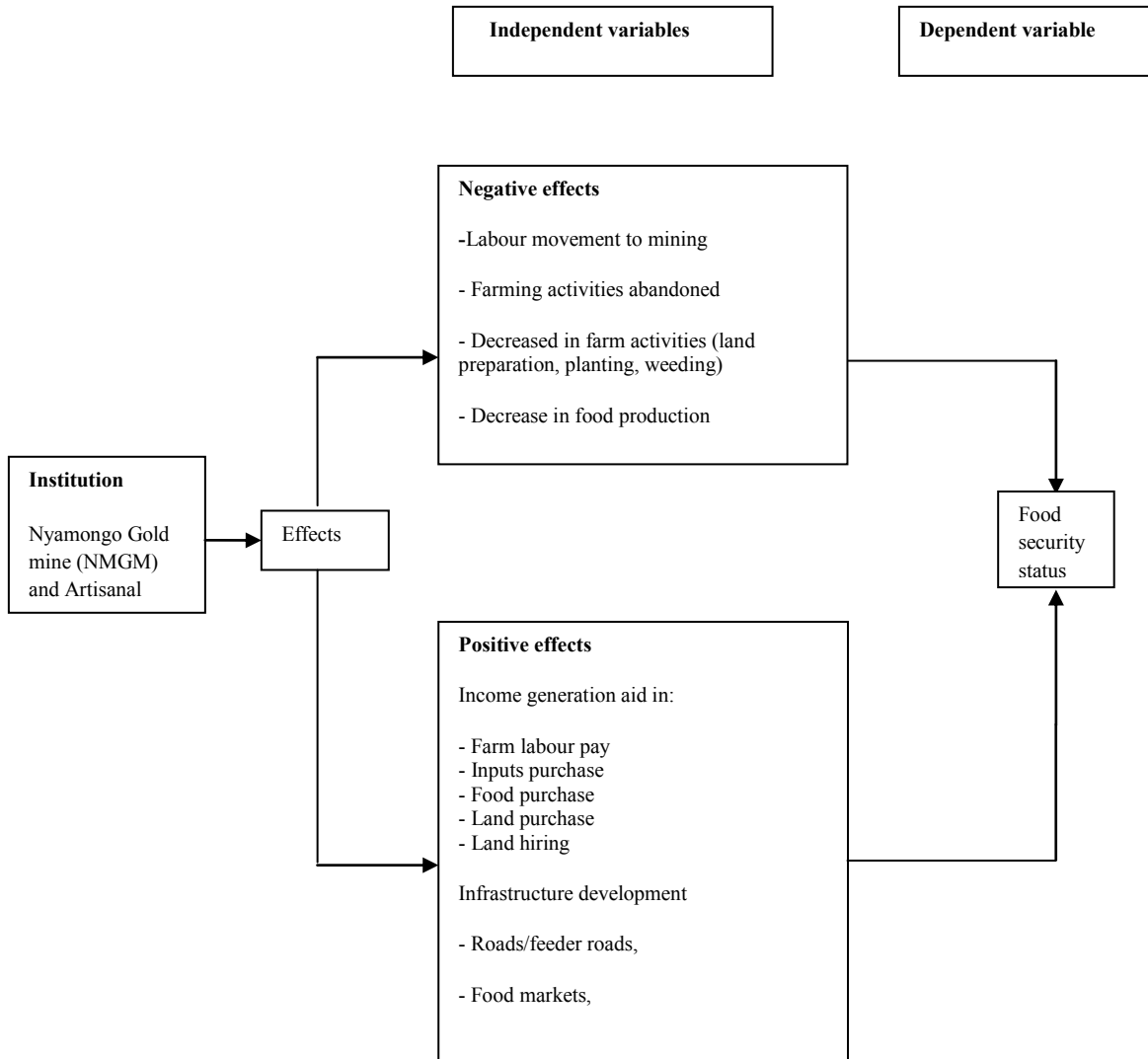


Figure 1: Conceptual framework showing effect of Mining on food security to farming communities surrounding NMGM.

Table 1: Definition of key variables

Variable	Definition
Age	Refers to range of respondent years
Sex	A biological condition of being male or female
Marital status	The state of being married or not
Effect	Positive or negative outcome
Mining	The process or business of extracting minerals from the ground
Farming communities	People whose basic occupation is farming activities
Farming activities	Activities involving raising of food, cash and horticultural crops
Food security	State of being free from food deficit
Income	Earnings
Source of income	Economic activities undertaken by head of household
Household size	The people who live together in a single home
Related mining activities	Activities present due to presence of mining e.g. food vendors, restaurants, bars, transport
Intruders	People who used to invade and steal mineral stones from NMGM fenced mine pit

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Food Security

Food security can be viewed at three levels: household, nation and global levels. At household level food security is defined as “the availability of food to all members of a household which will suffice the needs at all times for an active, healthy life”. The food will be either produced on farms by family or purchased from other places. At nation level food security is defined by World Food Summit (1996) as “a situation when all people in a nation at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life” (WHO, 2013). At global level food security is defined as “a situation when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life” (FAO, 2013).

Household food security is the application of this concept to the household level, with individuals within households as the focus of reference (FAO, 2010). At this level food insecurity exists when people do not have adequate physical, social or economic access to food as defined above, which lead to undernourishment. Undernourishment exists when caloric intake is below the minimum dietary energy requirement (MDER). MDER is the amount of energy needed for light activity and to maintain a minimum acceptable weight for attained height (FAO, 2010).

The International Federation of Red Cross and Red Crescent Societies (IFRCRCS) (2006) conceptualize food security as a situation where by “a person, household or community, region or nation is food secure when all members at all times have physical and economic

access to buy, produce, obtain or consume sufficient, safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life”.

Interest in food security became prominent in the 1970s and has been a topic of considerable attention and mostly concerned with food supply in the form of grain stocks available at regional levels. Interest in food security was particularly stimulated by world food crisis of 1972-74 and the African famine of 1984-85. The first World Food Summit of 1974 set the goal of ‘eradicating’ hunger within ten years. The results were revisited during the second World Summit in 1996 in which heads of states, United Nations’ agencies, the World Bank and non-governmental organizations (NGOs) pledged to ‘halve’ the number of chronically undernourished by the year 2015. The target was then adopted in one of the Millennium Development Goals (MDGs) agreed by 189 countries in New York in 2000. Such an objective appears to be a ‘grandiose scheme’ although its attainment might alleviate the food insecurity of roughly more than twenty-two million people and save the lives of ten million people, of which six million are children under five years of age dying of hunger and food insecurity-related diseases every year (UN/SCN, 2004).

Globally the number of undernourished people was 852 million between year 2000 and 2002; out of these 815 million were in developing countries, 28 million in the countries in transition and 9 million in the industrialized countries. It was further reported that the number of chronically undernourished individuals in developing countries increases at a rate of 4 million per year. The World Food Summit goal is to reduce, between 1990-92 and 2015 the number of undernourished people by half. Millennium Development Goal 1, target 1C, is to halve, between 1990 and 2015, the proportion of people who suffer from hunger (FAO, 2010).

In Tanzania, 19% of people were living below the national food poverty line of Tanzanian Shillings (TZS) 5295 per adult equivalent for 28 days and below a caloric poverty line of 2200 KCal per adult equivalent per day in 2000/01 (NBS, 2002). Also National Panel Surveys (NPS) of 2010-11 reported that at national level, about 730 000 households were food insecure or vulnerable to food insecurity (8.3% of all households in 2010-11) (CFSVA, 2012) while Tanzania's population was estimated to be around 44.9 million people in 2012 (NBS, 2013).

2.2 Four Pillars of Food Security

According to IFRCRCS (2006) the definition of food security is based on four important pillars (food availability, access, utilization and stability/adequacy): It is therefore important that measurement of food security is also based on the four pillars which are food availability, food access, food stability/adequacy and food utilization.

2.2.1 Food availability

Food availability has to do with the supply of food. This should be sufficient in quantity and quality and also provide variety (FAOSTAT, 2013). Food availability in a country, region or household means that food is physically present because it has been grown, manufactured, imported and/or transported there. For example: food is available because it can be found on markets, because it is produced on local farms, land or home gardens, or because it arrives as part of food aid, etc. This is food that is visible in the area (IFRCRCS, 2006).

2.2.2 Food access

Food access is the way different people can obtain the available food. There are two distinct types of access to food: direct access in which a household produces food using

human and material resources, and economic access in which a household purchases food produced elsewhere. The assets of a household, including income, land, products of labor, inheritances, and gifts can determine a household's access to food. Normally we access food through a combination of home production, stocks, purchase, barter, gifts, borrowing or food aid. Food access addresses the demand for the food. It is influenced by economic factors, physical infrastructure and consumer preferences. For households and individuals within them to be food secure, food at their access must be adequate not only in quantity but also in quality (FAOSTAT, 2013). Food access is ensured when communities, households and all individuals within them have adequate resources, such as money, to obtain appropriate foods for a nutritious diet. Access depends on income available to the household, on the distribution of income within the household and on the price of food. It also depends on market, social and institutional entitlement/rights to which individuals have access. Food access can be negatively influenced by physical insecurity such as conflict, loss of coping options, such as border closure preventing seasonal job migration, or the collapse of safety net institutions that once protected people with low incomes (IFRCRCS, 2006).

2.2.3 Food utilization

Another pillar of food security is food utilization, which refers to the metabolism of food by individuals. Once food is obtained by a household, a variety of factors impact the quantity and quality of food that reaches members of the household. In order to achieve food security, the food ingested must be safe and must be enough to meet the physiological requirements of each individual (Wikipedia, 2014).

