

## **Economic Implication of REDD+ Initiative on Food Security of Farmers in Rungwe District, Tanzania'**

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### **Abstract**

*REDD+ initiative is one of the climate change mitigations which conserves forest. It restricts communities living near forests from destructing them by accessing forest resources. This may affect food security and livelihood as communities cannot generate enough income for food and livelihood. The aim of this study was to assess REDD+ implication on food security of farmers living near Rungwe Forest Reserve in Rungwe District. The study was done from December 2012 to February 2013. It involved assessing level of livelihood dependency of farmers on forest resources, analyzing communities' perceptions on conservation initiatives, examining household food security status in the REDD+ pilot area and assessing REDD+ payment scenarios and their effects on food security. Sample size of 120 households obtained through simple random sampling was used. Food security measures were computed based on the extent to which the overall household income covered the estimated food requirements. Income from agriculture, forest, business, remittance and employment was calculated. Post hoc test was used for segregating the differing means. Likert scale was used to measure perceptions of respondents. Three scenarios were chosen from the base payment TZS 21 500 which are 25%, 50% and 100% increase to assess the potential REDD+ payments on food security. Results indicate that area under the study is food insecure; forest resources play a fundamental role, it contributes 26% of the total annual income; household perceptions on conservation measures were positive; also REDD+ payments will have positive effect on food security. Therefore REDD+ must address the needs of smallholder farmers to avoid exacerbating poverty and local food insecurity. Also compensation is needed in the study area and farmers must be provided with new agricultural technologies. Again gas must be available at reasonable price in the nearby shops.*

**Key words:** *Climate change, REDD+ implication, food security*

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### **1.0 Introduction**

Tanzania is endowed with large and valuable forest resources. About 35.3 million hectares is forests and woodlands. Out of this total area, 16 million are reserved forests and 2 million ha are in national parks. The remaining 17.3 million ha or 47% of all forest land are unprotected forests in general lands (URT, 1998, and URT, 2009). The forests offer habitat for wildlife, beekeeping unique natural ecosystems and genetic resources.

Forest related goods and services have a significant potential for the economic development of the country. However,

Tanzania is facing environmental degradation problems most important ones are deforestation and forest degradation. Deforestation and forest degradation are processes which are currently taking place in developing countries like Tanzania as a result of agricultural expansion, shifting cultivation and economic growth (URT, 2009). The rate of deforestation in Tanzania is estimated to range between 100 000 to 500 000 hectares per annum which takes place in both protected and unprotected forests but mainly takes in the unprotected forests in General Land (Mwakalobo *et al.*,

2011).

Forests in General Land are 'open access', characterized by insecure land tenure, shifting cultivation, annual wild fires, harvesting of wood fuel, poles and timber, and heavy pressure for conversion to other agricultural land uses, such as agriculture, livestock grazing settlements and industrial development (Zahabu, 2008). These activities have led to forest disappearance resulting into negative effect on the livelihood of forest dependent communities. The Government of Tanzania has realized that, a more comprehensive approach was needed to ensure sustainable forest management in the country. It is in this context that Tanzania has embarked on Reduced Emissions from Deforestation and forest Degradation (REDD+) initiative. REDD+ is an international policy approach and positive incentive which aims to reduce emissions from deforestation and forest degradation, and enhancing forest carbon stock in developing countries (Angelsen *et al.*, 2009). REDD+ is in many ways a double-edged sword: while it has significant potential for supporting poverty alleviation thereby improving forest-management policies and practices, and providing financial benefits from carbon credits to local stakeholders as Payment for Environmental Services (PES), which can thus be used for communal and/or individual investment (Funder, 2009). On the other hand REDD+ practices may worsen poverty for rural communities including reduced access to forest resources for food and shelter if local rights and forest use are ignored, and increasing food prices as result of reduced scope for agricultural

expansion since without land resources there is no agriculture and when rules for the use of this basic resource change, those of agriculture must follow suit (URT, 2009). REDD+ practices may also reduce household income obtained from forest resources and this might risk the revenue collection at district level and national level. This study will generate information on the risks and opportunities associated with REDD+ for the rural poor in developing countries in general and Tanzania in particular.

### **1.1 Problem Statement and Justification**

Tanzania is one of the 13 countries under the UN REDD programme, a collaborative initiative between FAO, UNDP and UNEP designed to assist developing countries get 'REDD+ ready' and support countries to develop capacity to reduce emissions from deforestation and forest degradation and to implement a future REDD+ mechanism (TFCG, 2009). Forest management faces a lot of human disturbances including crop production, building materials, collection of firewood and herbal medicines, which diminish the forests and also deteriorate condition of reserved forests (Sunderlin, 2004). As cited by Spiric, 2009.

REDD+ initiative with different practices has intervening with the aim of conserving forest resources, thereby addressing drivers of deforestation and find a way to compensate them so that they can shift from activities which

*and Other Land Use Practices* destruct forest to others which are forest

friendly. REDD+ provides payments, and conducting trainings on conservation/improved agriculture but also restricting agricultural expansion, livestock grazing, firewood collection, harvesting for building materials, and charcoal making and forest fruits collection which could have direct or indirect negative consequences for food availability, accessibility and economic development (Wollenberg *et al.*, 2011). However, little is known on how and to what extent REDD+ may risk food security, therefore the findings of this study will help the implementation of REDD+ initiative to be effective in Rungwe district and Tanzania as whole.

