



**Agricultural Productivity, Climate Change and Smallholder  
Farmer's Entrepreneurship:  
A Case Study of the Central and Western Regions of Liberia**

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## Abbreviations/Acronyms

ADP	Agriculture Development Project
AEDE	Agency for Economic Development and Empowerment
ASRP	Agriculture Sector Rehabilitation Project
AfDB	African Development Bank
CAADP	Comprehensive African Agriculture Development Program
CARI	Central Agriculture Research Institute
C&WRsL	Central & Western Regions of Liberia
CRL	Central Region of Liberia
CBL	Central Bank of Liberia
CPA	Comprehensive Peace Accord
C&WRsL	Central and Western Regions of Liberia
EAs	Enumeration Areas
EU	European Union
FAO	Food and Agricultural Organization
FGDs	Focus group discussions
GDP	Gross domestic product
GOL	Government of Liberia
HHs	Households
IFAD	International Organization for Agricultural Development
IPPM	Integrated pest and plant management
KII	Key informant interview
LASIP	Liberia Agriculture Investment Programme
LBDI	Liberia Bank for Development and Investment
LDHS	Liberia Demographic and Health Surveys
LISGIS	Liberia Institute of Statistics and Geo- Information Services
LMA	Liberia Marketing Association
MCI	Ministry of Commerce & Industry
MDGs	Millennium Development Goals (MDGs)
MGD	Ministry of Gender and Development
MIA	Ministry of Internal Affairs
MOA	Ministry of Agriculture
MOL	Ministry of Labor
MPEA	Ministry of Planning and Economic Affairs
NAPA	National Adaptation Programme of Action
NGOs	Non-government organizations
PPS	Probability Proportional to Size
PRS	Poverty reduction strategy
PSD	Private sector development
ShFs	Smallholder Farmers
SMAM	Singulate mean age at marriage
SPA	Simple Correlation Analysis
SPSS	Statistical Package for Social Sciences
UL	University of Liberia
UN	United Nations
UNDCF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
WAAPP	West Africa Agriculture Productivity Programme
WB	World Bank
WATSAN	Water and sanitation
WFP	World Food Programme
WRL	Western Region of Liberia

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## Overview

Liberia was making frantic efforts towards achieving some level of food security through improvement in smallholder farmers' productivity. But the 1989-2003 civil conflict adversely reversed all positive gains towards food security. This situation resulted to near collapse of the Liberian economy and undermined the growth of smallholder farmers' entrepreneurship in post-conflict Liberia. In order to reduce post-war food insecurity, government and its partners have been rehabilitating the agriculture sector. The research is to assess the impact of climate change and agricultural inputs on production of major food crops; and to analyze access to credit and the types of post-harvest technology in the two regions. The research was mainly based on primary data, using structured questionnaires to interview 864 ShFs and 48 persons focus group discussions (FGDs) and key informant interview (KII). A Statistical Package for Social Sciences (SPSS) was used to process data from structured questionnaire while information from KIIs and FGDs were processed manually.

Eighty-one percent of the 864 farmers were engaged in rice farming, with counties along the Atlantic Ocean (Margibi and Cape Mount) making inadequate rice farm as compared to Bong and Gbarpolu that are located in the hinterlands. The tools for clearing land for the planting of food crops (rice, cassava and vegetables) were mainly traditional (cutlasses, axes and hoes). The planting methods for rice and cassava were 95% and 92% traditional respectively, which does not add value to productivity. Ninety-five (95) percent of the 864 ShFs believed that the use of new techniques of farming would increase their productivity. It was found that 85% of farmers never used traditional tools for harvesting of rice. The average crops produced for rice and cassava was 276 and 535 kg bags respectively. In addition, an average 344 kg bag of vegetables was also produced. All of the 864 farmers revealed that the use of new planting techniques would increase production. Moreover, all 48 participants from the FGDs and KIIs believed that traditional methods and techniques of production affect the crop yields of ShFs.

Ninety-six (96) percent of ShFs revealed that climate change impact affected productivity & the length of entrepreneurship. The study shows that a lesser number of farmers sold rice after harvest as compared with harvesting seasons. In realty, the entrepreneurship among ShFs was limited to few months during and after harvest, which is attributed to the low level of production. The entrepreneurship of food crops among ShFs was 93% for vegetables; 67% for cassava; and

47% for rice. The cost of upland 100 kg bag of seed rice was US\$77.09 while that of upland clean rice was US\$51.54. Moreover, undeveloped lowland kg bag of seed rice was sold for US\$89.53 while clean rice was sold for US\$48.41. The overall average annual income of ShFs from the sale of food crops was US\$66.64 from sale of rice; US\$83.30 from vegetables sale; and 56.96 from the sale of cassava. Accordingly, 67% of 698 smallholder farmers dried rice using unsafe methods and materials while all rice farmers de-husk rice using traditional methods. Seventy-five percent of rice farmers used bush-tank (rice kitchen) as post-harvest storage facilities. As a consequence of rice threshers farmers used traditional methods. Rice harvested was carried to town physically by 97.9% of farmers while 77% of farmers carried produce to the market in non-motorized modes due to lack of access to motor roads.

As a result of the lack of access to milling machine, 85% of farmers processed cassava using traditional methods; 76% did not use fertilizers while 78% of the 864 farmers never received loan. Ninety-seven (97) percent of women owned farmland while 98% each made household decision and participate in community development. The research shows that 44% of youth did not participate in farming activities but were mainly engaged in gold/diamond mining. It was found that 98% of farmers had no draught resistant varieties of crops while 38 of farms were affected by sunshine; 85% by rodents; and 71% by birds. There is a need to ensure capacity building support to increase productivity, reduce climate change impact and ensure sustained entrepreneurship of smallholder farmers.



## **1. Background and Methodology**

### **1.1 Introduction and Context**

Liberia gained independence in 1847, thereby making it Africa's first internationally recognized independent country. The country later suffered many years of poor governance, political and economic exclusion, and grew without development (Clower et al, 1966). Growth without development means high GDP growth without the correspondent social economic development to account for the huge billions of US Dollars. As a result of these conditions, political militancy increased to a peak that influenced the 1980 military coup, and a 14-year civil war (1989-2003). Prior to the war, average per capita income was US\$750 and the annual GDP growth rate was 5.7% (GOL, 1975-1986). The estimated per capita GDP in 2007 was US\$500. But owing to the civil war, the current socio-economic situation of Liberians is deplorable, with all development sectors of the country destroyed. But since the signing of the Accra Peace Accord (CPA) and the election of a democratic government in 2005, the government and its partners have been working assiduously to reconstruct the war-affected country. One of the principal focal points of the reconstruction processes of the country is the agriculture sector. It is part of the pillar three of the development platform of Liberia – the Interim Poverty Reduction Strategy or PRS (MPEA, 2006) and Poverty Reduction Strategy (MPEA, 2008).

In the late 1980s, Liberia was making frantic efforts towards achieving some level of food security. But the civil conflict of 1989-2003, which adversely destroyed the economic life block of the country, reversed the positive move towards food security. This situation resulted to near collapse of the Liberian economy. It also has the propensity of undermining the growth entrepreneurship of smallholder farmers in post-conflict Liberia. In an effort to reduce the impact of the food insecurity created by the war, the Government of Liberia, donors, and non-governmental organizations have been making efforts to rehabilitate the agriculture sector. It is in light of this situation that the research wants to assess the impact of agricultural productivity and climate change on the entrepreneurship of smallholder farmers, using the Western and Central Regions of Liberia as a case study. Prior to and after the civil war, the Western Region of Liberia (WRL) has always been a food insecure region as compared with the Central Region.

This study is relevant because it will provide policy recommendations for governments' huge agriculture sector reform programmes such as the West Africa Agriculture Productivity Programme or WAAPP (MOA, 2006), the Liberia Agriculture Sector Investment Programme (LASIP), the Comprehensive African Agriculture Development Program or CAADP (MOA, 2009), and other agriculture sector rehabilitation interventions . This is so because the results of the research will influence decisions of Government and its development partners in achieving Liberia's food security dream. The achievement of LASIP is one of the key objectives of the Ministry of Agriculture and its partners because it will sustain the food security programme, which has positive implications for reinforcing the implementation processes of the country's overall development paradigm – the poverty reduction strategy (PRS).

Through proactive awareness creation, the research findings will be used to rejuvenate the process of private sector growth among smallholders' farmers, following a protracted period of the destruction of formal sector social economic development infrastructure. Employing proactive awareness creation techniques through dissemination and post-dissemination workshops, meetings and other forms of engagements, the research findings will be used to influence donors to identify and source funds for Liberia's agricultural investment programme (LASIP). This will further enhance a sustainable entrepreneurship that will increase food security and eventually improve the livelihood of smallholder farmers. The results of the study will also be used to create sensitization on good agricultural practices that could reduce climate change impact on agricultural productivity. Such climate change mitigation measures will include but not limited to the use of lowland farming to reduce deforestation from upland farming.

The high level of food insecurity in the Western and Central Regions of the country did not exist prior to the civil conflict (December 1989), when the average annual growth rate of gross domestic product or GDP was 5.7%; and the average per capita income was US\$750 (MPEA/GOL, 1975-1986), and later dropped to less than US\$500 between 1980 and 1989. Furthermore, Gross Domestic product was 9.8% of the 1988 level in 1995, and increased to 35% of the same level in 1999. During this period, GDP per capital was US\$40.4 and US\$169 in 1995 and 1999 respectively, as compared to US\$471.6 in 1988 (MPEA/GOL, 1989). Gross Domestic Product (GDP) at 1992 constant is 380.9 (MPEA/LISGIS, 2004); real GDP percentage change was 9.6 while GDP per capital was 191.5 ((MPEA/LISGIS, 2005). Currently, formal sector

unemployment is 78 percent (MPEA/ GOL, 2006). Also, of the employed 78% are in the public sector and are in the informal economy (in low productivity and meager income work), and in trading petty production (MPEA/ GOL, 2006). In essence, prior to the war, the prevalence of food insecurity was minimal, particularly in the Central Region of Liberia (CRL). Also, although there were food insecurity problem in the Western counties of Gbarpolu and Grand Cape Mount, the degree of farming activities were high. Hence, it minimized the effect of food insecurity of the population. The decreased level of smallholder farming activities during and after the war seems to draw a relationship between the impact of the war and food insecurity in the country, with specific reference to CRL (Margibi and Bong Counties) and the Western Region of Liberia or WRL (Gbarpolu and Grand Cape Mount Counties).

The research is to determine factors that influence smallholder farmers' productivity in relation to Liberia's major food crops during and after the war. The research is investigating farmers' access to key economic opportunities and value chain equipment and technology in Liberia. This situation has been referenced by the two recent baseline survey reports of the Liberia Agriculture Sector Rehabilitation Project (ASRP) supported by the African Development Bank or AfDB (AfDB/MOA, 2011) and the International Organization for Agricultural Development or IFAD (IFAD/MOA, 2010). According to these reports, Liberia's Agriculture Sector, as a consequence of the 14-year war, is faced with the problem of lack of tools; new farming methods / technology; new varieties of rice, cassava and vegetable (key food crops), and other crops that could enhance the food security issues in Liberia.

These reports also point to how environmental issues, such as irregularity of the dry and wet seasons, are impacting on the farming calendar, and hence affect productivity of smallholder farmers. Moreover, there seem to be a high level of infiltration of rodents, insects and other animals in the farms of small holder farmers for the three food crops of the country. There are no adequate integrated pest and plant management (IPPM) systems in the country's agricultural Programme prior to, during and after the civil war to remedy the environmental situation affecting smallholder famers' productivity. The gradual movement of desertification along the western, southwest, central and southeastern parts of Liberia (Atlantic Ocean side) is a potential threat of rapid climate that hinders progress of smallholder farmers (by reducing their productivity and affecting their ability to trade). In effect, climate change situation reduces the

opportunity for adequate production of the three key food crops to the extent that their produce partially meets household consumption needs. In reality, the production level of smallholder farmers is so subsistent that it compromises any commercialization of their produce.

This situation is exacerbated by the one-time per annum harvest system among smallholder farmers. In addition, the factors of environmental degradation affecting the productivity of smallholder farmers are stimulated by the enormous climate change situation. Hence, they (farmers) are unable to engage in any substantial and consistent sale of their agricultural produce to ensure a sustained entrepreneurship. Reports show that 69.7% and 70.3% of farmers never sold lowland rice in 2009 and 2010. Similarly for upland rice the proportion of smallholder farmers that never sold the commodity was 50.5% in 2009 and 52.3% in 2010. The commodity (rice) was sold in order to avoid starvation in Southeastern Liberia (AfDB/MoA, 2010). This situation was due to low productivity influenced by lack of capacity (tools, value chain processes, etc.) and climate change impact (through flood, soil infertility, rodents, pest, etc.).

The smallholder farmers in Liberia do not have access to value chain processes such as processing machines, driers, storage and other post-harvest facilities. This affects farming output and encourages high level of post-harvest losses. The lack of post-harvest processing facilities also impacts serious on the ability of farmers to engage in business as their goods rot after harvest. The production experience for rice and cassava in many parts of Liberia (where these good spoiled because of the lack of post-harvest processing equipment) is a good example of how the lack of access by smallholder farmers affects their productivity and entrepreneurship. There are also no value chain facilities to process and package food crops for sale or storage, which affects progress to promote food security and farmers' entrepreneurship. In most parts of the country, smallholder farmers have no access to transportation facilities in areas with motor roads or farm-to-market roads. There is also a lack of access to credit while most farmers in Liberia are not organized into cooperatives that could solicit assistance from donors. These multiple factors make it important for smallholder farmers in Liberia to assess access to key economic opportunities.

In addition to knowing the level of farmers' inaccessibility to key inputs, the research will also assess as to whether climate change is affecting farmers productivity and entrepreneurial

potential or progress. Before the war, there was a gradual growth in the entrepreneurship of smallholder farmers, although the emphasis was on tree crops as compared with food crops. The availability of food crops projects in Central and Northern Regions through the European Union (EU) and World Bank (WB) supported Agriculture Development Project or ADPs (MPEA/GOL, 1988), gave impetus to establishment of small skill wealth creation business among smallholder farmers. This scenario, which suggests a logical relationship between war on the one hand and food insecurity and the entrepreneurship of smallholder farmers on the other hand, requires scientific investigation.

Hence, assessing the problems, prospects, impact and other factors associated with the productivity and entrepreneurship of small scale and traditional farmers in the CRL and WRL is important, since it will be used to improve the agriculture sector and concomitantly make farmers small and medium level business people in Liberia. The study will be used to make informed decision on access to donor funds to enhance the activities of small holder farmers. Few farmers have high productivity and are engaged in small scale wealth creation, particularly in the informal business sector. However, sourcing funds to mitigate the impact of climate change and other negative impediments in order to improve productivity and stimulate entrepreneurship is a challenge that requires informed decisions and strategies. Many farmers do not have access to credit while those who have the opportunity do so through local credit clubs such as susu, which give marginal interest rate loans to customers, particularly disadvantaged women (Harshbarger, 2010). This research is not aware of any study that determines the productivity of smallholder farmers and their entrepreneurship in Liberia. Hence, its results and recommendations will be relevant in informing policy decisions on how entrepreneurship can be used to improve agricultural productivity. It will also inform policy decisions on how agricultural inputs and climate change factors can be used to enhance agricultural productivity. In addition, the Government of Liberia (GOL) is currently utilizing available data to seek donor support for its post-conflict economic reconstruction programme (including awareness creation for support to the agricultural sector, including support for the enhancement of smallholder farmers' agricultural and entrepreneurship activities.

## **1.2 Justification of the Study**

Therefore, the rationale of this study is to provide results and recommendations that will be utilized by government, international partners and other stakeholders in enhancing the post-conflict agricultural sector revitalization processes through the provision of micro-credit loans to smallholder farmers. In reality, the research findings will determine how and to what extent rural as well as urban smallholder farmers depend on the agricultural sector to meet their basic livelihood needs. The findings will also determine as to whether smallholder farmers are the main sources of livelihood for their families. The study will show how the variability and impact of the lack of agricultural inputs and negative climate situation influence the poverty level of the population in urban and large rural localities in the CRL and WRL. The information from the research will be used in strengthening smallholder farmers to enter the agricultural private sector in order to subsequently influence economic growth; project future trends and levels of smallholder farmers' agricultural activities and entrepreneurship; and indicate how smallholder farmers can increase job opportunities among target population in the two regions (CRL and WRL).