Utilization is commonly understood as the way the body makes the most of various nutrients in the food. Sufficient energy and nutrient intake by individuals is the result of good care and feeding practices, food preparation, and diversity of the diet and intra-

household distribution of food. Combined with good biological utilization of food consumed, this determines the nutritional status of individuals (FAO, 2008).

Food utilization is the way people use the food and is dependent on the quality of the food, its preparation and storage method, nutritional knowledge, as well as on the health status of the individual consuming the food. Certain diseases do not allow for the maximum absorption of nutrients and growth requires increased intake of certain nutrients. Food utilization is often reduced by endemic disease, poor sanitation, lack of appropriate nutrition knowledge or culturally prescribed taboos that affect access to nutritious food by certain groups or family members according to age or sex. Any of the above-mentioned factors can cause food insecurity (IFRCRCS, 2006).

Agricultural growth will not have a positive impact on utilization if it does not benefit the nutritionally insecure. In Tanzania, for instance, recent agricultural growth did not lead to nutritional improvements because the growth was in large-scale farming in a few parts of the country, and in a few crops (FAO, 2008).

2.2.4 Food stability

Food stability is the way food is available at all the time i.e. the ability to obtain food over time. Food stability can be transitory, seasonal or chronic. In transitory food may be unavailable during certain periods of time. At the food production level, natural disasters and drought result in crop failure and decreased food availability. Instability in markets resulting in food-price spikes can cause transitory food instability. Other factors that can temporarily cause food instability are loss of employment or productivity, which can be caused by illness. Seasonal food instability can result from the regular pattern of growing seasons in food production (Wikipedia, 2014). Even if food intake is adequate today, still

considered to be food insecure if has inadequate access to food on a periodic basis, risking a deterioration of nutritional status. Adverse weather conditions, political instability, or economic factors (unemployment, rising food prices) may have an impact on food security status (FAO, 2008).

Ensuring food stability is an essential component in food security of development planning in many countries. While food security continues to improve in the developed world, it dwindles yearly in the developing countries. This situation, therefore pose a major threat to millions of people in the developing world. According to the World Hunger Education Services (2011) cited by Ocansey (2013) more than 10% of the world's malnourished live in Asia and 26% in Africa and about 1.02 billion people suffer from chronic hunger worldwide. According to FAO (2010), in 2010 more than 925 million people globally were undernourished, meaning they did not have either available or access to food which results to consumption of unbalanced diet.

Food stability in Tanzania

Household food stability as a component of food security exists when all members, at all times, have access to enough food for an active, healthy life. Individuals who are food secure do not live in hunger or fear of starvation (Wikipedia, 2014). In Tanzania food status is not stable because most of the food produced in household level sold by households without leaving enough stocks to last until the next harvest when food is available and affordable. The stability and utilization pattern is determined by consumer's preferences some of which may embed in cultural norms and taboos (Kavishe and Mushi, 1993).

2.3 Food Security Assessment and Measurement

Food security assessment and measurement link together in sense that food security measurement is part of food security assessment. Before food assessment is done, food measurement is carried out so as to determine how food security can quickly change in a region, suddenly putting countless people at risk. Weather, population movement and road conditions are among the factors which can lead to a sudden decrease in food security. The information used during food security assessment and measurement are number of meals eaten per day, types of food consumed and general demographic information's (GeoPoll, 2013).

Typically, food insecure households employ any of four types of consumption coping strategy. First, households may change their diet (switching from preferred foods to cheaper, less preferred substitutes). Second, households can attempt to increase their food supplies using short-term strategies that are not sustainable over a long period (borrowing, or purchasing on credit; more extreme examples are begging or consuming wild foods, or even seed stocks). Third, households can try to reduce the number of people that they have to feed by sending some of them elsewhere (anything from simply sending the kids to the neighbour's house when they are eating, to more complex medium-term migration strategies). Fourth, and most common, households can attempt to manage the shortfall by rationing the food available to the household (cutting portion size or the number of meals, favouring certain household members over other members, skipping whole days without eating.) (Maxwell *et al.*, 2003).

2.3.1 Food security assessment

Assessment means judgment, appraisal, estimation or evaluation. It is a process that is used to understand a situation in order to make decisions on whether there is a need to respond to a hazard or to a situation that can lead to a disaster if nothing is done.

The assessment must collect information that will allow good analysis of the situation and the threats to life, human dignity, health and livelihoods of the population. The principle of an assessment is that the affected community and local authorities are consulted (IFRCRCS, 2006).

According to IFRCRCS (2006) the self-assessment food security measure done by asking households to characterize the state of food security as compared to a 'normal' i.e. food secure; slightly food insecure; moderately food insecure; very food insecure; extremely food insecure.

Food security assessments look more specifically at how people try to maintain a secure food environment for themselves, and whether they succeed. The general objective of a food security assessment is to understand how severe the food insecurity is, and why this is the case. The objective of food security assessments is to determine if there is a need to intervene to return people to a normal food security situation in the short term and/or long term (Jones *et al.*, 2013). The focus of a food security assessment will be on evaluating the food security situation for various groups of people. In addition, food security assessments can help to predict upcoming food insecurity or can predict the duration of an insecure food period (IFRCRCS, 2006).

2.3.2 Food security measurement

Food security measurement is derived from country level, household income and expenditure surveys to estimate per capita caloric availability. In general the objective of food security measurement is to capture some or all of the main components of food security in terms of food availability, access, utilization and stability/adequacy. Barrett (2010) cited by Maxwell *et al.* (2013) noted that approaches to measure food security

follow the four pillars of availability, access, utilization and stability, and the following seven measures are widely used to measure food security.

- (i) Coping Strategies Index (CSI) - assesses household behaviours and rates them based on a set of varied established behaviours on how households cope with food shortages. The methodology base on collecting data on a single question “what do you do when you do not have enough food?” or “What do you do when you do not have enough money to buy food?”
- (ii) Reduced Coping Strategies Index (rCSI) - Measure how the households cope with food shortfalls, and serve as a comparative indicator of household food security.
- (iii) Household Food Insecurity Access Scale (HFIAS) - continuous measure of the degree of food insecurity (access) in the household in the previous month.
- (iv) Household Hunger Scale (HHS) - measures the experience of household food deprivation based on a set of predictable reactions, captured through a survey and summarized in a scale.
- (v) Food Consumption Scale (FCS) - It measure the links between dietary diversity and household food access i.e. to monitor changes in food needs.
- (vi) Household Dietary Diversity Scale (HDDS) - measures the number of different food groups consumed over a specific reference period e.g. 24hrs, 48hrs or 7days.
- (vii) Self-assessed measure of Food Scale (SAFS) - Measure household behavior and lived experiences on food security.

In this study two measures were considered, that are CSI and HFIAS. CSI used to know the expenditure on food i.e. given the propensity of people closer to the edge of poverty to spend a greater and greater proportion of their income on food. Also consumption behaviors i.e. behaviour related to food consumption when people do not have enough

food or enough money to buy food. HFIAS used to capture household behavior signifying insufficient quality and quantity, as well as anxiety over insecure access.

2.4 Farm Labour Movement to Mining Areas

In Tanzania agriculture is the primary economic activity in rural areas. Research done by Mwalyosi (2004) in other mining areas in Tanzania show that there was high movement of farm labour to mining. Movement of people into mining areas is high (Kulindwa *et al.*, 2003) cited by Mwalyosi (2004). According to Mwalyosi (2004) 79% and 70.6% of the respondents in Mererani and Mwanza mining areas respectively consist of persons who moved to mining areas between 1985 and 1995 were mostly former farmers and retired civil servants. That indicates these two sectors of former farmers and retired civil servants contribute over 50% of mining employees which causes poor agriculture production due to less engagement in agriculture as man labour, thus can lead to food insecurity. Also according to Bose (2012) mining may adversely affect agriculture indirectly when workers switch from one sector to the other by declining labour force in agriculture activities. In Africa, the declining viability of agriculture has led to a large decrease in agrarian activities and increased mining activities. The discovery of large mineral deposits and the perceived income opportunities they represent can also lead to the abandonment of farmland, hence food insecurity.

In another way, mining may support food security through income generated from mining, artisanal mining, non-mining activities, labour, infrastructure, market, agricultural extension, expansion and diversification through Corporate Social Responsibility Programmes. For example, Newmont Ghana Gold's Ahfo Agribusiness Growth Initiative (AGGI) in Ghana has provided training to 1368 farmers in Ghana to increase agricultural productivity and farm business skills. Also Resource Development Philippines Inc.

(RDPI) in Philippine has supported the development of a commercial vegetable farm that increased local incomes and improved local food security (Bose, 2012). In Tanzania, Geita Gold Mine (GGM) establishes projects focusing on income generating. A total of 725 recipients have received loans to start business projects, generally within retail and services. Also Agro-forestry project was initiated by GGM and their catering contract in 2002 is situated in one of the villages closest to the mine. Through joining a cooperative, 56 villagers have been encouraged to produce vegetables, eggs, and chickens, as well as *Moringa Oliefera* tree seeds (Lange *et al.*, 2004).

2.5 Income Generated from Mining Activities

Income refers to money, assets and other products from agricultural and non-agricultural activities. Income is defined as the output of activities which contributes to the people's livelihoods measured in cash and in-kind. All goods and services produced in activities are valued at market producer prices regardless of their use (Ellis, 2000).

The income generated from mining is not enough to enable farming communities to live without cultivating crops. Apart from improving food security through increasing production and productivity, a household or community may also improve its food security by increasing income, from whatever source, so that people are able to procure enough food to meet their requirements (Rukonge *et al.*, 2008).

