IMPACTS OF REDD+ ACTIVITIES TO RURAL COMMUNITIES' LIVELIHOODS: EVIDENCE FROM KONDOA ADVANCING REDD+ IN KOLO HILLS FORESTS PROJECT IN TANZANIA

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE DEGREE OF MASTER OF SCIENCE IN ENVIRONMENTAL AND NATURAL RESOURCE ECONONICS OF AGRICULTURE. MOROGORO, TANZANIA.

2015

ABSTRACT

ARKFor was among nine piloted REDD+ Project aimed at addressing the challenges of climate change and poverty reduction. The initiative intended to reduce significantly deforestation and forests degradation by enhancing alternative livelihood activities. The activities aimed at contributing livelihoods improvement to rural forest dependent communities. However, if the initiative is not well implemented would affect rural livelihood. This study was carried out to assess the socio economic impacts of ARKFor project adoption to livelihoods' of rural communities. Data were collected through household survey using questionnaire administered to 115 households selected randomly from the REDD+ villages as well as focus group discussions and in-depth interviews conducted using checklist. Descriptive statistics and multivariate analysis was also used in analysis. *Gologit* model was also used to determine factors influencing level of adoption. Five livelihood activities were introduced by the ARKFor Project, however only three were adopted by the communities. Household income, ARKFor project support, marital status, education and gender were significant ($p< 0.05$) and positively influencing adoption, whereby land size and loan were significant and negative influencing adoption at ($p< 0.05$). Moreover, more than half of household were food insecure and living in deep poverty. Income per capita per day was USD 0.33 which is below poverty line. In general contribution of intervention of REDD+ to rural livelihood was immaterial. Need for appropriate innovation in equity and benefit sharing are recommended for effectively participation in climate change mitigation.

DECLARATION

I**, Agnes Gisbert Kapinga,** 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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ACKNOWLEDGEMENTS

I have a great pleasure to acknowledge the great help and support I received from my Parents and the entire SUA society which has made my MSc studies to be successfully accomplished. Special thanks must go to all lecturers in the Department of Forest Economics for the knowledge and skills they have imparted on me.

I am most grateful to my supervisors Dr. Jumanne. M. Abdallah and Felister. M. Mombo for their tireless efforts and great cooperation in supervising my research work. I highly appreciate their technical support and valuable suggestions which made this work to be a success.

I am indebted to Dr. Lusambo, Prof. G. Mlay and Mr. Kassimof SUA for their great contribution into my research work. Their valuable suggestions and comments helped to improve my research work. Also, I extend my appreciation to Dr. Kazuzulu of SUA for his inputs in my work.

My sincere gratitude goes to Kondoa Municipal Council, (Africa Wildlife Foundation (AWF) Officers, Ms Hawa Chora and the communities of Kolo, Kwadinu, Mnenia, Bukulu and BerekoVillages for their great cooperation rendered to me during data collection.

Lastly, I highly appreciate the good cooperation, support and sharing from my friends Daudi Bigirwa, Nunan Saidand Franco John without forgetting the entire Batch 2013-2015 ENAREC class. Their friendship provided a favorable environment for me to concentrate on my studies at SUA.

DEDICATION

This work is dedicated to my lovely Maswea's Gisbert Family for their prayers and trust on me.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST ABBREVIATIONS

ARKFOR	Advancing REDD+ In Kolo Hills Forests
CDM	clean development mechanism
CoP	Conference of Parties
Df	degree of freedom
GhG	Greenhouse gas
JUHIBEKO	*Jumuiya ya Hifadhi ya Mazingira tarafa za Bereko na Kolo*
Kg	Kilogramme
M	metre
MDG	Millennium Development Goal
MRT	Ministry of Natural Resources and Tourism
NGO	Non Government Organization
RED	Reduced Emissions form Deforestation
REDD	Reduced Emissions from Deforestation and Forest Degradation
REDD+	Reduced Emissions from Deforestation and Forest Degradation plus enhancement of Forest Carbon Stocks, Conservation and Sustainable Management of Forests
SEBS	Socio- economic baseline surveys
SLA	Sustainable Livelihood Approach
SPSS	Statistical Package for Social Sciences
SUA	Sokoine University of Agriculture
TFCG	Tanzania Forest Conservation Group
TNRF	Tanzania Natural Resource Forum
TRI	Tanzania REDD Initiative

UN	United Nations
UNFCCC	United Nation Framework Convention on Climate Change

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Forest is a valuable environmental and economic resource for supporting natural systems and human welfare (Ajake and Enang, 2012). More than 1.6 billion people around the world depend at varying degrees on forests for their livelihoods, not just for food but also for fuel, entertainments, income, and livestock grazing areas, watershed protection and medicine (Banerjee and Madhurima, 2013). At least 350 million people live inside or close to dense forests, largely dependent on these areas for subsistence and income, while about 60 million indigenous people are almost wholly dependent on forests for their livelihood (World Bank, 2006).

The huge dependence on forest for rural livelihood led deforestation to be common in most of the developing world. This is due to various drivers such as agriculture area expansion, forest product for export, poverty and increase of human population (Stephenson, 2011). Ever-increasing rate of forest deforestation and degradation has concurrently become a driver of climate change (IPCC, 2007). This is because, trees absorb and store terrestrial carbon in roots, branches and leaves by the process known as carbon sequestration. When deforestation happen especially when combined with burning results in stored carbon being converted back into carbon dioxide then back into the atmosphere. This significant contributes portion of global greenhouse gas emissions (IPCC, 2007; TFCG, 2009).

It is now widely accepted that increases in anthropogenic greenhouse gas concentrations are the cause of increasing global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level (IPCC, 2007). Predicted future changes in climate, with consequent impacts on ecosystems and physical systems, pose significant challenges for society (Brown, 2011). Such future changes will have a strong impact on natural resource-dependent communities through a multitude of primary and secondary effects in both natural and social systems (TFCG, 2009).

In Africa, population is expected to be more vulnerable to climate change effects as a result of the conflation of three factors: a higher than the global average degree of change, high levels of dependence on natural resources and forest goods and services, and a low degree of adaptive capacity (Eastaugh, 2010). United Nations Framework Convention on Climate Change (UNFCCC) concluded that, Reducing Emissions from Deforestation and Forest Degradation (REDD+) adopted at Conference of the Parties (COP) 16 in Cancun to mitigate climate change. ‘‘The initiative is regarded as cheaper, large and would have a rapid effect on reducing global carbon emissions’’. The initiative has five key elements which are *Reducing Emissions from Deforestation and Forest Degradation and forest Conservation, Sustainable Management of Forests, and Enhancement of Forest Carbon Stocks* (Stephenson, 2011).

Tanzania has about 48 million ha of forest land of which 93% is woodlands and 7% are classified as other forests like mangroves, coastal forests and plantations with unique natural ecosystems and biological diversity thus significant contributes to the rural livelihood and national economy (URT, 2015). Despite the uniqueness of ecosystem and

biodiversity such as incredible variety of wildlife, flora and even cultures, deforestation rates in Tanzania is still in progress (URT, 2015).

AKRF or project is among the nine National REDD+ Pilot Projects established in Tanzania aimed to pilot mitigating climate change and improving rural livelihood through introduction of alternative livelihood activities which protect community from forest degradation and deforestation. However, how REDD+ initiatives enhance the livelihoods of people living in or near forests remains a critical questions in many REDD+ projects (Phelps *et al*., 2010). The mitigation of climate change using REDD+ enhancing livelihood in AKRF or project expected to improve local environmental quality such as quality air and water, even income through selling of carbon and tee nurseries. Not only had that but also, improved agriculture expected to secure food and income. Therefore, knowing the impacts of this project to rural livelihood will be important in informing future REDD+ projects in the Country.

1.2 Problem Statement and Justification

Tanzania has shown willingness to take serious steps toward REDD+ (Kusaga *et al*., 2012). Introduction of ARKF or project is supposed to improve forests conditions and community's livelihoods in the area (AWF, 2012). Before project implementation, socio-economic baseline surveys (SEBS) was established to know prevailing indicative conditions for project impacts evaluation. This was conducted by Mung'ong'o *et al.* (2011) using household survey and participatory research. In 2012, Delloite conducted a midterm evaluation on the socio-economic impacts of ARKF or Project to local communities in area based mostly on reviewing documents and meetings/interviews with the high authority, the local communities was not much involved. The report from

evaluation concluded that Project participants have expressed happiness with the project in creating economic benefits from increased agricultural outputs, incomes from tree seedling sales and agriculture products.

Since the evaluation deviate from initial baseline designed, the results were insufficient and unreflective to cover the impacts of ARKF or project to rural communities' livelihoods. In order to come up with more detailed information about the contribution of REDD+ activities to rural communities' livelihoods, this study conducted a socio-economic survey in Kondoa district to evaluate the socio-economic impacts of ARKF or project to rural livelihoods.

It is necessary to assess the impacts of REDD+ activities to rural livelihood communities so as to come up with reflective information about the impacts of ARKF or project adoption to rural livelihoods, hence a socio economic survey was done so as to come up with reflective information about the impacts of ARKF or Project to rural livelihoods. This study provides information on how ARKF or Project has helped to improve rural financial, physical, natural, human and social capital. The information generated in this study will help policy makers and international community at large to understand the relationship exist between adoption level and win-win situation exist between international, centralized forest governance and local community. Further step more a study provide a way on how best they can design and implement REDD+ programs so as to meet intended goals.

1.3 Objectives

1.3.1 Overall Objective

The general objective of the present study was to assess impacts of ARKF or Project adoption to rural livelihood in communities surrounding Kolo hill forests in Kondoa District.

1.3.2 Specific objectives

The specific objectives of this study were to:

i. Analyze adoption of REDD+ Project's enhancing livelihood activities.
ii. Determine factors influencing the adoption of REDD+ enhancing livelihoods activities in the area.
iii. Examine contribution of REDD+ to the household's income.
iv. Examine contribution of REDD+ to the household's food security.

1.4 Research Questions

i. What are the extents of adoption for the livelihood activities introduced by REDD+ project?
ii. Is the adoption of enhancing REDD+ livelihoods activities influencing by any factors?
iii. Do the REDD+ enhancing livelihoods activities contribute to household's income?
iv. Do the REDD+ enhancing livelihoods activities contribute to household's food security?

1.5 Study Limitations

- During data collection, it was difficult for respondents to remember the estimates of quantity of crop harvested since the consumption of crops sometimes occurred when the crops still in the field. Not only that but also, the quantification of fire wood were difficult since the bundle/head load differ from one household to another. These consequences to outlays in finding which were corrected using Z-score.

- Some of the households were not willing to be interviewed because of their perception on REDD+ enhanced livelihood activities, claimed there was unequal benefits sharing between them, REDD+ Project and central government. In addition they complained there were biases in incentives provided by REDD+ Project. The village that some of household were denied to be interviewed were Kwadinu and Bereko. This reduced sample number, instead of getting 150 households that study proposed reduced to 115 households of which respondent agreed to be interviewed.

- Some of respondent mixed Swahili and Kirangi or aasi. In this situation interpretation had to be available. Thus limiting a researcher to get first-hand information. This was more pronounced in focus group discussion and focus group discussion.

CHAPTER TWO

2. 0 LITERATURE REVIEW

2.1 Theoretical Framework

This study was guided by the theory of Innovation-Diffusion derived from Roger (1995) and the Theory of Change. Subsequently, the sustainable livelihood approach is discussed and presented as the theoretical basis for the study. The dimensions of the livelihood approach included in this context are livelihood assets, activities, strategies and outcomes. Then conceptual framework is presented that depicts how these concepts are interrelated.

2.1.1 Innovation-diffusion model

Different scholars such as Dooley (1999), Stuart (2000) and Medlin (2001) suggests and described that, Roger's diffusion innovation is best model in adoption studies. The theory is widely applicable in deferent disciplines including human behavior, communication, economics, political science and technology. An innovation is an idea, practice or object that is perceived as new by an individual or other unit of adoption, it is regarded as a driving force of progress and development (Rogers, 1995; Valente, 1995). According to Roger (2003), innovation is decision process that characterized by five stages: knowledge, persuasion, decision, implementation and confirmation. In knowledge stage, individual or household is exposed to the innovation's existence and gains understanding of how it functions. Even after knowing about an innovation individuals may need to be influenced to use it because they do not regard it as relevant to their situation. The outcome of the persuasion stage is either adoption or rejection of the innovation. The implementation stage is when an individual puts an innovation into use. The final stage is confirmation during which the individual seeks support for the decision made (Rogers, 1995). The

newness in a livelihood activities enhanced by REDD+ need not just involves new knowledge but also to know what factors influencing a decision to adopt REDD+ enhanced livelihood activities. This is because someone may have known advantage of innovation enhanced but there are some obstacles that hinder them to adopt.

Technology should diffuse from one person or community to another. According to Rogers (1995), diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. Thus, diffusion depends on four elements: the innovation itself, communication channels, time, and a social system in which diffusion takes place (Rogers, 1995). Many communities in Africa trying to adopting different livelihood activities introduced or enhanced as the result of shocks and stress in natural environment. For example, the negative impact of climate change or variability leads to food insecurity and shortage of water. Therefore those situations forces communities to find alternative means of survival like conservation agriculture methods, improved stoves and tree nurseries activities. This does not guarantee households to adopt innovations simultaneously, some adopting at high than others, while some never adopt certain innovations at all depending on different factors influencing adoption.

2.1.2 Innovation diffusion model limitation

Model is assumes that the most important variable is information and the willingness of the individual to change. An individual is characterized only according to his behavior without considering factors that influence his behavior. Factors knows to influence the adoption of innovated livelihoods includes the household's income, access to resources, tenure security, farmers employment opportunity, age, farm size, availability of credits, availability of support systems and the characteristics of the innovation (Grazhani, 2013;

Nyanga *et al*., 2011). For example, access to resources such as labor or capital can limit the adoption of conservation agriculture. In such cases an innovative individual may be terms as a non-adoption while it caused by lack of resources. Due to this limitation, the factor endowment model has been used to support innovation diffusion model in this study.