## **2.0 Methodology**

### **2.1 Location and Characteristic of the Study Area**

Rungwe District is one of the National REDD+ pilot areas in Mbeya Region. It is also one of the eight districts of the Mbeya Region of Tanzania. It is bordered to the North by Mbeya Rural District, to the East by Iringa Region, to the Southeast the district is bordered by Kyela District, to the Southwest by Ileje District while Mbeya Urban District borders it to the West. The District lies between 8°30' and 9°30' S and 33° and 34° E, with a total area of 2211sq.km of which 1668.2sq.km (75%) of the total area is arable land used for agriculture. The remaining land is covered by 44.5sq.km of forest and 498.3sq.km is mountainous and residential areas (URT, 2010).

The population in Rungwe District is estimated to be 339 157 by March 2013 with average household size of 4.1 (URT, 2013). This study covers Mt. Rungwe Nature Reserve where, Ndala, Kibisi and Kabale were taken as

villages under intervention.

### **2.2 Data Collection**

Both primary and secondary data were employed in this study. The data collection tool was the questionnaire which was designed and used to obtain the required information for the study. The questionnaire elicited household characteristic such as demographic information (name, sex, age, level of education, etc) land assets, agriculture production, livestock production and the use of forest resources. The questionnaire was designed in such a way as to avoid ambiguity, and sensitivity. The sampling units were heads of household, who were randomly selected from the village registers. Secondary data were obtained from secondary source, mainly publications, reports from agriculture District offices and Sokoine National Agricultural Library (SNAL) at SUA.

### **2.3 Data Analysis**

The collected data were sorted, coded and entered in the Statistical Package for Social Sciences (SPSS) version 16.0 software in conformity with the objectives of the study. Descriptive statistical analysis including frequency distribution, tables, pie-charts and percentages were used to summarize the results from the household's questionnaires.

#### **2.3.1 To assess the level of livelihood dependency on forest resources**

This study also used income as an indicator of livelihood as used by Conway (1992) as cited by Kadozo (2009) and (UN, 2007). Income from different sources was calculated as follows;

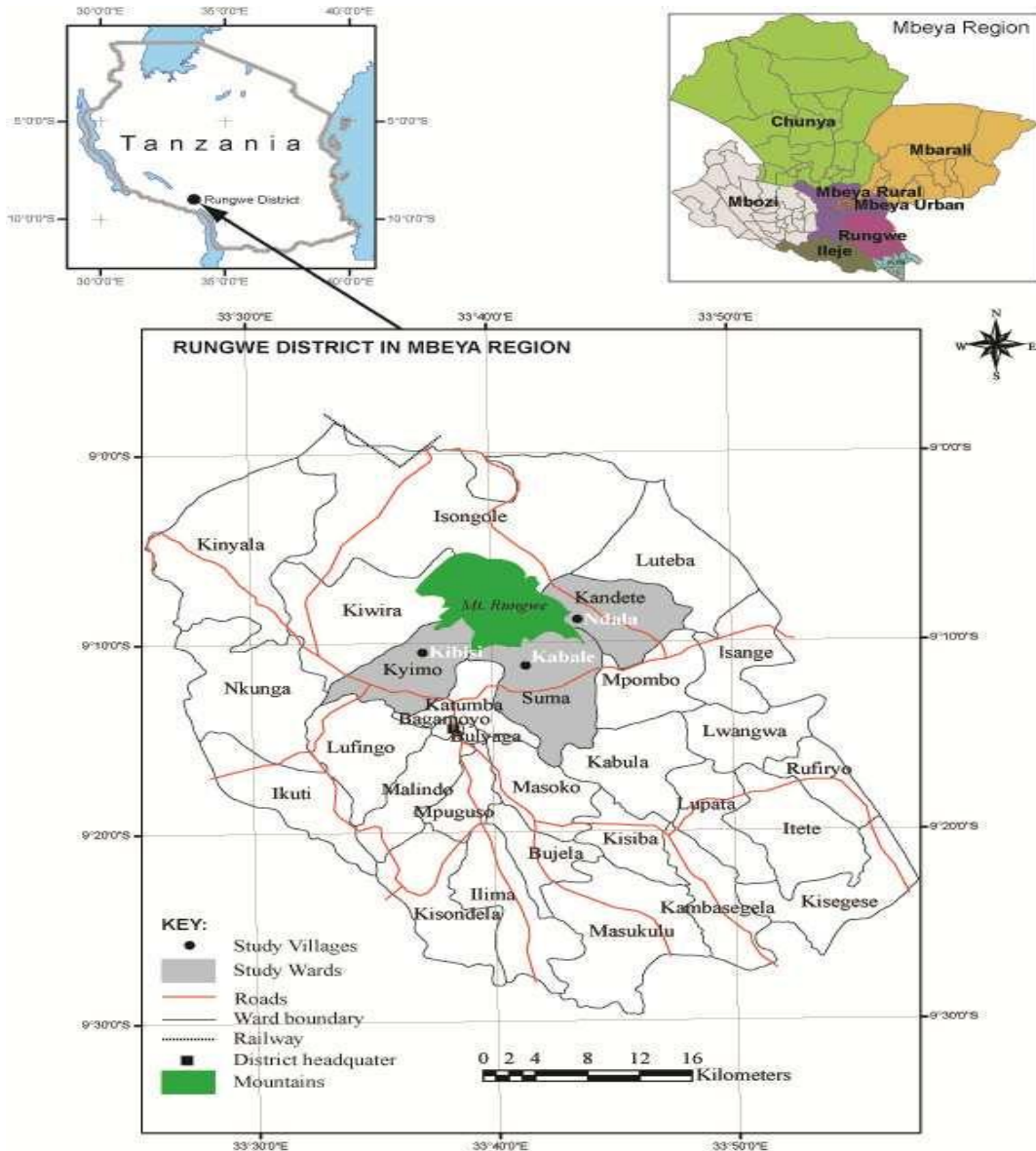


Figure 1: Location of the Study Area in Rungwe District

**Agricultural income**

Income from agriculture was obtained by valuing all agriculture products consumed and all products sold. Local market price was used in order to value those products.