The resulting income and employment opportunities may help to reduce poverty levels, particularly income poverty of local communities. The poor can reduce their non-income poverty if the earnings from gold mining activities are used to support health, education services and lands improving their well-being and capacities (Nyankweli, 2012). It also

contributes indirectly, through investments enabling better social services and catalyzing improvements in physical infrastructure (Weber-Fahr *et al.*, 2001).

2.6 Mining and Infrastructure Development and Its Contribution to Food Security

Mining projects usually located in remote rural areas, and companies have to make considerable investments in physical and social infrastructure, such as roads, schools, hospitals, power lines and water supplies (Nyankweli, 2012). Mining firms have improved infrastructure in a way that supports agricultural development. There is evidence that agriculture is growing in some areas as a result of mining and declining in others, depending on local circumstances. Rural road construction and improvements have also been shown to improve agricultural wages, decrease fertilizer costs, increase crop prices and output (Bose, 2012). Agriculture may also be the beneficiary of improvements in infrastructure supported by mining operations. For example, new roads constructed for the Yanacocha Peru mining operation decreased the time it took for farmers to reach markets as well as decreasing their transport costs. Local processing of agricultural goods may also be enhanced by improved access to water, electrification, and improved sanitation (Bose, 2012).

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Description of the Study Area

The study was conducted in 4 villages from 3 wards surrounding Nyamongo Gold Mine in Tarime District, Mara Region, Tanzania. These villages are Mrito (Kemambo ward), Nyarwana and Nyakunguru (Kibasuka ward) and Nyamwaga (Nyamwaga ward). The area was purposively selected due to presence of gold mine and artisanal mining activities surrounded by farming communities.

3.1.1 Geographical location of the study area

Tarime District is situated in the North-West of Tanzania and lies between latitudes 10° 00' – 10° 45' S and longitudes 33° 30' – 35° 00' E, with a total area of 1 534.47 square km which 270 square km are covered by the Serengeti National Park. The district is bordered by Kenya (Trans-Mara and Kuria District) to the North, Serengeti District to the East, and Rorya District to the west. Tarime District has 4 Divisions, namely Ingwe, Inchage, Inano and Inchugu. Tarime District has 30 wards with total of 53 221 households distributed 99 villages with 415 hamlets (DADP, 2010). The NMGM is located in the Northwestern part of Tanzania in Tarime District of Mara Region, some 100 kilometers East of Lake Victoria and 20 kilometers south of the Kenya border.

3.1.2 Administration of the study area

Tarime District is one among 6 local authorities in Mara Region. Other local authorities include Musoma Municipal, Musoma Rural, Butiama, Serengeti, Rorya and Bunda. According to data given by Tarime District Council Planning Report (TDCPR, 2013) Tarime District comprises of 4 Divisions, 40 Wards and 99 villages. The 2012 Population

and Housing Census (PHC) for United Republic of Tanzania show that the population of Tarime District council is 339 693 where by male are 162 986 and female are 176 707 with average household size 5.2 (NBS, 2012).

3.1.3 Climate of the study area

The climate of Tarime District area is a tropical one, with two distinct rainy seasons - long rains from March to the end of May and short rains from October to November. The temperatures are moderate throughout the year and they range from 15°C to 35°C. Wind direction is predominantly East-west (MacDonald and Roe, 2007).

3.1.4 Economic activities of the study area

According to District Agricultural Development Plan (DADP, 2009) the per capital income of majority people in the study area depends on farming activities where by different crops are grown in Tarime District. Coffee is the major cash crop while tobacco, sunflower and tea are grown on a limited scale by smallholder farmers. Major food crops produced are maize, cassava, sorghum, banana, sweet potatoes, finger millet, paddy and beans. Tarime District is one of the major livestock keeping districts in Mara Region. A good number of farmers keep poultry, cattle, sheep and goats.

3.2 Research Design

Cross – sectional design was used, where by data was collected at one point. This design is cheap, quick and effectively utilizes limited resources in terms of cash, labour, transport and time. The design is useful for descriptive purposes and data collected to be used to determine relationships between different variables focused in the study (Babbie, 1990; Kothari, 2004).

3.3 Sampling Procedure and Sample Size

For the aim of reducing a study area into a manageable size, a purposive sampling was employed to determine the study villages with farming communities surrounding NMGM: thus 4 villages among 7 villages surrounding NMGM which involved in farming activities were selected. A list of head of household farmers was obtained from the respective village registry book to form a sampling frame. In each sampling frame of selected village, 30 households were selected through a simple random sampling technique, where by a total sample size of 120 farmer households was obtained.

According to Bryman (2008), decisions about sample size represent a compromise between the constraints of time and cost, the need for precision, and a variety of further consideration. Bailey (1994) contended that a sample or sub-sample of 30 respondents is a bare minimum for a study in which statistical data analysis is to be done regardless of the population size. According to Matata (2001), sample size can range from 80-120 for most social-economic studies in Sub-Saharan African. For that matter, a sample size of 120 households (HHs) respondents was used for this study.

In addition to the sample of 120 HHs respondents, key informants were also interviewed during the study. Key informants included 4 village extension workers, 4 village leaders, 2 North Mara Gold Mine (NMGM) staff and 4 district leaders who include Tarime District Executive Director (DED), District Agriculture, Irrigation and Cooperative Officer (DAICO), District Community Development Officer (DCDO) and District Agriculture Extension Officer (DAEO).

3.4 Data Collection Instruments and Data collection

3.4.1 Data collection instruments

During the field work, three instruments were used in data collection. These instruments were interview schedule, diary and checklist. Interview schedule were used to obtain

information from the head of households. The checklist was used to hold discussion with officials at different levels (District, NMGM and villages) and the diary used to collect secondary data from relevant documentary sources including: internet website, Sokoine University National Agricultural Library (SNAL), district and village files and observation of farming communities' activities surrounding NMGM.

3.4.2 Data collection

Two types of data were collected. The study involved the collection of both primary and secondary data from the study area.

3.4.2.1 Primary data

Primary data were collected using both qualitative and quantitative approaches. Primary data from farmers' household (HHs) respondents collected by means of interview schedule, physical observation and Focus Group Discussion (FGD).

3.4.2.2 Interview schedule

Primary data focused on age, sex, marital status, education level, size of household, main occupation, food situation before and after introduction of mining activities in the study area, labour movement to and fro mining area (known as intruders), amount of money generated from mining activities and how used by farming communities in family level also available infrastructures such as roads, feeder roads, markets, water dam, water boreholes, electricity power and communication networks.

3.4.2.3 Key informants

Key informants are people who have specific knowledge about certain aspects of the community. They help researcher to collect information rapidly and in a focused way. Key

informants are those people who have an interesting perspective and are able to express it (IFRCRCR, 2006).

In qualitative data collection method, interview was used through checklist. Key informants included District Executive Director (DED), District Agriculture, Irrigation and Cooperative Officer (DAICO), District Agriculture Extension Officer (DAEO), District Community Development Officer (DCDO), Nyamongo Gold Mine staffs (NMGM), village extension workers and village leaders. The essence of using key informants was to supplement the information collected through observation and interview schedule.

3.4.2.4 Focus group discussion

This is a group of people gathered together to discuss a specific subject of common interest or knowledge. A focus group brings out a range of opinions and views as well as variations that exist in a particular community in terms of beliefs, experiences and practices. It helps to identify a range of information rather than precise information (IFRCRCR, 2006). In food security assessments the focus was on all topics related directly or indirectly to availability, access, stability and utilization of food. In this study Focus Group Discussion aimed to get ideas and experience on food situation before and after introduction of mining activities in the study area, amount of money generated from mining activities and how used by farming communities in family level, availability of infrastructures in the study area and how influence food security also suggestion or opinions on what to be done by farmers, district leaders and mining company to improve food security.

Focus Group Discussions were conducted in each selected village. Each group of Focus Group Discussion was formed by different actors of various age, sex marital status and

education level. The groups comprised 10-15 participants. During the focus group discussion, a checklist was provided to guide the discussion.

3.4.2.5 Observation

Physical observation was used to collect qualitative data such as labour movement to and fro mining area (known as intruders), available infrastructures such as roads, feeder roads, dam, water boreholes, markets, electricity power, the real situation on peoples' activities apart from farming, kind of crops grown, agriculture activities going on and communication networks available. The method enabled to connect together different information collected by using other methods.

3.4.3 Secondary data

Secondary data were obtained from documentary sources such as books, journals and official reports from DED's office, DAICO's office, CDC's office in NMGM, government reports and non-government organization report, Sokoine National Agricultural Library (SNAL) and internet. Secondary data were used as literature review to compliment primary data concerned food production trends from the start of mining 2002 to the time of study research, food imported in the district and its distribution, strategies to ensure food security in the district (NMGM surroundings) inclusively, contribution of NMGM (levy) to district council and how it was distributed among sectors (health, education, water, roads and agriculture).

3.5 Data Processing and Analysis

Data processing and analysis involves editing, coding, classification and tabulation of collected data (Kothari, 2004). In this study, the unit of analysis was the smallholder farmer household.

3.5.1 Data processing

The completed data from smallholder farmer HHs respondents' interview schedule were coded for computer analysis. Bulky data from research's diary and checklist were summarized manually to single sheet of paper. In summarizing the data, great care was taken to ensure that it accurately reflected the original meaning of the statements made.