## **1.3 Review of Literature**

Studies or agricultural policies related to improving the livelihood of smallholder farmers have been carried out in Liberia and elsewhere in other West African Countries. In other words, the review of literature outside Liberia shows that some African Governments are creating an enabling environment for the growth and development of their agricultural sector, particularly to ensure improvement in smallholder farmers' productivity and entrepreneurship.

Viatte and other researchers studied some West African Countries and observed several policy measures to improve the situation of smallholder farmers. The policy measures which reducing tariffs on imported; assisting farmers with equipment for land cultivation, the provision of loan for planting seeds, and the offering of tax relief for staple food proceeds covered Sierra Leone and La Côte d'Ivoire (Viatte, 1999). According to Viatte et al, the approach to improve smallholder farmers' production and livelihood in Burkina Faso included the development of a National Strategy to Combat Soaring Prices and suspension of import duties and taxes on edible food items. Similarly in Gambia, several million tons of seeds and fertilizers, pesticides,

groundnut, rice, seeds and other cereals were distributed among smallholder farmers to enhance food production.

Tarway-Twalla in his research on the National Adaptation Programme (NAPA) for the Government of Liberia (GOL) stressed that the degradation of the agricultural lands and the lost of biodiversity, put smallholder households at risk (NAPA, 2008). He further argued that the absence of an effective early warning system (i.e., a system of meteorological stations) that could allow farmers and other stakeholders to make informed decisions on production strategies. In his conclusion in the National Adaptation Programme of Action (NAPA), which was published in 2008, Tarway-Twalla further indicated that coastal erosion mainly in low-lying areas such as the urban centers does not only affect the agricultural activities but also affects urban settlements such as Harper, Robertsport, Monrovia, Buchanan and Cestos City in Liberia (Tarway-Twalla, 2008).

Outside of West Africa, similar studies in Tanzania about maize farmers have shown that the lack of extension services to use modern technologies, limited capital, land fragmentation, and unavailability and high input prices are found to have a negative effect on technical efficiency (Msuya et al, 2008). The researchers further found that smallholder farmers using hand-hoe and farmers with cash incomes outside their farm holdings (petty business) were more efficient; and that farmers who use agrochemicals were found to be less efficient. The researchers further found that farmers who use agrochemicals are found to be less efficient.

The use and role of fertilizer in enhancing African agricultural productivity has become a surprisingly controversial issue (Reardon et al, 1997). Although it seems self-evident to say that fertilizer increases productivity, yet there have been many attempts to remove it from the list of key productivity enhancing options worthy of government and donor policy support (Reardon et al, 1997). Some of the reasons given for downgrading the importance of fertilizer in Africa are: its riskiness under conditions of low or erratic rainfall; its relatively low yield response in Africa when compared to results in Asia and Latin America (Reardon et al, 1997). Also the high distribution costs in a context of low effective demand and poor storage facilities and roads are some of the reasons that the use and role of fertilizer in increasing productivity in Africa is controversial (Reardon et al, 1997).

In his report, Grant stressed that the pre-harvest impact of rodent pests on rice-based agricultural systems is enormous in most developing countries. He indicated that the impact of rodents affect the production of smallholder farmers in 11 Asian Countries. Hence, it is obvious that under traditional rice farming systems, rodents generally cause chronic losses to production in the order of 5–10% per annum (Grant, 2011). Studies have also shown that rodent infestation rose dramatically over the last few decades, most noticeably in places where cropping frequency has increased from one to two or more. Hence, Grant states that it is not unusual for smallholder rice farmers to report chronic yield losses of 20–30% per annum, rising to 50% or even more total crop loss in certain seasons.

In Nigeria Takeshima and Salau stressed that most of the smallholder farmers are too poor to employ modern tools (tractors and plows), even with substantial government support (Takeshima and Salau, 2006). They indicated that the inadequacy of farmer field school (FFS) services to enhance productivity was a key setback for ShFs. A study in the Philippines found that FFS farmers had learned enough from the field school to adopt organic rice growing (Carpenter, 2003). Similarly, a study in Peru found that potato farmers who had attended FFS had higher yields than their neighbors who never attended the school (Ortiz et al. 2004), see also Godtland et al. 2004.

#### **1.4 Problem Statement**

Prior to the 14-year civil war, the economy of Liberia was dominated by formal sector investment, which had some positive effects on the improvement of the agricultural sector. But the war paralyzed most of the formal sector industries that were augmenting efforts of government to harness smallholder farmers' productivity and entrepreneurship in Liberia, including its western and central regions. As a consequence, climate change impact and the lack of inputs seem to impede post-war farming regimes, particularly in most urban and large rural localities. Hence, productivity among smallholder farmers seems to be geared towards household consumption only to avoid starvation as most of the farming outputs are low. This inadequate agriculture produce affect the ability of farmers to engage into business as their output is subsistent and is only consumed to reduce hunger for a short period. As a result of the highly subsistent agricultural situation, there is a vicious circle type of low productivity that limited the entrepreneurial activities of farmers. This situation is impacting on the food security programmes



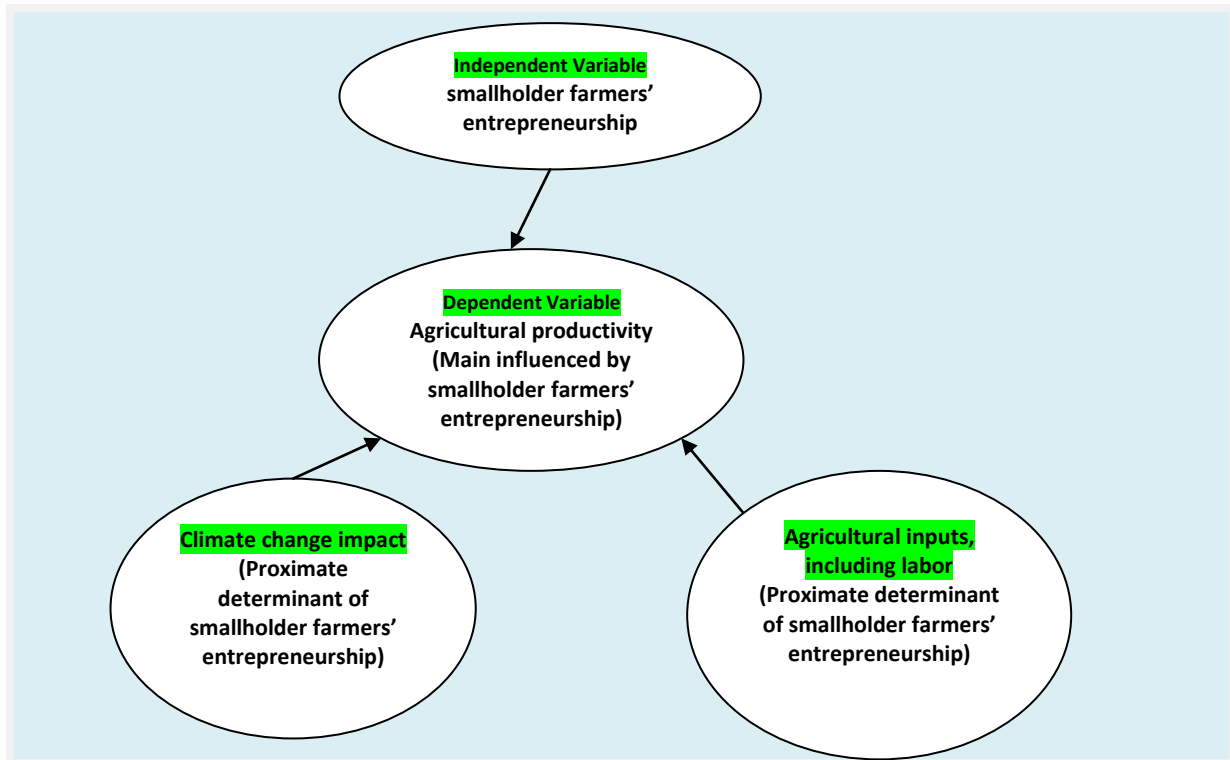
of government. Hence, the research is to examine the extent to which the lack of improved technology affects farmers' productivity. The research also investigates the impact of climate change on Liberia's major food crops (rice, cassava and vegetable) production. The research analyses the level of entrepreneurship among smallholder farmers.

### **1.5 Project theoretical and conceptual framework**

The research assumed that inadequate inputs and climate change are the two main variables that affect the entrepreneurship of farmers. This situation is possible because these variables have strong influence on the low productivity nature of smallholder farmers in Liberia to the extent that their farming outputs are low and only meant for consumption rather than sale. This situation also has implications for not making farmers entrepreneurs as envisaged in many agricultural development packages in post conflict Liberia. The research identified other proximate determinants that have strong influence on the low level of production and the subsequent impact on entrepreneurship of smallholder farmers.

The conceptual framework shows that the entrepreneurship of smallholder farmers is influenced by two main factors: one main determinant and two proximate determinants. The two proximate determinants are climate change and all of the inputs that are put into agricultural productivity (including but not limited to labor). These two proximate determinants seem to have strong influence on the productivity of farmers, while the level of productivity seems to also stimulate the entrepreneurship of farmers. The conceptual framework is clearly stated in figure1 as follows (Fig 1).

**Figure 1: Effects of inadequate inputs, climate change and productivity on smallholder farmers' entrepreneurship**



Reconsider specification of this model. See previous question about “what is agricultural productivity determinant of?”. Productivity cannot be an independent variable, i.e., productivity cannot cause entrepreneurship to occur. It is entrepreneurship that causes productivity to happen.

### **1.6 Objective**

Since the end of the civil conflict in 2003, the situation of food insecurity has increased to the extent that smallholder farmers are unable to engage into business. This situation, which affects the entrepreneurship of smallholder farmers, is a major policy issue in Liberia. For example, as contained in the Liberia Agriculture Sector Investment Programme (LASIP), all of the post-conflict agriculture projects in Liberia are focused on making farmers productive and business oriented people. The successful implementation of all policies and programmes aimed at making smallholder farmers entrepreneurs is hugely affected by low and inadequate productivity as a consequence of climate change impact and the lack of basic tools and improved technology. In

reality, the lack of adequate inputs and climate change seem to have a negative impact on efforts of national government and the international community in making farmers entrepreneurs.

Hence, the principal objective of the study is to assess the extent to which agricultural productivity and climate change impact affect smallholder farmers' entrepreneurship in Western and Central Regions of Liberia. The specific objectives are: to determine the impact of agricultural inputs on production of major food crops: rice, cassava and vegetables (pepper, egg plants and bitter balls); to investigate the level of climate change impact on agricultural productivity for major food crops (rice, cassava, and vegetables); to determine agricultural produce, income and business activities of smallholder farmers (during and after harvest); to determine as to whether other competing sectors such as mining, informal business activities, rural–urban migration are hindering the growth of and affecting the progress of the farming population; and to analyze access to credit and the availability of modern post-harvest technology. In order to achieve the research objectives, the researcher worked with Government Ministries (Agriculture, Planning and Economic Affairs; Gender and Development; Commerce and Industry; and Internal Affairs) and private sector partners (local and international NGO) that are involved with the agriculture sector.

## **1.7 Methodology**

### **1.7.1 Selection of Sample Size**

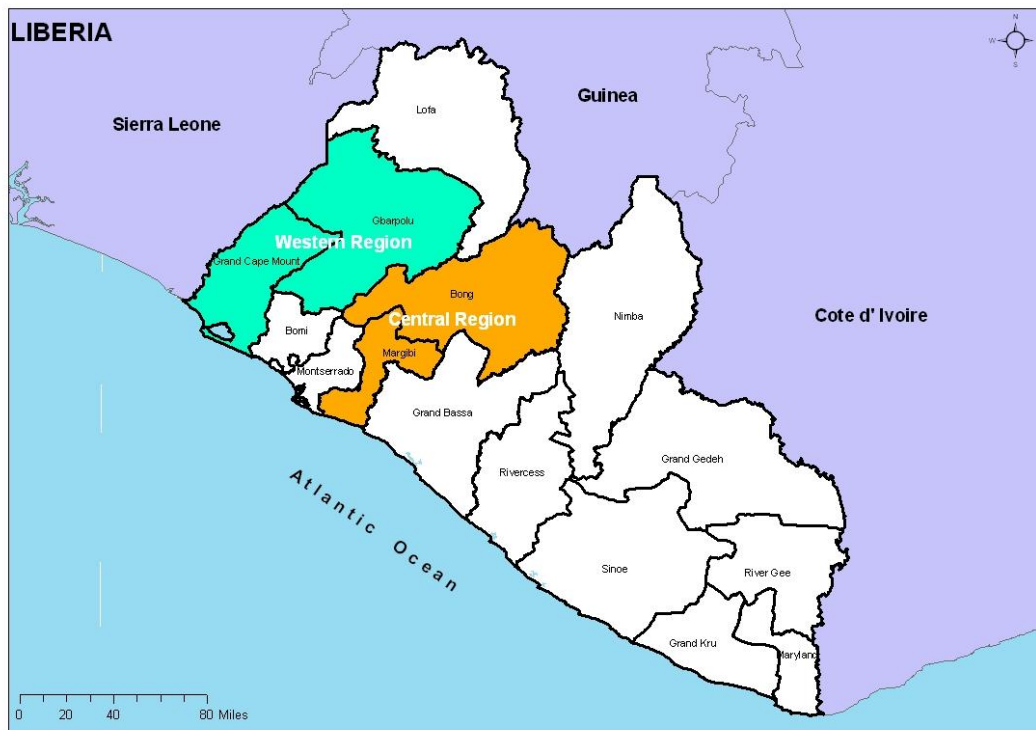
The scope of the project includes analysis of the factors that affect the productivity of farmers and increase negative climate change for the farming environment of major food crops in large rural localities and urban centers in the Central and Western Regions of Liberia. The principal activities of the project (which will take place in 12 months) are primary data collection, processing and analysis, report writing, dissemination and distribution of the research report. The Ministry of Agriculture, UN Food and Agriculture Programme (FAO), African Development Bank (AfDB), International Organization for Agricultural Development (IFAD) and other relevant stakeholders and data users of the study will utilize the reports to create avenues for the sourcing of funds and sustainable continuity of the rehabilitation of the agricultural sector and an eventual improvement in the lives of smallholder farmers in Liberia.

The research is based on primary data (with secondary information). Although a total of 800 farming heads of households were planned for interview, 864 were chosen. The increment in the sample size was based on the fact that more enumeration area or EAs (towns and villages) were accessible than previously envisage in the planning stage of the survey. The 864 households were distributed among the four counties of the central and western regions of Liberia using probability proportional to size (PPS) of the 2008 census households for the region. Four focus group discussions (FGDs) comprising of 24 persons were applied to augment the structured questionnaire interview process. In addition, 24 key informant interviews (KIIs) were conducted among key stakeholder institutions in the agricultural reform process, including the Ministry of Agriculture. The FGDs and KIIs are intended to add a greater context to the information collected from smallholder farmer households in two regions. In reality, a total of 912 respondents (i.e, 864 smallholder farmers, 24 FGDs and 24 KIIs) were interviewed during the data collection period of the study. The FGDs were held in the capital cities of the four counties. The percentage distribution of heads of household by sex as observed in the 2008 census of Liberia were applied to the selected sample size for the four counties (Table 1).

**Table 1: Distribution of Sample Size by Sex, Locality and County, SShFs 2012**

County	Enumeration Areas (EAs)		Questionnaires (households)		Gender (planned)		Gender (Actual)		Locality (planned)		Locality (Actual)		Qualitative data (same as planned)	
	Planned	Actual	Planned	Actual	Male	Female	Male	Female	Urban	Rural	Urban	Rural	FGDs	KIIs
Bong	8	9	320	322	231	89	234	88	96	224	97	225	6	4
Gbarpolu	3	4	112	129	90	22	100	29	34	78	32	97	6	4
Grand Cape Mount	4	5	168	190	123	45	138	52	50	118	44	146	6	4
Margibi	5	6	200	223	152	48	150	73	60	140	65	158	6	4
Monrovia														8
Total	20	24	800	864	596	204	622	242	240	560	238	626	24	24

**Figure 2: Map of Liberia with the Central and Western Regions, SShFs 2012**



As indicated earlier, a sample of 864 households was drawn from the four counties. Then, in each sampled household, the head of the household or his/her representative responded to the survey questionnaire. Considering the fact that most of the farmers to be interviewed are residing in the rural than in urban areas, the sample size was adjusted by giving more weight to rural areas. Hence, urban areas were purposively assigned 30 percent of the sample size while 70 percent was allocated to rural areas. Similarly, the proportion of female headed households, as observed in the 2008 census for the region, was used to determine the gender disaggregation of survey data (LISGIS, 2008).