$$IA = MP * Pr \dots\dots\dots(1)$$

Where:

IA= income from Agriculture

MP= Market price

Pr = product

**(a) Forestry income**

Income from forest was obtained by valuing forest product consumed and sold such as fire wood, honey, charcoal, poles, mushrooms and wild fruits. Three main types of measure can be used for forest product valuation i.e. direct market price, indirect market price and non-market estimates of values, but the simplest and most common used method is direct market prices (Adepoju and

Salau, 2007). Direct market prices were used to value forest product, where most of the products were estimated in bundles and bags.

$$IF = MP * Pr \dots\dots\dots(2)$$

Where:

IF= Income from forest

MP= Market price

Pr = product

**(b) Off-farm incomes**

Income from employment was obtained directly by household working in other people’s field. Income from business was obtained by calculating all annual incomes from the business done by the household, while incomes from remittance are those incomes household receive from their relatives, and it was estimated annually. Mean income from different sources was calculated. Krustakal-wallis test was used to determine whether there were significant differences between mean incomes and Post-hoc test was used for segregating the differing means.

$$Y = \sum_{i=1}^k X_i \dots\dots\dots X_k \dots\dots\dots(3)$$

Where:

Y= off farm income

Xi= income from employment

Xj= income from business

Xk= income from Remittance

**2.3.2 To analyze farmers perceptions on conservation initiatives**

$$TIAF = 0.6 (IFC + IF + ICC + IW + IB + IR) \dots\dots\dots(5)$$

Likert scale (5-point Likert type) was used to analyze farmers’ perception on conservation measures. Farmers were asked to state whether they are very satisfied, satisfied, somewhat satisfied, somewhat dissatisfied or very dissatisfied. During the analysis very dissatisfied and somewhat dissatisfied responses were coded -1 which indicates negative altitudinal direction. Somewhat satisfied, satisfied and very satisfied responses were coded +1 which indicates a positive altitudinal response. All +1 responses were summed together and all -1 responses were summed together. If +1 response outweigh -1 response then the response is positive and if -1 responses outweigh +1 responses the responses is negative. Cross tabulation was used to compare farmers’ perceptions and poverty level.

**2.3.3 Food security measurements**

Food security status was measured by using different indicators. Firstly, cash and food crops were obtained in kg and multiply it with market price to get income.

$$IFCC = FCC * P \dots\dots\dots(4)$$

Where:

IFCC= income from food and cash crops

P=market price,

FCC= food and cash crops

Secondly, income available for food was calculated by adding sixty percent of income from food crop and income from other sources e.g., cash crops, forest product, employment, entrepreneurship and remittance.

Where

- TAF= income from forest,
- ICC= income from cash crops,
- IW=Income from works,
- IB= Income from Business,
- IR= Income from Remittance.

Thirdly, According to WHO (2005), asafe minimum daily intake should notfall below 80% of the calorierequirement. Minimum calories intakeshould be 2780kcal per adult per dayFAO/WHO (1985).

**Table 5: Kilocalories content in 100g of banana, maize and potatoes**

Crop	Kcal (100g)
Maize	360
Banana	119
Round potatoes	93

Source: Lukmanji *et al.* (2008)

In order to estimate how much kilograms of maize, banana, and potatoes required to provide the required kilocalories the following equations were used. According to the village chairmen in Kibisi it showed that on average households consume 14 meals per week. Computations were done and it showed that banana meals were 57%, maize meals were 29%, and round potatoes meal were 14%.

**(a) Kcal required from each food**  
Main meal contributes about 80% of the total kcal, the rest 20% is obtained from meat, fish and vegetables (Lukmanji *et al.*, 2008). Therefore this study used 80% of 2780kcal which is equal to 2224kcal.

$$KRFF = \frac{FP}{100} TKR \dots\dots\dots(6)$$

Where:

KRFF= kilocalories required from food either maize, banana or round potatoes

FP = food percentage

TKR= total kilocalories required per adult person

Example, kcal required from maize =29%/100\*2224kcal. Equals to 645kcal

Since 100g of maize contains 360kcal. Therefore kilograms required to produce 645kcal was calculated as follows.

$$KPD = \left( \frac{\left( \frac{KR}{KC100g} * 100g \right)}{1000g} \right) \dots\dots(7)$$

Where:

KPD= kilograms required per person per day  
KR= kilocalories required from food either maize, banana or round potatoes

KC= kilocalories content for food either maize, banana or round potatoes in 100g

For example; kilograms of maize required per day = (645(kcal kcal of maize required) / 360 (kcal of maize in 100g) \* 100)/1000g equals to 0.18kg. In order to get how much kilograms will be required per year the obtained kilograms were multiplied by 365 days i.e. 0.18kg of maize x 365 = 65.7kg of maize per year.

$$IRF = ((M \text{ kg} * P M) + (B \text{ kg} * P B) + (P \text{ kg} * P)) \dots\dots(8)$$

Where:

IRF = Income Required for Food.

Mkg = maize in kilograms

Bkg = banana in kilograms

Pkg= round potatoes in kilograms

PM= Price of maize

PB=Price of banana

PP=Price of potatoes

**(b) Adult equivalent scales**

Adult equivalent scale involves grouping household members in age and sex categories (Berck and Bigman, 1993).