3.5.2 Data analysis

The completed data from smallholder farmer HHs respondents' interview schedule was coded and entered for computer analysis by using Statistical Package for Social Science (SPSS) computer programme. The method of analysis involved analysis by the technique of frequency, means and percentages. Furthermore, data obtained from researches' diary and checklists were also analysed. Qualitative data were analysed by using "content analysis" technique which mainly involved transcription of recorded notes and then clustering information into sub-themes. Quantitative data were processed and analysed to produce frequencies to facilitate the assessment of effect of mining on food security to farming communities surrounding NMGM.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 General Information of Respondents

4.1.1 Distribution of respondents

The distribution of respondents by village is presented in Table 2 where it shows that 30 (25%) farmers were from Mrito village, 30 (25%) from Nyarwana village, 30 (25%) from Nyakunguru village and 30 (25%) from Nyamwaga village.

Table 2: Village names, wards and number of respondents (n=120)

Village	wards	Number	Percent
Mrito	Kemambo	30	25.5
Nyakunguru	Kibasuka	30	25.5
Nyarwana	Kibasuka	30	25.5
Nyamwaga	Nyamwaga	30	25.5
Total		120	100.0

4.1.2 Demographic characteristics

4.1.2.1 Age and sex of respondents

Age of respondents plays an important aspect in social analysis due to the fact that different age groups perform different sets of activities in society. Table 3 depicts respondents' age categories. Study findings as presented in Table 3 show that 45 (37.5%) respondents were aged between 36 and 45 years, 34 (28.3%) between 18 and 35 years, 21 (17.5%) above 55 years, and 20 (16.7%) were aged between 46 and 55 years. Table 3 further show that 83 (69.2%) of interviewed respondents were males and the remaining 37 (30.8%) were females. According to the findings, female were few due to the fact that the

interview focused on head of households. Most of head of household in the study area were men.

Table 3 also show background of household respondents, whereby 118 (98.3%) were native to the area and two (1.7%) were immigrant. These results indicate that majority of respondents were native and this comply with North Mara Gold Mine Social Impact Assessment (NMGMSIA) which reported that 92.2% of people surveyed in 2004 had been born locally, and more than 96% had been living there since 2001 or earlier.

Table 3: Age, Sex and household background of respondents (n= 120)

	Number	Percent
Respondent age category in years		
18-35	34	28.3
36-45	45	37.5
46-55	20	16.7
Above 55	21	17.5
Total	120	100.0
Sex of respondent		
Male	83	69.2
Female	37	30.8
Total	120	100.0
Respondents' household background		
Native	118	98.3
Immigrant	2	1.7
Total	120	100.0

4.1.2.2 Marital status of respondents

Results in Table 4 show that 105 (87.5%) respondents were married and living together with their partners in the same house, 12 (10%) were widowed, two (1.7%) were separated

and one (0.8%) was single. These results indicate that most of respondents interviewed in the study area were married. Married couples are likely to be settled and more contented with various development activities like farming because of the existing family commitments and high labour requirements.

Table 4: Marital status of respondents (n=120)

Marital status	Number	Percent
Married	105	87.5
Widowed	12	10.0
Separated	2	1.7
Single	1	0.8
Total	120	100.0

4.1.2.3 Education level of respondents

Education improves knowledge and use of technology in agriculture operation. Also the level of education is one of the most important social factors that influence the participation of farmers in agriculture production. Agriculture as an enterprise needs someone with basic education. It is expected that the extent which farmers were educated would tend to influence the ability to gain knowledge on food security.

Results in Table 5 present the education level of respondents whereby 67 (55.8%) of the respondents had primary education, 21 (17.5%) had no formal education, 20 (16.7%) had secondary education, eight (6.7%) had post-secondary education and four (3.3%) had literacy education. These results indicate that large number of farming households surrounding NMGM (55.8%) had primary education. The results are in agreement with that of CIMMYT (1993) where it was reported that in Tanzania, most farmers have primary education.

Table 5: Respondents' education level (n=120)

Education level	Number	Percent
Primary education	67	55.8
No formal education	21	17.5
Secondary education	20	16.7
Post-secondary education	8	6.7
Literacy education	4	3.3
Total	120	100.0

4.1.2.4 Household size

Household size refers to the number of persons who reside in the same homestead/compound but not necessary in the same dwelling unit, have same cooking arrangements and are answerable to the same household head. Average household size is calculated by dividing the total number of persons by the total number of household in a given population (UNFPA, 2013).

Results in Table 6 show respondents' household size whereby 34 (28.3%) had a household size of 3-4 persons, 28 (23.3%) had more than 9 household size of persons, 25 (20.8) had household size of 5-6 persons, 22 (18.3%) had household size of 7-8 persons and 11 (9.2%) had household size of 1-2 persons. The largest household was having more than 9 members and smallest household was having one member. The study further indicates that the study area had average size of 3.1 people per household which is relatively smaller compared to 4.9 average household size in 2002 report (URT, 2003) and 4.8 as the average household persons in 2012 (UNFPA, 2013). The small household size implies that persons are engaging less in agricultural production because of the small labour force available in the household, as many times it is farmers with more labour that are able to take advantage of high production in agriculture.

Table 6: Respondents' household size (n=120)

Respondents' household size	Number	Percent
1-2	11	9.2
3-4	34	28.3
5-6	25	20.8
7-8	22	18.3
9 and above	28	23.3
Total	120	100.0

4.1.2.5 Main occupation and household agriculture land holding

Results in Table 7 show respondents' main occupations whereby 120 (100%) households were involved in agriculture as their main occupation regardless of whether there were employed in NMGM, engaged in artisanal mining activities or non mining activities. These results indicate that households in the study area sustain their livelihoods from farming as the main occupation. These findings differ with that of PADEP (2010) which generalized that agriculture is the source of food and provides employment opportunities to about 80% of Tanzanians.

Table 7: Respondents' main occupation and household agriculture land holding in hectares (n=120)

	Number	Percent
Main occupation		
Agriculture	120	100.0
Others	-	-
Total	120	100.0
Household agriculture land holding in hectares*		
Less than 0.8	15	12.5
0.8-1.56	64	53.3
1.57-2	11	9.2
Above 2	30	25.0
Total	120	100.0

*Hectares obtained by converting acres provided in the questions of the survey instrument

Study results as presented in Table 7 also show that all 120 (100%) households in the study area had agricultural land holding, where by 15 (12.5%) had less than 0.8 ha, 64 (53.3%) had 0.8-1.56 ha, 11 (9.2%) had 1.7-2 ha and 30 (25%) had more than 2 ha. Kauzeni (1989) studies in rural areas generalized that many farmers own small plots which cannot provide a decent standard of living because income derived from such plots are small (without indicating how many/percentage). This is different from the study area where 53.3% own plots of land for cultivation which ranges between 0.8-1.56 ha while the average land holdings per household is 3.3 ha. It was expected that the total area of land owned by smallholder farmer's respondents would influence food security.

4.1.2.6 Mode of land acquisition

Results in Table 8 show that 90 (75%) respondents inherited the land they own, 13 (10.8%) purchased it, nine (7.5%) rented and eight (6.7%) obtained the land from village council for farming activities.

Table 8: Respondents' mode of land acquisition (n=120)

Mode of land acquisition	Number	Percent
Inherited	90	75.0
Bought	13	10.8
Rented/hired	9	7.5
Allocation by village council	8	6.7
Total	120	100.0

4.1.2.7 Farm size under cultivation

Results in Table 9 show that 62 (51.7%) respondents had less than 0.8 ha under cultivation, 45 (37.5%) had 0.8-1.56 ha under cultivation, six (5.0%) had 1.6-2 ha under cultivation and seven (5.8%) had more than two ha under cultivation. These findings

reveal that apart from all households in the study area owning land but the area cultivated for most households was less than 0.8 ha. The research study comply with Ruta (2012) which stated that Tanzanian agriculture is dominated by small-scale subsistence farming, and approximately 85 per cent of the arable land is used by smallholders who operate between 0.2 and 2 ha. Also URT (1999) stated that most smallholder farmers in Tanzania usually cultivate 0.36-0.8 ha of land for crop production. This implies that the farm size situation of many respondents in the study area was not different from other small holder farmers in other parts of Tanzania. The findings differ with NBS (2012) which indicate that agriculture in Tanzania is dominated by smallholder subsistence farming, around 85% of farmers own fewer than four hectares of land and average size of a cultivated farm plots being 2.6 hectares.

Table 9: Farm size under cultivation in hectares (n=120)

Farm size under cultivation in hectares	Number	Percent
Less than 0.8	62	51.7
0.8-1.56	45	37.5
1.57-2	6	5.0
Above 2	7	5.8
Total	120	100.0

4.1.2.8 Tools/implements used to cultivate farms and ownership

Results in Table 10 show that 87 (72.5%) respondents used both oxen plough and hand hoe, 31 (25.8%) used hand hoe only and two (1.7%) used tractor and hand hoe to cultivate their farms. Further, findings in Table 10 shows that 83 (69.1%) farmers used own tools/implements, 37 (30.9%) used hired tools/implements to cultivate their farms. That finding implies that most of farming communities surrounding NMGM own their tools/implements for farming activities.

Table 10: Tools/implements used to cultivate farms and ownership (n=120)

	Number	Percent
Tools/implements used to cultivate farms		
Ox- plough and hand hoe	87	72.5
Hand hoe only	31	25.8
Tractor and hand hoe	2	1.7
Total	120	100.0
Tools/implements ownership		
Owned by respondents	83	69.1
Hired by respondents	37	30.9
Total	120	100.0

The findings above indicate that farming communities surrounding NMGM do not rely only on hand hoe as the main cultivating tools; instead oxen implements are highly used in cultivation of farms. The findings in the study area differ from Ruta (2012) which stated that, the major limitation on the size of land holdings and utilization is the heavy reliance on the hand hoe as the main cultivating tool which sets obvious limitations on the area of crops that can be grown using family labour and the achievement of food security and poverty reduction.