The sample size of EAs required to cover the interviewers was 20. Hence, 60 EAs were made available in order to obtain the selected sample size in the wake of obstacles such as migration, inaccessibility, missing EAs and other unforeseen factors. In light of this situation, interviewers selected 20 EAs from a frame of 60 EAs. Similarly, interviewers also selected 864 households from a total of 2592. Hence, there was a three-time chance of replacing a missing or migrated household in each of the four counties. This wide and flexible interval for sample selection ensured a complete fulfilment of the planned sample size since the census households was

selected in 2008, and that most rural parts of the Central and Western Regions (C&WRsL) are difficult terrain for data collection.

Moreover, the 20 EAs from the available list of 60 EAs were selected using systematic random sampling method. It was assumed that the average size of 40 HHs per EA as declared by Liberia Institute of Statistics and Geo-Information Service (LISGIS) would remain valid up to the end of the field work aspect of the survey. As a consequence, the 20 EAs were expected to produce the 800 farming HHs targeted for the study. For example, each EA in the sample had four chances of being selected, which had positive implications for replacing migrated or inaccessible EAs or HHs. The probabilistic sampling technique ensured full coverage of all planned targets of HHs for the study. Easy identification of HHs, EAs, towns and villages in project counties was guaranteed by the use of EA maps of the 2008 census. In reality, both the maps and EA listing made the field data collection process easy and successful. In essence, field data collection was easily achievable because the maps identified the localities while the EA listing provided the names of respondents that were interviewed.

### **1.7.2 Data Processing and Analysis**

The data from structured questionnaires (864 persons) was programmed and processed using version 16 of the Statistical Package for Social Sciences (SPSS) while the data gathered from focus group discussions (FGDs) was processed manually. The analytical methods employed included rates, ratios and other descriptive statistics. Other descriptive statistical methods used included frequency tables, measure of central tendency (e.g. mean), percentages and graphical presentations. These methods were used to determine the impact of climate change and productivity on the entrepreneurship of smallholder farmers' population in the C&WRsL.

### **1.7.3 Ethical Issues**

All international protocols for the protection of human subjects in data collection was observed during the field work aspect of the study. The survey is non-invasive and involves no risk to participants. All participants willingly consented to participate in the data collection process of the study. The human protection issues of data interviewees such as confidentiality and verbal consent for interview were adhered to.

#### **1.7.4 Data Dissemination Strategy**

The initial information dissemination about the research will be the inception/data users' workshop in Monrovia. Also, the research activities were launched at the end of the training of the data collection teams. The results of the research will be disseminated in the four project counties and in Monrovia. The dissemination workshops highlighted factors that influenced agriculture productivity and the entrepreneurship of smallholder farmers; show the overall performance of smallholder farmers in the WRL and CRL; expose the impact of climate change on smallholder farmers' productivity and wealth creation opportunities; sensitize participants on the recommendations of the research. The dissemination workshops will show how smallholder farmers can be used to enhance the food security and entrepreneurial activities in order to improve the livelihood of the rural population. The results dissemination workshop will also show how the results of the research can be used to strengthen private sector economic growth in Liberia.

During the dissemination workshop, the requisite stakeholder from Universities, Government agencies, the international community and other partners will be invited. The results of the study will be published on the website of relevant GOL ministries and agencies, NGOs and other key players in the agriculture sector. The results will also be mailed to civil society groups, including women business organizations and community-based groups. The results will be published in the most popular daily newspapers, in order to increase awareness and stimulate investment opportunities among smallholder farmers. There will also be post-dissemination workshops to follow-up policy implementation processes of the research findings. In other words, dissemination and post dissemination workshops and meetings (with relevant stakeholders) will be used to sell the research results to the GOL, NGOs and other partners who have interest in developing the smallholder farmers' technology as a means of stimulating food security, entrepreneurship and private sector investment.

#### **1.8 Research Limitations**

##### *Convenience sample*

For the selection of urban and large rural localities for data collection, a true random sampling procedure would have chosen inaccessible or long distance localities that could have expanded

the scope of work of data collection team. Also the interview of smallholder farmers in selected enumeration areas would have been delayed by capturing smallholder farmers that would not be available on the enumeration day, and could require callbacks. This could have inevitably delayed data collection by increasing the time required to complete the survey. But with the convenient/ purposive sampling techniques, the data collection team interviewed only those smallholder farmers that were available on the day of data collection. In effect, the sample size selected and interviewed using convenient sampling method had no negative impact on the results of the study since the major idea of avoiding a true sampling technique was to save time and ensure smooth and fast data collection. The analysis of data was largely descriptive statistics, which has no impact on the policy recommendations of the research.

#### *Geographic focus on the Central and Western Regions of Liberia (C&WRsL)*

There are no systematic differentials between the C&WRsL and the rest of the regions of Liberia. Therefore, it is rationally assumed in this study that regional difference in population and other social and economic development will not affect the farming activities of smallholder farmers. The differential in regional differences will have any significant impact on the climate change of farms, entrepreneurship and agricultural productivity in the C&WRsL. Also the farming situation of smallholder farmers in the two regions (C&WRsL) is macrocosmic of the smallholders elsewhere in the rest of the regions of Liberia.

#### *Regional Differentials of War Impact*

The war did not affect the C&WRsL differently in terms of its impact on the social and economic needs of the population, the environment, entrepreneurship and climate change. Although the headquarters of the main rebel group was in the CRL and some key cities in WRL, the situation had a limited impact on the wellbeing of smallholder farmers population in the C&WRsL as well as in other regions of the country. In essence, the destruction of all basic social services and human lives during the 14-year of civil war indiscriminately affected all of the five development regions of Liberia (including the C&WRsL).



### *Sample Size Impact*

A limitation of this research is that it focused on the C&WRsL, with concentration in the accessible parts of the two regions only. Also, the planned sample size (800) for smallholder farmers was increased by 8% during the data collection process. The increment in the sample size was due to access to more towns and villages than previously planned in the design stage of the research. In addition, total sample size of 912 respondents (smallholder farmers=864, FGDs=24 and KIIs=24) is small as compared to the population of the farmers in the two regions. However, the sample size has no negative impact on the results because it satisfied the purpose of the study. The data collected from the C&WRsL is reliable and interprets the situation of smallholder farmers in all parts of Liberia. Hence, the key findings of the research are macrocosmic of the productivity and entrepreneurial situation of smallholder farmers in Liberia.

### *Measurement Problem*

The problem of measuring agriculture outputs such as bags or bundle of rice harvested, which is problem that needs to be resolved by the Ministry of Agriculture (MoA) and LISGIS arose during the study; tin of rice planted; pile of cassava; pile of corn, etc, have serious differences from one household to another, from one district to another and even from one county to another. In essence, the problem of measurement appears to be generic to the extent that neither the MoA nor the LISGIS has standard units of measurement for these agricultural products. Moreover, the differential of these units of measurement from county to county and from district to district, etc., make research work not only cumbersome but poses difficulties for key policy makers such as MoA and LISGIS to review the research work. For example, a bundle of rice in Sinoe in the Southeast could be different from that in Grand Cape in the Western region. This situation makes it uneasy to generalize a standard measurement for ‘bundles, tins or piles’ during the research. However, effort was made to measure these units to suit the purpose of the study as there are no nationally accepted standards for farmers to use when responding to research questions.

### *Geographic and Physical Barriers*

Due to budget limitations and the constraints of inaccessibility (poor transportation infrastructure) in most parts of the C&WRsL, all of the towns and villages in the four counties in

the two regions were not visited. Instead, only towns and villages that were selected and had access to motor roads were visited for interview. Also, towns or villages that were selected but were outside of motor roads and more than 6 hours of walking distance were replaced by other accessible towns. The replacement of a household or town did not have any effect on the sample size and the results of the study because there is an homogeneity of agricultural practices in the C&WRsL.

In addition, care was taken also to ensure that respondents were drawn from a wide variety of locality, urban and rural areas, and that there was no bias against selecting men or women as respondents. Further, the research employed random sampling techniques (in selecting EAs and households) which ensured increased reliability of the statistics presented in this report. The Western (Grand Cape Mount and Gbarpolu) is among some of the food unsecured counties in Liberia as compared with the Central Region (Margibi and Bong), prior to and after the 14-year war.

#### *Recall lapses and Bias*

In addition recall lapse and bias could have affected the accuracy of respondents' answers. This may have been especially true for the production and income sections, given that many questions required respondents to recall events that happened a year ago.

### **1.9 Validation of Survey Data**

Because the sample was purposive, the study can only be considered exploratory. One cannot, strictly speaking, generalize the findings to the universe of smallholder farming or types of players under study. This is the limitation on the use of the observed results. However, the following validation of the research was made:

- That the study was conducted in line with the basic principle of survey – sampling design, questionnaire construction, development of a tabulation plan, data processing, analysis of data, and presentation of findings. The area selected for the study provided a suitable environment for the field work.
- That the sample size of 912 reflects a true representation of the smallholder farmers population in the C&WRsL. The responses given represent the views of a cross-section of smallholder farmers in the study area.

- That the structured interview covered 864 heads of households as expected. That the 100% coverage of heads of households of smallholders farmers as planned shows that most of the information provided in the research are valid and reliable since they (farmers) know more about the farming than any other members of their households in the C&WRsL.
- That the questionnaires were edited both manually and electronically; and that the report vividly described the finding of the survey.

Hence, given the above considerations the research conducted presented valid findings that ensure the achievement of research objectives by measuring the productivity of farmers; impact of climate change on farming; the entrepreneurship of smallholder farmers; and factors affecting smallholder farming processes and food security in the two regions.

### **1.10 Organization of Report**

The research report comprises of 4 chapters as follows: the first chapter is the introduction, background, purpose of the study. It further focuses on the history of Liberia; presents the objectives of the study; summarizes the problem statement of the research; reviews literature. It also highlights the methodology, and outlines the limitations and validation of research data. Chapter two reviews the social and demographic status of smallholder farmers (ShFs) and examines gender issues and the involvement of youth in agricultural activities. Chapter three looks at ShFs' food crops production technology and access to post-harvest technology and value chain processes in the research area. It also focuses on the climate change impact on food crops production and the entrepreneurship of level of ShFs. Finally, chapter Four presents results, conclusions, policy implications and recommendations of the study.

## **2. Social Demographic Situation**

The social and demographic analysis of respondents is provided in this section. This includes age-sex analysis of smallholder farmers and their marital statuses. Gender analysis, educational and economic dependency of respondents is also discussed in this section.

### **2.1 Age-Sex Analysis of Smallholder farmers**

The mean age of smallholder farmers in the C&WRsL was 41 years. This suggests that the average smallholder farmer was a middle age adult. Accordingly, Liberia's population is generally youthful (LISGIS, 2008). The population of Liberia is very youthful, with less than 49 percent in the labor force while less than 3 percent is in the retirement age bracket

(UNFPA/GOL, 2007). More than half of the smallholder farmers were males. The age at which people enter into smallholder farming sector, is realistic and represents the age structure of Liberia at the national level. Male population dominated the heads of household-ship of smallholder farmers in the C&WRsL, with 72% of the 864 farmers interviewed. Urban and peri-urban farmers constituted 28% of the smallholder farmers' population (of 864 persons) that was interviewed (Table2.1).

**Table 2- 1: Heads of Household-ship of ShFs by Sex and Locality, SShFs 2012**

County	Male		Female		Total		Urban		Rural		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Bong	234	73	88	27	322	100	97	30	225	70	322	100
Gbarpoplu	100	78	29	22	129	100	32	25	97	75	129	100
Cape Mount	138	73	52	27	190	100	44	23	146	77	190	100
Margibi	150	67	73	33	223	100	65	29	158	71	223	100
	622	72	242	28	864	100	238	28	626	72	864	100

## 2.2 Social and Demographic Status of Smallholder Farmers

The majority of the ever married persons are located in Margibi and Grand Cape Mount Counties, constituting 88 percent of married persons; 2% of widowed; 1% of separated persons and 4% of smallholder farmers who are living together in the two counties. Ninety-three (93) percent of the smallholder farmers in Bong and Gbarpolu were respectively ever married (i.e., married, living together, separated, divorced and widowed). Current marriages among smallholder farmers in the C&WRsL were 88% of the total ever married population of 821. In reality of the 864 farmers covered by the study, only 43 farmers (or 5%) were single (Table 2.2).

**Table 2- 2: Percentage of Smallholder Farmers by Marital Status, SShFs 2012**

County	Bong	Gbarpoplu	Grand Cape Mount	Margibi	Total
Single	7	7	5	5	5
Married	73	78	88	88	88
Widowed/Widower	7	2	2	2	2
Separated	1	1	1	1	1
Divorced	2	1	0	0	0
Living together	10	11	4	4	4
	100 (n=322)	100 (n=129)	100 (n=190)	100 (n=223)	100(n=864)

The singulate mean age at marriage (SMAM) for smallholder farmers in the C&WRsL was 17 years. This means that all further marriages to single farmers will take place at an average age of 17 years. In addition, the SMAM of 17 years means that all famers who attained the age 15 years

will get marry after two years. This means also that smallholder farmers who reached 15 years in Liberia will remain single for only two years, which is very low. The SMAM of the smallholder farmers in 2012 is lower than that of the 1984 census, LDHS 1999/2000 (UNFPA/GOL, 2000) and the 2008 census reports (GOL/LISGIS, 2008). The SMAM is an estimation of the mean age at marriage for persons that have not been subjected to marriage life (single population).

### **2.3 Economic Dependency level of Smallholder Farmers**

The dependency ratio of farmers is computed with the assumption that all of the occupants of each household are dependent upon the head of household for their livelihood. In this case, the overall economic dependency ratio is 1.97:1 or nearly two dependents per smallholder farmer in the two regions under study. The highest number of persons per household was as follows: 42% of smallholder farmers had between 3-4 males per household; 40% of smallholder farmers had 3-4 females per household; and on the whole 41% had 3-4 persons per household. The mean number of persons per household was 3.4 males and 3.3 females (Table 2.3).

**Table 2- 3: Mean number of dependents per Smallholder Farmer’s Household, SShFs 2012**

County	Mean # of males per household	Mean # of Females per household
Bong	3.4	3.4
Gbarpoplu	3.4	3.4
Grand Cape Mount	3.5	3.3
Margibi	3.2	3.2
Total	3.4	3.3

### **2.4 Educational Characteristics of Smallholder Farmers**

Thirty-seven (37) of smallholder farmers had no education while 5 percent had university/college level of education. Twenty six (26) percent of smallholder farmers were at the elementary level while 30% had some secondary level of education. Smallholder farmers in the Western Region (Grand Cape Mount and Gbarpolu) were more illiterate than those from the Central Region (Bong and Margibi). There was not much difference in University level of educational level among counties (Table 2.4).

**Table 2- 4: Percentage of Smallholder Farmers by Educational Level Completed, SShFs 2012**

County/ Education	Bong	Gbarpoplu	Grand Cape Mount	Margibi	Total
None	31	43	49	33	37
Primary (Grade 1 -6)	28	27	17	30	26
Secondary ( 7 -12)	34	23	26	30	30
University/College	4	6	6	5	5
Vocational	4	1	3	1	2
C&WRsL	100 (n=322)	100 (n=129)	100(n=190)	100 (n=223)	100 (n=864)

### 2.5 Some Gender Issues

Gender mainstreaming and the empowerment of women is one of the key principles that drives Liberia’s development paradigm – the poverty reduction strategy (PRS). In general, women in Liberia are on the down side of all social and economic development as well as political issues such as education, health, political participation (the executive, judiciary and legislature) and community leadership. However, following the election of a female president in 2005, gender mainstreaming and the empowerment of women and youth have been increasing against the normal tide. Since then there has been more, female educationalists, medical practitioners, legislators, judiciary officers, etc. The rising participation of females in economic, technical and social activities in the country is triggering down to the agriculture sector where women’s access to land and credit seem to be increasing.