2.1.3 Factor endowments model

Factor endowments model perceives households as decision makers whose concern in performance of livelihood activities introduced by REDD+. This depends on their goals or objectives and the resource constraints of the individual household (Blackman, 1999). The heterogeneity in factor endowments; the benefits of an innovation differ among households and thus the households with the highest perceived benefit being the first ones to adopt; however this can be triggered by social economic and demographic factors such as age, education, access to land and income (Blackman, 1999).

2.1.4 Theory of change approach

Theory of change approach is a systematic and cumulative study of the links between activities, outcomes and contexts of the initiative (Weiss, 1995). Anderson (2005) defines theory of change as the building blocks or pathway required to bring about a long term achievements. Those set of building block interchangeably refer to outcomes, indicators, interventions, results or accomplishment. Building block illustrates the relationship between actions and outcomes and also shows how outcomes are related to each other over the lifespan of the project. Well articulated theory of change represents a testable hypothesis regarding how the planned activities will contribute to achieving the desired results for the programme (Ortiz and Macedo, 2010). In order to evaluate impacts of

REDD+ Project, it is important to determine the intended outcomes, the activities expects to be implemented to achieve those outcomes, and the contextual factors that may have an effect on implementation of activities and their potential to bring about desired outcomes (Funnell and Rogers, 2011).

The goal of REDD+ is to mitigate climate change while improve the rural livelihoods. In this case, one of an initiative's primary activities might be addressing multiple driver of climate change. An important related driver might be absence of legislation allowing for sustainable livelihood activities. Another central activities might be introduction of sustainable livelihood activities, sustainable natural resource management, Forest Monitoring, and provide training and awareness raising on REDD+ to different stakeholders at national and sub- national, which in turn could be affected by contextual factors such as social, economic, resources, technological, political, existing policies, capacity of target group to respond, practices and beliefs. Therefore the theory has been adopted in this study to understand how far ARKF or project initiatives bought changes to the rural livelihoods of Kondoa communities and what are the factors affecting those initiatives.

2.2 REDD Concept

REDD (Reduced Emissions from Deforestation and Forest Degradation) is a mechanism to create an incentive for developing countries to protect, better manage and wisely use forest resources, contributing to the global battle against climate change (UN-REDD, 2010). The goals of REDD are to reduce forest-related climate emissions, sequester more carbon, and financially benefit low-income countries, communities and forest users (UN-REDD, 2010). REDD can be seen as evolving from the clean development mechanism

(CDM), an outcome of the 1997 Kyoto COP 3. Though CDM does not include avoided deforestation, it made afforestation and reforestation activities eligible for carbon credits (UNFCCC, 2011). The idea behind REDD is that, REDD payments can tip the economic balance away from loss of forests and in favor of sustainable forest management and in the process yield climate benefits (Kindermann *et al.*, 2008).

The economic rationale for including REDD in global approaches to reducing climate change comes from recent analysis, which suggest that developing country carbon sequestration can effectively compete with other climate investments as part of a cost-effective climate policy (McKinsey and Company, 2010). Since the Framework Convention on Climate Change (FCCC) went into force in March 1994, there have been 20 conferences of the parties. With the exception perhaps of COP 3 held in Kyoto in 1997, international negotiations are generally considered to have yielded little agreement and fewer results while, atmospheric carbon concentrations and global average temperatures continue to increase and most mitigation activities are regional (Agrawal *et al.*, 2011). An exception to the norm of limited international agreement has been in the area of reducing emissions from deforestation and forest degradation in developing countries. Beginning with COP 13, held in Bali, Indonesia in 2007, and continuing through COP 16, held in Cancun, Mexico in 2010, there has been an increasing focus on developing country forest-related sequestration and emissions. Controversy remains, however, as to whether local opportunity costs have been effectively included (Gregorsen *et al.*, 2011).

2.3 History of REDD+

The 13th and 14th CoP of Bali and Poznan, Poland, in 2007 and 2008 respectively, saw the definition of REDD - Reducing emission from deforestation and forest degradation,

evolve over time (Sunderland *et al.,* 2010). Evolution has made changes to the scope from Reduced Emission from Deforestation (RED) to Reduced Emissions from Deforestation and forest Degradation (REDD). This is because it was clear that forest degradation was an even bigger problem in some countries than deforestation, hence the second D was added and further to Reduced Emissions from Deforestation and forest Degradation plus enhancement of forest carbon stocks, conservation and sustainable management of forests (REDD+) (Fossestøl, 2011). REDD+ was set in motion by the international society as an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development (UN REDD, 2010).

2.4 UN- REDD and World Bank FCPF

The UN-REDD and World Bank FCPF (Forest Carbon Partnership Facility) Programme are the United Nations Collaborative initiative on Reducing Emissions from Deforestation and forest Degradation (REDD) in developing countries(UN-REDD, 2010). The Programme was launched in September 2008 to assist developing countries prepare and implement national REDD+ strategies, and builds on the convening power and expertise of the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP) (UN-REDD, 2010).

2.5 REDD+ in Tanzania and ARKFor Project

Tanzania piloted REDD+ through nine national projects, it was among the nine pilot countries to enter the UN-REDD collaboration with FAO, UNEP and UNDP. Moreover is the Country pioneered REDD+ activities (TNRF, 2011). In addition, Tanzania together with Brazil was the first countries to sign a bilateral agreement and receive supports from the Government of Norway to develop the National REDD Strategy. Pilot activities aimed

to enable Tanzania to draw lessons for purpose of making the REDD+ implementation effective and pro-poor (Vatn *et al*., 2009). The introduction of the initiative in Tanzania underwent a series of preparation activities including, selection of implementing NGOs, launching and implementation of nine REDD+ pilot projects in both Tanzania Mainland and Zanzibar. The areas involved in the pilot include Kondoa, Shinyanga, Mbeya, Sumbawanga, Lindi, Kilwa Kivinje, Kigoma, Kilosa and Zanzibar (TNRF, 2011).

In Kondoa Pilot Project is being implemented by the African Wildlife Fund running a project known as Advancing REDD+ in Kolo Hills Forests (ARKFor). It was three years project, from January 2010 to December 2012. It was funded by the people of Norway, the total project area reaches 71 632 ha and 21 villages are involved (AWF, 2012). The livelihood activities enhanced by project are forestry management practices, agroforest practices, Improvement of marketing infrastructure and incentives and products and value addition, mention as a few (AWF, 2012).

2.6 Food Security

"Food security exists 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. Household food security is the application of this concept to the family level, with individuals as the focus of concern" (FAO, 2008). According to FAO (2008), four dimensions of food security are food availability, food accessibility, food utilization, stability of food supply and food and nutrition safety.

Food availability refers to the physical presence of food which may come from own production, purchases from internal market or import from overseas (FAO, 2008). *Food*

Accessibility is the ability to obtain sufficient food of guaranteed quality and quantity to meet nutritional requirements of all household members. Here, the food should be at right place at the right time and people should have economic freedom or purchasing power to buy adequate and nutritious food explained that food access is determined by physical and financial resources, as well as by social and political factors (FAO, 2008). *Food Utilization* refers to ingestion and digestion of adequate and quality food for maintenance of good health (FAO, 2008). This means proper biological use of food, requiring a diet that contains sufficient energy and essential nutrients, as well as knowledge of food storage, processing, basic nutrition and child care and illness management and *Stability*; to be food secure (FAO, 2008). A population, household or individual must have access to adequate food at all times. They should not risk losing access to food as a consequence of sudden shocks such as an economic or climatic crisis or cyclical events, example seasonal food insecurity. The concept of stability can therefore refer to both the availability and access dimensions of food security (FAO, 2008). In this study only food stability is coved to understand how far crop production, trade, stock, income, price and infrastructure has been affect household's food security (FAO, 2008).

2.6.1 Forest and food security

Majority of rural households in developing countries, and a large proportion of urban households, rely on forest to meet food, nutritional, health and livelihood needs (CIFOR, 2011). This is because forests contribute to food security in many diverse ways including environmental role and ecosystem services (Ferraro and Hanauer, 2011). Destruction of forest brings to stress the importance of forest in maintaining the soil and water base that underpins sustainable agriculture; providing habitats conducive to the biological interactions that maintain crops and livestock; and in mitigating impacts of climate change

and extreme weather events at the landscape scale (CIFOR, 2011). Despite the fact that a total of 842 million people in 2011–13, in the world were estimated to be suffering from chronic hunger, regularly not getting enough food to conduct an active life (Angelsen *et al*., 2014). Among the factor which leads to food insecurity is climate change. Climate change affects all four dimensions of food security: food availability, food accessibility, food utilization and food systems stability. It has an impact on human health, livelihood assets, food production and distribution channels, as well as changing purchasing power and market flows (FAO, 2008). Although agriculture-based livelihood systems that are already vulnerable to food insecurity face immediate risk of increased crop failure, new patterns of pests and diseases, lack of appropriate seeds and planting material, and loss of livestock (FAO, 2008).

2.6.2 REDD+ and food security

REDD+ has the potential to contribute significantly to benefits for people and nature; it can strengthen the crucial role that forests play in the livelihoods of the rural poor but if badly designed could harm people (Espinosa *et al*., 2011). According to Finighan (2011), relationship between forest carbon and food security within REDD+ can be captured between two stylized positions: the win-win and the trade-off. The win-win position argues that REDD+ presents an opportunity to improve food security: expanding forests and tree cover will benefit agriculture by enhancing ecosystem services, including rainfall generation and soil conservation that can boost productivity and stability. The trade-off position argues that REDD+ presents a threat to food security: forests and tree cover will expand at the expense of farmland and undermine the food security of subsistence farmers (Espinosa *et al*., 2011).

Studies such as FAO (2011); Ferrarro and Hanauer (2011) and Sanchez (2000) show that, many farmers stated that planting carbon trees has improved the environmental conditions on their farms for their crops and livestock. Among the changes reported by farmers were protection from sun and wind, reduced soil erosion and improved fertility (FAO, 2011). Farmers were found to use the carbon credit in ways that can increase household income. Some farmers used the credit to hire labor. Others bought animals and topped up savings to buy plots of land, which can increase the amount and diversity of food available to households. REDD+ may also provide a source of resilience for households, helping to maintain food security under changing conditions. Some farmers reported that the carbon credit helped them to support their family. For households dealing with more sudden changes, such as illness or death, or crop disease, the low labor requirement of the carbon trees can provide a stable source of income that can help them cope with these changes (FAO, 2011; Ferrarro and Hanauer, 2011; Sanchez, 2000).

2.6.3 Conservation agriculture and agro silviculture practices

Conservation agriculture is claimed to reduce negative impacts of climate change by optimizing crop yields and profits while maintaining a balance between agricultural, economic and environmental benefits (FAO, 2011). Conservation agriculture is defined as an agricultural system involving minimum soil disturbance, permanent residue soil cover and diversified crop rotation (FAO, 2008). It is a mix of agronomic practices proposed as essential for soil and water conservation, building and maintaining healthier soils, sustainable optimal crop production and maintenance of a rich agro-biodiversity (FAO, 2008). In this study conservation agriculture use interchangeably with improved agriculture, it is not necessary improved agriculture to be conservation agriculture but in context of REDD+ the improved agriculture must be sustainable in term of conservation.

Therefore, the REDD+ Project addressed the improved agriculture which is sustainable (conservation agriculture).

2.7 Forest Dependency and Household's Income

The concept of forest dependency is focused on the degree of concentration of a particular forest based livelihood in a particular area (Vedeld *et al*., 2004). While Bahuguna (2000) explains forest dependency as the percentage of income delivered from forest products of household. Vedeld *et al*. (2004) reported that livelihood of rural households depends on forests directly for timber, non-timber products, and recreational experience and indirectly for things such as air and water quality, biodiversity, carbon sequestration, and other ecological services. Thus, forest products remain an important source of income for the rural poor throughout the developing world, especially in Sub-Saharan Africa this is because most of households depend on forest for survival.

Income refers to the earnings of individuals or households from productive activities and current transfers. It can be seen as comprising claims on goods or services produced by individuals or households (Atkinson, 1989). In Africa, various studies have shown that while most rural households are involved in agricultural activities such as livestock, crop or fish production as their main source of livelihood, they also engage in other income generating activities to expand sources of income (Barrett *et al.,*2001; FAO, 2008; Adepoju and Obayelu, 2013).

In Tanzania most of households depend on agriculture income which is direct or indirect depends on forests. However, the agricultural sector weighed down with problems which include soil infertility, infrastructural inadequacy, risk and uncertainty and seasonality

among others. Thus, rural households are forced to develop strategies to cope with increasing vulnerability associated with agricultural production through diversification, intensification and migration or moving out of farming (Ellis, 2000). Struggle for survive and welfare improvement, off-farm and non-farm activities have become an important component of livelihood strategies among rural households in Tanzania (AWF, 2012). Although, some livelihood strategies is not sustainable, the enhanced REDD+ livelihood activities are sustainable one; Including sustainable agriculture, woodlots activities, hydro-foam bricks, sustainable charcoal production and efficient stove making.

2.8 Livelihood and REDD+ Introduced Activities

The term livelihood attempts to capture what people do in order to make a living by using resource available, reducing risk factors that occurred in managing resources and the institutional and policy context that either helps or hinder them in improving living (Ellis, 2000). REDD+ activities are supportive means for strengthening and creating people's livelihoods because it both uses and creates a range of different capital assets. According to the accepted definition originally developed by Chambers and Conway (1992), livelihoods comprise of capabilities, assets and activities required for a means of living. A livelihood is sustainable when it can cope with, and recover from, stresses and shocks and maintain or enhance its capabilities and assets, both now and in the future, while not undermining the natural resource base. The goal of REDD+ in livelihood improvement can be achieved by linking all five capital asset which are natural, social, physical, human and financial capitals. This is because the five capital assets are a fundamental in Sustainable Livelihoods Approach and used to determine the size and form of people's income and livelihood in general (Ellis, 2000).

Measuring the livelihood has some difficulties and challenges, because not all livelihood asset can be monetize (Angelsen and Wunder, 2003). In general, income refers to the earnings from productive activities and current transfers. It can be seen as comprising claims on goods and services by individuals or households. In other words, income permits people to obtain goods and services (Morris *et al*., 2000). In contrast, consumption refers to resources actually consumed. Although, many components of consumption are measured by looking at household expenditures, there are important differences between the two concepts. First, expenditure excludes consumption that is not based on market transactions. Second, expenditure refers to the purchase of a particular good or service. However, the good or service may not be immediately consumed, or at least there may be lasting benefits (Atkinson, 1989).