4.1.2.9 Major source of farm labour

Results in Table 11 show that 95 (79.2%) respondents used families as their only source of labour for farm activities, 19 (15.8%) used both family labour and hired labour for farm activities, five (4.2%) used neighbours for farm activities and one (0.8%) used only hired labour for farm activities.

Table 11: Major source of farm labour (n=120)

Source of farm labour	Number	Percent
Family only	95	79.2
Family and hired farm labour	19	15.8
Neighbours	5	4.2
Hired farm labour	1	0.8
Total	120	100.0

4.2 Food Security Status

4.2.1 Main/staple food crops and source of food

Results in Table 12 show that the main food crops cultivated in the study area were maize (60.8%), cassava (22.5%) and sorghum (12.7%). This finding implies that farming communities surrounding NMGM depends on maize rather than drought resistance crops such as sorghum and cassava and early maturity crops such as finger millet, bulrush millet, sorghum and sweet potatoes. Findings from respondents and focus group discussion indicate that maize was most preferred by the farming communities around NMGM because the crop is used for both home consumption and as a cash crop. Apart for being drought resistance crop, cassava also acts as food security crop even though its production in the study area is limited due to its susceptibility to Cassava Mosaic Virus Disease (CMVD). The crop also takes long time to mature compared to maize and sorghum. This complies with other studies which show that Most farmers cultivate four or more crops (53%) with maize being the main one (cultivated by 83% of all farming households) (CFSVA, 2012).

Further results in Table 12 show that the source of food was 80 (66.7%) as both production/harvest and purchase, 38 (31.7%) own production/harvest and two (1.7%) purchases only.

Table 12: Main/staple food and Source of food (n=120)

	Number	Percent
Main/staple food item		
Maize	73	60.8
Cassava	27	22.5
Sorghum	20	16.7
Total	120	100.0
Source of food		
Both production/harvest and purchase	80	66.6
Own production/harvest	38	31.7
Purchase only	2	1.7
Total	120	100.0

4.2.2 Food stability and ways to supplement food during deficit/shortage

4.2.2.1 Food stability

Food stability is the way food is available at all the time i.e. the ability to obtain food over time. Results in Table 13 reveal that food stability in the study area was not good, because 82 (68.3%) respondents lack food stability almost the whole year, while 38 (31.7%) had food stability all over the year.

4.2.2.2 Ways to supplement food during deficit/shortage

Findings in Table 13 also reveal that in order to ensure food is available at household all the time, farming communities surrounding NMGM supplement food during deficit/shortage through different ways where by 97 (80.8%) buy from market, 21 (17.5%) buy from neighbours, two (1.6%) sell labour to get food or cash which they use to purchase food.

Table 13: Food stability and ways to supplement food during deficit (n=120)

	Number	Percent
Food stability		
Lack food stability all over the year	82	68.3
Had food stability all over the year	38	31.7
Total	120	100.0
Ways to supplement food during deficit/shortage		
Buy from market	97	80.8
Buy from neighbor	21	17.5
Sell labour to get food or cash	2	1.6
Total	120	100.0

Results in Table 13 show that 97 (80.8%) households buy food from market. The study found out that shortage of food in farming communities surrounding NMGM was filled in by supplement food from neighbouring village markets such as Nyarero, Keisangora, Kemakorere and Nyamwigura. Other sources of food supply were Tarime town and Serengeti District. But that supplement was not a total solution of maintaining food security in the study area. According to FAOSTAT (2013) the importance of foods purchased from markets in meeting household food security depends on household food income and market price. The seasonality of foods available at the household level may highly influence food availability in places where little to no food preservation is practiced. This comply with the report from URT (2002) and URT (2003) which reported that food production has been failing to meet demand and the country has been importing food and receiving food aid so as to meet the demand due to its production shortfalls. Report from CFSVA (2012) shows that Tanzania's overall food security status in 2010-11 around 730 000 households (8.3% of all households) in Tanzania were classified as having poor dietary intake.

4.3 Labour Movement to Mining, Artisanal Mining and Engagement in Mining

Activities

4.3.1 Labour movement to mining and artisanal activities

The study reveals that there were movement of people from farming communities surrounding NMGM to mining areas, not only to NMGM but also to nearby artisan mining places such as Nyabilama, Nyabori, Mikende, Mosege, Byantang'ana, Nyamatiryo, Botana, Mwitende and Itandura. The main group of people who move from farming communities to NMNG and artisanal mining area were both males and females aged between 18 to 45 years. This movement takes place at any time when gold erupts regardless of what agriculture activities were being under taken; the aim being to supplement income at household level as well as wealth creation.

Movement of labour from farming communities surrounding NMGM seemed to reduce farm labour. Through my personal observations, farming activities which were proceeding are crops weeding and bush clearing as land preparation for the next coming season which starts at the end of February, while many youth known as intruders were seen waiting outside the NMGM fenced mining area, standing on heaped stones excavated from mining pits or roaming around the mining area while carrying plastic bottles of water as a defending mechanism (to wash faces) if it happen that they bombed by guardians. Also many people were seen moving to or fro artisanal areas.

4.3.2 Engagement in mining activities

Results in Table 14 show that 85 (70.8%) respondents apart from engaging in agriculture as their main occupation, were also engaged in non-mining activities such as local beer brewery, charcoal making and selling, firewood selling, milk selling, fish monger, food vendors, kiosks and motorcycle transport (*bodaboda*); 23 (19.2%) respondents apart from

engaging in agriculture as main occupation, were also engaged in artisanal mining activities and 12 (10.0%) respondents were employed in NMGM. This means that, apart from agriculture as main activity in the study area, respondents participated in other activities that are influenced by presence of mining and artisan. Through Focus Group Discussion, I noticed that, other activities were carried out in order to supplement their daily needs while in other side it affects agriculture activities due to less participation in agriculture activities.

Results in Table 14 are in line with Nyankweli (2012) who stated that, the demand for basic needs within the family also encouraged people to adopt non-farming activities. Common non-farming activities include brewing beer; providing services (milling, retail shops, tearooms, selling firewood); selling second hand clothes (*mitumba*); pottery, sewing, canteens and providing food.

Table 14: Engagement in mining, artisanal mining and non-mining related activities (n=120)

Engagement in mining activities	Number	Percent
Non-mining related activities	85	70.8
Artisanal mining	23	19.2
NMGM	12	10.0
Total	120	100.0

4.3.3 Negative effect of mining on food security caused by farm labour that moves to mining from farming communities

Results in Table 15 show that presence of mining, artisanal mining and other non-mining activities in the study area brought about negative effect to farming communities and to food security, whereby 112 (93.3%) respondents reported a decrease in both area

cultivated and food production, two (1.7%) reported decrease in area cultivated, six (5.0%) reported decrease in food production and two (1.7%) said there was no negative effect caused by farm labour that goes to mining from farming communities on food security.

Table 15: Negative effect of mining on food security caused by farm labour that moves to mining from farming communities (n=120)

Negative effect on food security	Number	Percent
Decrease in both area cultivated and food Production	112	93.3
Decrease in food production	6	5.0
Decrease in area cultivated	2	1.7
Total	120	100.0

Findings in Table 15 above show 112 (93.3%) respondents reported that, if the area cultivated reduced will also affect the production. Apart from farm labour that moves to mining from farming communities, two reasons were given by Focus Group Discussion as to why the area cultivated if reduced will also affect the production: (i) most farming communities do not follow extension workers advices hence production is therefore based on area cultivated and not productivity per unit area, (ii) most farming communities do not practice modern agriculture technologies and principles of crop production which emphasizes on small area but aims at high production. The results are in line with Bose (2012) who stated that mining may adversely affect agriculture indirectly when workers switch from one activity to another. In fact what happens when workers switch from agriculture activities to other activities such as mining and artisanal mining is abandonment of farm activities which lead to low crop production. Abandonment of farms and low crop production not only affect the household food security but also farming communities and the nation in general because the government will need other extra

efforts to ensure demand of food in the affected area is accomplished. Further, Bose (2012) explained that; In Africa, the declining viability of agriculture has led to a large decrease in agrarian activities and increased mining activities. The discovery of large mineral deposits and the perceived income opportunities mining represent can also lead to the abandonment of farmland.

The results are also in line with Mishra and Pujari (2009) who reported that mining activities contribute to transfer of labour from agriculture, which causes loss in agricultural production. This is also supported by Wikipedia.org/wiki/list of academic database which states that: “due to mining activities, shift of livelihood from agriculture to mining activity work tends to change agriculture productivity into negative”.

4.4 Income Generation and Use of Income Generated From Mining

4.4.1 Annual household income generated from mining

Findings in Table 16 show that annual household income generated from mining and artisan activities vary from below TZS 100 000 to above TZS 1 000 000. It was found that 87 (72.5%) respondents earned below TZS 100 000 from mining, 15 (12.5%) earned between TZS 501 000 and TZS 1 000 000, ten (8.3%) earned above TZS 1 000 000 and eight (6.7%) earned between TZS 100 000 and TZS 500 000.