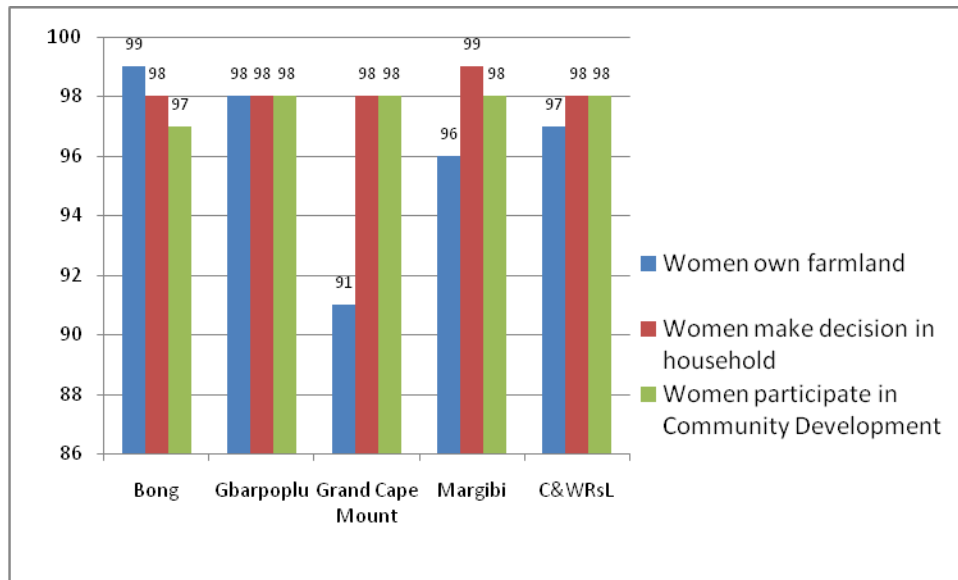
### 2.6 Women’s Access to Land Ownership

The access to land is one of the key issues that affected gender mainstreaming and the empowerment of women in the agricultural sector. In Liberia, access to or ownership of land by women was a cardinal issue prior to the 14-year war. But after the war women’s access to land has tremendously increased in some parts of Liberia to the extent that women are nearly on par with their men counterpart. The data obtained from a survey of smallholder farmers show that women are allowed to own land for agricultural purposes. This situation promotes agricultural activities for women now than in the past where women did not have the right to own land. At the county level, Gbarpolu and Bong Counties permit the ownership of land by women as compared with Gbarpolu and Margibi (Fig3).

## 2.7 Women’s Participation in Decision Making

One of the key issues that drive empowerment and mainstreaming is their participation in household decision making. In the past, it was difficult to get women involved in participating household decision making. But following the election of a female president in 2005, the potential of women’s decision making in household began to increase. The survey of smallholder farmers in the C&WRsL is a good representation that women are now fully participating in decision making. The overall participation of women household level decision making is 98%. At the county level, Margibi, Bong and Gbarpolu lead the process (Fig3).

**Figure 3: Women’s Land Ownership and Decision-Making Status, SShFs 2012**



Like the participation of women in household decision making, the tide is climbing in favor of women’s participation in community decision making in Liberia. The enhanced opportunity for women to participate in community decision making gear towards development precedes the election of a female president in 2005. The survey of smallholder farmers in the C&WRsL shows that women are fully participating in decision making. The overall participation of women in community decision making for development is 98%. At the county level, Margibi, Grand Cape Mount and Gbarpolu lead the statistics (Fig3).

## 2.8 Youth Participation in Agricultural Activities

The status of youth participation in farming activities is one of the major factors that determine the level of smallholder farmers' productivity and entrepreneurship. Forty-four (44 percent of farmers revealed that youth do not participate in farming activities across the two regions. This information draws a conclusion that most of the smallholder farmers are middle age adults. With middle aged adults participating in a labor intensive agricultural activities, the chances of low productivity is obvious, as youth constitute a significant portion of the country's population. The highest youth participation in agricultural activities was reported in Bong (68%) and Margibi (64%). On the whole, youth in the western region (Grand Cape Mount and Gbarpolu) have low participation rate in agricultural activities (Table 2.5).

**Table 2- 5: Status of Youth Participation in Farming Activities in 2011, SShFs 2012**

County	Youth Participate in Framing Activities		Youth dot not Participate in Framing Activities		Total	
	#	%	#	%	#	%
Bong	220	68	102	32	322	100
Gbarpoplu	44	34	85	66	129	100
Grand Cape Mount	121	64	69	36	190	100
Margibi	102	46	121	54	223	100
C&WRsL	487	56	377	44	864	100

Some of the activities that prevent youth from fully engaging in agricultural activities with their parents are mainly gold/diamond mining business, followed by motor cycle transport and petty trading. In reality the alternative sources of income for youth who do not participate in farming activities are artisanal Gold and Diamond Mining for Gbarpolu county; and motor cycle transport business in Margibi County Table2.6).

**Table 2- 6: Sources of Income for Non-Farming Youth in 2011, SShFs 2012**

County	Bong		Gbarpoplu		Grand Cape Mount		Margibi		C&WRsL	
	#	%	#	%	#	%	#	%	#	%
Gold /diamond Mining	3	2	72	54	45	34	14	10	134	100
Oil Palm Production	25	53	10	21	12	26	0	0	47	100
Motor Cycle Transport	44	41	0	0	1	1	62	58	107	100
Petty Trading	30	38	2	3	9	11	38	48	79	100
NGO Job	0	0	0	0	2	25	6	75	8	100
Other Jobs	0	0	1	50	0	0	1	50	2	100
All businesses	102	27	85	23	69	18	121	32	377	100



### **3. Level of Technology, Entrepreneurship, Financial and Climatic Impacts**

This chapter of the report focuses on the level of technology used by ShFs for the cultivation of land and planting and harvesting of crops in Liberia, which is largely traditional. The chapter also explains post-harvest technology and value chain process by analyzing the methods and technology of processing food crops; access to improved storage facilities and the means of transporting produce from the farm to town and to the market. This section of the report presents the level of entrepreneurship among ShFs, access to inputs and agricultural loans and the finances earned from the sale of food crops. The chapter analyzes the impact of climate change on the productivity of ShFs in the C&WRsL.

#### **3.1 Crops Production Level**

The farming tools used by smallholder farmers were determined by the type of crop cultivated. The major food crops in Liberia that were included in the research are rice, cassava and vegetables. Of the 864 smallholder farmers interviewed, 81 percent made rice farm. Although rice is the major staple food in Liberia, followed by cassava, the rate of farmers who made rice farm varied from one county to another. The data from central regions show that 91% of farmers from Bong made rice farm while 64 % did so in Margibi County. In the Western region, 88% of smallholder farmers in Gbarpolu made rice farm, followed by 77% in Cape Mount County. Interviews with key informants involving policy makers and technicians in agriculture at the central and county levels show that most parts of the land of counties along the Atlantic Ocean are not suitable for rice farming because of the sandy nature of the farming land. Most of the key informants (98%) confirmed that instead, these counties are predominantly used for cassava production. The rice farming data from the two regions justified the argument that farmers in counties along the Atlantic Ocean do not make adequate rice farm because of the sandy land. This is one of the reasons why smallholder farmers in Margibi (Central Region), and Cape Mount (Western region) did make more rice farm as compared to Bong and Gbarpolu that are located in the hinterlands.

**Table 3- 1: Status of rice farming for Smallholder farmers in 2011, SShF 2012**

County	Made Rice Farm		Never Made Rice Farm		Total	
	#	%	#	%	#	%
Bong	294	91	28	9	322	100
Gbarpolu	114	88	15	12	129	100
Grand Cape Mount	147	77	43	23	190	100
Margibi	143	64	80	36	223	100
Total	698	81	166	19	864	100

*Land Clearing Tools*

The research report verifies the fact that smallholder farmers predominantly use traditional tools such as cutlasses and axes for land clearing/cultivation. All of the 864 smallholder farmers interviewed in the Western and Central Regions of Liberia (C&WRsL) never used machine to cultivate land for the planting of Liberia’s major food crops (rice, cassava and vegetable). The use of machine to clear land for farming adds values to agricultural productivity as compared to the use of traditional tools such as hoes, cutlasses and axes. Other studies conducted in the western (IFAD-MOA, 2011) and southeastern (AfDB-MOA, 2011) parts of Liberia identified traditional tools as the only means of clearing land for planting of food crops. The use of traditional tools has implications for the productivity and entrepreneurship of ShFs in Liberia.

Similar experience in Nigeria shows that due to their poverty level, ShFs are unable to employ modern tools, such as tractors and plows, even with substantial government support (Takeshima and Salau, 2006). In addition, there is an extreme lack of farmer field school (FFS) services to enforce extension services in most parts of Liberia. Hence, it compromises efforts by ShFs to increase productivity and engage in entrepreneurship since they do not have modern capacity (material and knowledge). It is believed that proactive FFS improves smallholder farmers’ productivity. Various studies show that farmers adopt the principles taught in FFS. For example, a study in the Philippines found that FFS farmers had learned enough from the field school to adopt organic rice growing (Carpenter, 2003). A study in Peru found that potato farmers who had attended FFS had higher yields than their neighbors who never attended the school (Ortiz et al. 2004, see also Godtland et al. 2004).

### **3.2 Tools for Planting Food Crops**

Similar to the clearing for land for planting, all of the 864 farmers interviewed used hoes for planting of rice, cassava and vegetables. The use of traditional tool indicates that Liberian smallholder farmers have not added much value to the planting of food crops to increase productivity. This assertion is based on the fact that hoe is a traditional tool that could affect the ultimate output of farmers as compared with the use of machines for planting. Little or no efforts have been made to introduce mechanise farming for ShFs in Liberia. Even in most African countries, including Nigeria, where urbanization is rapidly increasing and the farmers are fast ageing, the effective demand for modern tools has not been accomplished (Takeshima and Salau, 2006).

#### *Techniques for Planting*

The planting of rice was also predominantly traditionally (scratching/broadcasting). Scratching or broadcasting is a situation where the rice is spread and the soil is later overturn using hoe. This method has been used since the founding of Liberia and has been yielding the same subsistent level of production. The tillage/sow method is an improved method that leads to high level of germination. The research shows that 5% of the farmers used improve technology for rice planting which could be one of the major factors of food insecurity in the two regions.

Similarly, Cassava planting technology is overwhelmed by traditional methods. In reality, the issue of food insecurity still persist because 92% of the smallholder farmers used flat cassava planting method, which does not yield adequate products. The improved techniques for rice and cassava planting need to be taught and decentralized by extension agents in order to promote reduce hunger, increase entrepreneurship and contribute to poverty reduction. The overall techniques for rice (tillage/sow) and cassava (mound &ridge) planting are traditional, with 5% and 8% employing improved methods respectively. This level of technology for Liberia' major food crops will not allow production to go above subsistence stage of agricultural practices (Table 3.2)

**Table 3- 2: Upland Rice and Cassava Planting Techniques for 2011, SShFs 2012**

Upland Rice Planting methods							Cassava planting methods							
County	tillage/sow (improved)		Scratching/ broadcasting		Total		Mound (improved)		Ridge (improved)		Flat		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Bong	18	7	244	93	262	100	42	16	6	2	218	82	266	100
Gbarpolu	4	4	100	96	104	100	1	1	1	1	107	98	109	100
Cape Mount	3	2	119	98	122	100	1	1	2	1	160	98	163	100
Margibi	5	4	116	96	121	100	7	3	1	0	201	96	209	100
Total	30	5	579	95	609	100	51	7	10	1	686	92	747	100

Many ShFs in the two regions believe that the introduction of new farming techniques, particularly planting methods will improve productivity. Ninety-five (95) percent of the 864 ShFs interviewed see the introduction of new techniques through extension officers, using farmers' field school (FFS) or other procedures would address the problems of low productivity and pre and post harvest losses. The strong belief of farmers that new techniques of farming will increase productivity could have implications for training needs in order to enhance both productivity and entrepreneurship (Table3.3). In Nigeria Takeshima and Salau believe that the inadequacy of farmer field school (FFS) services affected the productivity of ShFs (Takeshima and Salau, 2006).

**Table 3- 3: Status of New Farming Techniques in Increase Productivity Among Farmers, SShFs 2012**

County	New Farming Techniques will Increase Productivity		New Farming Techniques will not Increase Productivity		Total	
	#	%	#	%	#	%
Bong	315	98	7	2	322	100
Gbarpolu	123	95	6	5	129	100
Grand Cape Mount	183	96	7	4	190	100
Margibi	211	95	12	5	223	100
Total	824	95	40	5	864	100

### 3.3 Tools for Harvesting Food Crops

*Rice Harvesting Instrument:* The harvesting of rice is predominantly carried out by the use of knife instead of sickle which shows that traditional tools characterises most of the production activities of smallholder farmers. The use of traditional tools also reflects an unimproved rice harvesting technology among a majority of the smallholder farmers in Liberia. Of the 698 smallholder farmers who produce rice, 85% used knife for harvesting. The minimum use of

improve technology will have serious implications for food security among smallholder farmers' households.

**Table 3- 4: Tools for Harvesting Rice in 2011, SShFs 2012**

County	Sickle (improved)		Knife		Total	
	#	%	#	%	#	%
Bong	77	26	217	74	294	100
Gbarpolu	2	2	112	98	114	100
Grand Cape Mount	10	7	137	93	147	100
Margibi	14	10	129	90	142	100
Total	103	15	598	85	698	100

Interviews with 48 key informants and focus group participants show that traditional methods and techniques of production affect the crop yields of ShFs. The respondents recommended increase in the number of agriculture technicians at the county, district and chiefdom levels as a means of reducing the traditional methods and techniques of farming in order to increase productivity. Research from East Africa have further confirmed that ShFs using traditional methods and techniques of farming but with cash incomes outside their farm holdings (petty business) are found to be more efficient than those without additional income (Msuya, 2008). In other words, ShFs using traditional methods and techniques of farming may not be efficient without additional income outside their farming work, including access to credit.

### **3.4 Smallholder Farmers' Food Crop Production Level**

*Rice Production Level:* The level of rice production was low to support sustainable livelihood in the central and western regions of Liberia. The average smallholder rice farmer produced 276Kg bags of rice per farm in 2011. Eighty-nine (89) percent of smallholder farmers believe that the use of traditional techniques and the lack of tools and access to credit are some of the major factors responsible for the low level of production. Similarly, key informants interviews further confirmed that unimproved method and techniques of agricultural practices among ShFs are major factors responsible for the low level of production in the two regions. The low level of rice production could affect the entrepreneurship of farmers. The highest level of rice production was experienced in Bong County in the Central Region where an average of 320 kg bags of rice was produced. This situation confirms results from national crops surveys in which Bong is ahead of Grand Cape Mount, Gbarpolu and Margibi in agricultural production, productivity and food security issues (MOA, 2010).

**Table 3- 5: Average Crops Produced in the C&WRsL in 2011, SShF 2012**

Mean Number of Crops in Kg Bag			
County	Rice	Cassava	Vegetable
Bong	320	546	306
Gbarpolu	273	520	347
Grand Cape Mount	213	521	370
Margibi	249	539	381
Total	276	535	344

The average kg bags of cassava produced in 2011 had similarly trend of rice production, where Bong County had the highest harvest of the food crop. The high levels of rice and cassava production in Bong also confirm findings that the county is the most food secure among the areas of study in the Central and Western Regions of Liberia. However, the level of food insecurity is still in the regions because of low level production among smallholder farmers, which is associated with inputs and the predominant traditional methods of crop planting. The level of vegetable production is also low for both rural and urban consumption.

As reflected in Table 3.4, an average of 344 kg bags of vegetables was produced per farmer in the two regions, with Margibi leading the production level. The highest production of vegetable was found in Margibi. Moreover, Margibi County is one the three counties that has been targeted for production of vegetable in Liberia's food security strategic planning to achieve poverty reduction in a smooth manner. The other two counties to augment the boom of vegetable production in Liberia are Montserrado and Bong Counties.

Although this study lacks data (e.g., cross sectional, time series data, etc.) to prove the influence of the types and levels of techniques (tools used for production) on productivity of food crops in the region (using correlation or regression analysis), it is evidently clear that the use of traditional methods (for planting and harvesting) negatively impacted on the level of food production in the two regions. Interviews (KIIs and FGDs) of 48 participants revealed that traditional method of planting and harvesting negatively affect the productivity of smallholder farmers in the four counties covered by the study. Similarly, research shows that the use of traditional methods in Tanzania (Msuya et al, 2008) negatively impacted on the maize production level of ShFs as compared with the use of improved techniques. The study also revealed that the lack of improved techniques of maize planting and harvesting due to the absence of extension services and limited capital had negative effect on the technical efficiency of smallholder farmers (Msuya et al, 2008).