Criticisms is on the use of monetary measures, either income or expenditure to household livelihood analysis in developing countries. One criticism is that using a monetary indicator does not take into account how money is earned and how much time is spent to work for it. The quality of income and expenditure data is most likely to be poor, particularly in middle- and low-income countries (Filmer and Prichett, 2001). Second, income is imperfect measure of livelihood this is because it tends to vary over a course of a year, especially in developing countries where income highly depends on seasonal agriculture. Moreover, large proportion of household's income in developing countries is shared by the informal sector and self-employment both inside and outside agriculture (Montgomery *et al*., 2000). Therefore, the contribution of REDD+ activities to rural livelihood in this study is analyzed in both non-monetary and monetary indicators. The asset-based index has been developed as an alternative tool for classifying household socio-economic status and annual income analyses based on farm and non-form activities.

2.9 The Sustainability of Livelihoods Activities as the Results of Introducing REDD+

A livelihood is sustainable when it can cope with, and recover from, stresses and shocks (Ashley *et al.,* 1999). Sustainable Livelihood Approach (SLA) considers various factors that impacting the livelihoods of rural households. It considers vulnerabilities as the main factor that shapes how people make their living, choosing risk-adverse strategies. The level of vulnerability of an individual or community is determined by how weak or strong their livelihoods are, what occupational activities they are engaged in, the range of assets they have access to for pursuing their livelihood strategies and the strength and support of the social networks and institutions that they are part of or which have influence over them (Ellis, 2000).

In the Framework shown in Fig.1, the understanding of sustainable livelihoods is separated into five parts: the vulnerability context; people's livelihoods assets; policies, institutions and processes; livelihoods strategies, and livelihoods outcomes.

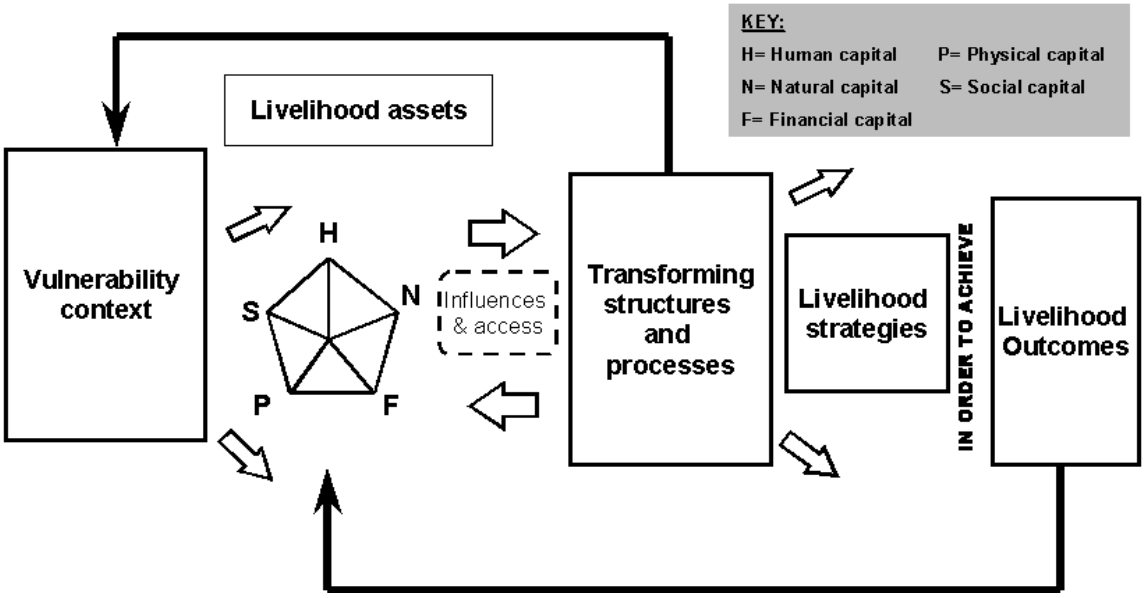

Figure 1: Sustainable livelihoods framework

Source: DFID (1997)

Among the important aspect that influences the choice and strengths of the livelihoods that people pursue is the range of resources or assets that people are able to access and use. The assets required to make a living are well explained under the following sub- section.

2.9.1 Natural capital

Livelihoods depend upon natural resource stocks: in the case of REDD+ introduced livelihood activities, these are flora and fauna, land and water. Rural households depends forest for meeting their needs such as energy, livestock feed, medicine, food, water, construction material, agricultural implements, apiculture, raw material for wood-based industries, and leaf litter used as compost fertilizer in agriculture fields, soil erosion protection, mention as a few (Salehi *et al.,* 2010). Water is important in agriculture for irrigation, household uses and wild animals. Although, forests are also important direct sources of water while Land is vital in all activities, all activities is undertaking on the land, thus mean no land no life. Moreover fauna is important in balancing the nature (Gautam, 2009). Therefore natural assets are very important to those who derive all or part of their livelihoods from natural resource-based activities (salehi *et al*., 2010).

2.9.2 Human capital

Traditionally human beings have good skills and knowledge relating to different livelihood activities example agriculture production, although some are sustainable and others are not (Salehi *et al.,* 2010). Dependence on timber products for their livelihoods such as energy, poles for building and income generation for purchase of various processed goods and payments for social services like school fees, hospital bills and clothing which later result to forest degradation and deforestation; poor farming practices force most of rural communities to engage in shifting cultivation and concentrate their

farming in areas with favorable agro-climatic conditions. These areas happen to be where there are important forests that have specific ecosystem values. Consequently practices that meant to enhance the farmers' agricultural productivity lead to cutting of trees which are important for sustenance of the ecosystem services (Mutabazi *et al.,* 2014). REDD+ introduced and created sustainable livelihoods activities by providing various knowledge, employment, skills and education relating to the sustainable improve agricultural production, processing and marketing of goods for betterment of life by raising food security, income, health improvement, employment and environment in general (AWF, 2012). However Angelsen *et al.* (2012) pose a big question regarding on how to meet increased food demand arising from higher incomes, increase in population associated with changes in eating habits. Then there is a tradeoff between "conserving the forests" and "feeding the hungry? Indeed, profitable agricultural intensification is likely to reduce and not to stop conversion of woodland/forests to farmland. This is because human population growing at faster over time.

2.9.3 Physical capital

These include the infrastructure (transport, water, energy, communications, and buildings) and the production equipment that enables people to make their livelihoods from activities introduced (Ngaga *et al*., 2005). Lack of particular types of infrastructure is considered to be a core dimension of poverty. Without adequate access to services such as water and enerFgy, human health deteriorates and long periods are spent in non-productive activities such as the collection of water and fuel wood. Moreover people can not engage in production activities such as irrigation agriculture in absent of water and energy. The opportunity costs associated with poor infrastructure can hinder education, access to health services and income generation (DFID, 1997). For example, without transport

infrastructure, essential fertilizer and improved seed cannot be distributed effectively, agricultural yields remain low, people lack income from agriculture, food insecurity and it is then difficult and expensive to transport limited produce to the market. Not only infrastructure but also insufficient production equipment also constrain people's productive capacity and therefore deteriorate the human capital.

Example hydro- foam bricks promoting by REDD+ Project leads to improved quality for house at low cost; improved stoves making, improved/conservation agriculture and tree nurseries activities diversify the income sources which then affects food security, education, roads in market accessibility, health mention as a few. However developing countries face a big challenge in high level of poverty which hampers those REDD+ introduced livelihood activities because of poor infrastructure and production equipment (FAO, 2008). Therefore the REDD+ Project should take into consideration the physical capital during launching of the livelihood activities in developing countries.

2.9.4 Social capital

Social capital refers to formal and informal social resources or social relationships of people, such as family networks, membership of groups, relationships of trust and access to wider institutions of the society. It also includes social relation's degree of trust, reliability and adaptability. People draw on these social resources when pursuing different livelihood strategies (Ellis, 2000). The existence of social capital such as networks, membership of more formalized groups, relationships of trust, producer and marketing relations contribute much and are of great significance for livelihood improvement. Such associations provide the means for household to advance their skill in production and processing, access to markets and marketing support (Scoones, 1998). Moreover access to

a network at a wider level, assists household to make contact with national and international networks, to find out about sources of training, markets, research findings, and raises their awareness of the industry and available opportunities to their products (Ngaga *et al*., 2005).

Social capital has a direct impact upon other types of capital; improving the efficiency of economic relations, social capital can help increase people's incomes and rates of saving; Social capital can help to reduce the 'free rider' problems associated with public goods. This means that it can be effective in improving the management of common resources and the maintenance of shared infrastructure. Furthermore it facilitates innovation, the development of knowledge and sharing of that knowledge (DFID, 1997).

2.9.5 Financial capital

The financial capital is assets of monetary terms such as income, savings and credit. These are assets that contribute to the household's wealth, diversification strategies and improved livelihood activities (DFID, 1997). Access to finance is essential for the further development of livelihood activities, for example, successful improved/conservation agriculture depends upon the purchase of inputs such as fertilizers, herbicides, insecticide, labor and agriculture equipment hiring such as ox and tractors. However, it is also the asset that tends to be the least available to the poor. Indeed, it is because the poor lack financial capital that other types of capital are so important to them (Montgomery *et al*., 2000).

2.10 Vulnerability Context

The sustainable livelihoods framework indicates the different aspects of peoples' vulnerability and point out the social, political and economic structures and processes

which influence vulnerability. The Framework considers people living and working within a condition of vulnerability. Analysis of vulnerability means to identify the risks of household and resilience they have to cope with negative change in their environmental, both short and long-term (Ellis, 2000). Vulnerability includes shocks (sudden onset of natural disasters, conflicts, economic traumas, health problems and crop or livestock distress), trends (in population, resources, health problems, the economy or governance) and seasonal constraints (cyclic fluctuations in prices, production, health and employment). This complex of influences has direct and indirect impact on people's livelihoods, including the options available to them (DFID, 1999). Trends may be the gradual decline in the quantity of agriculture production due to ecological destruction, or gradual increase of population which leads to increase demand of assets such as food, water and natural one. Vulnerability may be also seasonal: for example, a household may have less food at the beginning of the rainy season, making them more vulnerable to illness, and with less time for participating in livelihood activities. People's access to assets, and their capacity to utilize them, is shaped by their resilience to negative shocks, trends and seasonality (Ashley *et al*., 1999). Thus Individuals or households with larger asset portfolios have more livelihood options, as well as less vulnerability, than those do with fewer assets (Scoones, 1998).

The use of the SLA can help to identify the ways in which people are most vulnerable, and how they are strongest in relation to REDD+ project. This may lead to suggestions of how to make them stronger, for example by helping them to diversify their livelihood activities. It may also help a REDD+ to identify ways for government and donors to reduce vulnerability through policies, institutions and laws. For instance, by providing training to cope and adapt with the effects of a climate change (Kajembe *et al.*, 1999). However

Castro (2001) has pointed out that development policies and interventions often underestimate the role and significance of the vulnerability context, usually with very serious consequences.

2.11 Livelihoods Strategies and Outcomes

Livelihood strategies are the ways in the way people combine and use assets to meet their objectives. They are comprised of activities that generate the means of household wellbeing. Ellis (2000) has divided livelihood strategies into two categories, natural resource based activities and non-natural resource based activities. Natural resource based activities include harvesting wild resources from forests cultivation of food or non-food crops, and livestock rearing. They also include non-farm activities like stove making, charcoal making and brick making. Examples of non-natural resource based activities are rural trading, remittances and other transfers such as pensions.

People's ability to make a livelihoods, and their resilience to negative change, is shaped by their livelihoods strategies. These strategies are the combination of people's activities and the choices they make in order to achieve their livelihoods goals (Ngaga *et al.,* 2005). For example, in a household that depends on farming for most of its food and income, one person may decide to take up beekeeping, charcoal production or making improved stove, this may provide capital for another to start a small enterprises (DFID, 1999). It is important to note that livelihood strategies are dynamic, responding to changing challenges that households confront and to which they adapt (Ellis, 2000). Structures and processes also influence the outcomes of livelihood strategies. Ideally, livelihood strategies would generate more income, increase well-being, reduce vulnerability, improve food security, and result in more sustainable use of natural resources (DFID, 1999). However selecting livelihood strategies have got some challenge like which strategies are

sustainable, skills and knowledge, policies, laws, available opportunities and information relating to the livelihood activities (Ashley *et al.,* 1999).

2.12 Transforming Structures and Processes

Social, economic and policy consideration intervenes transformation of assets into a livelihood strategy (Ellis, 2000). Although vulnerability stress the importance of capital assets in people's livelihoods, the sustainable livelihoods approach recognizes the role of transforming structures (government and private sector) and processes (policies, laws, rules and incentives) on people's livelihoods options. These are important in defining access to assets, and people's livelihood strategies and therefore give meaning and value to livelihood assets (Carney, 1998; Scoones, 1998; DFID, 1999). According to (Ellis, 2000), 'structures and processes' consist of social relations, institutions and organizations. A social relation in this context refers to the social status of individuals and households within society. For individuals social status may be related to factors such as gender, wealth group, age, ethnicity and religion. Social relations are important because in any community the distribution of livelihood assets is always irregular. Social factor significantly affects access to livelihood assets within the household or community. In rural communities dependency on forest income vary between households to households because socio economic factors (Myhren, 2007). For example contribution of both firewood and charcoal in Democratic Republic of Congo (DRC) employs a large number of mostly poor, with substantial revenues that contribute up to 75% of the total income of charcoal (Angelsen *et al*., 2014).

Institutions refer to the formal rules, conventions, and informal codes of behavior, that compromise constraints on human interaction. Examples of such institutions are rules and customs and property rights while Organizations are groups of individuals bound by some

common purpose to attain objections. Fore Examples, farmers' associations, SACCOS, NGOs and government agencies (Ellis, 2000). Social relations and institutions determine the way in which AWF, Kondoa District Council, URT and individuals operate and interact. They comprise the agencies that constrain or facilitate the exercise of improving capabilities and choices by household's livelihoods at sometime providing everyday framework, rules and relations for human interaction.