**Table 6: Adult equivalent scales**

Age group (yrs)	Unit equivalent
Infant and children 0-15	0.56
Adult 15 and over	1.00

Adopted from Tedford *et al.* (1986)

After adult equivalent scale per each household was calculated then estimation of total income required for food was done based on household sizes.

$$TIA F = IR F * HS \dots\dots\dots(9)$$

Where:

TIRF= total income required for food

IRF= income required for food

HS= household size

Fourthly a comparison between total income available for food and income required by a household determine the food security status of a household where households whose total income available for food is greater than required income for food were regarded as food secured, while households whose income available for food is less than required income for food were regarded as food insecure. Therefore if many households in the REDD+ pilot area were food secure the area was termed as food secure and if

many household were food insecure the area was termed as food insecure.

$$HHFS = TIA F - IR F \dots\dots\dots(9)$$

Where:

HHFS= household food status.

TIAF = total income available for food

IRF= income required for food

Poverty categories were used to find out who are mostly food secured between the rich and the poor. This study referred the poverty categories by (Filmer and Pritchett, 2001). Income per capital of each household was used where from the bottom 40% of the household with low income per capital was regarded as poor, the next 40% as middle class, and the top 20% with higher income per capital as rich

**2.3.4 To analyze potential REDD+ payment scenarios and their effects on food security in Rungwe district**

The base payment TZS 12 500 done in Lindi and Kilosa was used to set other payment scenarios which if have to be done may have effect on food security. This study chose three scenarios which are 25%, 50% and 100% increase from the base payments. Hence Food security status was calculated from each scenario where the formula of calculating food security was as follows:

$$TIAF = 0.6 IFC (+ IF + ICC + IW + IB + IR ) \dots\dots\dots(17)$$

Where:

TIAF= total income available for food,

IFC = income from food crops

,IF= income from forest

ICC= income from cash crops,

RP= REDD+ payments,

IW=Income from works,

IB= Income from Business,

IR= Income from Remittance.

$$IRF = ((645kg * P_{m}) + (1268 kg * P_{b}) + (311 kg * P_{p})) \dots\dots\dots(18)$$

Where

IRF = Total income required for food

PM= Price of maize

PB=Price of banana

PP=Price of potatoes

$$HHFS = TIA F - IRF \dots\dots\dots (19)$$

Where:

HHFS= household food status.

A comparison between total income available for food and total income required by a household determine the food security status of a household where households whose total income available for food is greater than required income for food were regarded as food secured, while households whose income available for food is less than required income for food were regarded as food insecure. Therefore if many households in the REDD+ pilot area falls on food secured side, the area was termed as food secured and vice versa.

### 3.0 Results and Discussion

#### 3.1 Existing Organisation in the Study Area

REDD+ Piloting in this area is being implemented by the Wildlife Conservation Society (WCS). WCS is an NGO which seeks to develop both the capacity and knowledge for Tanzania to participate actively and comprehensively in REDD+ activities. It focuses on assessing and supporting the conservation of stands of well defined montane forests within the Wildlife Conservation Society. These forests are: Mt Rungwe Nature Reserve Rungwe, Mporoto Ridge Forest Reserve, Livingstone Forest within Kitulo National Park and Mbizi Forest.

The organisation is working with 40 villages in Mbeya including Ndala, Kibisi and Kabale which are in Rungwe forest and it implements economic incentives that

provide benefit sharing to local communities and environmental education and reforestation programs addressing the drivers of local forest degradation. The organisation works with local communities and trains them on beekeeping and performs local honey market analysis. They also link farmers with small industry development organisation for further trainings on beekeeping.

Other activities supported by the NGO include dairy cattle keeping in Kabale village. To reduce wood fuel consumption the project supports development of fuel efficient stoves. To ensure sustainable supply of timber and other forest products WCS distributes tree seedlings to the project villages where farmers acquire them for free and plant in their areas.

According to Village Executive Officer at Kibisi, WCS has helped them a lot to find alternative ways of income generation for forest conservation. However there are challenges since the organisation works with groups and not individuals, those who are not attached with any group miss those benefits which make them not to participate in conservation activities effectively.

#### 3.2 Household Characteristics

Findings in Table 3, 4, 5 and 6 show household characteristics in Rungwe District. These characteristics include gender, family size, age, and education level of the respondent. The findings showed that 58.3% of the household heads were male with the rest being females. The reason for women being fewer was due to the fact that, the interview was administered to the head of households where male headed household formed majority of respondents. Findings also showed, that 75% of the respondents were married while the rest either were single, divorced, separated or, widowed



**Table 7: Sex of the Household head**

Sex of the house hold		Income per capital			Total
		Higher	Middle	Lower	
Male	Count	15	30	25	70
	% within poverty level	62.5	62.5	52.1	58.3
Female	Count	9	18	23	50
	% within poverty level	37.5	37.5	47.9	41.7
Total	Count	24	48	48	120
	% within poverty level	100.0	100.0	100.0	100.0

The analysis of the age, education level and family size in the area show that majority are aged between 16-45 years. However poverty level show that most of the respondents aged between 16-45 have higher income while most of the respondents aged above sixty have low income. Age is an important parameter since different age groups perform different sets of activities in most societies. Overholt *et al.* (1991) in a study on gender

analysis framework found that, age is a function of knowledge and experience as well as a measure of maturity of individuals. Age of the respondents at the household level was considered and the findings showed that, majority of the respondents were adults. This shows empirically that respondents interviewed were mature in age and were likely to express their ideas on REDD+ and its implementations.