### 3.5 Access to Improved Drying Facilities

The issue of post-harvest technology is serious in Liberia because it leads to the lost of huge percentage of crops produced by smallholder farmers. Research has shown that every year Liberian farmers lose 60 percent of their harvest to birds and vermin or poor storage conditions, contributing to country-wide food insecurity, say UN officials, who are calling on donors to put more funding into pest management and storage. The Ministry of Agriculture estimates 52,000 tons of rice out of 144,000 produced in 2007 was lost, while 44,027 tons of a 155,293 ton harvest was lost in 2008 (MoA, 2009). The interaction of farmers with a NGOs (Agency for Economic Development and Empowerment or AEDE) promoting agricultural development shows that smallholder farmers lack very basic knowledge of pest control. The AEDE partners with the Food and Agriculture Organization (FAO) in Liberia. It is believed that as a consequence of post harvest losses eight out of 10 rural Liberians are moderately or highly vulnerable to food insecurity (MoA, 2009).

The 2012 survey of smallholder farmers in the C&WRsL revealed that post-harvest technology has not improved for most farmers in Liberia. Findings of key informant interviews confirmed that the lack of improved post-harvest technology leads to post-harvest loses among ShFs in the two regions, and could be responsible for the food insecurity situation among household members in rural areas. According to the survey, 67% of 698 smallholder farmers dried rice using traditional methods and materials (on ground, mat, fire hearth and other unrefined method). The use of these unrefined methods and techniques is the main cost of stones in local rice sold on the Liberian market. The data shows that the widely used method of rice drying is mat, followed by tarpaulin (Table 3.6).

**Table 3- 6: Farmers by Access to Improved or Better Drying Facilities for Drying Rice**

County	Bong		Gbarpoplu		Cape Mount		Margibi		Total		C&WRL	
	#	%	#	%	#	%	#	%	#	%	#	%
Ground	54	53	18	18	18	18	12	12	102	100	102	15
Mat	115	50	31	13	36	16	50	22	232	100	232	33
Tarpaulin	81	45	30	17	34	19	36	20	181	100	181	26
Concrete Floor	29	56	9	17	9	17	5	10	52	100	52	7
Fire hearth	15	12	26	21	48	38	36	29	125	100	125	18
Others Drying methods	0	0	0	0	2	33	4	67	6	100	6	1
All methods	294	42	114	16	147	21	143	20	698	100	698	100

### 3.6 Method of De-Husking Rice

The lack of improved method of de-husking rice seems to be universal in Liberia. An AfDB supported MoA survey of crops production in South-eastern Liberia revealed that 73.5% of 1500 smallholder farmers de-husked rice by beating /pounding. The number of farmers who thresh rice using their feet constituted 25.4%. Similarly in C&WRsL, none of 698 smallholder rice farmers had access to machine for the de-husking of rice after production. Instead, the beating/pounding was the only means of de-husking rice in the two regions. In reality the use of machine to de-husk rice is almost non-existent in most parts of Liberia. This situation of using foot or pounding rice does not add value to rice production as it increases post-harvest loses and pollutes de-husked rice with sand and stones. The pollution of de-husked rice with sand stones compromises the quality and quantity of rice produced smallholder farmers. This situation eventually leads to the loss of taste for Liberian rice in urban markets as well as export from one region of the country to another. All of the 698 rice farmers never used rice mill or machine to de-husk rice for cooking of sale (Table 3.7).

**Table 3- 7: Farmers by Method/Equipment for De-husk Rice (for cooking or sale), SShFs 2012**

County	Used Machine		Do not Used Machine		Total		Beating/pounding		Other methods		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Bong	0	0	294	100	294	100	294	100	0	0	294	100
Gbarpoplu	0	0	114	100	114	100	114	100	0	0	114	100
Grand Cape Mount	0	0	147	100	147	100	147	100	0	0	147	100
Margibi	0	0	143	100	143	100	143	100	0	0	143	100
C&WRsL	0	0	698	100	698	100	698	100	0	0	698	100

### 3.7 Access to Improved Storage Facilities

The rice storing facilities for smallholder farmers in Liberia seem to be still primitive and therefore lead to post-harvest losses. Studies conducted by MoA under the sponsorship of AfDB and IFAD in the Southeastern and Western Liberia in 2010 and 2011 revealed that most farmers store rice in bush-tent known as rice kitchen that are not protected from birds, rodents and worms (MoA, 2010 and 2011). This situation does not only leading to huge post-harvest loses but infest rice with sand and tiny rocks. In the case of the research of smallholder farmers in the C&WRsL, it was found that only 2% store rice in warehouses, which is an improved method of food crops



storage. The rest of the 698 rice farmers stored rice in primitive facilities that do not add value to the crops but rather reduce the quantity and quality of the crops being stored. In essence, 23% of the 698 rice farmers use attic as post-harvest storage facility while 75% use bush-tent or rice kitchen (Table3.8).

**Table 3- 8: Distribution of Farmers by Rice Storing Facilities Available in 2011, SShFs 2012**

County	In the Attic		Rice Kitchen/ Bush-Tank		Warehouse		Other storage		Total	
	#	%	#	%	#	%		%	#	%
Bong	72	24	215	73	7	2	0	0.0	294	100
Gbarpoplu	33	29	79	69	1	1	1	0.9	114	100
Grand Cape Mount	27	18	118	80	1	1	1	0.7	147	100
Margibi	30	21	111	78	2	1	0	0.0	143	100
C&WRsL	162	23	523	75	11	2	2	0.29	698	100

### 3.8 Methods of Threshing Rice

Threshing of rice among smallholder farmers is predominantly a traditional method which does not add value to rice production and food security as a whole. Like in other parts of Liberia, 34% of the smallholder farmers in C&WRsL use foot to thresh their rice while another 66% beat/pound rice as a means of threshing it. The threshing of rice by beating or the use of foot does not ensure its safety for neither eating nor reduces post-harvest losses. This is so because by the use of foot or pounding of rice as a means of threshing increasing post-harvest losses and infects the rice with sand and rocks, which does not promote food security and encourage entrepreneurship of smallholder farmers (Table 3.9).

**Table 3- 9: Farmers by Means of Threshing Rice in 2011, SShFs 2012**

	Use Foot		Beat/pound		Other Methods		Total	
	#	%	#	%	#	%	#	%
Bong	117	40	177	60	0	0	294	100
Gbarpoplu	27	24	87	76	0	0	114	100
Cape Mount	35	24	112	76	0	0	147	100
Margibi	56	39	87	61	0	0	143	100
C&WRsL	235	34	463	66	0	0	698	100

The post-harvest technology in the C&WRsL is predominantly traditional, and therefore led to the lost of huge quantities of food crops produced (27% of rice; 26% of cassava and 28% of vegetable) by ShFs in the two regions. Interviews (KIIs and FGDs) confirmed that the lack of improved post-harvest technology leads to post harvest losses among ShFs in the two regions.

Further studies suggest that the traditional nature of post-harvest techniques led to the loss of 36.1% of the tons of rice produced in 2007 while that of 2008 was 28.4% (MoA, 2009). The level of post-harvest losses due to traditional post-harvest technology in the C&WRsL is enormous (Table 3.10).

**Table 3- 10: Famers by percentage of Post-Harvest Losses in the C&WRsL, SShFs 2012**

County	Rice (%)	Cassava (%)	Vegetable (%)
Bong	27	28	30
Gbarpolu	30	31	32
Grand Cape Mount	29	28	29
Margibi	26	29	29
Total	27	26	28

The lack of cassava processing/milling machines in most parts of Liberia leaves most farmers' cassava to rot or remain on the farm without being harvested. This situation is true for the C&WRsL where 85% of the farmers did not use cassava processing machine to process their cassava after harvest. At the county level, in Gbarpolu and Margibi 94% and 92% of smallholder farmers did not have access to cassava milling machine to process cassava products (farina, flour and fufu). See Table 3.11 for more details of access to cassava processing mills.

**Table 3- 11: Status of Using Milling Machines to Process Cassava (farina, flour or fufu)**

	Use Cassava Milling Machine		Do Not Use Cassava Processing Machine		Total	
	#	%	#	%	#	%
Bong	66	25	200	75	266	100
Gbarpoplu	6	6	103	94	109	100
Grand Cape Mount	25	15	138	85	163	100
Margibi	17	8	192	92	209	100
C&WRsL	114	15	633	85	747	100

### 3.9 Access to Improved Transport Facilities

One of the major components of food security is the means of transport from farm to town. This is very important in ensuring the reduction of post-harvest loses, which is the major problem that Liberian smallholder farmers are faced with. Interviews (KIIs and FGDs) show that one of the factors that increase post-harvest loses and affect entrepreneurship of ShFs is the lack of transportation. The interviewees see the lack of motorized transportation of goods as a factor that hinders progress towards the entrepreneurship of ShFs in the C&WRsL. The survey of smallholder farmers in the C&WRsL shows that most of the farmers or 92% transport from the farm to town on their heads, which is highly primitive and does not add value to food security,

productivity and the entrepreneurship. In essence only 7% use wheelbarrows; 2% use motor cycles and 0.1% use cars to transport rice from the farm to town. In most of the towns and villages where smallholder farmers are based, there are no motor roads linked to their farms, which affects any attempt to introduce or improve value chain processes. Transporting rice on head from the farm to the town has been an age old process that needs to be improved if Liberia is to meet the food security needs of its population and make farmers business people (Table 3.12).

**Table 3- 12: Farmers by means of transporting farm produce from the farm to town for storage, SShFs 2012**

County	On the head		Wheelbarrow		Motor Cycle		Use Car		Other means		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Bong	284	88	38	12	0	0	0	0.0	0	0.0	322	100
Gbarpoplu	122	95	4	3	2	2	0	0.0	1	0.8	129	100
Grand Cape Mount	172	91	15	8	0	0	1	0.5	2	1.1	190	100
Margibi	216	97	7	3	0	0	0	0.0	0	0.0	223	100
C&WRsL	794	92	64	7	2	2	1	0.1	3	0.3	864	100

The marketability of food crops in Liberia is grossly affected by the lack of either motor roads or the lack of vehicles to ply motor roads where they exist or the lack of funds to pay for transport fair. In some instances, all of the above conditions are not met by farmers. Hence, they transport food crops from homes to markets. Studies have also shown that most of the villages are not connected with farm-market roads, which makes the use of head to transport food crops to the market as the only means of reaching the market place to sell their farm produce. As a consequence of the use of heads to transports food crops, most crops rot while in the process of transporting them. The lack of transport facility also limits the chances of famers increasing their crop production due to the post-harvest lose experienced while transporting crops to the market.

The research of smallholder farmers in the C&WRsL shows that more than 56.4% of the food crops are carried to the market on head, which is not only inadequate but leads to the destruction of crops that have been harvested for marketing since the human head cannot carry reasonable crops to withstand the food inadequacies in large rural localities and urban centers for sale. As a consequence of the lack of transport facilities most of the crops are to the market by either wheelbarrows or other inefficient and labor intensive equipment. Hence, farmers lose their produce to destruction or post-harvest losses since most of the methods of the transportation methods are labor intensive and poor. Twenty-four percent of the farmers in the C&WRsL use vehicles to transport their crops to the market, with Grand Cape Mount and Margibi leading (Table 3.13).

**Table 3- 13: Famers by Means of carrying farm produce to the market for sale, SShFs 2012**

County	Bong		Gbarpoplu		Cape Mount		Margibi		Total		C&WRsL	
	#	%	#	%	#	%	#	%	#	%	#	%
On your head	211	43	77	16	64	13	135	28	487	100	487	56.4
Wheelbarrow	75	59	10	8	18	14	24	19	127	100	127	14.7
On motorbike	2	5	10	23	17	39	15	34	44	100	44	5.1
By car	34	17	31	15	89	44	49	24	203	100	203	23.5
Others specify	0	0	1	33	2	67	0	0	3	100	3	0.3
All methods	322	37	129	15	190	22	223	26	864	100	864	100.0

Ninety (90) percent of the 864 ShFs considered the lack of motorized means of transporting agricultural produce from the farm to town as one of the major reasons for post-harvest losses and low entrepreneurship. Similarly, 85% of the ShFs believe that the lack of motorized transportation of produce from the town/ village to the market reduces the ability of farmers to engage in petty trade. Hence, it affects the promotion of entrepreneurship among farmers in the four counties of the C&WRsL.

Further analysis show that the lack of motorized means of transport affected the entrepreneurship of ShFs. Ninety-five (95) percent of the 864 ShFs indicated that the lack of motorized means of transport affected the level of entrepreneurship in the C&WRsL. Interviewees from FGDs and KIIs confirmed impact of the lack of motorized transportation on post-harvest losses and the entrepreneurship of farmers. At the county level only 2% of ShFs in Gbarpolu County did not confirm the impact of non-motorized medium of transport on entrepreneurship of ShFs in the C&WRsL (Table 3.14).

**Table 3- 14: Famers by whether non-motorized transport means affect entrepreneurship, SShFs 2012**

County	Lack of Motorized Transport Affect Entrepreneurship		Lack of Motorized Transport Does Not Affect Entrepreneurship		Total	
	#	%	#	%	#	%
Bong	300	93	22	7	322	100
Gbarpolu	127	98	2	2	129	100
Grand Cape Mount	180	95	10	5	190	100
Margibi	200	90	23	10	223	100
Total	824	95	40	5	864	100

### 3.10 Access to Agricultural Loan

One of the major problems affect the achievement of food security in Liberia is the lack of adequate input to produce food to commensurate with the needs of households. Research

conducted in 2010 and 2011 on the basic inputs needs of smallholder farmers shows the situation is even grave not only in terms of material inputs but also labor supply and the lack of agricultural loans to smallholder farmers. Studies conducted by the Ministry of Agriculture (MoA) through support from the African Development Bank (AfDB) and the International Fund for Agriculture Development (IFAD) clearly show that the issues of loans to augment the agricultural activities of smallholder farmers has been a difficult task for government to achieve. Interview with major agricultural policy makers at the central, county and district levels revealed that the lack of access to agricultural loan among most of the ShFs in the two regions affect productivity and entrepreneurship, and food security level of rural population that survives mainly on subsistence farming. The key informants believe that the lack of inputs such as fertilizer have impact on the production level of ShFs, who are mainly engaged in slash and burn type of farming.

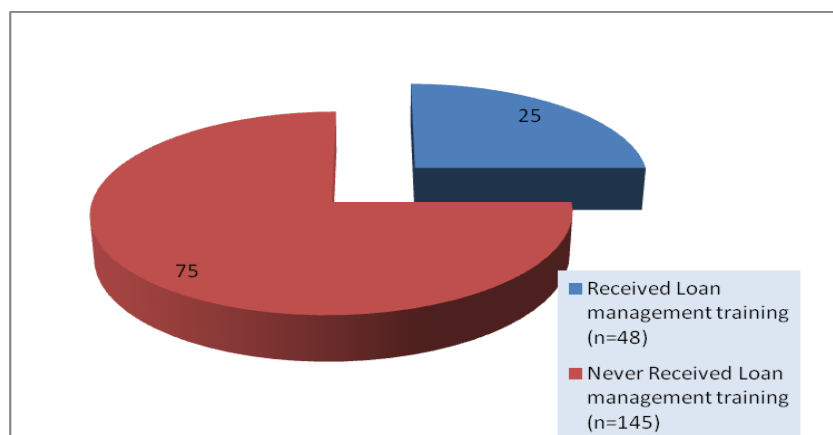
A survey of smallholder farmers in the C&WRsL has confirmed previous studies that agricultural loans to smallholder farmers must be prioritized if the end hunger goal of the MoA must be achieved. The data from the survey shows that of the 864 farmers interviewed, only 22% received loans during the 2011 farming calendar year. County level analysis revealed that 29% of the loans received in the two regions was allotted to Gbarpolu, followed by Bong county with 25%. The low level of loans received in the two regions is an indication that smallholder farmers have difficult times ahead in rising above the subsistent level of farming and its subsequent poverty situation (Table 3.15)

**Table 3- 15: Loan Receiving Status of ShFs by County, SShFs 2012**

County	Received Loan		Never Received Loan		Total	
	#	%	#	%	#	%
Bong	80	25	242	75	322	100
Gbarpoplu	38	29	91	71	129	100
Grand Cape Mount	38	20	152	80	190	100
Margibi	37	17	186	83	223	100
C&WRsL	193	22	671	78	864	100

Of the 193 ShFs who received loans for agricultural purposes in 2011, only a quarter benefited from any form of loan management training. This is an indication that most farmers in the regions do not receive skills training for small business management. This situation has implications for the utilizations of funds from the loan (Fig4).