Table 16: Annual household income (TZS) generated from mining (n=120)

Annual household income (TZS) generated from mining	Number	Percent
Below 100 000	87	72.5
100 000 – 500 000	8	6.7
501 000 – 1 000 000	15	12.5
Above 1 000 000	10	8.3
Total	120	100.0

4.4.2 Use of income generated from mining

Findings in Table 17 show that 92 (76.7%) respondents used income generated from mining and related activities for building houses, buying transport facilities such as bicycles, motorcycles and buying clothes, 14 (11.7%) used income generated from mining in buying livestock and home assets, seven (5.8%) on buying food, three (2.5%) on other uses (school fees, uniforms and stationery), two (1.7%) on buying agricultural inputs, tools and implements and two (1.7%) on hiring farm labour.

Table 17: Use of income generated from mining (n=120)

Income generated from mining used by household	Number	Percent
Building houses, buying motorcycles, buying clothes	92	76.7
Buying home assets	14	11.7
Buying food	7	5.8
Other uses (school fees, uniforms and stationery)	3	2.5
Buying agricultural inputs	2	1.7
Hiring farm labour	2	1.7
Total	120	100.0

The results indicate that not many households spend money earned from mining in food security aspect. The study reveals that the bulk of income generated from mining and related activities is directed more to different uses/expenditures and food security was given low priority. The findings in the Table 17 above shows that only 11 (9.2%) out of 120 (100%) respondents' income generated from mining and other related activities contributed to food security (5.8% of income generated from mining used for buying food, 1.7% for buying agricultural inputs, tools and implements and 1.7% hiring farm labour). The findings in the study area do not differ from Bose (2012) who stated that mining may support food security through income generated.

4.5 Contribution of Infrastructures to Food Security in the Study Area

Results in Table 18 show contribution of infrastructures to food security in the study area. In order for food to be available (food availability in a country, region or local area) means that the food is physically present because it has been grown, manufactured, imported and/or transported there). Finding in Table 18 shows that 92 (76.7%) respondents said infrastructures contributed positively to food security in the study area and 28 (23.3%) respondents said that the infrastructures contributed negative food security in the study area.

Table 18: Contribution of infrastructures to food security in the study area (n=120)

Contribution of infrastructures		
to food security in the study area	Number	Percent
Positive	92	76.7
Negative	28	23.3
Total	120	100.0

The study reveal that there were infrastructures such as roads, feeder roads, deep well (water borehole), schools, markets, telecommunication towers, electricity, dispensaries and on progress construction of dam. On the east the study area (Mrito village) is connected by the road from NMGM to Serengeti District, on west (Nyakunguru and Nyarwana) connected by road from NMGM to Tarmac road from Musoma town to Tarime town. The north (Nyamwaga) is connected by road from NMGM at the junction of Tarime town to Keisangora village.

Further, the study reveals that, through improved infrastructures some amount of food crops produced by smallholder farmers for home consumption were sold to other villagers

in the study area and also to employee of NMGM during weekly market known as “*soko*” and monthly market known as “*mnada*” so as to earn cash for family needs such as soap, kerosene, salt, sugar, cooking oil, fish, meat and school uniforms. Respondents in the study area claimed that food stuffs in areas surrounding NMGM were sold at higher price which attract them to sell their farm produce regardless of food deficit they had. For example in the weekly market known as “*soko*” and monthly market known as “*mnada*” maize was sold at TZS 15 000.00 per 20 kg tin, cassava TZS 13 000.00, finger millet TZS 17 000.00 and sorghum TZS 13 000.00 compared to normal price in other areas/markets (maize sold TZS 10 000.00 – TZS 12 000.00 per 20 kg tin, cassava TZS 9000.00 – TZS 11 000.00, finger millet TZS 15 000.00 and sorghum TZS 8000.00 – TZS 10 000.00). Nyamekye (1996) pointed out that where mining is practiced, there is the effect of reduction in food production in general that leads to increases in prices of all kinds of foodstuffs, hence the rising cost of living and the low standard of living in general.

The study reveal that apart from the farming communities selling their farm produce to NMGM and its surrounding areas through market, infrastructure also facilitate to access food from other parts during deficit. The road infrastructure facilitates the transportation of passengers and goods (food stuff inclusively) from nearby villages also from Musoma, Bunda, Geita, Sengerema and Serengeti District to the study area and NMGM center.

4.6 Efforts to Improve Food Security

Respondents were asked to mention what they think should be done by government and NMGM so as to improve food security in the study area. Findings in Table 19 show that 71 (59.2%) respondents were requesting for the government and NMGM to construct water dams for crop irrigation in order to avoid dependence on rain fed crops cultivation, 24 (20.0%) request for supply of subsidy inputs and implements to farming communities,

eight (6.7%) cited construction of roads, seven (5.8%) cited water boreholes, two (1.7%) asked for provision of credits to farmers and two (1.7%) asked for construction of food stores. According to Kashuliza *et al.* (1998) credit is an important element in modernizing agriculture because it allows use of other factors of production, for example industrial materials which are important in agriculture so as to promote new technologies if they are to be adopted quickly.

Table 19: Efforts to improve food security (n=120)

Efforts to improve food security	Number	Percent
Construction of water dams	71	59.2
Subsidy in inputs, tools and implements	24	20.0
Construction of roads	8	6.7
Construction of water boreholes	7	5.8
Establishment of reliable markets	6	5.0
Provision of credits	2	1.7
Construction of food stores	2	1.7
Total	120	100.0

4.7 Effect of Mining on Food Security to Farming Communities Surrounding

NMGM

Effect means the outcomes. These outcomes can be either positive or negative. The following are the outcomes which resulted due to the presence of mining on food security to farming communities surrounding NMGM.

4.7.1 Positive effect

According to report of African Gold Mine (2013) and explanations from key informants in NMGM, district and village level, Focus Group Discussion and through physical

observation the study reveals that mining contributed to positive food security in farming communities surrounding the study area as follows:

4.7.1.1 Infrastructures

Infrastructures are important in supporting the community's efforts to fight poverty at local levels. The study reveals that there were infrastructures such as road (Nyamwaga), feeder road (Nyakunguru) which facilitates accessibility to other area in the study area and within the district, water dam (one in Nyakunguru – still in progress) and drilled water boreholes (two in Nyakunguru completed and in Nyamwaga still in progress). The main goal is to facilitate and promote local development.

4.7.1.2 Farmers groups

Formation of farmers groups called “Nyabibago” which deal with livestock keeping, and Utu farmer group which deal with horticultural crop production where by the mining company supplied them with water pumps, water tanks, implements and fertilizers so as to practice drip irrigation and promote modern farming through green house (Wahirimi-Kwimange group) whereby the group was assisted by NMGM by sending group leader to Arusha for short course training, also group members were given extension services from NMGM in collaboration with Tarime Agriculture, Irrigation and Cooperative Department. The aim being to initiate and implement Agriculture Revolution Campaign (Kilimo kwanza initiative) also to maintain food security in areas surrounding NMGM.

4.7.1.3 Agribusiness development

Through motto “buy local first” NMGM provided market to farmers/producers around the mining where by more than 20 suppliers are local people, example being vegetable producers from Nyakunguru village known as ‘Sodexho’ who supply vegetables to

NMGM and Nyamwaga banana wine processing group. The above findings are supported by Jones (1986) who stated that; rural development involves the perception of rural people of possible and often new ways and means of developing their economies. Jones further notes that this implies development of agriculture as means and end.

Further studies shows that rural development also embraces an active concern for improvement of welfare and wellbeing of all rural inhabitants. Real example is Cuncashca Peru which was a remote community of 64 farming families near Barrick's Pierina mine. Pierina was an open-pit gold mine that operated from 1996 to 2010. During this time Barrick voluntarily initiated projects to extend the benefits of mining to the community including the Cuncashca Business Development Project that was developed with community involvement in agriculture, animal husbandry, dairy production, and entrepreneurial training to support agri-business development. Project components included business and agricultural training, improving water infrastructure, and building a new dairy and processing plant. That project led to a number of positive results for farmers and supported subsistence farming towards income generation (**Error! Hyperlink reference not valid.**).

4.7.1.4 Development/production groups

The broad goals are to alleviate poverty and promote sustainable economic development and resource use. In case of "intruders", NMGM made needs assessment and found that many "intruders" who used to invade and steal mineral stones from the fenced mine pit were youths so NMGM decided to sensitize them to form group known as Nyakigema group which was then assisted in conducting production activities such as fish rearing, bakery, cereal milling machines, modern farming and bricks making. The agricultural produce will be consumed or sold so as to earn money which then can be used to purchase food during deficit. However the study found out that young people were attracted to short

term food crops such as vegetables, irish potatoes and fruits that takes less time for harvest. This is due to the fact that with the economic pace of today's world young people prefer farming of crops that take less time to harvest for them to make "quick money" to meet their life desires. This comply with Tacoli (2004) who stated that rural households should design different ways to raise income for purchasing food and labour selling is the most common income strategy in Tanzania, but it differ in the use of labour to raise income for purchasing food because in the study area the most common method was participating in off farm activities. Other social activities which have been supported by NMGM in the study area and which support indirectly food production and food security in the study area are education, healthy and water.

4.7.1.5 Education and training

NMGM provided direct sponsorship to students from farming communities surrounding NMGM, built and renovated school buildings, provided school equipments such as desks, books and uniforms through NGO known as CanEducate. Currently 200 students from farming communities surrounding NMGM benefit from CanCare sponsorship in Ingwe Secondary School. Also 8 teacher houses, 6 classrooms, 16 pit toilets been built and 2700 desks provided in Bung'eng'e Primary School. This enable farming communities to obtain quality education for their children and to provide education opportunities for adults so as to have better access and use of agricultural knowledge, better access to technologies, marketing systems and infrastructure, all of which contribute to higher productivity and farm incomes.