**Table 8: Age of the household head**

Age of the household	Income per capital			Total
	Higher	Middle	lower	
16-45	14	31	24	69
	58.3	64.6	50.0	57.5
46-60	6	11	17	34
	25.0	22.9	35.4	28.3
above 60	4	6	7	17
	16.7	12.5	14.6	14.2
Total	24	48	48	120
	100.0	100.0	100.0	100.0

Findings in Table 5 showed that, about 80% of the respondents had attained primary education. About sixteen percent of the respondents have informal education, and the rest have attained secondary education. The findings also showed that most of the households with informal education have low income while most of the households with formal education and above are in the middle

class. Understanding education levels of the respondents is an important aspect in assessing their skills and knowledge in judging and reasoning on different issues. Kajembe and Luoga (1996) reported that education creates awareness, positive attitude, values and motivation, and is perceived as one of the factors that influence an individual's perception and decision making on a particular development. Thus, education promotes better

management of household resources and reduces pressure on the easily accessible natural resources.

Findings showed that household size range between 3 to 8 individuals. Household size is

one of the factors which influence food security of the households. It is also shown in Table 6 that most of the families with household size above 9 have low income and households with family size below 4 have higher income.

**Table 9: Education level of the household head**

Education of the Household		Income per capital			Total	
		Higher	Middle	Lower		
Informal	Count	3	6	11	20	
	% within poverty level	12.5	20	22.9	16.7	
	Count % within poverty level	83.3	1	83.3	2	36
Primary O-Level	Count			75.0	80.0	
	% within poverty level			1	4	
Total	Count	4.2	24	4.2	48	
	% within poverty level	2.1	3.3	48	120	
		100	100	100.0	100.0	

**Table 10: Family size**

Income per capital	Number of Family Member	Income per capital			Total
		Higher	Middle	Lower	
1-3	Count	11	11	6	28
	% within poverty level	45.8	22.9	12.5	23.3
4-6	Count	9	27	21	57
	% within poverty level	37.6	56.3	43.7	47.5
7-9	Count	4	7	18	29
	% within poverty level	16.7	14.6	24.2	24.2
Above 9	Count	0	3	3	6
	% within poverty level	0	6.2	6.2	5
Total	Count	24	48	48	120
	% within poverty level	100.0	100.0	100.0	100.0

### 3.3 Land Ownership

The findings showed that in the study area land ownership is limited to all respondents in the three villages this is because they are surrounded by the forest which is kept as a reserve. This makes difficult for them to access new land. Findings in Table 7 showed that majority

of the respondents have land between 0-2.5 ha. Since land is a factor of production that contributes to agricultural output and income, it was observed that production is very low to most of the respondents and among of the reasons for low production was shortage of land and lack of agriculture inputs.

However, in order to increase output and income growth, access to land must not only be secured, but must also be accompanied by access to agricultural inputs and occur in a context favorable to productive use of land. Empirically well-established complementary inputs include other types of natural capitals such as water, working capital, and human capital. Access to land without these inputs in the agricultural production function is not useful for development. In addition, the context where land is used affects its productivity.

When a family has land of their own, they have the opportunity and the means to improve nutrition, income and shelter as well. Also if land rights are secured, the cycle of poverty is broken for an

individual, a family, a village, a community and the entire country. For the agricultural households, land is more than just a factor of production. Its endowment leads to other sources of productive resources which help in generating income resulting in increased participation in social activities and government and non-government programs.

### **3.4 Agricultural Production**

Findings showed that agriculture is the main economic activity in Rungwe District as about 92.5% of the households are involved in farming (Table 8). The main crops grown are maize (92%) as their staple food while others like beans, bananas, round potatoes sweet potatoes, tea, and coffee were grown as cash crops

**Table 11: Land ownership**

Land owned (ha)	Frequency	Percent
0-2.5	59	49.1
2.6-4.5	38	31.7
4.6-6.5	18	15.0
Above 6.5	5	4.2
Total	120	100.0

**Table 12: Main Occupation**

Main occupation		Income per capital			Total
		Higher	Middle	Lower	
Agriculture	Count	22	42	47	111
	% within poverty level	91.7	87.5	97.9	92.5
Forestry/forest use(NTFPs)	Count	0	2	0	2
	% within poverty level	0.0	4.2	0.0	1.7
Hunting	Count	2	2	1	5
	% within poverty level	8.3	4.2	2.1	4.2
Off-farm activity	Count	0	2	0	2
	% within poverty level	0.0	4.2	0.0	1.7
Total	Count	24	48	48	120
	% within poverty level	100.0	100.0	100.0	100.0

Other activities that community pursues in the area included hunting and forest use. Majority are involved in agriculture since it is the activity which can be done by any person with formal and informal education. Main crops grown are beans, bananas, round potatoes, sweet potatoes, tea, sunflowers and coffee. Forest use and hunting show very small percentages since the forest is kept as reserved forest. Off farm activities are not their main activities since most of the activities require skilled labours and capital while:

- Few of them have formal education and
- Many of them lack capital.

### 3.5 Livestock Production in Rungwe District, Tanzania

Findings in Table 9 showed that about 75.8% of the respondents in Rungwe District keep cattle for different reasons. Most keep cattle mainly for milk

production to be consumed at the household level and some is sold for income generation. Few are kept for sale in order to generate income which is then used to buy food and other uses. It was learned as well that livestock production faces several problems including diseases, shortage of fodder and shortage of grazing land. As a result farmers collect fodder from distant places to feed their livestock. Livestock provides not only food for the households but also a number of other products which could be sold or consumed by the household members to provide nutrition, income, traction and fuel. Products from livestock include draught power, meat, milk, eggs, manure which is used as fertilizer or fuel, fibre and hides. Finding in Table 10 showed challenges faced by livestock keepers most of them being shortage of fodder, grazing land, as well as pests and diseases

**Table 13: Livestock production**

Farmer response	Frequency	Percentage
Livestock keepers	91	75.8
Non keepers	29	24.2
Total	120	100.0

**Table 14: Problems faced by livestock keepers**

Problem	Frequency	Percentage
Non keepers	29	24.2
Disease	44	36.7
Shortage of fodder	14	11.7
Pest	27	22.5
Shortage of grazing land	5	4.2
Shortage of expertise on animal	1	0.8
<b>Total</b>	<b>120</b>	<b>100.0</b>

### 3.6 Household Dependency on Forest Resources for Livelihood

Findings showed that forest resources play a fundamental role to the economy and

livelihoods in the study area. It was established that most of the respondents depend on forest for firewood, bee keeping, mushrooms, wild fruits and medicines, while

few of them depend on forest for timber and poles. Table 11 shows that firewood is the main source of energy for cooking and heating. It shows that 54.2 percents of the respondents depend on REDD+ forest for firewood.