**Figure 4: Percentage of Farmers by loan management training in the C&RsL, ShFs 2012**



### 3.11 Sources of Agricultural Loans

The sources of loans received by 22% of the smallholder farmers came from a cross session of stakeholders in the two regions. However, most of the loans were received by smallholder farmers in Bong (41%) and Gbarpolu and Grand Cape Mount Counties with 20% each. The distribution of loans to farmers by institutions revealed that more than half or 57% of the loans provided to smallholder farmers came from family / friends, followed by susu club (20%). Only accessible counties (Bong and Margibi Counties) with high level of banking facilities received adequate bank loans while remote counties (Gbarpolu and Grand Cape Mount) received limited amount of loans. In other words, Bong and Margibi counties received the highest Bank and NGO loans as compared with the remaining three counties (Table 3.16).

**Table 3- 16: Sources of Agricultural Loan Received in Last farming Season (2011), SShFs 2012**

County/Loan Institution	Bong		Gbarpoplu		Grand Cape Mount		Margibi		Total	
	#	%	#	%	#	%	#	%	#	%
Bank	21	78	1	4	0	0	5	19	27	100
Non-Governmental (NGO)	5	63	0	0	2	25	1	13	8	100
Family/friends	37	34	29	26	24	22	20	18	110	100
Susu Club	11	29	6	16	10	26	11	29	38	100
Local financial club	6	60	2	20	2	20	0	0	10	100
C&WRsL	80	41	38	20	38	20	37	19	193	100

### 3.12 Fertilizer Used Among Smallholder Farmers in 2011

Of the 864 smallholder farmers in the C&WRsL in 2012, only 24% used fertilizers on their farms in 2011. Moreover, Farmers from the Central region, comprising Margibi and Bong Counties, used the highest amount of fertilizers as compared with counties from the western

region. Farmers in the Central Region have more adequate access to fertilizers perhaps because Liberia's Central Agriculture Research Institute (CARI) is located in Bong County.

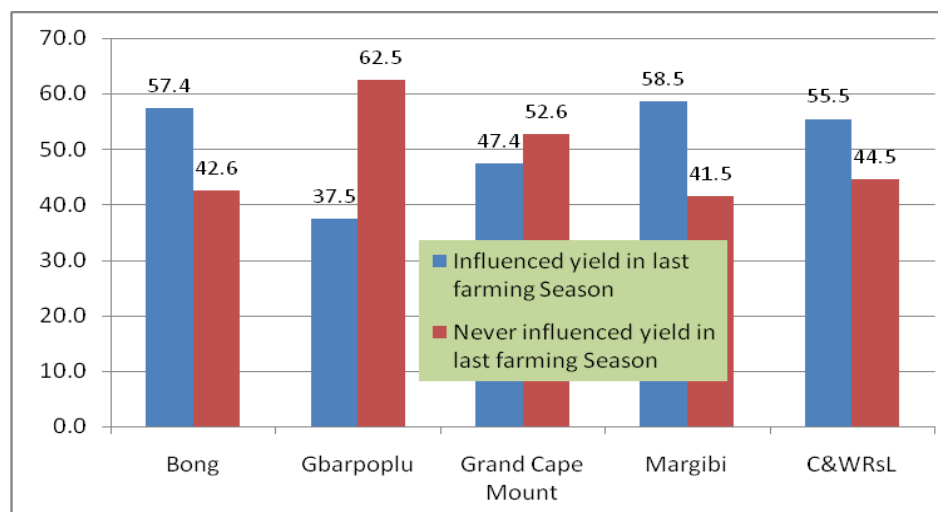
The distribution of the use of fertilizer in the 2011 farming year reflects a high regional differential as Bong and Margibi from the Central Regions used more granulated fertilizers than Gbarpolu and Grand Cape Mount Counties. On the other hand, Gbarpolu and Grand Cape Mount Counties used more liquid fertilizers as compared with counties from the central region. The use of predominantly granulated fertilizers could reflect the technical level of farmer from the central region, CARI is located (Table 3.17).

**Table 3- 17: Status of Using Fertilizers by types of in last Farming Season (2011), SShFs 2012**

County	Used fertilizer in Last Farming Season		Never used Fertilizer in Last Farming Season		Total		Liquid Fertilizers		Granulated Fertilizers		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Bong	94	29	228	71	322	100	24	25	71	75	95	100
Gbarpoplu	16	12	113	88	129	100	7	44	9	56	16	100
Grand Cape Mount	19	10	171	90	190	100	9	47	10	53	19	100
Margibi	82	37	141	63	223	100	11	14	70	86	81	100
C&WRsL	211	24	653	76	864	100	51	24	160	76	211	100

The research on ShFs confirms the fact the application of fertilizer is not independently responsible for high crops productivity. County level analysis shows that fertilizer use influenced 58.5% of ShFs' crops productivity in Margibi while that of Bong was 57.4%. The crop productivity levels for rice, cassava and vegetables of the majority of ShFs in Gbarpoulu (65.5%) and Grand Cape Mount (52.6%) Counties were never influenced by fertilizer in the last farming season or 2011. Other factors that jointly influence productivity along with fertilizer use are the levels of sunshine and rainfall, and integrated pest plant management or IPPM (including weeding, fencing, bird scaring, etc.). The data also shows that 55.5% of ShFs' productivity was influenced by fertilizer use (Fig.5).

**Figure 5: Fertilizer Use and Crops Productivity among Smallholder Farmers in 2011, SShFs 2012**



Findings from interviews (FGDs and KIIs) confirmed that fertilizer use does not influence productivity in isolation. In effect, other factors such as planting techniques, the use of IPPM and the environment are highlighted as major determinants that influence high crop productivity among ShFs. The lesser influence of fertilizer use on ShFs' productivity experience in Gbarpolu and Grand Cape Mount Counties proves that the application of agro-chemical elements alone cannot lead to high crop productivity in the C&RsL. In Tanzania, it is also proven that farmers who use agro-chemicals alone were found to be less efficient in the production of maize (Msuya et al, 2008).

Research has further shown that the use and role of fertilizer in enhancing African agricultural productivity has become a surprisingly controversial issue (Reardon et al, 1997). Although it seems self-evident to say that fertilizer increases productivity, yet there have been many attempts to remove it from the list of key productivity enhancing options worthy of government and donor policy support. Accordingly, some of the reasons given for downgrading the importance of fertilizer in Africa are: its riskiness under conditions of low or erratic rainfall; and its relatively low yield response in Africa when compared to results in other parts of the World (preferably Asia and Latin America). Also the high distribution costs in a context of low effective demand and poor storage facilities and roads are some of the reasons that the use and role of fertilizer in increasing productivity in Africa is controversial (Reardon et al, 1997).



### **3.13 Some Climate Change Issues**

One of the key issues that the study is investigating is the perceived impact of environmental issues on the progress of smallholder farmers' productivity and entrepreneurship in the C&WRsL. The key environmental considered under the study therefore, are how the irregularity of the dry and wet seasons, draught, increased level of rodents, birds, armyworms, etc., affect farmers' livelihood, particularly sustainable food security and commerce in the two regions. The research is to determine as to whether climate change situation reduces the opportunity for adequate production of the three key food crops to the extent that their produce partially meets household consumption needs.

From key informant interviews and focus group discussion that involved ShFs themselves, the impact of excess rain, rodents, insects, sunshine and armyworms on the productivity and entrepreneurship of smallholder farmers is grave. Interviews with key policy makers in the agriculture sector (at central and county levels) further revealed that the introduction of weather monitoring instrument and integrated plant and pest management technology are required if the effect of the environment is to be reduced to ensure high productivity and entrepreneurship of ShFs in Liberia. From the survey of smallholder farmers, climate change has a tremendous impact on the production level of smallholder farmers so much that it leads to subsistent output that tends to compromise any commercialization of their produce.

### **3.14 Access to Draught Resistant Varieties of Crops**

The survey of smallholder farmers from the two regions, only 2% of the 864 farmers had draught resistant varieties of crops. At the county level, only Grand Cape Mount County had the highest rate of draught resistant varieties of crops (3%). With the gradual movement of desertification along the western, southwest, central and southeastern parts of Liberia (Atlantic Ocean side), the lack of draught resistant varieties of crops in the C&WRsL is a serious climate challenge that may hinder progress of smallholder farmers (by reducing their productivity and affecting their ability to trade) and compromise the sustainability of crop production and entrepreneurship (Table 3.18).

**Table 3- 18: ShFs by Access to Draught Resistant Varieties of Crops in 2011, SShFs 2012**

	Had Draught Resistant Varieties		Had No Draught Resistant Varieties		Total	
	#	%	#	%	#	%
Bong	5	2	317	98	322	100
Gbarpoplu	3	2	126	98	129	100
Grand Cape Mount	5	3	185	97	190	100
Margibi	5	2	218	98	223	100
C&WRsL	18	2	846	98	864	100

The research shows that only Bong County had the highest draught resistant varieties for both rice and cassava, which are the first and second staple food crops for Liberia respectively. The rest of the three counties (Gbarpolu, Grand Cape Mount and Margibi) had draught resistant crop varieties for cassava only. Moreover, only Bong County had draught resistant crop varieties for vegetable.

The research shows that Margibi, which produced the highest vegetables crops in Liberia in 2011 did not have draught resistant vegetable crops (pepper, bitter and egg plant) in the 2011 farming season. The study shows that 15 out of the 18 smallholder farmers had draught resistant crops for Cassava, while 2 out of 18 farmers had draught resistant crops for rice while 1 out of 18 farmers had draught resistant varieties for vegetables (bitter balls) as shown in Table 3.19. With the fluctuation of Liberia's cropping calendar, and the lack of adequate instruments to determine the trends of rainfall and sunshine, the lack of draught resistant crops has serious implications for increased crop productivity and entrepreneurship of smallholder farmers.

**Table 3- 19: Types of Draught Resistant Crops and average area of farmland covered in 2011, SShFs 2012**

County/ Crops	Rice		Cassava		Bitter ball		Total		Average covered by Draught Resistant crops Area in hectares
	#	%	#	%	#	%	#	%	
1=Bong	2	40	2	40	1	20	5	100	1.5
2=Gbarpoplu	0	0	3	100	0	0	3	100	6.5
3= Cape Mount	0	0	5	100	0	0	5	100	3.1
4=Margibi	0	0	5	100	0	0	5	100	2.9
C&WRsL	2	11	15	83	1	6	18	100	3.2

In order to ensure higher productivity, the number of hectares covered by draught resistant crop varieties is important in Liberia, where desertification is fast approaching, particularly in the C&WRsL. The survey of smallholder farmers in the two regions indicates that draught resistant varieties of crops covered an average of 3.2 hectares. Further, Gbarpolu, which had draught

resistant varieties for cassava alone covered an average hectares of 6.5, followed by Margibi (3.1 hectares). The low level of hectares covered by draught resistant crops varieties is a clear indication that the efforts of smallholder farmers to increase agricultural productivity and reduce the impact of climate change is futile, and will not ensure sustainable livelihood and entrepreneurship.

### **3.15 Relation of Rainfall and Sunshine with Smallholder Farmers' Productivity**

Liberia is blessed with abundant rainfall and sunshine. Nearly half of the West African Country's seasons are equally divided between rainfall and sunshine, with each lasting for six (6) months. However, the absence of an effective early warning system (i.e., a system of meteorological stations) that could allow farmers and other stakeholders to make informed decisions on production strategies (Tarway-Twalla, 2008) is enormously impacting on the progress of smallholder farmers. Further, the degradation of the agricultural lands and the lost of biodiversity, put the production and entrepreneurship of smallholder households farmers at risk.

According to the data from the 2012 survey of smallholder farmers from the C&WRsL, 30% of the 864 farmers' crop production level was affected by undue rainfall. The high level of effects on the farms of these predominantly rural people has serious implications for food security and the achievement of the end hunger development [programme of the Ministry of Agriculture in Liberia.

Similarly, the rainfall pattern in Liberia affected the C&WRsL in 2011. The 2011 smallholder farmers interviewed revealed that of the 864 farmers, 45% were affected by climate change through sunshine. Gbarpolu and Grand Cape Mount Counties were worst of, with 60% and 56% respectively. The lack of instrument to detector the weather (sunshine and rainfall) is seriously impacting on agricultural productivities in the short run and entrepreneurship of farmers in the intermediate and long run (Fig4).

### **3.16 Average Area of Farmland Covered by Rainfall and Sunshine**

The research has shown that 21.6% of smallholder farms were affected by flooding due to unchecked rainfall system in Liberia. At the county, the 2011 farms of smallholder farmers in Bong and Grand Cape Mount Counties were most affected by climate change through excessive and unstable rainfall pattern in Liberia. The effect of sunshine on smallholder farmers' farmland

and subsequent productivity was also high. The research further revealed that Gbarpolu was most affected (28.3%); followed by Grand Cape Mount (27.2%). The least sun or draught affected counties were found in the central region (Bong and Margibi). A comparative analysis of the study reflects more sunshine impact on average farmland cultivated as compared to rainfall (Table 3.20).

**Table 3- 20: Average Farm Area (in hectares) Affected by Excessive Rainfall and Sunshine, SShFs 2011**

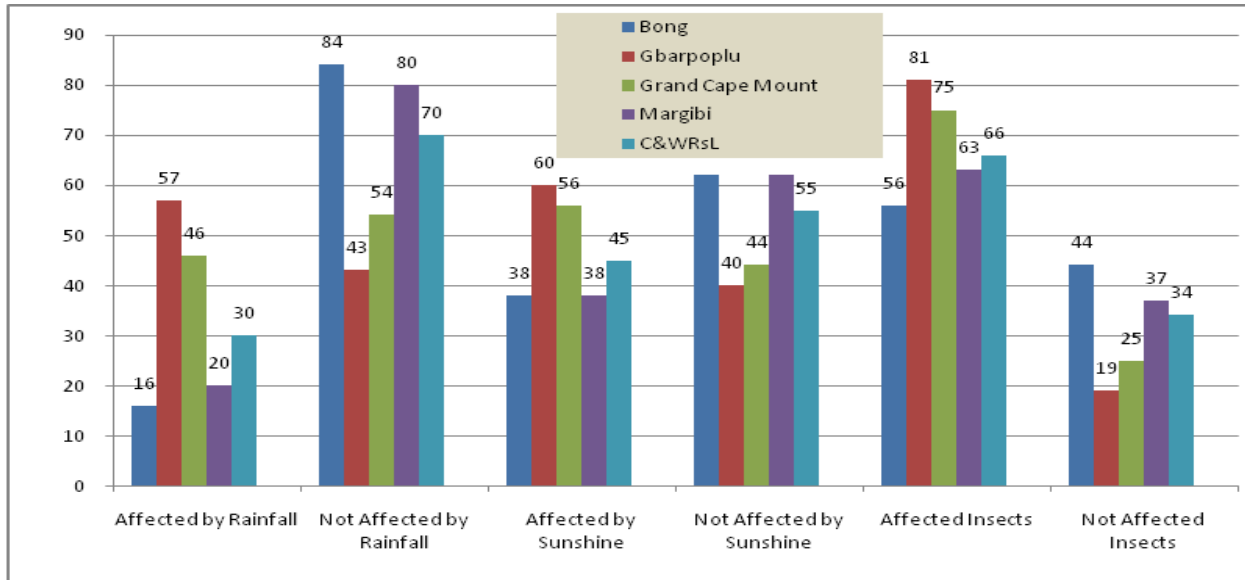
County	Average Area (in%) affected by excessive Rainfall	Average Area (in %) Affected by excessive Sunshine
Bong	23.0	23.8
Gbarpoplu	21.0	28.3
Grand Cape Mount	22.2	27.2
Margibi	20.0	23.8
C&WRsL	21.6	25.7

The issue of minimum number of Ha of major food crop under Integrated Plant & Pest Management (IPPM) in most parts of Liberia comes true when it comes to the 2012 study in the C&WRsL. A research conducted by Agriculture Sector Rehabilitation Project at the Ministry of Agriculture under the support of the AfDB shows that 0.2% in 2010 and 0.1% in 2009 of 1600 smallholder farmers' farms had partial IPPM system covering up to 1-3 hectares of farmland (MoA, 2011). The lack of IPPM is demonstrated by the profuse destruction of farming products by rodents, birds and insects in accordance with the 2012 research on smallholder farmers in the C&WRsL.