2.13 Livelihood Impacts Analysis Techniques

Mushrooming of conservation project calls for impact assessment to see how project promote the sustainable use and conservation of resources by contributing to local development and creating economic incentives for conservation by local people (Ashley *et al*., 1999). However, doing an impact assessment in both private and governmental organization is inherently challenging in many project. Most impacts assessment are done in minimal satisfies methodological standard (Fathian, 2008). The concept of SL approach is used to incorporate methods for assessing impacts of ARKFor project to rural livelihood. This is because the SL is not only used in planning the project but also review of existing one even where these were not planned with SL concept (Ashley and Hussein, 2000). Since main objective of livelihoods assessment is to gain an understanding of the significance of the project to the livelihoods of project participants and other local residents. The assessment should base on the premise that the project and project participants shared a core aim assessment (Ashley *et al*., 1999). The enhancement of local people's livelihoods can be assessed using the following methods;

2.13.1 Background understanding of local livelihoods

According to Scoones (1998), this is the first step in livelihood impact assessment which associated with series of question which helps adequate understanding of local livelihoods.

For example, what outcomes do people achieve? What activities do they pursue and in what ways do these contribute to livelihoods? What assets do they have?, What are the underlying priorities and preferences that influence household livelihood strategies?, How do external forces shape people's options, and can people themselves influence the external forces? How and why are livelihoods changing? Which changes are due to shocks or externally driven trends? Which changes are short-term 'coping' strategies, and which are long-term 'adaptive' strategies. The question mostly focuses on how livelihoods were changed or influenced by the project. Sometimes this change can be quantified, but more often it is the direction and type of change that is important (Chamber and Conway, 1992).

2.13.2 Identifying changes in livelihoods

According to Scoones (1998), this step begins with an assessment of the widest possible range of impacts and who might be affected. The different types of impact can be linked to the various elements of the livelihoods framework such as impact on assets and impact on other activities. Questions needed to be addressed in this process should guide the planning and analysis of the project. Example the question includes in this study could be, does the REDD+ affect access to assets, or change their quality or productivity? If natural resources are used, are they used sustainably? Is time spent on REDD+ enhancing activities taken away from other activities? Is there competition for inputs such as land and forest resources between the REDD+ and other activities? How does the REDD+ contribute directly to improved livelihood outcomes; example income and food? Is the REDD+ enhanced activity financially sustainable? Does the REDD+ Project affect how households invest their incomes into assets, or how external institutions influence household opportunities? Does the REDD+ change people's ability to cope with shocks or benefit from positive trends? Does the REDD+ Project match with strategies that people use when selecting activities?

2.13.3 Assessing empowerment

Empowerment can be elaborated in different ways; the more important is to have a control. That is why before project development the baseline is formulated (Ashley *et al*., 1999). The livelihood empowerment could be individually, like most of people marginalized within their communities such as poorest and women; community organizations and their capacity to work together for common objectives. Take an example food security improvement. The improvement also could be between a community in its relations with outsiders and the wider society such as political authorities and central government (Ashley and Hussein, 2000).

2.13.4 Assessing differences between stakeholders

The complexity of livelihoods makes it unlikely that there will be a generalized solution to meet everyone's needs (Brock, 1999). The livelihood impacts assessment methodology should emphasis a strong integration between stakeholders. For stance stakeholders for purposes of comparison, and survey data was disaggregated between groups. Moreover the stakeholders distinguishing could be between local and external stakeholders and within each, between participants and non-participants (Ashley and Hussein, 2000).

2.14 Empirical Studies

The links between REDD+ and livelihood of rural people who leave near or in the forest have been studied by many scholars. The studies focused on how REDD+ implementation has leads to livelihood improvement. However, the debate on how REDD+ contribute to rural livelihoods' improvement remains a critical issue in many REDD+ projects (Phelps *et al*., 2010; Agrawal *et al.*, 2011). Example Mutabazi *et al*. (2014) conducted a study in Kilosa District, Tanzania using survey technique. The results found that adoption of

enhancing REDD+ livelihood activities is very low especially the poor households. For stance improved stoves adoption for poor households decrease by 41%, that is 154 pre-REDD+ to 91 Post-REDD+. Furthermore food production has declined significantly in the lowland following REDD+ interventions especially in the lowland and among the relatively poorer households. In the post-REDD+ period, the average maize production per capita declined by 40% in the lowland area and by 22% among the poor. Those negative externalities found by Mutabazi *et al*. (2012) as the results of REDD+ interventions has impacted on food security and income generation. The study also conducted by Atela *et al*. (2014) and Kjosavik (2013) in Kasigau Corridor project Kenya and Aowin District in Ghana respectively found that, Apart from poor households benefited from carbon and alternative livelihood activities, REDD+ intervention has impacted negative land ownership, land productivity and size for most poor households. In addition to that, REDD+ intervention restrict hunting, felling of trees and lumbering which consequence reduce income and food security.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

3.1.1 Geographical Location and Size

The study was conducted in five villages of Kolo, Mnenia, Kwadinu, Bukulu and Bereko in Kondoa districts of Dodoma region in central Tanzania. The area lies between Latitude 4^{o} 12' to 5^{o} 38' South and Longitude 35^{o} 6' to 36^{o} 2' East with approximately total land area of 14,435 km^2 (Fig. 2). The district has four divisions namely Bereko, Pahi, Kondoa Mjini and Kolo. There are 28 wards and 108 villages in the District. The District borders with Babati in the North, Kiteto District in the East, Manyoni District in the South West, Singida District in the West and Hanang District in the North West (URT, 2012a). The selection of the study area was based on involvement of local communities to REDD+ Livelihood activities and the dependency of local communities on forest for livelihood income and food security.

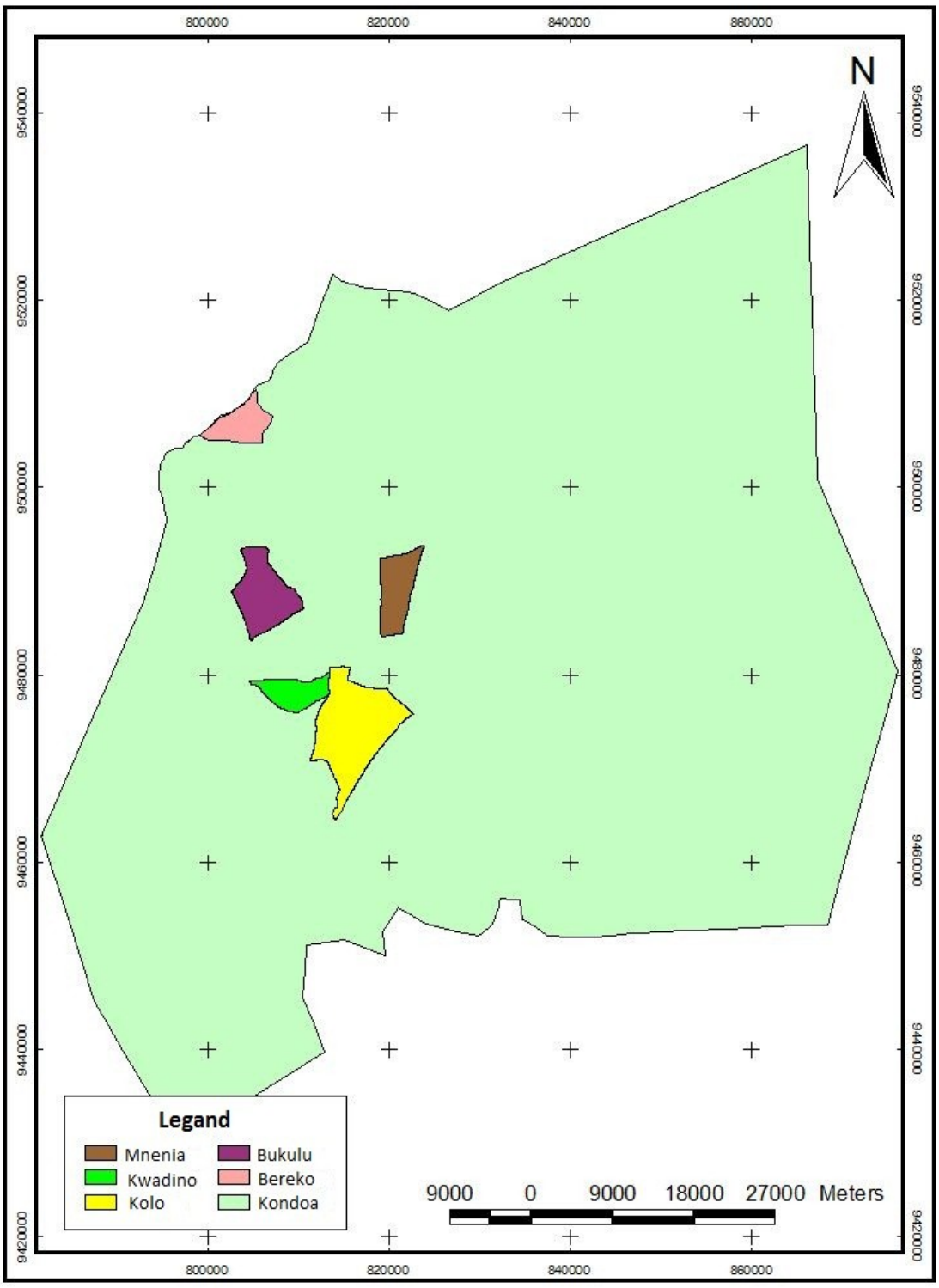

Figure 2: A map of Kolo, Mnenia, Bukulu, Kwadinu and Bereko in Kondoa District

Source: Geographical Information System at SUA (2014)

3.1.2 Climate

District is characterized as dry Savannah type of climate with a long dry season between late April to December, and a short wet season between early December to April (5 months) (Mung'ong'o *et al.,* 2004; URT, 2012a). The average rainfall ranges between 400mm in the plateau and up to 1000 mm in the highlands. About 85% of the annual rainfall, falls between November and March with a long dry spell of approximately 30 days in February. Rainfall in the District is unevenly distributed; condition that imposes a pattern of risk evasion in traditional agriculture especially in lowland areas with less rains. Temperatures vary with altitude; high altitudes between 915 to 1200 meters above sea level have temperatures ranging between 15^{o}C to 20^{o}C per annum. Areas of low altitude including the rift valley zone experience high temperatures of 21^{o}C to 30^{o}C (URT, 2012a).

3.1.3 Topography and Soil

The topography of the district has two unique features. To the east and southwest the District is dominated by gigantic plains locally recognized as Lower Irangi (*Sereri).* From the central parts to the north and northwest the district is dominated by the Kondoa Irangi Hills; over 90% of which is designated the most eroded part in Tanzania. This area is often referred to as the Kondoa Eroded Area (KEA) (Mung'ong'o *et al.,* 2012). The landscape of the area is dominated by steep rocky outcrops with broad sand river valleys in between. These outcrops rise up to 200 metres above these valley bottoms. The altitude ranges from 1 000 metres to 2 100 metres above sea level; the highest point being Mount Mkongwi on the Mambishi outcrop. The lower lying areas are characterized by moderately sloping pediments that are cut across deeply weathered rock. The valleys have been subjected to rapid sedimentation and aggregation as a result of accelerated erosion higher up in the hills (Mung'ong'o *et al.,* 2012) Generally, the soils are described as irregular, relatively low in

fertility, low in organic matter, and have a low water retention capacity. Variability of soil types over small distances has resulted into complex chain forming like a curve (catenary) relationships (Mung'ong'o *et al.,* 2012).

3.1.4 Population and ethnicity

The population of Kondoa District comprises the Rangi and the Sandawe as the major ethnic groups. The other groups include the Alagwa (also known as Aasi), the Burunge, the Fyome, the Nyaturu and the Barabaig (Mung,ong'o *et al.,* 2011). The district has total population of 516732, people, whereby 261 874 are females and 254 858 are males, as projected from 2002 census at an average growth rate of 1.7% per annum. The average household size is 5-6 people living in the 103 346 households (URT, 2012a).

3.1.5 Forests, land uses and socio-economic activities

The study area consists of short seasonal grasses and scattered, stunted and usually heavily coppiced *Brachystegia* spp (type of grass). Also highland forest reserves area is covered by 10%-15%of Miombo woodlands. Livelihood strategies and diversification in the areas is through expansion of agricultural activities, charcoal production and timber extraction from the woodlands. This leads to deforestation and forest degradation experienced (Mung'ong'o *et al*., 2011).

The main crops that are cultivating include maize, millet, sorghum, and sunflower. Other crops cultivated include sesame, finger millet, sorghum, horticultural crops, pigeon peas and beans. The economy of the District depends mainly on crop and livestock production. The total arable land in the District is about 1 362 648 hectares of which only 66% of this area is suitable for agricultural production. About 30% of this area (398637 hectares) is

under agricultural production. According to the 2012 Population and Housing Census, about 56.3% of the population is involved in farming while 35.3% is involved in both farming and livestock keeping includes: cows, goats, sheep, and poultry. Dependency on natural resources (forests, land and water) for livelihood activities (such as cultivation and grazing) in the area is high (URT, 2012b).

3.2 Research design, Sampling Procedure and Data Collection

3.2.1 Research design

Cross-sectional design was used; information gathered represents what is going on at point in time (Olsen and George, 2004). Saunders *et al*. (2007) defines cross sectional survey as a method of collecting data at one point in time from a sample of respondents. The method consume less time in data gathering although more triangulation and probing is needed to get valuable information. By using this research design a subject population was selected and from these individuals, data were collected to answer questions of interest.

3.2.2 Sampling Design

The target population for this study was villages surrounding Kolo Hill Forests. The study employed a multi-stage sampling technique where the first stage involved purposive selection of the Kondoa District from Dodoma region. In stage two, 21 villages where the ARKFor were implemented (Kolo, Mnenia, Itundwi, Filimo,Masange, Kwadinu, Bukulu, Itololo, Kisese, Sauna, Pufii, Mapinduzi, Mitati, Mkurumuzi, Madege, Kikore, Bereko, Karidaga, Salanka, Masawi, Pahi and Haubi) was purposely selected from Kondoa District. Finally, households involved in ARKF or Project were systematically selected from the given village registry.