In terms of non destructive activities in the forest, beekeeping plays a fundamental role to the household income. Practical trainings to farmers by WCS on beekeeping help farmers to generate income, and it reduces farmers' dependency on forest products such as fodder, mushrooms and firewood.

Findings in Table 12 show that 55% of the sample households depend on forest for fodder. It also shows that 44.2% of the sample households depend on forest for wild fruits and medicinal plants and 29.2% of the sample households depend on forest for mushrooms. Collection of wild fruits and mushrooms contribute toward food security in the study area and some are sold for income generation. Fodder collected helps to feed livestock which produce milk and meat for food and income generation.

**Table 15: Source of energy**

Source of energy	Frequency	Percent
Brought fire wood	6	5.0
Fire wood collected from REDD+ pilot forest	65	54.2
Fire wood collected from other forested landscape	47	39.2
Charcoal	1	0.8
Kerosene	1	0.8
Total	120	100.0

**Table 16: Importance of fodder, wild fruits, and mushroom collection**

	Fodder collection		Wild fruits collection		Mushroom collection	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Do not collect	38	31.7	41	34.2	41	34.2
Somewhat important	9	7.5	10	8.3	22	18.3
Important	7	5.8	16	13.3	22	18.3
Very important	66	55	53	44.2	35	29.2
Total	120	100	120	100	120	100

### 3.7 Income from Different Sources

Together with forest resources rural households in Rungwe District earn income from other sources, including agricultural products, wage employment, business as well as from remittances. Fig. 3 presents the mean contribution of the

primary income sources to total household income.

#### 3.7.1 Income from agriculture

Overall finding of this study in Fig. 3 indicates that agriculture is still the dominant economic activity in rural areas,

49% of income is earned from agriculture followed by income from forest 26%, workers contribute 12%, business contribute 7% and income from remittance is 6%. Traditionally the

Tanzanian economy is heavily dependent on rain fed agriculture, which contributes significant share to the GDP. Most people in Tanzania live in rural areas where agriculture and the use of natural resources such as forest product are crucial to their livelihoods compared to other sources of income (URT, 2009).

Income from business is the total annual income earned from sales of crops and livestock. Income is very crucial for purchasing agricultural inputs, food and non-food items, hiring of labour, and generally utilization. In economic theory, since income and expenditure are proxy indicators of wealth, the impact of food expenditure on food security status of the area was assumed to be reflected in income from sales of agricultural produce (Tsegaye and Bekele, 2010).

### **3.7.2 Income from forests**

Analysis of forest products was done to see the contribution of forest and forest product to the household food security in Rungwe District. Findings showed that forest resources such as honey, charcoal, mushrooms, wild fruits, medicines and building materials have a significant contribution to the household income which also contributes to food security of the household.

Findings in Fig. 3 showed that forests resources contribute about 26% to household total annual income whereby 60% -70% of the total income from forest

are used to buy food. Income from forest is low compared to that from agriculture. The reason behind is that there are no many forests in the study area, and the only forests in the area is also reserved.

### **3.7.3 Income from employment, business and remittance**

Employment is another source of income in communal areas. Farmers receive income for working in other peoples' fields or homesteads, the study shows that only 12% of the income is generated by the respondents by working in the fields of other people and get paid. Findings show that only few people work, because there are no many investments in Rungwe District like factories which demand more paid labour.

On the other hand this happens because many people in Rungwe District have no practical skills or education that qualifies them to work in the factories like tea factory. Other activities include business which contributes 7% of the total annual incomes this is because to run a business needs more capital which many farmers lack.

Remittance is another source of income to many families which contributes 6% of the total income; the contribution is too low. This finding is surprisingly low and may indicate a level of poverty in urban areas such that people in urban areas contribute very little to the income of households in the communal areas.

The analysis of variance indicates that there was highly statistical significance variability between incomes from different sources as shown in Figure 3 with  $p = 2.2e-16$ .