### **3.17 Relation of Insects and Rodents with Smallholder Farmers' Productivity**

The study indicates that 66% of the 864 smallholder farmers interviewed admitted that their crops were destroyed in 2011 by insects. The destruction of crops by insects affected 81% of farmers in Gbarpolu and 56% in Bong. Similarly, the report revealed that 85% of the 864 farmers' food crops were destroyed by rodents in the two regions in 2011. The destruction inflated by rodents affected 95% of the major food crops produced in Gbarpolu and Grand Cape Mount Counties. Moreover, the destruction of smallholder farmers' crops in Bong was 78% while that of Margibi was 82%. The overall effects of rodents on food crop (rice, cassava and vegetables) were higher than that of insects with 85% and 34% respectively (Fig6).

**Figure 6: Status of the Effect of Rainfall, Sunshine and Insects on Smallholder Farmers' Farm in 2011, SShFs , 2012**



Due to the lack of IPPM, including spray to destroy insects and the absence of fence around farms, a significant proportion of the smallholder farms were affected by insects and rodents in most parts of Liberia. This has been confirmed by studies conducted by government international partners in Liberia. Such studies covered the southeast, northern, northern and central parts of the country. The 2011 survey conducted on smallholder farmers further in the C&WRsL shows similar results as previous studies.

### **3.18 Average Area of Farmland Covered by Insects and Rodents**

The survey report also shows rodents that insects destroyed an average farm area of 27.3% while affected 26.0%. These high averages of farm areas invested by insects are clear indications that hunger cannot easily end in Liberia if the protection of crops using IPPM and other methods to alleviate the destruction of insect are not achieved. The insect destruction of crops was severe in Gbarpolu (29.9%), followed Grand Cape Mount (28.9%). The minimum impact of insects was experienced in Bong County which hosts CARI - the nation's highest agricultural research center. Furthermore, Gbarpolu and Grand Cape Mount were also most affected by rodents in C&WRsL. The trend of the destruction of insects was not significantly different from those of rodents. Like the insects, the least effect of rodent was found in Bong County (Table 3.21).

**Table 3- 21: Average Number of Farms Area (in %) Affected by Insects and Rodents, SShFs 2011**

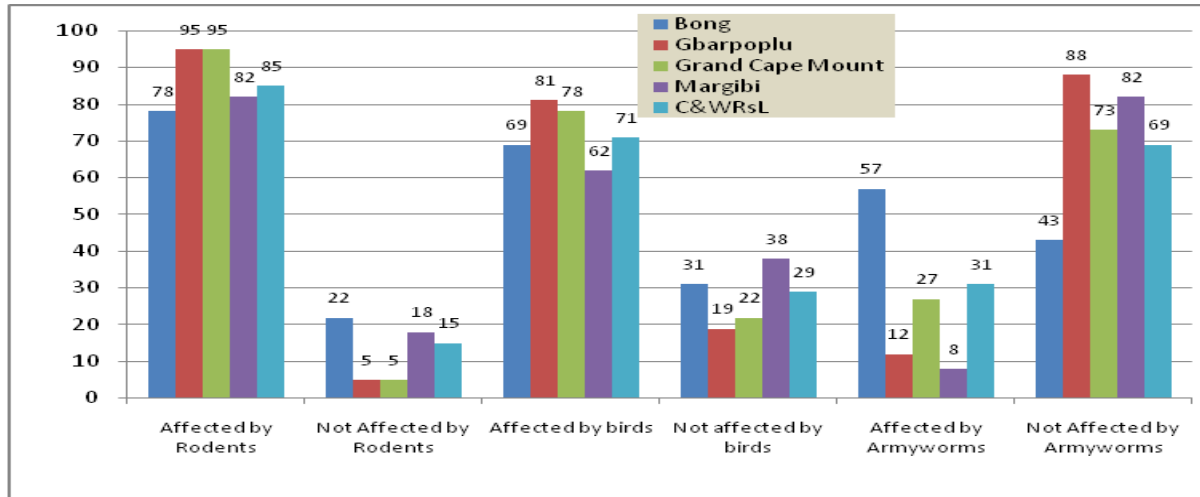
County	Average Areas (in%) affected by insects	Area (in%) affected by Rodents
Bong	24.5	23.8
Gbarpoplu	29.9	28.2
Grand Cape Mount	28.9	26.0
Margibi	27.1	27.8
C&WRsL	27.3	26.0

### **3.19 Relation of Birds and Armyworms with Smallholder Farmers' Productivity**

Birds and armyworms are some of the major climate change issues that retard the progress of smallholder farmers in Liberia. In the past three years, armyworms have made headlines for the destruction of farm produce, as well as the pollution of drinking water in many villages. The research on smallholder farmers has shown that birds affected 71% of the 864 respondents interviewed while that of armyworms was 31%.

The county level analysis shows that the birds were responsible for the destruction of 81% of the crops produced in Gbarpolu while that of Grand Cape Mount County was 78%. The destruction of farm crops by armyworms is major symptom of variation in the climatic conditions. The impact of armyworms was severe in Bong (57%) followed by Grand cape Mount 27%. The overall impact of armyworms on smallholder farmers was less than that of birds. The increased in the armyworm and birds, was minimize prior to the 14 year war. During and after the civil conflict in 2003, there have been tremendous efforts by government to support smallholder farmers to meet their livelihood needs. However, the post-war support to smallholder farmers during and after the war focused on relief type of farming, which made little efforts in introducing IPPM to reduce the high level of crops destruction (Fig4).

**Figure 7: Effect of Rodents, Birds and Armyworms on Smallholder Farmers' Farm in 2011, SShFs 2012**



In a report titled “LIBERIA: Reclaiming rice from rats and rot” it was reported that every year Liberian farmers lose 60 percent of their harvest to birds and vermin or poor storage conditions, contributing to country-wide food insecurity (UNHCR, 2012). As a result of this situation, government and its partners need to put more funding into pest-management and storage facilities. The Ministry of Agriculture estimates 52,000 tons of rice out of 144,000 produced in 2007 was lost, while 44,027 tons of a 155,293 ton harvest was lost in 2008 (UNHCR, 2012). The ministry believes that interaction with farmers has shown the lack of basic knowledge on pest control. It was estimated that eight out of 10 rural Liberians are moderately or highly vulnerable to food insecurity.

### **3.20 Average Area of Farmland Covered by Birds and Armyworms**

During the country’s 14 years of conflict, which ended in 2003, production plummeted, and Liberians went from importing 30 percent to 60 percent of their rice needs, an FAO adviser mentioned. It is also believed that production has not recovered since, leading the Agriculture Ministry to try to reverse the trend by encouraging Liberians to return to their farms. But the high level of harvest lost is reversing efforts by farmers to intensify to production boom food crop (MPEA, 2006). The argument has been further strengthened by results of the survey of smallholder farmers in C&WRsL in Liberia. The survey indicates that birds destroyed an average of 32.4% of the farmland of smallholder farmers. The most affected counties were Gbarpoplu and Grand Cape Mount with 39% and 39.8% respectively. Also, Bong County and Margibi were most

affected by armyworms. The average land area covered by armyworms in the two regions was 36.8% (Table 3.22).

**Table 3- 22: Average Farms Area (in %) Affected by Birds and Armyworms, SShFs 2011**

County	Area (in %) Affected by Birds	Area (in %) Affected by Armyworms
Bong	26.6	41.6
Gbarpoplu	39.0	21.1
Grand Cape Mount	39.8	24.4
Margibi	28.9	36.7
C&WRsL	32.4	36.8

The impact of all forms of climate change activities mentioned in the study affect productivity and entrepreneurship of smallholder farmer. Accordingly, 96% of the 864 farmers experienced the impact of climate change on agricultural productivity and entrepreneurship in the two regions. They indicated that climate change activities affected their productivity and the length of entrepreneurship. Although there is differential of the impact of climate change on productivity and entrepreneurship of ShFs, it is heavily felt in the Western Region (Gbarpolu and Grand Cape Mount Counties) than in the Central Regional counties of Bong and Margibi Counties (Table 3.23). Similarly, respondents from FGDs and KIIs confirm the impact of climate change on ShFs' productivity and entrepreneurship.

**Table 3- 23: Famers by Whether Climate Change Impact Affect Productivity and Entrepreneurship, SShFs 2012**

County	Climate Change Impact Affects Productivity & Entrepreneurship		Climate Change Impact Does Not Affect Productivity & Entrepreneurship		Total	
	#	%	#	%	#	%
Bong	305	95	17	5	322	100
Gbarpolu	125	97	4	3	129	100
Grand Cape Mount	186	98	4	2	190	100
Margibi	214	96	9	4	223	100
Total	827	96	37	4	864	100

### 3.21 Entrepreneurship of Smallholder Farmers

The sale of food crops included rice, cassava and vegetables. Although food insecurity is high in the Central and Western Regions of Liberia, food crops are sold during and after harvest to meet other basic needs of smallholder families' households. The sale of rice affected both upland and lowland production of the commodity in the two regions. Of the 864 smallholder farmers, 61% made upland farmer. Moreover, of the 609 farmers who made upland rice farm, 55 percent never sold rice. Similarly, more upland smallholder rice farmers sold rice as compared to those who



made undeveloped lowland rice farms in 2011. The research also shows that of the 333 undeveloped lowland rice farmers, 50% sold rice. Gbarpolu County farmers sold the highest amount of kg upland and undeveloped bags of rice, followed by Grand Cape Mount County (Table 3.24).

**Table 3- 24: Rice Selling Status for Upland and Undeveloped Lowland in 2011, SShFs 2012**

County	Upland rice per kg bag						undeveloped Lowland Rice per kg bag					
	Sold Rice		Never Sold Rice		Total		Sold Rice		Never Sold Rice		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Bong	79	30	183	70	262	100	58	41	85	59	143	100
Gbarpolu	76	73	28	27	104	100	40	66	21	34	61	100
Grand Cape Mount	73	60	49	40	122	100	44	65	24	35	68	100
Margibi	48	40	73	60	121	100	25	38	41	62	66	100
C&WRL	276	45	333	55	609	100	167	49	171	51	338	100

### 3.22 Sale of Seed and Clean Rice

The sale of seed and clean kg bag of rice or both indicated that smallholder farmers sold more clean upland rice than undeveloped land rice or both. There was more sale of upland seed kg bags of rice in Bong and Gbarpolu as compared the rest of the counties. Similarly, there were clean kg bags of rice sold in Bong and Margibi Counties while Gbarpolu and Grand Cape mount counties sold the highest amount of both clean and seed rice upland kg bags of rice. There sale of undeveloped lowland rice per kg was higher for clean kg bags of rice than for seed rice. Of the total kg bags of rice sold, upland rice was more than undeveloped lowland kg bags of rice (Table 3.25).

**Table 3- 25: Sale of Clean and Seed Rice by Upland and undeveloped lowland Rice in 2011**

County	Type of Upland Rice Per kg Bag Sold								Type of undeveloped Lowland Rice per kg bag Sold							
	Seed		Clean		Both		Total		Seed		Clean		Both		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Bong	12	15	58	73	9	11	79	100	12	21	43	74	3	5	58	100
Gbarpolu	12	16	39	51	25	33	76	100	12	30	16	40	12	30	40	100
Grand Cape Mount	10	14	41	56	22	30	73	100	12	27	21	48	11	25	44	100
Margibi	5	10	37	77	6	13	48	100	4	16	17	68	4	16	25	100
C&WRL	39	14	175	63	62	22	276	100	40	24	97	58	30	18	167	100

The average cost of kg bag of rice sold per county shows that upland seed rice was more expensive than clean rice. In addition, upland seed rice was more expensive in Bong and Grand Cape Mount with US\$90.09 and US\$81.08 respectively. Like upland rice, the cost of undeveloped lowland seed rice was expensive than clean rice while the cost of seed rice in Bong

and Grand Cape Mount Counties was higher than the rest of the counties in the two regions. The overall cost of undeveloped lowland kg bag of seed rice was US\$89.53 as shown in Table 3.26.

**Table 3- 26: Average Cost of Seed and Clean Rice Sold by Types of Farmland in 2011, SShFs 2012**

County/Price	Upland Rice Per kg Bag				Undeveloped Lowland Rice Per kg Bag			
	Seed		Clean		Seed		Clean	
	L\$	US\$	L\$	US\$	L\$	US\$	L\$	US\$
Bong	6666	90.09	3966	53.59	7083	95.72	3547	47.93
Gbarpoplu	5000	67.56	4167	56.31	5833	78.83	4375	59.12
Grand Cape Mount	6000	81.08	3841	51.91	7500	101.4	2976	40.22
Margibi	4500	60.81	3176	42.91	5000	67.57	3676	49.68
C&WRL	5705	77.09	3814	51.54	6625	89.53	3582	48.41

### 3.23 Rice Sale During and After Harvest

During harvest, lesser number of farmers sold rice than after harvest. Also, ShFs in Gbarpolu and Grand Cape Mount Counties sold more rice during harvest as compared with after harvest. On the sale of rice after harvest, both Gbarpolu and Grand Cape Mount were the highest, with 51% and 41% respectively. Similarly, 33% of farmers sold rice after harvest than during harvest in the C&WRsL in 2011. The sale of rice during harvest was lesser than after harvest. The lesser sale of rice can be attributed to the availability of more rice in each household to the extent that no one wants to sell. The number of persons selling rice after harvest increased because those who had lesser harvest are forced to buy rice in order to survive. The period during which many smallholder farmers sell rice is described as hunger season in Liberia, which varies from one region to another (Table 3.27).

**Table 3- 27: Sale of Rice per Salmon Cup During and After Harvest, SShFs 2011**

County	During Harvest						After Harvest					
	Sold rice		Never Sold Rice		Total		Sold Rice		Never Sold rice		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Bong	54	18	240	82	294	100	74	25	221	75	295	100
Gbarpolu	46	40	68	60	114	100	58	51	56	49	114	100
Grand Cape Mount	57	39	90	61	147	100	58	40	88	60	146	100
Margibi	25	17	118	83	143	100	42	29	101	71	143	100
C&WRL	182	26	516	74	698	100	232	33	466	67	698	100

### 3.24 Level of Cassava and Vegetable Sale

Of the 747 farmers that made cassava farms, 67% sold the product, with Bong and Margibi Counties leading the sale in the C&WRsL in 2011. The study further shows that the Central

Region sold more cassava than the western regions of Liberia, which includes Gbarpolu and Grand Cape Mount Counties (Table 3.28).

**Table 3- 28: Cassava selling Status of Smallholder Farmers in 2011, SShFs 2012**

County	Sold Cassava		Never Sold Cassava		Total	
	#	%	#	%	#	%
Bong	218	82	48	18	266	100
Gbarpoplu	63	58	46	42	109	100
Grand Cape Mount	84	52	79	48	163	100
Margibi	138	66	71	34	209	100
C&WRL	503	67	244	33	747	100

Of the 244 farmers who never sold cassava 41% produced fufu; 54% produce farina or gari while 5% used their cassava produce for other things. Like the sale of cassava, farmers from the Central Region of Liberia produced more fufu while those from the Western region produced more farina or gari in the two regions in 2011 (Table3.29).

**Table 3- 29: Distribution of Farmers Who Never Sold Cassava by Other use of the Product, SShFs 2012**

County	Produce Fufu		Produce Farina		Produce other things		Total	
	#	%	#	%	#	%	#	%
Bong	34	71	7	15	7	15	48	100
Gbarpoplu	11	24	34	74	1	2	46	100
Cape Mount	16	20	61	77	2	3	79	100
Margibi	39	55	29	41	3	4	71	100
C&WRL	100	41	131	54	13	5	244	100

Smallholder vegetable farmers had the highest percentage of entrepreneurship in the C&WRsL. Of the 547 vegetable farmers, 93% sold vegetables in 2012. The majority of the vegetable farmers indicated that the perishable nature of the crops and the lack of post-harvest storage facility to preserve them led to the high level sale of the vegetable as compared with cassava and rice. According to interviews from key informants (KIIs and FGDs), in addition to such for money to meet the needs of ShFs, the level of crop sale is dependent on the perishable of the product. Smallholder farmers from Gbarpolu and Grand Cape Mount Counties in the Western region had the highest entrepreneurs as compared with Bong and Margibi Counties (Table 3.30).