3.2.3 Sample size

Thirty households (Bailey, 1994) were proposed from each village. A total of 150 household from five villages were proposed. However, only 115 were interviewed. In addition, one key informant was selected from Kondoa District Council, one from AWF office and four in each village based on leadership and familiarity of the project. Furthermore, 10 people were selected for focus group discussions in each village based on age group, experience of the area (not less than 20 years), education and wealth status.

3.2.4 Data collection and analysis

Data collected were both primary and secondary data. The primary data were collected through livelihood questionnaire surveys (Appendix1), focus group discussions and in-depth interviews with key informants using checklists (Appendix 2 and 3) respectively. Secondary data were obtained from Africa Wildlife Foundation offices, district offices, *Jumuiya ya Hifadhi ya Mazingira Tarafa za Bereko na Kolo* (JUHIBEKO) and from relevant literature published and unpublished reports. Analytical techniques used in this study were descriptive statistics and Principal component analysis. The Econometric model used was generalized ordinal logistic regression model. Section 3.3 to 3.8 provides details of data collection and analysis methods by specific objectives.

3.3 Principal Component Analysis and Wealth Index

In developing countries generation of wealth index based on income or expenditure leads to unreflective results due to reasons mention in literature review section (2.8).Therefore, asset based indicators have become quite common in characterizing welfare states of people (Filmer and Prichett, 2001; Vedeld *et al*., 2012). Hence Principal Component

Analysis (PCA) was used to generate the wealth indices for household based on fixed/tangible asset endowments.

PCA is a statistical procedure used to show contrast and visibilities of the variability in the sample population. In so doing it reduces the replication of the variables by grouping together those which are similar in terms of aggregating variables through orthogonal linear combinations of the variables. Mathematically, from an initial set of n correlated variables, PCA creates orthogonal components in which each component is a linear weighted combination of the initial variables.

$$pc_1 = a_{11}x_1 + a_{12}x_2 \dots\dots a_{1nx_n} \quad \text{.....equation (i)}$$

$$pc_{1m} = a_{m1}x_1 + a_{m2}x_2 \dots\dots a_{mnx_n} \quad \text{.....equation (ii)}$$

Where a_{mn} represents the weight for the m_{th} principal component and the nth variable and x is asset. The weights for each principal component are given by the eigenvectors of the covariance matrix as used in the original data. The correlation matrix could be used if the data were standardized. Using the scores generated by the first principal component and the mean and standard deviation of the original data set, the wealth indices were computed using the formula:

$$WI = \alpha_i * (x_{ij} - x_{i)} / s_i \quad \text{.....equation (iii)}$$

where, WI is the wealth index for each household; α, represents the weights (scores) assigned to the n assets on the first principal component; x_{ij} is the original observation of asset i in household j, x_i is the mean holding of asset i in the sample, of each of the n variables; and s_i is the standard deviation of holding of each of the assets in the sample. The wealth indices were used to categorize the households into three wealth classes; poor, middle and least poor. This was done by creating quintile though STATA software. Poor

households were classified as those with negative wealth index; least poor households were those with positive wealth index while a middle household had a wealth index between negative and positive.

3.4 Assessment of Adoption level of REDD+ Project's Enhanced Livelihood Activities

Household questionnaire (Appendix 1) was used to get adoption level information toward introduced livelihood activities. Individual household can decide to adopt one or several livelihood activities, sometimes not to adopt at all. Adoptions of livelihood activities can be at different level. Therefore, Likert scale was used to capture those adoption levels for individual households (high, middle, low and none). Data collected were; how many people are implementing the introduced activities, technology used and when started to perform technology, type energy source and land size. This was for each livelihood activity Introduced. Data on adoption levels were cross tabulated with wealth ranking criteria based on assets.

3.5 Assessment of Factors Influencing Adoption Level on REDD+ Livelihood Activities in the Area

Household questionnaire (Appendix 1) was used as the data collection tool. Data collected to answer this objective were adoption level and socio economic and demographic factors (income, number of labor force in households, education, occupation, access to forest, age of household, distance to water source, sex, marital status, Project support, land size, access to loan awareness and access to extension services).

Binary Logit model is used by many researchers to identify factors influencing adoption level, however, this type of analysis is crude, and it may leads biased and imperfect

conclusion. It assumes adoption level is binary; however, adoption can be at different level, more than two. To avoid this limitation ordered logit model was employed to allow for multiple outcomes and scaling of multiple responses (Williams, 2009). Adoption level of enhanced livelihood activities in this study was continuous measured using interval scale.

To account for the multiple adoption possibilities and the ordinal nature of the dependent variable, an ordered logit model was estimated. Among four adoption level to REDD+ enhanced livelihood activities considered in this study, four possible choices are generated: 0 (none), 1 (low), 2 (midlle) and 3 (high). To model the four level of adoption of REDD+ enhanced livelihood activities outcomes the ordered logit model used is as follow:

Pr (Yi>j) = g ($X_{i\beta_j}$)= $\frac{\exp(\alpha j+xi\beta j)}{1+[\exp(\alpha j+xi\beta j)]}$, j=1,2,……J…… equation (iv)

$Y_i^*=\sum_{j=1}^{j}\beta j\, X_{ji}+\ \varepsilon_i, \frac{\varepsilon}{X}$ ~ logistic (0,$\frac{\pi 2}{3}$) ……..…….. equation (v)

Y_i =observable variable (the level of adoption of REDD+ livelihood enhancement activities by household i ;*Y*i* represents the probability of that ith household will make a adoption of livelihood activities enhanced , given explanatory variables (Xi); Xi represents the explanatory variables; $\beta_j$are parameters to be estimated;K represents the number of explanatory variables, i = 1, 2, 3 …, k, ε= random disturbances. The higher the value of Y, the more likely an individual is to report a higher adoption level is the adoption categories, and *J* is the number of adoption categories.

Estimation of ordered logit regressions must meet the parallel line assumption. That is, the β_s must be equal for each equation for the ordinal categories. The intercept term is

absorbed in the cutoff points. Parallel line assumption implies that the ordinal variable can be fit by one set of regression parameters (Williams, 2009).

3.5.1 Violation of parallel line assumption

Violation of the parallel line assumption can lead to results being incorrect, incomplete, or misleading (Williams, 2009). The parallel line assumption is very restrictive and is frequently violated (Long and Freese, 2003). Multinomial logit or generalized ordered logit models can solve this limitation (Williams, 2009). However, the multinomial logit is the least preferred because it does not take into account ordering information, thereby rendering the model inefficient (Boes and Winkelmann, 2004). It also estimates more parameters than is necessary making the interpretation more difficult (Williams, 2009). Therefore generalized ordinal logit model was used to overcome this limitation. It estimate models that are less restrictive than ordered logit models and more parsimonious and interpretable than multinomial logit model. Therefore, the model relaxes the constraints on the variables when the parallel line assumption is violated, and simultaneously retains the information obtained from the ordering of the data (Polsky *et al*., 2006). The generalized ordered logit model Presented as follows:

$$\Pr(Yi>j) = g(X_{i\beta_j}) = \frac{\exp(\alpha j + xi\beta j)}{1+[\exp(\alpha j + xi\beta j)]},\ j=1,2,\ldots\ldots J-1 \quad \text{.....equation (vi)}$$

Where *i* represent the individual, *j* is the adoption categories, and *J* is the number of adoption categories. The generalized ordered logit model estimates results, coefficients and standard errors, for *J-1* adoption categories, and these results are similar to estimating a series of binary logistic regressions. In the first series of estimated coefficients, the lower adoption category is compared to all other adoption categories, and the second regression result compares the lower two adoption categories with the other categories. This pattern

continues until the last regression result compares the highest adoption category to all other lower categories. The probabilities that Y will take on each of the values 1…*J* is equal to:

Pr(Y_i=1)= 1-g($X_i\beta_j$)

Pr(Y_i=J)=g($X_i\beta_{j-1}$) –g($X_i\beta_j$) j=2…,J-1

Pr(Y_i=J)= 1 –g($X_i\beta_{j-1}$)

3.6 Contribution of REDD+ Introduced Livelihoods Activities to the Households' Income

Data collected to answer this objective were; what are sources of income, income from different sources including REDD+ livelihood enhancement activities, price of harvest, price of livestock and household number. Data analysis was done using SPSS software where descriptive statistics such as mean, frequency distribution and median were obtained to summarize results. The descriptive statistics were used to compare results obtained from the questionnaire admitted to households and secondary data obtained from annual reports, and other relevant documents from AWF offices.

3.7 Contribution of REDD+ Introduced Livelihoods Activities to the Households' Food Security

Data collected to answer this objective were type of crops used for food, number of bags harvested, number of bags consumed, family size, area for cultivation, amount of harvest sold.The analysis was done using cross tabulation using chi $x^2$and F test by help of SPSS software.This data focused only on food availability.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Household Livelihood Assets and Outcomes

Despite the soil erosion problems, the district seems to have a variety of agricultural potentials (Mung'ong'o *et al*., 2004). Table 1 shows household controls around four acre of land in average and 14% of households do not own any land while the average of land cultivated was three acre. The Average of household age was 46 with low education levels (about six years of schooling for household head; this is only primary education); while the average household members were six. About 100% sampled households' used fuel-wood as the main source of energy. The average uses of firewood and charcoal per month were seven bundles and one bag respectively. Most households are male-headed and about 79% of heads of households are married and 20% not married. Household used much time fetching water, the average distance to water source was 1.2 km. Splitting the sample by wealth index based on asset it is found that, houses with individuals who are not married had different ownership of wealth compared to those who are married at (x^2=15.576 and p< 0.05). Furthermore there is significant different per capita income among sampled villages at (p < 0.05).

Table 1: Socio-economic factors in different wealth groups, Kondoa, Tanzania, 2014

Household socioeconomic Factors		Poor (n=39)	Medium (n=38)	Least Poor (n=38)	Sample Mean	Max (min) Values
Age of respondent		45.26	44.92	47.05	45.74	70(21)
Labor force number		3.4872	3.5789	3.7368	3.6	8(1)
Education(year spend to school)		6.2821	5.8947	6.2632	6.15	7(0)
Family size		6.15	5.46	6.11	5.9	10(2)
Distance to water source*		941 [b]	1518.4[a]	1407.9[a]	1286.09	4000(0)
No land ownership		20.5	10.5	13.2	14.8	
land ownership (hectares)		3.76	4.68	5.37	4.6	30(1)
Land cultivated(hectares)		3.27	3.89	3.76	3.64	28(1)
Hh income(USD)		558	784	645	662	4051.5(69.7)
Hh income/cap/day (USD)		0.289	0.364	0.324	0.325	1.85(0.02)
Sex of responsent	Male	51.3	60.5	71.1	60.9	-
	Female	48.7	39.5	28.9	39.1	-
Marital status***	Married	64.10[a]	78.90[b]	94.70[b]	79.1	--
	Not married	5.10[a]	7.90[b]	0.00[b]	4.3	-
	Widowed	15.40[a]	10.50[b]	5.30[b]	10.4	-
	Divorced	15.40[a]	2.60[b]	0.00[b]	6.1	-
firewood used/month in head load		6.62	6.16	7.05	6.61	20(1)
Charcoal used/ months in bags		0.9	0.9	1.2	1.02	2(0.5)

USD1=TSh 1650, but it depend on exchange rate (This was in November, 2014)

* = significant difference between some of the three categories (F-test and x^2).

*p<0.05; **p<0.01.

a,b,c, turkey test; groups with different letters are significantly different from each other (p<0.05) in F test.

Table 2: Socio-economic factors in different sample village: Kolo Hill adjacent Communities in Kondoa, Tanzania

Household Socio- economic factors		Kolo	Mnenia	Bukulu	Kwadinu	Bereko	Sample mean
age of respondent		44.57[a]	47.8[ab]	45.83[b]	41.5a[b]	47.38[ab]	45.74
labor force number*		4.2333	3.2	3.0333	4	4	3.6
education (yrs) for head of hh		6.3	6.0667	6.5333	5.25	5.9231	6.1478
family size		6.27	5.63	5.4	6.25	5.92	5.9
Land ownership		100	80	73.3	91.7	84.6	85.2
total area of land owned		4.9	5.32	4.33	3.58	3.77	4.6
total area of land used		3.17	4.65	3.5	2.92	3.38	3.64
Sex of respondent (%)	Male	50	46.67	76.67	66.67	76.92	60.87
	Female	50	53.33	23.33	33.33	23.08	39.13
Marital status (%)	Married	83.3	63.3	76.7	100	92.3	79.1
	not married	3.3	3.3	6.7	0.00%	7.7	4.3
	Widowed	6.7	20	13.3	0	0	10.4
	Divorced	6.7	13.3	3.3	0	0	6.1
Distance to water source (m)		1150[b]	390[c]	2253.33[a]	2233.33[a]	561.54[c]	1286.09
firewood used (head load/m)		5.7	6.67	7	6.92	7.38	6.61
charcoal used (bags/month)		1	0.944	1	1.2	1	1.021
Total household income/year*** (USD)		478[b]	1040[a]	612[b]	598[b]	371[b]	662
Income/cap and day***(USD)		0.23[b]	0.51[a]	0.33[ab]	0.27[b]	0.18[b]	0.33

USD1=TSh 1650, but it depend on exchange rate (This was in November, 2014)

* = significant difference between some of the three categories (F-test and x^2).

*p<0.05; **p<0.01.

a,b,c, Turkey test; groups with different letters are significantly different from each other (p<0.05) in F test.

4.2 Identification of REDD+ Enhanced Livelihood Activities Performed by Project

The livelihood activities identified in ARKFor Project were tree nurseries activities, conservation/improved agriculture, sustainable charcoal making, improved stove making, hydro-foam brick making. However, only tree nurseries activities, conservation/improved agriculture and improved stoves making were in practices. Also in Table 3 shows adoption level for identified livelihood activities were not significant different between wealth groups. According to factor endowment model as discussed by Blackman (1999), the adoption of livelihood activities not only depends on goals of ARKF or but also the resource constraints and benefit households getting from adoption. The study also conducted by Chirwa (2005) found that, the decision whether to adopt or not is influencing not only by access to information but also to socio-economic and demographic factors. Perhaps the same factors that were influencing a study conducted by Chirwa (2005) also may influence the adoption REDD+ enhancing livelihood activities in ARKF or Project.