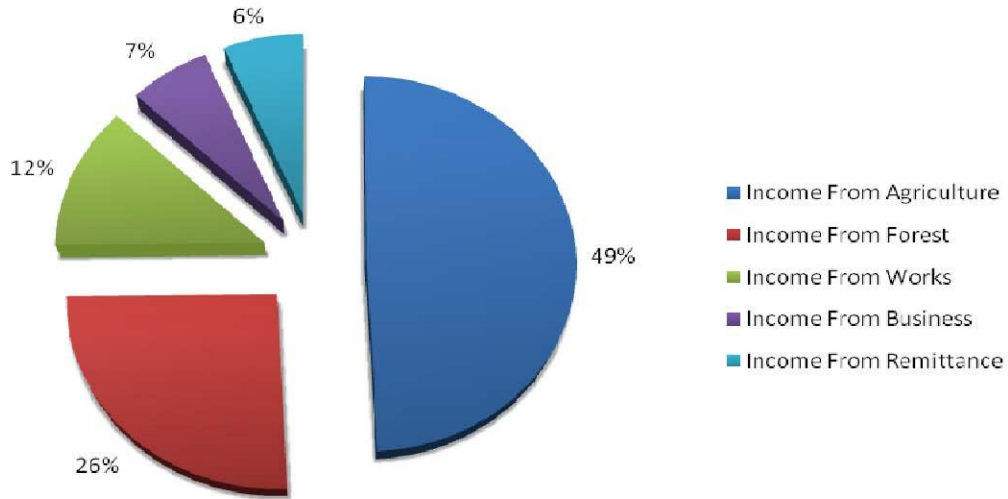


Figure 2: Income from different sources

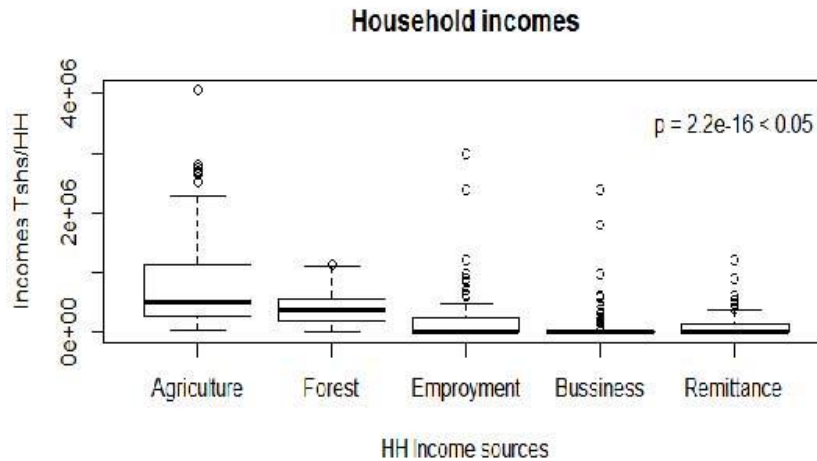


Figure 3: Income Sources Variations

Results from post-hoc analysis indicates that among the income sources, income from forest was not significantly different from agriculture, but was significant different from all other sources of income. Income from business and employment was not significant difference from remittance. This result implies that the dependency of most of the respondents on forest products is equal to agriculture in terms of income generation.

### 3.8 Households Perceptions on Conservation Initiatives in Rungwe District

Findings in Table 14 show 75.9% of respondents are satisfied with the conservation measures with hope that REDD+ payments will be made to compensate for their livelihoods. By comparing satisfaction with income per capital, the findings show that households with higher income are satisfied and

households with low income are not satisfied. The findings further showed that most respondents prefer compensation to be made by providing better social facilities in the community like building schools, hospitals or by providing them with reliable potable water.

The fact that Rungwe forest is reserved, access to this forest is highly restricted. Because of the restrictions community use their own forest resources which actual do not meet their livelihood needs. According to WCS there are some Components of REDD+ initiatives that communities would like to see implemented. These included establishments of vegetable gardens, fish ponds, cattle rearing, poultry keeping (layers and broilers) and indigenous chicken. Real compensation for foregoing consumption of carbon must be provided at the household level. Together with the recognition of communities' dependence on natural resources to be given priority in REDD+ initiatives, also they would like industries to contribute on forest conservation efforts, and assist the communities financially so that they can reduce their dependency on forest resources.

They further suggested the introduction of village environmental Savings and Credits, Cooperative Society (SACCOS). In addition to this, small village environmental entrepreneurial groups should be formed and supported. Carbon credit payments could be channeled through such entrepreneurial groups. Environmentally friendly SACCOS would result in a multiplier effect which could contribute towards sustaining the rural economy. These groups would encourage local communities' involvement in forest conservation as well as reducing their dependence on the use of forest resources. These groups should be given skills which link with conservation of environment and REDD+ projects and the Government should focus on the provision of alternative sources of energy to local communities, such as solar, wind, biogas and biomass. Pressure to use the forest as a source of energy is high only because people have no alternative means. Suggested forms of energy are cheap hence can be afforded by local communities. This in turn would decrease the need for charcoal and firewood for fuel.

**Table 17: Household perceptions on conservation measures**

Satisfaction		Income per capital			Total
		Higher	Middle	Lower	
Very dissatisfied	Count	1	8	3	12
	% within poverty level	4.2	16.7	6.2	10.0
Somewhat dissatisfied	Count	1	0	2	3
	% within poverty level	4.2	0.0	4.2	2.5
Somewhat satisfied	Count	2	7	5	14
	% within poverty level	8.3	14.6	10.4	11.7
Satisfied	Count	11	15	15	41
	% within poverty level	45.8	31.2	31.2	34.2
Very satisfied	Count	9	18	23	50
	% within poverty level	37.5	37.5	47.9	41.7
Total	Count	24	48	48	120
	% within poverty level	100.0	100.0	100.0	100.0



### 3.9 Household Food Security Status in the REDD+ Pilot Area

From the findings presented in Tables 15, without forest resources access the area under the study could be regarded as food insecure given the fact that only 41% of the sampled households were food secured, while 59% of the sampled households were food insecure. The findings also showed that food security status depends on the level of poverty where 17.5% out of 20% sampled rich households were food secure. 18.7% out of 40% sampled middle households were food secure while 5% out of 40% sampled poor households were food secure.

However, if farmers will be allowed to

access forest then 60% of the sampled household will be food secure and 40% will be food insecure. But to be food secured also depends on poverty level. Findings in Table 16 show that 19% out of 20% sampled rich households were food secure and about 8% out of 40% sampled poor households were food secure.