**Table 3- 30: Entrepreneurship Among Vegetable Farmers in 2011, SShFs 2012**

County/Price	Sold Vegetables		Never Sold Vegetables		Total	
	#	%	#	%	#	%
Bong	187	90	20	10	207	100
Gbarpoplu	100	98	2	2	102	100
Grand Cape Mount	112	97	3	3	115	100
Margibi	112	91	11	9	123	100
C&WRsL	511	93	36	7	547	100

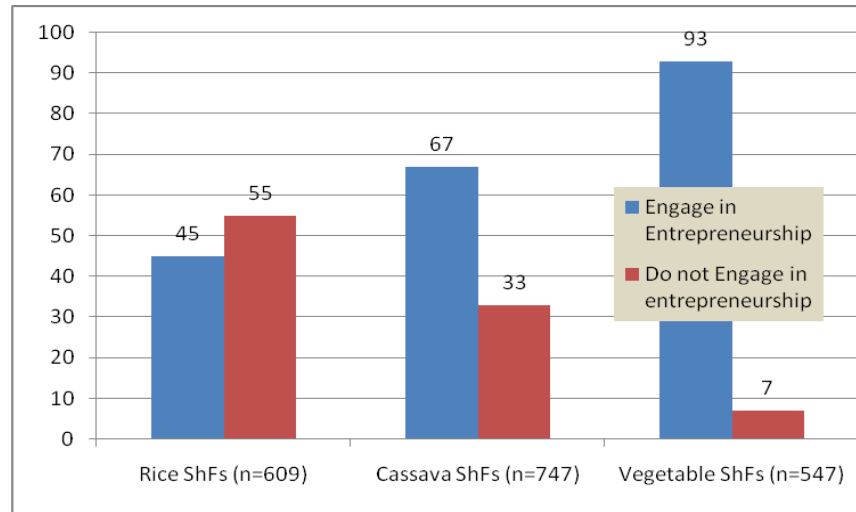
The average amount of money received from the sale of vegetable is higher than those of rice and cassava. The overall average amount received from all of the three crops is US\$68.97 (L\$5,104). This amount is higher than the average start-up capital and income of farmers in the Central region of Liberia (CRL). In his article, Tarway-Twalla found that the mean amount start-up capital informal business owners was US\$60.25 while mean profit level was US\$30.97 (Tarway-Twalla, 2011). Accordingly, the average money received by ShFs for vegetable was US\$83.30; that of rice was US\$66.64 and US\$56.96 for cassava (Table 3.31).

**Table 3- 31: Average amount money received from Cassava, Vegetable and Rice Sold by ShFs in 2011, SShFs 2012**

County/ Cost	Average Cost of Cassava Sold		Average Cost of Vegetable Sold		Average Cost of Rice Sold	
	L\$	US\$	L\$	US\$	L\$	US
Bong	4083	55.17	5628	76.06	5316	71.83
Gbarpoplu	4722	63.81	7300	98.65	4844	65.46
Grand Cape Mount	4345	58.72	6473	87.48	5079	68.64
Margibi	4275	57.78	6585	88.98	4088	55.24
C&WRsL	4215	56.96	6164	83.30	4932	66.64

Of the three major food crops produced in Liberia, vegetable has the highest entrepreneurship. This information was proven by the data from the 2012 survey of smallholder farmers, where 93% of the 547 vegetable farmers engaged in entrepreneur activities. The second highest crop that attracted sale of agricultural product among ShFs was cassava, with 67% of the 747 farmers who produced cassava engaging in entrepreneurship in 2011. However, the level of entrepreneurship was limited to few months during and after harvest, which is not sustainable. Interview with smallholder farmers confirmed that the short duration of entrepreneurship was due to the low productivity for rice and lack of post-harvest storage cassava and vegetables. Results from FGDs and KIIs further confirmed that the entrepreneurship of ShFs was highly affected by low productivity and the lack of modern storage facilities. The participants from the interviews (KIIs and FGDs) believe that factors such as the technology for farming and the impact of the environment had adverse effect on productivity while the low level of harvest also had greater influence over the entrepreneurship of farmers.

**Figure 8: Percentage of ShFs who engaged in entrepreneurship in 2011, SShFs 2012**



#### **4. Findings and Recommendation**

##### **4.1 Results and Conclusion**

The mean age 41 years suggests that a smallholder farmer in the C&WRsL is a middle age adult. The mean age suggest that most youths are not engaged in farming. Male heads of households was 72% of the 864 ShFs while 37% of the farmers were illiterate. The research shows that although 81% of the 864 farmers were engaged in rice farming, counties along the Atlantic Ocean (Margibi and Cape Mount) made inadequate rice farms due to the lack of fertile soil as compared to Bong and Gbarpolu that are located in the hinterlands. Ninety-eight (98) percent of the 24 key informants and 96% of focus groups discussants confirm most parts of the land of counties along the Atlantic Ocean are not suitable for rice farming because of the sandy nature of the farming land. As a consequence, most of the counties along the Ocean are engaged in cassava farming.

It was found that 97% of women owned farmland while 98% each independently made household decision and participate in community development decision makings. This is an indication that women in the region have the freedom to participate in decision makings that affect their future. It is also clear that women's farmland ownership for farming purposes have improved since the end of the 14-year war, particularly with the election of Liberia's Female President. The increased level of farmland ownership and independent decision making has the propensity of enhancing women's entrepreneurship.

The role of youth in smallholder farming activities is pivotal given the manual labor intensity of the agricultural sector in the regions of study. However, the research revealed that most youths do not participate in the smallholder agricultural activities in Liberia. Hence, 44% of youths in the regions under study did not participate in farming activities. But, instead, most of them were mainly engaged in gold/diamond mining. In addition, it was observed that the second highest activities for non-farming youths in the C&WRL was motor cycle transport services commonly known in Liberia as “pehnpehn”.

All of the 864 ShFs used traditional tools such as cutlasses and axes for land clearing to plant rice, cassava and vegetables. The predominant use of traditional tools verifies the fact that most ShFs in Africa are so poor that, even with government support, it is difficult to make them to engage in mechanize farming (Takeshima and Salau, 2006). The dominant use of traditional tools for clearing that does not add value to the farming process. The planting methods for rice and cassava were 93% and 82% traditional respectively. Even the rice harvesting method which is 85% knife (instead of sickle) is also traditional and does not add value to farmers' productivity. The traditional nature of the methods and tools for clearing of land and planting seem to undermine productivity and entrepreneurship as compared with improved technology that could increase yield of ShFs.

The study revealed that the average crops produced for rice and cassava was 276 kg and 535 kg bags respectively. In addition, it was further shown that an average of 344 kg bag of vegetables was also produced in 2011. The study indicated that the entrepreneurship was limited to few months during and after the harvest seasons. The research data on food crops entrepreneurship of ShFs was limited to few months during and after the harvest seasons. Hence, it was not sustained for a longer period to ensure the continuity of business. The upland rice sale records in 2011 revealed that 45% of ShFs' sold rice while 49% of the farmers sold undeveloped lowland rice. The low productivity from three food crops could lead to the short duration of entrepreneurship.

The cost of upland rice per kg bag of seed rice was US\$77.09 while that of upland clean rice was US\$51.54. Moreover, it was realized also that undeveloped lowland kg bag of seed rice was sold for US\$89.53 while clean rice was sold for US\$48.41. Hence, it was evident from the survey of smallholder farmers that seed rice was more expensive than clean rice in all of the four counties. The higher price for seed rice could be due to its use for planting purposes. The expensive nature of seed rice could have serious implications for low productivity and entrepreneurship of ShFs.

The study also shows that post-harvest technology in the C&WRL was weak and purely traditional. This was further evident by the fact that 48% the 698 smallholder farmers dried rice on the mat and on the ground while all rice farmers de-husk rice using traditional methods and tools (without rice milling machines). It was discovered that the post-harvest storage facilities were also traditional as 98% of rice farmers used bush-tank (rice kitchen) and attic as principal storage facilities. As a consequence of the lack of improved post-harvest facilities such as rice threshers, farmers used traditional methods and materials such as feet and beating/pounding as a means of threshing rice. The use of predominantly traditional method of post-harvest technology has implications for huge post-harvest losses. Therefore, there is a need to introduce and support the use of improved post-harvest technology among smallholder farmers in the two regions.

The research shows that the lack of motor roads and transport facilities (i.e., vehicles) affect access to value chain processes. It was further shown that the lack of adequate enabling environment to promote value chain processes affect the amount of agricultural produce sold in local markets in the C&WRL. For example, 97.9% of the 864 farming households interviewed carried harvested rice to town physically on their heads or in wheel barrows. The research indicated further that 77% of farmers carried produce to the market without car due to lack of access to motor roads or motorized transport system. Hence, there is a need to for government to extend its farm-to-market roads development in the C&WRsL in order to reduce the incidences of non-motorized mode of transporting produce to the market, which is not productive and effective in promoting entrepreneurship among farmers.

The research revealed that the absence of modern equipment to process rice and cassava further affected access to post-harvest facilities and value chain processes in the C&WRL. This is so because, for example, it was found that due to the lack of mailing machines, 85% of farmers processed cassava into farina and fufu using traditional methods, which did not add much value that could sustain the marketability of their produce and increase the overall entrepreneurship of ShFs in Liberia. In light of the above, government and its development partners should improve value chain processes in the agriculture sector by introducing and supporting the use of modern agro-processing equipment, particularly for rice and cassava in the regions under study.

The lack of inputs and access to credit to increase productivity was one of the key issues that affected smallholder farmers' progress in ensuring food security and sustained entrepreneurship in Liberia. According to data from the research, 76% of the 864 ShFs did not use fertilizers (for rice, cassava and vegetable production) in the 2011 farming year. In addition, it was observed that 78% of the 864 farmers never received loan for agricultural purposes. In order to increase productivity of framers, there is a need for government increase access to agricultural loans in order to stimulate productivity and the entrepreneurship of farmers. For example, it was found in Tanzania that smallholder farmers using hand-hoe and farmers with cash incomes outside their farm holdings (petty business) were more efficient (Msuya et al, 2008).

There is a need also to increase the supply of fertilizer, although the use of fertilizer alone does not lead to high productivity. Studies in Tanzania also prove that farmers who use agrochemicals were found to be less efficient (Msuya et al, 2008). Reardon believes also that the use and role of fertilizer in enhancing African agricultural productivity has become a surprisingly controversial issue (Reardon et al, 1997). Some of the reasons given for downgrading the importance of fertilizer in Africa are: its riskiness under conditions of low or erratic rainfall; its relatively low yield response in Africa when compared to results in Asia and Latin America (Reardon et al, 1997). In spite of the above, fertilizer use if properly carried out could influence the level of productivity among smallholder farmers in Liberia.

The research indicated that climate change affects the productivity of farmers; hence, it hinders their entrepreneurship as well. The research data revealed that 98% of farmers had no draught resistant varieties of crops. Further, 30% of farmers reported the destruction of their farms by undue rainfall. In addition, 45% of farmers revealed the impact of sunshine on their farms. It was found that climate change impact also influenced the destruction of 66% farmers' produce by insects; 85% by rodents; 71% by birds and 69% by armyworms. The destruction of crops due to environmental impact have implications for the level of productivity and entrepreneurship in the two regions.

Of the three major food crops produced in Liberia, vegetable had the highest entrepreneurship. In reality, 93% of the 547 vegetable farmers engaged in entrepreneur activities. The second highest crop that attracted sale of agricultural product among ShFs was cassava, with 67% of the 747



farmers who produced cassava engaging in entrepreneurship in 2011. The number of persons selling rice after harvest increased because those who had lesser harvest are forced to buy rice in order to survive. The period during which many smallholder farmers sell rice is described as hunger season in Liberia, which varies from one region to another. The average amount of money received from the sale of vegetable is higher than those of rice and cassava. The overall average amount received from all of the three crops was US\$68.97 (L\$5,104). Moreover, the average money received from the sale of vegetable, rice and cassava in the region in 2011 were US\$83.30, US\$66.64 and US\$56.96 respectively. In addition, the level of entrepreneurship was limited to few months during and after harvest, which is not sustainable.

#### **4.2 Policy Implications and Recommendation**

*Discussion and Policy Implications:* Given the lack of existing research on how productivity and climate change influence smallholder farmers' entrepreneurship in post-conflict agricultural development in Liberia and the important role in rebuilding the social and economic fabric of society, the findings of this research have a number of important policy implications and recommendations.

Factors influencing agricultural technology, climate change, productivity and entrepreneurship of smallholder farmers are directly associated with human capacity development. The research in the C&WRsL identified similar capacity issues of ShFs. In addition to quantitative analysis, interviews (KIIs and FGDs) of 48 participants revealed that traditional method of planting and harvesting negatively affect the productivity of smallholder farmers in the four counties covered by the study. Therefore, increased capacity development has implications for enhancing productivity and entrepreneurship of ShFs. As a consequence, the government of Liberia should focus on and invest in capacity building of ShFs in order to ensure high productivity and the entrepreneurship in the two regions.

Further, 95% of the 864 ShFs interviewed see the introduction of new techniques through extension officers, using farmers' field school (FFS) or other procedures as a way of addressing the problems of low productivity and pre and post harvest losses. Expanding and strengthening extension services, including FFSs; providing training, life skills and education, start-up and sustainability loans for smallholder farmers is relevant in enhancing the growth of the

productivity and entrepreneurship of smallholder farmers. The capacity building of smallholder will create an enabling environment for a viable entrepreneurship of smallholder farmers. Therefore, there is a need for the Ministry of Agriculture to provide tools and improve on-farm technology through extension services.

The capacity development of ShFs will improve the output of smallholder farmers above the 2011 level of 276 kg, 535 kg and 344 kg bag for rice, cassava and vegetables respectively. In addition, it will ensure high productivity and ensure the sustainability of farmers' productivity in the regions of study. The study indicated that the entrepreneurship was limited to few months during and after the harvest seasons. But the implementation of the recommendation to improve tools and technology will sustain the entrepreneurship of farmers that will go beyond the seasonal trade and commerce among smallholder farmers in the regions. Other studies conducted in the western (IFAD-MOA, 2011) and southeastern (AfDB-MOA, 2011) parts of Liberia identified traditional tools and the lack of improved transport and agricultural inputs as major causes of low productivity and entrepreneurship of ShFs.

Evidences from the study shows that seed rice was more expensive than clean rice in all of the four counties. Hence, government should strengthen supply of inputs including seed rice as the average price of US\$77.09 for upland seed rice and US\$89.53 per kg bags of lowland seed rice was high and could influence the low productivity of farmers. Moreover, 76% of the 864 ShFs did not use fertilizers (for rice, cassava and vegetable production) in 2011 farming year. In addition, it was observed that 78% of the 864 farmers never received loan for agricultural purposes. Also 44% of farmers reported the non-participation of youth in agricultural activities. But instead most of them were mainly engaged in gold/diamond mining and motor cycle transport services. Hence, there is a need to encourage the involvement of youth in agriculture activities.

The study also shows that post-harvest technology in the C&WRL was weak and purely traditional. This was further evident by the fact that 53% of 102 smallholder farmers dried rice on the bear ground while all rice farmers de-husk rice using traditional methods and tools. It was discovered that the post-harvest storage facilities were also traditional as 98% of rice farmers used bush-tank (rice kitchen) and attic as principal storage facilities. As a consequence of the

lack of improved post-harvest facilities such as rice threshers, farmers used traditional methods and materials such as feet and beating/pounding as a means of threshing rice. All of the above traditional post-harvest technologies have implications for high level of post-harvest losses. Hence, there is a need for government to help in improving harvest and post-harvest management of crops in order to enhance productivity and entrepreneurship.

The research shows that the lack of motor roads and transport facilities (i.e., vehicles) affect access to value chain processes. It was further shown that the lack of adequate enabling environment to promote value chain processes affect the amount of agricultural produce sold in local markets in the C&WRL. For example, 97.9% of the 864 farming households interviewed carried harvested rice to town physically on their heads or in wheel barrows. The research indicated further that 77% of farmers carried produce to the market without car due to lack of access to motor roads. The research revealed that the absence of modern equipment to process rice and cassava further affected access to post-harvest facilities and value chain processes in the C&WRL. This is so because 85% of farmers processed cassava into farina and fufu using traditional methods. In light of the above, it is important for government to improve the development of farm-to-market roads and provide food crops processing equipment in rural parts if the country is to promote high productivity and the entrepreneurship among smallholder farmers.

The research indicated that climate change affects the productivity of farmers; hence, it hinders their entrepreneurship as well. The research data revealed that 98% of farmers had no draught resistant varieties of crops; 30% of farmers reported the destruction of their farms by undue rainfall; 45% of by sunshine; 66% reported destruction of insects; 85% by rodents; 71% by birds and 69% by armyworms. This means that climate change interventions have implication for enhanced productivity of smallholder farmers. Hence, in order to limit the impact of climate change activities on the productivity of ShFs, integrated pest and plant management technology should be provided to smallholder farmers in the region. In addition, weather monitoring information should be made available in the regions in order to reduce the effect of excess sunshine and rainfall on the productivity of ShFs.

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