Table 3: Adoption level across wealth group in percentage

Livelihood activities	Poor (n=39)	Medium (n=38)	Least Poor (n=38)	sample mean (n=115)
Improved agriculture	64	66	78	69.0
Improved stoves	54	50	45	49.6
Tree nurseries	85	72	68	75.0

4.2.1 Improved stove

However FGD discussion revealed that the improved stoves were there long time ago before REDD+, Table7 and 8 show there was significant different in improved stoves adoption between villages at x^2=29.39 (p<0.05). 49% of sample households were participating in improved stove (making and using), where 26.5 %, 71% and 2.5% were in low, middle and high level of adoption respectively. Bereko, Mnenia and Kolo showed

high participation in improved stove as compared to Kwadinu and Bukulu. The reason may include availability of improved stoves making groups like *Twiga, Maizingira* and *Okoa jangwa* in Mnenia, Kolo and Bereko respectively. This perhaps influence diffusion in improved stoves uses to other households which are not in those groups.

Possession of improved stove does not show significant increase or decrease of wood fuel consumption as shown in Table 4. For example, 69% of sampled households in Bereko used improved stoves; firewood and charcoal consumption per month was 7 bundles and 1 bag respectively. In Bukulu 23% of sampled households used improved stove; firewood and charcoal consumption was 7 and 1 respectively. This implies that probably the people not using the improved stoves or the improve stoves were not such efficient. During household survey improved stoves were seen to be not dominant in most of the households visited. It was also observed that some of the households maintained traditional three-stone fire places alongside with the improved ones. The reasons for maintaining the traditional stove were stated as the improved stove is not durable and it consume more time. Similar result were found by Sem (2004) who reported that, apart from other factors which affect the utilization of improved stove the characteristics of the construction materials and time saving affects the utilization of improved stove. Most of household prefer using improved stove which consume little time and are durable. However, Sem (2004) revealed that the use of improved stoves consume less time, which is different to what this study found.

Table 4: The correlation between adoption of stoves and firewood consumption

		Improved stoves	**Firewood consumption**
improved stoves	Pearson Correlation	1	-0.299
	Sig. (2-tailed)		0.625
Fire wood consumption	Pearson Correlation	-0.299	1
	Sig. (2-tailed)	0.625	

* = significant difference between some of the three categories (x^2test). *p <0.05.

4.2. 2 Fuel wood consumption

Efforts towards wood energy conservation have mainly revolved around activities on improved stoves for charcoal and fuel wood. These designing energy efficient stoves expressly to cut down on fuel consumption hence forest degradation and deforestation. The study reveals that 100% of household uses fire wood in their houses, collected from houses trees that planted during HADO Project and from Village's Forest Reserve. Despite of decrease in charcoal consumption from baseline and this study, there was increase in number of households from 29% to 42% and 19% to 36% from baseline result who collected eight bundles and four bundles per month respectively as shown in Table 6a. The reason behind to increase fuel-wood consumption include the current road construction opened opportunity to food venders, who use wood fuel as the main source of energy for cooking. Also opening of area for road line as lead to remove vegetation in general, this made increase in availability of wood fuel. The reasons also were supported by FGD and key informants those who collected more than eight bundles per month were engaged in business associated with use of firewood like local brew and large family size.

Table 5: Percentage of fuel wood consumption in month by location

Type of fuel wood	Kolo	Mnenia	Bukulu	Kwadinu	Bereko	Sample mean	Std
firewood (bundles)	5.7	6.7	7	6.9	7.4	6.6	0.63
charcoal in bags	1	0.9	1	1.2	1	1.0	0.1
Improves stove*	69	67	23	17	69	49	26

* = significant difference between some of the three categories (x^2test). *p<0.05.

4.2.3 Fuel wood consumption in relation to wealth group

Table 6a and 6b indicates that there is no significant different among the wealth group in wood fuel and charcoal consumption between the sampled village. The study differs from

Mutabazi *at al*. (2014) who revealed that, relatively poor collected more fuel-wood from the forest compared to richer households. FGD revealed that, almost all wealth groups in Bereko, Kwadinu, and Bukulu depends on wood fuel because of lack of electricity. While in Kolo and Mnenia stated that, the cost of electricity is too high, so unaffordable to majority for cooking except for lighting. The result concur with the findings of study by Abdallah and Monela (2007) who reported that , people enforced to use wood fuel because lack of national electricity grid for example Ruvuma and Kigoma and high tariffs/prices associated with alternative sources of energy (electricity).

Table 6a: Percentage of fire wood consumption by wealth groups in Kondoa, Tanzania, 2014

Firewood consumption per month (bundle)	Poor	Middle	Least Poor	Sample Mean	Std
<4	7.7	5.4	2.6	5.2	2.55
4	35.9	47.4	23.7	35.7	11.85
5-7	10.3	7.8	5.2	7.8	2.55
8	33.3	36.8	57.9	42.6	13.30
>8	13.6	2.6	9.6	8.6	5.56

Table 6b: Percentage of charcoal consumption by wealth groups in Kondoa, Tanzania, 2014

Amount of charcoal in bag per month	Poor	Middle	Least poor	Sample mean	Standard deviation
0.5	20% (1)	22.2%(2)	0%(0)	12.5%(3)	12.23
1	80%(4)	77.8%(7)	80%(8)	79.2%(19)	1.27
2	0%(0)	0%(0)	20%(2)	8.3%(2)	11.55

4.3 Conservation / Improved Agriculture

Despite crop cultivation is the main source of livelihood in sampled population by 95%; Table 8 and 9 shows, only 69% of households were engaged in improved agriculture practices, where 27.5%, 69.5% and 3 were in low, middle and high level of adoption respectively. About 80% of Mnenia household participated improved agriculture practice which is high compared to other sample villages. Focus group discussion also reveals that, communities adapt improved agriculture in order to secure food and income. This is one of the resilience options from shocks and stress resulted from climate change. Also there is law enforcement which restricts farms expansion. But, household complained deficient in capital/income and credit/loan for buying improved seeds, fertilizers, herbicides, insecticide and hiring equipment for cultivation like tractors hindered improved agriculture practice. This was found also by baseline of the project which conducted by Mung'ong'o *et al*. (2011). The mean household's income/year is significant different at (p<0.01) and (F=4.325 and df=4) and Mnenia village income/year is significant different from others sampled villages as shown by post hoc test in Table 2. This probably the fact that Mnenia household practiced more improved agriculture than other sampled villages. This supported by the study of Peter *et al*. (2011) who revealed that, conservation agriculture requires well-resourced smallholder farmers regarding implements; basic finance like loan/credits and other livelihood assets but most farmers lack such basic resources.

Table 7: Correlation of improved agriculture and area of land cultivated

		Improved agriculture	**Land cultivated**
Improved agriculture	Pearson Correlation	1	0.948
	Sig. (2-tailed)		0.014
land cultivated	Pearson Correlation	0.948	1
	Sig. (2-tailed)	0.014	

* = significant difference between some of the three categories (x^2test). *P<0.05.

Although Mnenia had high percent in improved agriculture practice, there was strong positive correlation between land cultivated and improved agriculture across all sampled village as shown in Table 7. This implying those households were not well captured the methodology of the improved agriculture. FGD and Key informant interviews reveled that, few people are trained about improved agriculture and the rest got secondary information from those who trained at first. This can lead misinformation, possibly affected the performance of improved agriculture. This supported by Kaliba *et al*. (2004) who found, farmers needs information in relation to fertilizer and improved seed, improved varieties, planting method, weeding, and pesticide use from the skilled personnel. This is essential for effectively and efficiently diffusion of improved agriculture technology.

Table 8: Household's engagement in REDD+ livelihood enhancing activities by village in Kondoa, Tanzania, 2014

Livelihood activities (%)	Kolo	Mnenia	Bukulu	Kwadinu	Bereko	Sample mean	Std
Improved/conservation agriculture	66.7	80	66.6	58.4	69.2	69.6	7.7
Improved stoves*	60	66.6	23.3	16.7	69.2	48.7	25.1
Tree nurseries	80.1	86.7	70	66.7	61.6	75.7	10.0

* = significant difference between some of the three categories (x^2test). *p<0.05.

4. 3.1 Agro silviculture system

Table 9 shows that, there is significant different in agro silviculture system between sampled village at (x^2=10.964, p<0.05). There was decrease in number of household who participated in agro silviculture from 86% to 79% from baseline of this study. Agro silviculture practice in Mnenia village was high (96.7%) compared to other villages, while in Bereko, was small (58.8%) compared to other villages. During focus group discussion and key informant interview, Mnenia households were more active, aware about important

of trees and they got many incentives from AWF (NGO that implemented REDD+) officers perhaps this contributed to agro silviculture practices. On other hand other sampled villages complained that there is biases in incentives provided by AWF offices, possibly this affects much agro silviculture system in Bereko. Generally, availability of water in Mnenia compares to other sampled villages may affect agro silviculture practice, because tree nurseries growing depends water availability.

Table 9: REDD+ livelihood enhancement activities adoption level

Livelihood activity	Number of household participated	Level of adoption in %		
		Low	Middle	High
Conservation agriculture	79	27.5	69.5	3
Improved stoves	56	26.5	71	2.5
Tree nurseries	86	6	74	20

4.3.2 Tree nurseries

As shown in Table 8 and 9 in all village 75% in each village participated in tree nurseries and there was no significant different in tree nurseries activities among the sampled village. Whereby, 6%, 74% and 20% of households were in low, middle and high level of adoption respectively. FDG and key informants revealed that, communities were aware in skill, which got during HADO Project (*Hifadhi Ardhi Dodoma).*Moreover, inputs including technology and income is cheaper, everyone who is interested with tree nurseries can do. On the other hand tree nurseries activities encountered with is water shortage, pests and market availability. As shown in table 3, there is significant different in water accessibility distance at ($F=57.448$ and $p<0.01$). This different in water accessibility perhaps affected the performance of tree nurseries. These findings are in line with those of Shisanyal *et al*. (2007) who reported the most important problems that face tree nurseries

activities in East Africa were pests damaging seedlings, scarcity of water and lack of adequate market for nurseries.

Table 10: percentages of Agro silviculture in sampled population

Agro silviculture*	Kolo	Mnenia	Bukulu	Kwadinu	Bereko	Sample mean	Standard deviation
No	23.30	3.30	23.30	25.00	46.20	20.90	15.19
Yes	76.70	96.70	76.70	75.00	53.80	79.10	15.19

* = significant difference between villages (x^2test). *p<0.05.

4.4 Factors Influencing the Adoption Level of Livelihood Enhancing Activities

Validity of the ordered logit model was tested, the model was found to be significant at (x^2=53.46, p = 0.000) as shown in Table 12. The parallel lines assumption was also tested using Brant test as shown in Table 12.

$$\beta_0 = \beta_1 = \beta_2 = \beta_3; \quad \beta_0 \neq \beta_1 \neq \beta_2 \neq \beta_3$$

The model was found to have x^2 = 45.17; p = 0.0212, that means the null hypothesis is rejected, therefore parallel lines assumption does not hold. The model changed to generalized ordered logit model, this is because the model does not take into account the parallel line assumption. Table 13 shows the generalized ordered model was significant at (x^2= 155.48, p=0.0000<0.005).

Table 11: Ordered logit model, showing factors infuencing level of adoption to REDD+ introduced livelihood activities.

Explanatory variables	β coefficient	Standard error	P>|z|
Education	.4224414	.5867902	0.472
Extension	-.1014452	.5048591	0.841
Income	6.65e-07	1.94e-07	0.001
labor force	.2563362	.3865305	0.507
Awareness	1.517885	.7515708	0.043
Age	.0136469	.0195858	0.486
Loan	.8416627	.672986	0.211
Land size	-.0870617	.0496863	0.080
Government support	2.232543	.4660695	0.000
Access to forest	-.1900526	.2964551	0.521
Sex	1.067845	.4716574	0.024
Marital status	1.302484	.5433915	0.017
Distance to water source	-.0000503	.0002111	0.812
Family size	-.2360345	.1430767	0.099
/cut1	3.137601		
/cut2	5.935801		
/cut3	7.878547		
Number of observation= 115			
LR chi2(14) = 53.46			
Prob > chi2 = 0.0000			
Pseudo R2 = 0.1843			
Log likelihood = -118.26411			

Table 12: Test of the parallel regression assumption

Type of parallel test	Chi2	Df	p>chi2
Brant	45.17	28	0.0212

Table 13: Generalized ordered logit model, showing factors influencing level of adoption to REDD+ enhanced livelihood activities

Explanatory variables	Model 1 Pr (y>0/Y=0)		Model 2 Pr(y>1/y≤1)		Model 3 Pr(y=3/y≤2)	
	B coefficient	P>|z|	B coefficient	P>|z|	B coefficient	P>|z|
Education	2.322199	0.024	-1.593689	0.224	-2.221891	0.169
Extension	3.385884	0.018	-447.0997	0.130	3.73e+08	0.201
Income	7.92e-07	0.119	7.70e-07	0.042	-5.85e 07	0.287
labor force	-.4554495	0.518	-.2542075	0.692	-.193947	0.832
Awareness	.3695948	0.690	10.07942	0.798	3.38687	0.693
Age	.0544914	0.119	.0113754	0.786	-.089647	0.174
Loan	-1.025823	0.362	-.342586	0.849	4.048857	0.032
Land size	-.1807658	0.066	.0328508	0.815	.0254775	0.912
Government support	1.017901	0.159	4.033785	0.000	.0808269	0.951
Access to forest	-.0098016	0.982	-.5305372	0.327	-.5033642	0.531
Sex	1.232205	0.115	2.519887	0.010	1.386155	0.231
Marital status	2.444524	0.007	1.799348	0.133	.7554476	0.724
Distance to water source	.0000492	0.874	-.0004462	0.260	.0002345	0.710
Family size	-.2538707	0.311	-.3171012	0.209	.2832388	0.482
Constant	-8.064481	0.077	-11.18402	0.778	1.140374	0.842
Number of observation = 115						
LR chi2(39) = 115.48						
Prob > chi2 = 0.0000						
Log likelihood = -85.254675						
Pseudo R2 = 0.5382						
The model tested at 5% significant level						

Education coefficient appears with positive sign in model one, which means that as the household head' education increase, the chances of adopting at lower level from not adopting increase. Households whose head is educated can realize, examine and understand the advantages of different technologies easily than households who household head is low uneducated. Krishana *et al*. (2008) found that, education of household head was positively related to the adoption of sustainable livelihood activities such as conservation agriculture and soil water conservation. This provides support for the theory

that, better education levels are associated with greater information on sustainable livelihood activities and consecutively results in a greater adoption of livelihood activities (Ellis, 2000). For that reason, if the number of educated people increases in district and country, the sustainable livelihood activities will be highly adopted.