#### 3.10.1 Food security status with Base payments of TZS 12 500

Results from Table 17 showed that if households in Rungwe District will get the base payments of TZS 12 500, 45% of the sampled households will be food secure. This shows that REDD+ payments will improve household's food security.

**Table 18: Food security status in different poverty class with REDD+**

Income per capital		Food security		Total
		Food insecure	Food secure	
Rich	Count	3	21	24
	% of Total	2.5	17.5	20.0
Middle	Count	26	22	48
	% of Total	21.7	18.3	40.0
Poor	Count	42	6	48
	% of Total	35.0	5.0	40.0
Total	Count	71	49	120
	% of Total	59.2	40.8	100.0

**Table 19: Food security status in different poverty class with forest access**

Income per capital		Food security		Total
		Food insecure	Food secure	
Rich	Count	1	23	24
	% of Total	0.8	19.2	20.0
Middle	Count	9	39	48
	% of Total	7.5	32.5	40.0
Poor	Count	38	10	48
	% of Total	31.7	8.3	40.0
Total	Count	48	72	120
	% of Total	40.0	60.0	100.0

**Table 20: Food security status in different poverty class with base payments of TZS 12 500**

Income per capital		Food security		Total
		Food insecure	Food secure	
Rich	Count	2	22	24
	% of Total	1.7	18.3	20.0
Middle	Count	23	25	48
	% of Total	19.2	20.8	40.0
Poor	Count	41	7	48
	% of Total	34.2	5.8	40.0
Total	Count	66	54	120
	% of Total	55.0	45.0	100.0

**3.10.2 Food security status with 25% Increase in base payments compensation**

Results showed that the increase of 25% from the base payments will improve food security status of the sampled households from 45% of the secured sampled households to 46%. This is because the increase of REDD+ payments increases income of the households.

**3.10.3 Food security status with 100% increase in base payments compensation**

From Table 19 results shows that 100% increase in compensation will increase the

status of food security of the sampled households by 2% i.e. from 46% to 48% secured sampled households.

**3.10.4 Foodsecurity status with REDD+ payments of TZS 150 000**

Results showed that TZS 12 500 REDD+ payments compensations will help on food security of farmers if it will be paid twelve times a year. This is shown in Table 20 that if REDD+ will pay TZS 12 500 twelve times a year, 90% of the sample households will be food secure and only 10% of the sample households will be food insecure.

**Table 21: Food security status in different poverty class with 25% increase in compensation**

Income per capital		Food security		Total
		Food insecure	Food secure	
Rich	Count	1	23	24
	% of Total	0.8	19.2	20.0
Middle	Count	23	25	48
	% of Total	19.2	20.8	40.0
Poor	Count	41	7	48
	% of Total	34.2	5.8	40.0
Total	Count	65	55	120
	% of Total	54.2	45.8	100.0

**Table 22: Food security status in different poverty class with 100% increase in compensation**

Food security		Food insecure		Food secure		Total
Income per capital		Food insecure		Food secure		Total
Rich	Count	1	23			24
	% of Total	0.8	19.2			20.0
Middle	Count	21	27			48
	% of Total	17.5	22.5			40.0
Poor	Count	41	7			48
	% of Total	34.2	5.8			40.0
Total	Count	63	57			120
	% of Total	52.5	47.5			100.0

**Table 23: Food security status in different poverty class with TZS 150 000 payments compensations**

Income per capital		Food security		Total
		Food insecure	Food secure	Total
Rich	Count	0	24	24
	% of Total	0.0	20.0	20.0
Middle	Count	2	46	48
	% of Total	1.7	38.3	40.0
Poor	Count	10	38	48
	% of Total	8.3	31.7	40.0
Total	Count	12	108	120
	% of Total	10.0	90.0	100.0

#### **4.0 Conclusions and Recommendations**

##### **4.1 Conclusions**

- (i) This study therefore concludes that before the introduction of REDD+ initiative the sample households was food secure. However, after introduction of REDD+ initiative, the area became food insecure. This is because households could no longer go into the forest reserve for their domestic needs including expansion of farm lands.
- (ii) Secondly forest resources play a greater role on income generation as shown in Fig. 3, forest contributes about 26% of the total income and that is the amount they are losing due to restriction to forest resources.
- (iii) Thirdly if there are TZS 12 500 payment compensation of REDD+ initiative as the baseline payments to

the lost livelihood, 45% of the households will be food secure while 75% will be food insecure. With different payment scenarios i.e. 25%, and 100% increase, food security status will be 46% and 48% food secure respectively. However if REDD+ Payments will pay TZS 12 500 twelve times a year 90% of the sampled households will be food secure.

- (iv) Fourthly farmers are satisfied with the conservation measures. This is because they believe REDD+ initiative would honor its obligation.
- (v) Fifthly the study observed that sampled households had less capacity to improve the fertility of permanent agriculture land and they were observed having fewer parcel of land. Also the study found that 54.2 percents of the respondents depend largely on

firewood as their source of energy.

#### 4.2 Recommendations

- (i) REDD+ initiatives to be well implemented it must build on the interests of forest communities and indigenous people so that it will not harm forest dependency. REDD+ also must address the needs of smallholder farmers to avoid exacerbating poverty and local food insecurity.
- (ii) Secondly the study recommends that REDD+ must compensate households in the study area as they are doing in other District in Tanzania. However in order to compensate households in Rungwe District base payments must be TZS 150 000.
- (iii) Thirdly, it recommended that REDD+ initiative must not only think on payment but also agriculture intensification. Sustainable intensification by increasing crop yields per area is one of several pathways to increase food security.
- (iv) Fourthly since firewood is the only sources of energy for most households in the study area it is recommended that gas must be available at reasonable price in the nearby shops.

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