4.7.1.6 Health

Available literature examines the impact of mining on the health of both mine workers and the people within the surrounding communities of the mines. NMGM in collaboration with African Care; provided trainings on HIV and AIDS to communities surrounding NMGM

through capacity building of health workers, renovation and building of clinics and health centers and supply of equipments and beds. The purpose is to maintain healthy of people in order to engage in development activities such as agriculture.

4.7.1.7 Water

Water is an element in sustainable development. World Summit on Sustainable Development (WSSD, 2002) highlighted that water is not only the most basic need but also the center of sustainable development and is essential for poverty eradication. Water is intimately linked to health, agriculture, energy and biodiversity. Without progress on water, reaching the other Millennium Development Goals will be difficult, if not impossible.

NMGM had short term plan of supplying water to communities surrounding NMGM by using water boozers, while long term plan was to drill deep wells/water borehole, construction of water pipes from Mara River to Nyangoto, Kewanja and other surrounding villages. The company also supported construction of Kewanja water dam, Kerende water dam and Nyakunguru water dam (still in progress). This goes hand by hand with Tanzania Development Vision (TDV) 2025 which emphasize that the area under irrigation will be increased by 16% in 2015. Such increase is expected to contribute towards reduction of rural income poverty through increase in productivity and production by linking irrigation schemes with inputs, extension services and land use plan (URT, 2007).

4.7.1.8 Contribution of levy from NMGM to Tarime District Council on food security

Mining can also play a role in promoting development, although more indirectly, by generating revenues for governments. Governments can use taxes and royalties paid by mining companies for infrastructure investments and other productive purposes. Mining

companies also pay for community development programs, build schools and roads, and make other investments. The 1982 Local Government Finance Act (LGFA) states that all companies-including mining companies-within the jurisdiction of particular local government area are required by law to pay a local government levy set at 0.3% of their turnover (URT, 2012).

According to Tarime District Council (TDC) annual report of 2013, The Council collected 200 000 US \$ per year from NMGM which then used by TDC for development activities. NMGM is surrounded by seven villages and each village signed a contract concerning its community services demand and needs such as dispensaries, clinics, schools, roads (health, education and infrastructures).

4.7.2 Negative effects

4.7.2.1 Labour from farming activities moved to NMGM and artisanal activities

The study reveal that mining contributed to negative food security in farming communities surrounding the study area where by labour from farming activities moved to NMGM and artisanal activities.

4.7.2.2 High price of commodities and dislike to engage in agriculture activities

High price of commodities includes food stuffs attracted farmers to sell their crop produce to NMGM residents without leaving enough amounts to suffice their needs. High population in NMGM and artisanal area caused high demand of food which must be obtained from farming communities surrounding NMGM and artisanal area because NMGM not producing its own food. According to Population and Housing Census (PHC), population of Matongo ward (NMGM communities) in 2012 were 19 176 people (URT, 2013). Thus NMGM communities depend on food stuffs from nearby villages, Tarime

town market and Mugumu market in Serengeti District. Also most people in the study area from farming communities surrounding NMGM they do not like farming activities instead they said that they can complement basic needs through mining, artisanal activities and non-mining activities.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

Most of the farmers were aware of meaning of food security at household level, that is “the availability of food at family level which will suffice the needs all times for an active, healthy life - the food will be either produced in farms by family or purchased from other places or both”. However, on the basis of specific objectives of this study the following conclusions and recommendations can be drawn to assist development planners, change agencies, policy makers, practitioners and farmers with regard to the effects of mining on food security to farming communities surrounding mine for stability and sustainable food security.

5.1 Conclusions

Food security status of farming communities surrounding NMGM is not good by considering the four pillars of food security which are availability, accessibility, utilization and stability. Farming communities surrounding mining area cultivate different food crops then sell them to earn money/income without leaving enough amounts to sustain their food needs all over the year. Also small area cultivated which produce small amount of produce per unit area which results to food unavailability and instability.

Movement of labour from farming communities surrounding NMGM seemed to reduce farm labour. farm labour especially people aged 18-45 years shifts to mining activities, few are employed in NMGM, while many deals with artisanal activities in different areas surrounding the study area such as Nyabilama, Nyabori, Mikende, Mosege, Byantang’ana, Nyamatiryo, Botana, Mwitende and Itandura or roaming about as intruders which resulted

to abandonment of farm activities, small area cultivation, low productivity hence food insecurity.

Mining activities in the study area contributes to negative food security on amount due to the fact that many people from farming communities surrounding NMGM deals with artisanal activities in different areas surrounding the study area which resulted to abandonment of farm activities.

Annual household income generated from mining, artisan and non mining activities vary from below TZS 100 000 to above TZS 1 000 000, and those who employed by NMGM earn above TZS 1 000 000. This income attracts most people in farming communities surrounding NMGM to engage in mining, artisan and non mining activities which resulted to abandonment of farm activities.

Not many households spend money earned from mining in food security aspect. The bulk of income generated from mining and related activities is directed more to different uses/expenditures such as building houses, buying transport facilities such as bicycles, motorcycles, clothes, livestock, home assets, uniforms, stationery, paying school fees while food security was given low priority thus only 11 (9.2%) out of 120 (100%) respondents' income generated from mining and other related activities support or contributed to food security.

Infrastructure such as roads facilitates transportation of people, items also foodstuffs accessibility to NMGM and its surrounding communities. Infrastructure such as markets used by farming communities to sell their farm produce to NMGM and its surrounding

villages, also facilitated to access food from other parts such as Musoma, Bunda, Geita, Sengerema and Serengeti District during deficit.

5.2 Recommendations

In correspondence to the findings and conclusions the following were recommended.

- i) Mining company can use its available resources to support irrigation infrastructures eg. Use implements (bulldozers) in collaboration with experts from Tarime district council to construct more dams for irrigation schemes and fish rearing purposes in order to ensure food security in the study area maintained.
- ii) The government, agricultural stakeholders and other development agencies should make sure smallholder farmers get agricultural inputs and technologies such as tractors and irrigating machines at affordable prices. This will attract many people surrounding NMGM including youths to engage in farming activities so as to boost food security instead of moving to NMGM, roaming about or to be intruders.
- iii) Government leaders, political leaders, NMGM company, agricultural stakeholders and agricultural extension officers should sensitize, advise then harmonize farmers and other residents in the farming communities surrounding NMGM to use income generated from mining, artisanal and non-related activities to invest in agriculture activities so as to sustain food security.
- iv) Mining company in collaboration with government, NGOs and other agriculture stakeholders should support adoption of modern techniques of farming in the study area such as irrigation scheme by using Mara River as source of water. Deep wells/boreholes and proposed dam construction in Nyakunguru village can be used efficiently for crop irrigation purposes in order to maintain food security in the study area. Establishment of water dams and irrigation schemes will assist

farmers to boost food security in the study area by producing food crops the whole year instead of relying on rain fed.

- v) Tax and levies collected by Tarime district from NMGM should be allocated to farming activities to boost food security in order to alleviate food insecurity. Levy collected can be used to empower farmers from farming communities surrounding NMGM to improve agriculture by using modern tools/implements eg. Tractors and power tillers instead of relying on ox plough and hand hoe.
- vi) District authority in collaboration with village leaders should formulate by laws which will ensure that farming communities follow extension workers advice in practicing modern agriculture technologies where by extension services should be properly linked with farmers especially those smallholder, emphasize being to cultivate small area but aims to high production.

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APPENDICES

Appendix 1: Interview Schedule for Household

SECTION A: Basic information

Questionnaire No..... Name of interviewer.....Date.....

Village.....ward.....Division.....District.....

Respondent personal characteristics

1. Respondent's name

2. Age of respondent in years. (tick one)

1 = Less than 18 years.....[] 2 = 18-35 years.....[]

3 = 36-45 years.....[] 4 = 46-55 years.....[]

5 = Above 55 years.....[]

3. Sex of respondent. (tick one)

1 = Male..... [] 2 = Female.....[]

4. What is the marital status of the respondent (tick one)

1 = Single.....[] 2 = Married.....[]

3 = Divorced.....[] 4 = Widowed.....[]

5 = Separated.....[]

5. Education level of the respondent (tick one)

1 = None formal education.....[] 2 = Adult education.....[]

3 = Primary education.....[] 4 = Secondary education.....[]

5 = Post secondary education...[] 6 = Others (specify).....

6. How many years respondent has lived in the village

7. Background of head household (HHH) (tick one)

1 = Native.....[] 2 = Immigrant.....[]

8. Size of household members (tick one)

- 1 = 1 – 2..... [] 2 = 3 – 4..... []
 3 = 5 – 6..... [] 4 = 7 – 8..... []
 5 = Above 9..... []

Respondent socio economic status

9. What is your main occupation?

- 1 = Agriculture..... [] 2 = Livestock keeping..... []
 3 = Business..... [] 4 = Artisanal..... []
 5 = Mining..... []
 6 = Wage employment (specify).....
 7 = Other business (specify).....

10. If it is agriculture, do you have your own land for farming?

- 1 = Yes..... [] 2 = No..... []

11. If no, how did you obtain land for farming?

- 1 = Rented/hired..... [] 2 = Bought..... []
 3 = Allocated by village council.....[] 4 = Leased.....[]
 5 = Inherited..... []

12. What is the total agriculture land do you own in acres?

- 1 = Less than 1..... [] 2 = 2 -3.....[]
 3 = 4 – 5..... [] 4 = Above 5.....[]

13. What is the size of your farm in acres under cultivation?

- 1 = Less than 1..... [] 2 = 2 - 3.....[]
 3 = 4 – 5..... [] 4 = Above 5.....[]

14. Are your land holdings adequate for farming activity?

- 1 = Yes..... [] 2 = No..... []

15. If no in question 14, explain why not adequate.....

16. What tools/instruments do you use to cultivate your farm?

1 = Hand hoe..... [] 2 = oxen plough.....[]

3 = power tiller.....[] 4 = Tractor.....[]

17. How did you obtain the tools/implements?

1= own ship..... [] 2 = Hired..... []

Section B: Food Security

18. What types of crops do you grow for food

i)..... ii).....

iii).....iv).....