Access to extension services had positive coefficient in the model one, implying that as household access to extension services increase, the chances of household to adopt at lower level increases. Good extension services are a key aspect in technology dissemination and hence adoption. Kariyas and Dewi (2013) explained that high level of implementation in improved agriculture activities is due to guidance from agricultural extension workers, who disseminate information concerning agriculture correctly.

Income coefficient appears with positive sign in model two, which means that as household income increase, the likelihood of adopting at middle level from low level increases. This suggests that, adoption of livelihood activities enhanced by REDD+ Project needs money for buying seed, improved stoves, hiring equipment and hiring labor. This finding is in agreement with results reported by Mutabazi *et al*. (2014) who also found a positive and significant relationship between high income households and adoption of improved stove and conservation agriculture in Kilosa District Tanzania.

Land size had negative coefficient in model one, which means that as household land size increases, adoption decrease to the low level from none level of adoption. Land availability probably triggers household to participate in shifting cultivation or sketchy land uses. Not only that but also households perhaps depended only on unsustainable extensive agriculture for the income and food security without depending on other alternatives sources of livelihood. This study similarity to Yunez- naude and Taylor (2001)

who found, land size per adult had a negatively and significantly affects engagement nonfarm wage employment. Therefore, land scarcity was the driving force participation in nonfarm wage employment. The collected evidences indicate that scantiness of the land available for household member leads to participate in sustainable livelihood activities enhanced by ARKF or Project including farm and nonfarm activities.

Access to loan had negative coefficient in model three, that is, access to loan decreases household's chances of adopting at high level from middle adoption level. During focus group discussion suggested that, the project could have better livelihood impacts if could provide subsidized loan. Also said taking loan to commercial agents for poor household is too risky. Those who taking loan mostly are well off households , and not participate much on those livelihood activities rather than they are business oriented people, using the loan in crops buying, livestock and owning shops.

Project support had positive sign coefficient in model two, which means that as project support increases the household's chances of adopting at middle level from low adoption level. Probably technical support and incentives that ARKF or provided to households motivated them to adoption those sustainable livelihood activities introduced. The study concurs with Nasir (2014) who found, the government/ non government support had a positive significant impacts in enforcing contract, technical information in organized forms and removing other barriers that influence the sustainable off farm activities, since off farm employment is the means to escape rural people from poverty since most the income generated from off farm employment spend on household consumption.

Household head gender had positive coefficient in model two, which means the chance of hhh who is male to adopt at middle level from low adoption level increase compare to female. Gender is an essential and always together part of rural livelihoods. Men and women have different assets in term of resources assessment and opportunities. Women

rarely own land, may have lower education due to discriminatory access as children, and their access to productive resources as well as decision making tend to occur through the negotiation of men (Ellis, 2000).

Marital status of household head had positive coefficient in model one. That is, as household marital status increase household's chances of adopting at least lower level from not adopting increase. Perhaps this helps in labor division, since women are always takes care of family when their husband participate in off farm activities. Not only that but also, coupled households advised each other on the advantages of adopting the sustainable livelihood activities for their betterment of their family in term of food security and income generation. The result in line with Nasir (2014) who found that, the likelihood of adopting off-farm activities is positively significant to married household than unmarried households.

4. 5 Diversification by Income Sources and Wealth Groups

4.5.1 Diversification by income sources by wealth group

The differences in income sources between the three wealth groups were no statistically significant. However the improved stoves and tree nurseries were not included in off farm and environmental income respectively, this was purposely in order to sort out the contribution of activities enhanced by REDD+ to household income.

Income from crop cultivation from poor household group was marginal high compare to middle and least poor group. This implies that most of poor households do not keep large ruminants, Chickens and goats. They depend more on agriculture activities. However, the environmental was the main source of income to middle groups, where household were

collected and sold pole, timber and honey. The least poor households were depended much on livestock as the main source of income. The middle group households had high percent in nonfarm activities compare to others group. The reported non-farm incomes relate to food venders, small shops, crop businesses and casual labor like working on other people's farms using own labor and carpentry. In addition to that percentage of remittances income to poor household and middle household is slightly high compare to other lest poor households. Remittances are received mainly by parents of urban migrant's older people living at home with their grand-children. According to URT (2012b) approximately per capita income of Kondoa was 247.88 per year. This study revealed that there was an increase of per capita income per year by 27.23 USD (10.97%). Rise in income per capital per year, possibly due to REDD+ intervention.

Table 14: Sources and relative importance of mean annual incomes across wealth groups; Kolo Hill Forest surrounded communities Kondoa, Tanzania, 2014.

Income source in USD	Poor (n=39)	Share	Medium (n=38)	Share	least poor(n=)	Share	Sample mean	Share
		(%)		(%)		(%)		(%)
Environmental	105.45	8.38	409.09	21.32	175.15	13.34	216.97	13.37
Livestock	175.76	13.96	249.09	12.98	487.27	37.11	340.00	20.94
Cultivation	342.42	27.20	341.21	17.78	301.82	22.99	327.27	20.16
Remittances	173.33	13.77	181.82	9.470	81.82	6.23	152.73	9.41
off-farm	168.48	13.38	261.82	13.60	140.00	10.66	200.61	12.36
Improved stoves	48.00	3.81	270.00	14.07	82.96	6.318	206.06	12.69
Tree nurseries	245.45	19.49	206.06	10.74	43.94	3.35	179.39	11.05
Total Income	**1258.89**	**100.00**	**1919.09**	**100.00**	**1312.96**	**100.00**	**1623.03**	**100.00**

4.5.2 Income sources diversification from REDD+ enhanced livelihood activities

As shown in Table 14, Livestock (21%) and cultivation (20%) had large percent compare to other source of income. This is because rural community depends mostly in agriculture as the main source of income. Contribution of tree nurseries to poor household is relative high (19%) compare to other wealth groups. This due to fact that, capital and operation cost of tree nurseries activities is relative small, therefore poor household afford and practice this activities seriously. However the contribution of improved stove income to poor household is relative low (4%), compare to middle households (14%) and least poor (6%), but also middle household earned high income from improved stoves making than other wealth group.

4.6 Maize Productivity and Food Security

Maize followed by sorghum was the main crops and source food for all household in the study area. The study focuses on maize production because most of sampled household were not grown sorghum. Table 15 shows that, there was significant different in maize consumption between the wealth groups at ($F=3.385$, $p<0.05$); Least poor household were food secured, because what consumed and trade not exceed what produced. On other hand poor and middle wealth group households suffered from food insecurity, because what consumed and trade exceed what produced. This is because poor and middle group households used maize as the main food crop at the same time as the cash crop.

Table 15: mean of maize produced, consumed and sold

Maize in kg	Poor	Middle	least poor	Total
Production	1102.7	1280.59	2675.05	1706.35
Consumption *	291.11[b]	413.71[ab]	366.86[a]	356.6
Trade	811.59	950.26	947.69	903.18

4.7 Maize Productivity in Relation to Cultivation Area

On average household cultivates about 3.6 acre per year: Poor, Middle and Least Poor cultivated about 3.3, 3.9 and 3.8 acre per year respectively. Table 14 shows that, the average maize production for poor household was 337kg (3.4 bags of 100kg) per acre; while the middle household was 329 kg (3 bags of 100kg) per acre; and 688kg(6.9 bags of 100kg) for least poor. On average the maize production per ac was 474 kg (4.7 bags of 100kg). Contrary to results in Table 15, the baseline reported that some households harvested more than 20 bags of maize per acre in both wealth groups. Kadapatti and Bagalkoti (2014) revealed inverse relation between farm size and land productivity. Making more intensive use of land, intensive management and use of modern technology is among the factors for higher productivity in small farms. However, the productivity of least poor was relative higher than the poor group; the least poor used more land compare to the poor group. This could be due to less intensive use of land, poor management and uses of old technology as also stated by Kadapatti and Bagalkoti (2014).

4.8 Maize Productivity in Relation to Adoption of Improved Agriculture

Table 16 shows there was positive strong correlation between adoption of improved agriculture and maize production. As the improved agriculture high adopted, the high the maize production. That is to say, agriculture technology that enhanced by the ARKF or Project if well implemented could positively impacted on food security, because more households adopted improved agriculture the more chance of being food secured than those who not adopted. Therefore, the emphasis on adoption of improved agriculture can eliminate the problem of food insecurity. This study supported by FAO (2011), by considering climate change or variability, any like adoption of improve agriculture that

succeeds in increasing the productivity of resources devoted to maize production will bring about real food security for the vast majority of the rural population.

Table 16: Correlation between adoption of improved agriculture and food security

		Improved agriculture	**Maize production**
Improved agriculture	Pearson Correlation	1	1
	Sig. (2-tailed)		0.018
Maize production	Pearson Correlation	0.999	1
	Sig. (2-tailed)	0.018	

Correlation is Significant at 0.05 levels.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study was undertaken in a REDD+ pilot area with the purpose of eliciting information regarding people's adoption to enhanced livelihood activities and its impacts. It was evident that, communities in the study area adopt only woodlots activities, improved agriculture and stoves. Although people depend heavily on maize production farming for their household incomes and food security, the adoption of improved agriculture was positive strong correlated with land size. This tells, household were not captured the knowledge and skill of improved agriculture correctly. Most households complained knowledge and skills on improved agriculture got from neighbor households who trained direct by extension officers, this leads to misinformation in diffusion process of improved agriculture knowledge. There was also a heavy dependence on forests for fuel wood; the possession of improved stoves was no correlation with fuel wood consumption. This is implying that, improved stoves are not efficient or households do not using it. Large percent of household adopt woodlots activities, this is because the activities required less inputs and the knowledge were there since HADO project. In general there was no significant different in adoption level between wealth groups in all livelihood activities identified. However, Income, ARKF or Project support and marital status and gender, land size were significant influencing adoption level.

Average income per capita per day was USD 0.33which was below poverty line. This is to say contribution of ARKF or Project to household income was insignificant. In addition to that, maize was the main food crop in the study area; and there was a strong positive correlation between adoptions of improved agriculture and maize production. However,

only least poor households were food secured; the middle and poor households were food insecure. They sold more quantity of maize than what produced; this is because households used maize as the food crop at the same time as the cash crop.

In general contribution of intervention of REDD+ to rural livelihood was insignificant because still people live below poverty line, the objective of secure food to rural livelihood was not meet and still significant number of household were relying on forest as main source of energy for cooking. The study reveals that, adoption of enhanced REDD+ livelihood activities are likely to succeed if there is equity in benefit sharing between international, national and local community levels.

FGD reveals that, although there was effort to promote community involvement in REDD+ enhanced livelihood activities, there was conflict between benefit sharing and local engagement effort. Villages complained that negative externalities incurred from the project are high compared positive ones. This supported by Griffiths (2007) who reveals that integration of enhanced livelihood activities and community participation in REDD+ will depend on concrete incentives. While UNFCCC does not have mandate to monitor benefit sharing, or local involvement, the incentives obtained from REDD+ Project mostly controlled by central government. It is seriously detrimental to efficiency and equity in benefit sharing due to factors such as corruption, bureaucracy, poor governance and institutional arrangement.

5.2 Recommendations

i. New research is suggested on REDD+ enhanced livelihood activities to focusing on relationship exist between adoption level and win-win situation

exist between international, centralized forest governance and local community. Furthermore should also focus on how carbon think varies with differing levels of community livelihood activities adoption.

ii. The negative and significant influence of the variable land size on adoption considers government and other responsible bodies to design necessary strategies so as to create awareness among the community to the intensive land utilization so that generate adequate income and food.

iii. The strong positive correlation between adoption of improved agriculture and maize productivity call for government and other responsible bodies to design necessary strategies via promoting adoption of improved agriculture via capacity building, provision of subsidized loan to local community, developing farmers' training centers, expanding technical and vocational schools, local community participation in relevant forums as they appear regardless of the gender along with better facilitation in policies through learning and networking. This will help to increase maize productivity and consequences will reduce the problem of food insecurity and increase household income.