19. What is the main/staple food item in your family?

1 = Maize.....[] 2 = Cassava.....[]

3 = Sorghum.....[] 4 = Finger millet.....[]

5 = Sweet potatoes.....[] 6 = Others (specify).....

20. What are the sources of your staple food in your family

1 = Own production/harvest only...[] 2 = Purchase only....[]

3 = Both production/harvest and purchase.....[]

21. What is the main portion of your staple food in your family

1 = Own production/harvest only...[] 2 = Purchase only....[]

22. When they are good/enough to sustain your food demand?

1 = All over the year.....[] 2 = During harvesting period..[]

23. In which months there are food shortage.....

24. In which months there are food adequacy.....

25. How many meals your family eats per day when food is abundant?

1 = Once.....[] 2 = Two.....[]

3 = Thrice.....[]

26. How many meals your family eats per day when food is scarce?.....

27. If in question 21, the main portion of your staple food in your family is own production/harvest only, do you have surplus to sell?

1 = Yes.....[] 2 = No.....[]

28. If yes in question 27, to whom you sell?

29. If yes in question 27, how much money (Tshs) annually do you get from selling your crops.....

30. How do you supplement staple food during deficit/shortage?

1 = Buy from neighbour.....[] 2 = Buy from market[]

3 = Get from government food relief.[] 4 = Get from NGOs relief/aid..[]

5 = Sell labour to get food or cash...[]

31. What measures do you take to ensure you maintain food security in your family?

.....

Section C: Farm Labour

32. What is the source of farm labour in your family?

1 = Your whole family only.. [] 2 = Cooperate with neighbour.....[]

3 = Hired farm labour only.....[]

4 = Your whole family and hired farm labour.....[]

33. If the source of labour is the whole family, how many people in your family work on farming activities?

34. Are they adequate for your farming activities?

1 = Yes..... [] 2 = No.....[]

35. If no, what number of farm labour is adequate for your farming activities?

.....

36. At what farming activities do you encounter problem in farm labour availability?

1 = Land preparation.....[] 2 = Planting.....[]

3 = Weeding.....[] 4 = Harvesting.....[]

37. Why do you encounter problem in farm labour availability in that stage?

38. What do you do to supplement shortage of farm labour in your family?

39. Recently, do you have any member of your household engaging in mining?
 1 = Yes..... [] 2 = No.....[]

40. If yes in question 39, is it in NMGM or artisan mining.....

41. What is the situation of movement from family to mining activities?

Name of person	Sex	Age	Year of movement
Total			

42. What negative effect caused by farm labour that goes to mining from farming communities on food security.

1 = Decrease in area cultivated... [] 2 = Decrease in food production... []

3 = Decrease in both area cultivated and food production.....[]

Section D: Income Generation

43. What is the major source of household income (economic activity)?

1 = Selling crop..... [] 2 = Selling livestock..... []

3 = Farm labour..... [] 4 = Artisanal..... []

5 = Mining..... []

6 = Wage employment (specify).....

7 = Other business (specify).....

44. If you engage in mining activities, what is your annual household income (Tshs) generated from mining

1 = Below 100 000.00 Tshs.....[]

2 = Between 100 000.00 Tshs and 500 000.00 Tshs[]

3 = Between 500 000.00 Tshs and 1000 000.00 Tshs....[]

4 = Above 1000 000.00 Tshs.....[]

45. How income generated from mining used by your household?

Expenditure	Amount used
Buying food	
Buying agricultural inputs	
Hiring farm labour	
Buying home assets	
Others (specify	

Section E: Infrastructure Development

46. What types of infrastructures are present in your village?

i)..... ii).....

iii)..... iv).....

47. Who constructed those infrastructures?

1 = The villager.....[] 2 = The government.....[]

3 = Donors.....[] 4 = Mining company.....[]

48. Does those infrastructures contribute to **positive** on food security in your area?

1 = Yes..... [] 2 = No..... []

- 49. If yes, explain how infrastructures contribute to positive on food security in your area.....
- 50. Does those infrastructures contribute to negative on food security in your area
1 = Yes.....[] 2 = No.....[]
- 51. If yes, explain how infrastructures contribute to negative on food security in your area
- 52. What are your opinions on NMGM to ensure there is food security in the farming communities. surrounding. the. mine?

Thank you for your cooperation

Appendix 2: Checklist for Key Informants - District Executive Director (DED)

Name.....

District.....Date.....Sex.....

1. What constructed infrastructures are present in farming communities surrounding Nyamongo Gold mine?
2. How these infrastructures are related to food security in Tarime District?
3. How the levy collected from mining used to improve food security in your district?
4. What strategies are imposed to insure the farming communities surrounding Nyamongo Gold Mine secure food security?
5. What are your recommendations on improving food security in communities surrounding Nyamongo Gold Mine?

Appendix 3: Checklist for DAICO, DAEO, DCDO.

Name.....District.....Date.....Sex...Occupation.....

1. What are the most food crops grown in Tarime district? (by rank)
2. What are the most cash crops grown in Tarime district? (by rank)
3. What are the major agricultural services provided by the district to farmers?
4. What is the status of food security in farming communities surrounding Nyamongo Gold Mine?
5. If in question 4, food status is good (positive), do mining contributes to positive food security in farming communities surrounding Nyamongo Gold Mine?
6. If yes, explain how mining contributes to positive food security?
7. If no, explain what do you think contributes to positive food security?
8. If in question 4, food status is bad (negative), do mining contributes to negative food security in farming communities surrounding Nyamongo Gold Mine?
9. If yes, explain how mining contributes to negative food security in farming communities surrounding Nyamongo Gold Mine?
10. If no, what do you think contributes to negative food security in farming communities surrounding Nyamongo Gold Mine?
11. What are the major problems facing crop production in farming communities surrounding Nyamongo Gold Mine?
12. What are the contributions of District so as to improve food security in farming communities surrounding the mine?
13. What strategies are imposed to insure the farming communities surrounding Nyamongo Gold Mine secure food security?
14. What are your recommendations on improving food security in farming communities surrounding Nyamongo Gold Mine?

Appendix 4: Checklist for NMGM staff

Name.....District.....Date.....Sex.....

Occupation.....

1. When NMNG started to operate its mining activities in Nyamongo area?
2. What are the contributions of NMGM to Tarime District?
3. What kind of infrastructures constructed within the farming communities surrounding the mine?
4. What are roles of mining to farming communities surrounding the mine?
5. What are the contributions of NMGM so as to improve food security in farming communities around the mine?
6. What strategies are imposed to insure the farming communities around Nyamongo Gold Mine not moving to NMGM as introducers?
7. What are your recommendations on improving food security in farming communities around NMGM?

Appendix 5: Checklist for Village Extension Worker

Name.....District.....Date.....Sex.....

Village.....Occupation.....

1. How many years have you been working as extension worker in this village?
2. What are the most food crops grown in this village? (by rank)
3. What are the most cash crops grown in this village? (by rank)
4. What are the major agricultural services you provide to farmers?
5. What is the status of food security in farming communities in this village?
6. If in question 5, food status is good (positive), do mining contributes to positive food security in this village?
7. If yes, explain how mining contributes to positive food security?
8. If no, explain what do you think contributes to positive food security?
9. If in question 5, food status is bad (negative), do mining contributes to negative food security in this village?
10. If yes, explain how mining contributes to negative food security in this village?
11. If no, what do you think contributes to negative food security in this village?
12. What are the major problems facing crop production in farming communities in this village?
13. What strategies are imposed to insure the farming communities in this village secure food security?
14. What are your recommendations on improving food security in farming communities in this village?

Appendix 6: Checklist for village leaders

Name..... District..... Date..... Sex.....

Village..... Occupation.....

1. How many years have you been working as a village leader in this village?
2. What is the status of food security in farming communities in this village?
3. If in question 2, food status is good (positive), do mining contributes to positive food security in this village?
4. If yes, explain how mining contributes to positive food security?
5. If no, explain what do you think contributes to positive food security?
6. If in question 2, food status is bad (negative), do mining contributes to negative food security in this village?
7. If yes, explain how mining contributes to negative food security in this village?
8. If no, what do you think contributes to negative food security in this village?
9. What strategies are imposed to insure the farming communities in this village secure food security?
10. What are your recommendations on improving food security in farming communities in this village?

Appendix 7: Checklist for Focus Group Discussion (FGD)

- (i) What is food security status in farming communities surrounding NMNG?
- (ii) What contributes to that food security status?
- (iii) If good, is there excess/surplus to sell so as to earn income?
- (iv) How mining activities in Nyamongo influence food security in the communities surrounding NMNG?
- (v) How income generated from mining is used for food security purposes?
- (vi) What is the source of farm labour in this village?
- (vii) What infrastructures present in your village?
- (viii) Who constructed those infrastructures?
- (ix) What strategies done by farmer to ensure food security in your area?
- (x) What strategies done by NMGM to ensure food security in your area?
- (xi) What are your opinions to ensure food security is maintained in your area?

Thank you for your cooperation