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APPENDICES

Appendix 1: Structured questionnaires

Part I

Socio demographic characteristics

1.0 Basic household information							
Interviewer:				Respondent:			
Village:				Household no.			Date:

2. 0 Household members:						
Position	Name	Marital status	Sex	Age	Education	Main occupation
HHH						
spouse 1						
spouse 2						
spouse 3						
spouse 4						
Number of other adult members (16 years or older):						
Number of children between 8 and 15 years of age:						
Number of children 7 years old or younger:						

Note 1: 1- Married, 2- Unmarried, 3- Divorced, 4- Widow, 5-Separated

Note 2: 1-none, 2-primary, 3-ordinary level, 4- certificate level, 5-advanced level, 6-diploma, 7- university

3. 0 Household Basic needs and Assets					
Type of houses Observe roof, wall and floor in last 12 months?.		**Pre**	**Post**	**number**	**Total value**
	Cement bricks,	1	1		
	plastered brick walls	2	2		
	corrugated floors	3	3		
	iron sheet roofs	4	4		
	mud bricks	5	5		
	Cement floor	6	6		
	sticks with mud plastering,	7	7		
	wood,	8	8		
	mat/leaves	9	9		
	Other.:.....	10	10		
4.0 Do you have electricity in your House?	Yes	1	1		
	No	2	2		
5.0 What is the major source of Lighting in your household in last 12 months? (SINGLE RESPONSE)		**Pre**	**Post**	**Indicate total value if any**	
	Electricity	1	1		
	Kerosene Lamp	2	2		
	fuel wood	3	3		
	Candle	4	4		
	Solar Energy	5	5		
	Others. Specify	6	6		
6.0 What is the main fuel your Household uses for cooking in last 12 months? (SINGLE RESPONSE)			**Pre**	**Post**	**Indicate total value if any**
	Fuel wood collected from REDD+ pilot forest		1	1	

	Crop residues	2	2	
	Dung cakes	3	3	
	charcoal	4	4	
	Kerosene	5	5	
	Electricity	5	5	
	Liquid petroleum gas	6	6	
	Bio-gas	7	7	
	Fuel wood collected from other forested landscapes	8	8	
	Bought fuel wood	9	9	
	Other (specify)……	10	10	

7.0 What is the main source of drinking water for members of your household in last 12 months? (SINGLERESPONSE)	**Sources**	**Pre** Avg. Distance (m)	**Post** Avg. Distance(m)
	Piped water in residence	1	1
	Public tap		2
	Hand pump in		3
	Improved well/spring in resident		4
	Public Hand pump		5
	Improved well/spring in public		6
	Surface water (river, etc.),		7
	Traditional well in public		8
	Traditional well in resident		9
	If ‘other’, please specify		10

8.0 Does your household own any of the following: (Items are to be in working condition last 12 months)	**Asset**	**Pre**	**Post**	**Number**	**Total value**
	Chair	1	1		
	bed	2	2		
	Table Clock / watch	3	3		
	Bicycle	4	4		
	Radio	5	5		
	Sewing machine	6	6		
	Telephone/mobile	7	7		
	television	8	8		
	Shops or kiosks	9	9		
	Car	10	10		
	Water pump	11	11		
	Tractor	12	12		
	Milling machines.	13	13		
	Motorbikes	14	14		
	Trucks	15	15		
	Sawing machine	16	16		

Part II

Livelihood portfolio

9.0 Detail Description of livelihood's income source in last 12 months (Multiple Response)	Activities undertaken post project (Yes-1, No-2)	Activities undertaken pre project (Yes-1, No-2)	Cost	Revenue	Whether increase the employment (Yes-1, No-2)
Conservation agriculture.eg Agro forestry					

Sustainable grazing					
Sustainable charcoal production					
Beekeeping fishing					
Horticulture					
Vegetable cultivation					
Dairy					
Goat and Sheep Rearing					
Poultry and duck rearing					
Fisheries					
Local labor activates					
Migration for labor					
Processing/Sale of NTFP					
Traditional skill based occupation; **Specif**y					
Rock painting tourism					
Petty trade/Services					
Others; **Specify**					

Description	Options	Codes
Has there been an overall increase in your household income since the Project has started?	Yes, Significantly	1
	Yes, to some Extent	2
	No	3
	Deteriorated	4

i. Has the household's income have been sufficient to cover what you consider to be the needs of your household? Codes: 1= yes; 2= reasonably, 3= no ( )

ii. Is the household income sufficient to cover household need after REDD+ implementation? Codes: 1= yes; 2= reasonably, 3= no ( )

iii. How well-off is your household compared to other households in the village/community Codes: 1=worse-off, 2=about average; 3= better-off ( )

iv. How well-off is your household today compared to the situation before REDD? Codes: 1=less well-off now, 2=about the same; 3=better off now ( )

v. Has your household faced any major income shortfalls or unexpectedly large expenditures after REDD+ implementation? Codes: 1=Yes; 2=No ( )

If 'yes', please complete the table

Part III

Stresses and shocks

10. Serious event	How severe?	How did you cope with the income loss or costs? Please indicate the most important strategy
Serious crop failure		
Death/serious illness in family (productive age-group/adult)		
Loss of agriculture land because of REDD+		
Loss of grazing area because of REDD		
Loss of waged employment because of REDD+		
Climate/drought/floods		
Price changes on products and consumer goods because of REDD+		
Loss of sources of forest products like firewood because of REDD+		

Codes: 1= somewhat severe, 2 = severe, 3= very severe

Part IV

Forest resource use

11. What are the values of the following timber forest products that the members of your household have collected from the forest both for own use and sale over the last month?

Main forest products	**Own use (indicate quantity)**	**For sale (indicate quantity)**	**Unit price in Tzs**	**Income in Tzs**
Firewood				
Barks				
Timber				
Firewood				
Charcoal				
Poles				
Fodder				

Note: 1=own use, 2= sale

12. How would you rank your access to and use of forest products (firewood, poles & timber, charcoal) after REDD+ implementation?

1. Much reduced	2. Reduced	3. The same	4.Increased	5. Much increased

13. If **'much reduced'** or **'reduced'**, what do you consider to be the most important factor(s) limiting your access to and use of these forest products today? If more than one, please, rank up till three most important factors.

1.	
2.	
3.	

14. If 'increased' or 'much increased', what do you consider the most important factor(s) for increasing your access to and use of these forest products today? If more than one, please rank up till three most important factors.

1	
2	
3	

15. Does a member of your household engage in NTFP collection? Yes=1, No= 2 ( )

16. What is the non Forest products (NTPF) collected from the forest by household members before implementation of REDD+ for your own use or sale?

NTFP	**Quantity Collected Pre-project**	**QuantityCollected Post-project**	**Quantity sold**	**Price in Tzs**
Wild fruits				
Honey				
Gums				
Wild vegetables				
Fodder (collected or grazed)				
Bamboo				
Medicinal plants				
Nuts				
Bush meat				
Mushroom				
Other; **specify**				

Part V

Land

17 (a)

Size of household's cropland last 12 months:	
Tenure on household's cropland:	
Tenure: 1=own land, 2=rented land, 3=borrowed land, 4=communal land	

(b). Please indicate the total size of farmland (in hectares) and specify size that currently has been in **use** (last 12 months)

Total farm land size	Area used for (hectares)	Main crop (last 12 months)

Part VI

Services and information availability after REDD+

18. Does project improved/ provided services and information? Yes = 1, No = 2 ( )

If yes, Please specify the services and information accessed?

Services/ Information	**codes**	Put '✓' if that services/ information provided by Project
Processing of products	1	
Value addition	2	
Training/exposure visit	3	
Formulation of financial institutions e.g	4	

SACCOS.		
Adequate market infrastructure and incentives	5	
Social infrastructure interventions	6	
Formation of producer groups or cooperatives	7	
Others specify	8	
Has the access to services and information improved Your income from the activity?	Option	Codes
	Yes, Significantly	1
	Yes, to some extent	2
	Not improved	3

18. If "yes" what support has been provided to the enterprise through the REDD+ Project?

Yes = 1, No = 2 ( )

20. Options from Project	**Codes**
Grant capital	
Credit	
Technology	
Information/demonstration	
Training/exposure	
Input supply like fertilizer	
Marketing/linkage with buyer	
Other; Specify	
Has there been an improvement in returns (in case of existing activity) or increase on HH income (in case of new activity) due to the interventions?	
If "yes"= 1, by how much?	In Tzs

Part VII

Agriculture production and food security

21. Do you produce enough food to sustain your family over the whole year?

Codes: 1= Yes; 2 =No ( )

22. Which crops and vegetables have you cultivated within the last 12 months?

Crop	**Area under cultivation (In acre)**	**Production in kg**	**Quantity of consumed by households**	**Quantity sold**	**Price**	**income**	**Agriculture practices**
Maize							
Pigeon peas							
Sorghum							
Sunflowers							
Oil seeds							
Bulrush millet							
Groundnut							
Finger millet							
Vegetables							
Fruits: eg banana							
Potato							
sugar cane							

1= shifting cultivation, 2=local seeds, 3= manure, 4=improved seeds, 5=-agroforestry,6=others; **specify**

23. Expenditures on farm inputs last 12 months

Input	Total cost in Tzs
Seed	
Fertilizer	
Pesticides	
Irrigation	
Hiring/maintenance of equipment	
Man power	
Planting	
Sowing	

24. Do you have any problem(s) that limit your agricultural production?

Codes: 1= Yes; 2 =No ( )

25. If 'yes', what do you consider to be the most important problem limiting your agricultural

production?_____

26. Do you depend on clearing forest for your agricultural production? ☐

Codes: 1= Yes; 2 =No

27. If 'yes' how much do you depend on clearing forest?

1. A bit dependent	2. Quite dependent	3. Very dependent

28. Is it easier to get new land for agriculture today than five years ago?

1. By inheritance	2. By buying	3. By renting	4. By clearing forest

Codes: 1=easier; 2=difficult 3=more difficult

29. You have marked ‘more difficult’ (3) in any of the above categories, why is it so?

Please state the most important reason:

(a).....

(b).....

(c).....

Part VIII

Livestock ownership and exchange

30. Transactions last 12 months

Type	Bought last 12 months				Sold last 12 months				Given last 12 months	Received last 12 months
	Quantity	Price	Cost	bought from?	quantity	price	Income	sold to?		
Cattle										
Mature females										
Mature males										
Young										
Donkeys										
Goats										
Sheep										
Other (pigs?)										

NOTE:

- Young animals = two years old or less
- "Bought from" and "sold to" (type of market): 1=within village, 2=local primary market, 4=secondary market, 5=travelling trader, 6=other
- When different animals of the same type are exchanged in different markets, indicate market with number of animals in brackets, e.g. 1(4), 2(73), 3(14)
- Note: different animals of the same type are often bought or sold at different prices, so calculations are necessary; give price range (min-max)
- Note: gifts include animals slaughtered for communal ceremonies

Stock

31.

Type	Stock	Stock
	Today	1 year ago
Cattle		
Mature females		
Mature males		
Young		
Donkeys		
Goats		
Sheep		
Other; Specify		

32. Consumption, loss & breeding last 12 months

Type	Slaugh-Tered	Died or Born Lost	
Cattle			
Mature females			
Mature males			
Young			
Donkeys			
Goats			
Sheep			
Other			

- Note: "died" means animals that were not consumed;
- Animals that died but were consumed should be entered in the "slaughtered" column

33. Inputs last 12 months

Type of input	Put ✓ in case you use	Total Cost
Medicines/veterinary services		
Dipping		
Herding		
Motorized transportation		
Licks		
Fodder (including husks)		
Renting of land (incl. stubble)		
Other (including fines)		

Part IX

Livestock production

34. What is the number of livestock and livestock products that your household has sold, bought, slaughtered or lost over last 12 months?

Livestock	**Product produced**	**Number of animal Sold**	**Price**	**For own use**	**Total number owned**
Cattle	Live animal (no)				
	Meat (kg)				
	Milk (liters)				
	Dung (kg)				
	Hide (kg)				
	Meat (kg)				
	Milk (liters)				
	Dung (kg)				
Goat	Live animal (no)				
	Meat (kg)				
	Milk (liters)				
	Dung				
Sheep	Live animal (no)				
	Meat (kg)				
	Milk (liters)				
	Dung				
Other; **specify eg chicken;**	Live animal (no)				
	Meat (kg)				
	Eggs				
	Others				

Note: Please indicate sold live animals in numbers and sold meat from slaughtered animals in kg

35. Do you have any problem(s) that limit your livestock production?

Codes: 1=Yes; 2=No ☐

36. If 'yes', what do you consider to be the most important problem limiting your livestock production? _____

37. What do you consider to be the most important suggestion to improve your livestock production? _____

38. How do you feed your livestock[)]?

No	**Type of animals**	A. Forest land (grazing and/or collected fodder)	B. Non-forest land (grazing and/or collected fodder)	C. Using crop residues	D. Other (specify)
1	Cattle				
2	Goat				
3	Sheep				
4	Other; specify				

Note: Please rank (1, 2, 3...) if more than one type is used for any of the animal categories. (So if 'crop residues' is most important, write '1' in the column for 'crop residues' and '2' in the column for 'forest land' if that is the second most important etc.).

Part X

Adoption of livelihood activities introduced by REDDS+project

39. (a) Are you participate in conservation agriculture 1=yes, 2=no

(b)When started to participate (i) five past years (ii) three past years (iii) one past year

(c) What is your technology using in improved /conservation agriculture activities?

(i) Improved seed (ii) organic fertilizer (iii)inorgamic fertilizer (iv) spacing in planting (iv) agroferest practices

(d) Level of adoption (i) high (ii) middle (iii) low

40. (a) Are you participating in improved stoves 1= yes, 2=no

(b)when started to participate (i) five past years (ii) three past years (iii) one past year

(c) Frequency of using the improved stove per week

(d) Amount of fuel wood using per week (i) less than four bundle (ii) four bundle (iii) eight bundle (iv) great than eight bundle.

(e) Level of adoption (i) high (ii) middle (iii) low

41(a) are you participate in tree nurseries activities 1=yes, 2=no

(b)When started to participate (i) five past years (ii) three past years (iii) one past year

(c) Have you grown tree nurseries (a) this year (b) last year (c) before last year?

(d) have you planted those grown tree in you field? How much have you planted (a) < =50 (b) 50- 100 (c)>=100

(e) Level of adoption (i) high (ii) middle (iii) low

Appendix 2: Checklist for key informant

1. Village leaders

i. Awareness on the importance of REDD+ introduced livelihood activities.

ii. Limitation in motivating those livelihood activities introduced by REDD+ project?

iii. Limitation in implementing those livelihood activities introduced by REDD+ project

iv. Local community and access to forest products and services from forest

v. Good and services obtained from forest services

vi. Income generating activities introduced by REDD+ Project.

vii. Food security resulted from REDD+ livelihood activities.

viii. Condition of people livelihood before and after REDD+ Project.

2. District officers

i. The contribution of REDD+ to the livelihood improvement of the rural community in food security.

ii. The contribution of REDD+ to the livelihood improvement of the ruralcommunity household income.

iii. Emerging of other alternative means of livelihood as a result of REDD+ intervention.

iv. Infrastructure improvement as the result of REDD+ intervention.

3. AWF Officers

i. Livelihood activities introduced by REDD+ Project.

ii. The contribution of REDD+ to the livelihood improvement of the rural community in food security.

iii. The contribution of REDD+ to the livelihood improvement of the rural community household income.

iv. Limitation in motivating those livelihood activities introduced by REDD+ project.

v. Limitation that hindering most of them implementing the Introduce DREDD+ livelihood activities.

Appendix 3: Checklist for guiding focus group discussion

i. Sources of livelihood before and after project

ii. Involvement of community in REDD+ introduced livelihood activities.

iii. Changes on forest livelihood options as a result of REDD+ project

iv. Factors to adopt or not to adopt the REDD+ introduced livelihood activities.

v. Limitations for implementing those livelihood activities introduced by REDD+ project.

vi. Contribution of forest to the livelihood product before and after project

vii. Infrastructures introduced by REDD+ project do household members have access to and use (eg. transport, marketing facilities, health services, water supply)