Agricultural Innovations and Adaptations to Climate Change Effects and Food Security in Central Africa: Case of Cameroon, Equatorial Guinea and Central Africa Republic

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Agricultural Innovations and Adaptations to Climate Change Effects and Food Security in Central Africa: Case of Cameroon, Equatorial Guinea and Central Africa Republic

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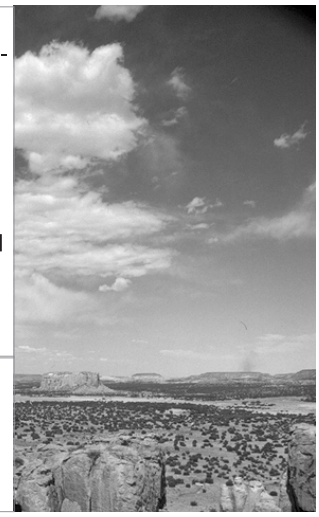

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1. Introduction

Climate change is increasingly altering ecosystems which are the foundations of agricultural productivity worldwide. This has brought uncertainties in the use of farm inputs as well as food security. Challinor et al. (2009) noted that uncertainties in regional crop production are not only related to biophysical data, but rather to socio-economic and crop management factors which affects food security. Africa's economy is predominantly rural based with agriculture (farming, livestock, forestry and unconventional farming methods) accounting for about 40% of the GDP (FAO, 2008). A greater proportion of Africa's population strives on agriculture. In Africa, agricultural productivity greatly depends on precipitation and natural conditions of the environment.

Central Africa lies between longitude 9o _ 31o E and latitude 9o to 24o N and includes Cameroon, Central Africa Republic, Gabon and Equatorial Guinea. It lies in the inter-tropical zone with an Equatorial type of climate. Despite its location, climatic conditions are unevenly distributed. These variations are as a result of uneven rate of precipitation, varying temperatures and altitudes that give rise to different ecological zones which to a great extent are affected by the incidence of climate change. According to Sigha and Mafany (2008), rainfall patterns in Cameroon on which local agricultural practices rely are inconsistent; resulting in crop failure, post harvest losses, food insufficiency and diseases in many parts of the country. The people of Central Africa cannot relocate because of the perils of climate change so they have to confront it by evolving innovative adaptation strategies to mitigate and cope with the climatic effects.

The main thrust of this works is therefore to identify, evaluate and document innovative adaptation strategies and their effectiveness in coping with climate change effects by answering the following questions:

- What is climate change?
- What is the perception of the local people towards climate change?
- What are they doing about it?
- What innovative agricultural practices are they evolving to cope with climate change?
- How good and effective are these indigenous local practices/innovations?
- How best can we exploit these local innovations for the development of an effective agricultural extension package that can cope with climate change?

Objectives

The main objective of this study is to identify agricultural innovations and adaptations for climate change effects and food security in Central Africa.

Specifically, the study set to:

1. Evaluate climate change perception, and identify on a general scale emerging indigenous agricultural innovations in the study area.
2. Evaluate indigenous agricultural innovation and good practices suitable for climate change adaptation that will effectively sustain food security in Central Africa.

2. Literature Review

Africa is one of the most vulnerable areas to climate change impacts (WHO, 2001). Several efforts towards the estimation of crop production for regions in temperate, sub-tropical and tropical climate zones have been made recently in the framework of regional planning, climate impact adaptation measures and food security studies (Lal et al., 1993; Soler et al., 2007; Hartkamp et al., 2004; Garcia et al., 2006; Sultan et al., 2005; Liu et al., 2007). This has led to holistic management practices in both temperate and tropical regions to improve productivity levels while reducing environmental impacts resulting from climate change (Adams, 1999; Savory and Butterfield, 1999). The process of transferring agricultural innovations across agro-ecological and climatic zones is often subject to agronomic constraints (Lybbert and Sumner, 2010). These constraints are mainly related to precipitation variations and the progressive impoverishment of arable land/soils.

According to MINADER (2008) factors that commonly impede agricultural development include: regular soil dryness in certain parts, flooding during heavy rains, poor nature of farm to market roads, the use of rudimentary agricultural tools and the high cost of fertilizers. Reduction of pasture land due to expansion of settlement and farmlands, agro-pastoral (grazers-farmers) conflicts are equally emerging issues of concern. A major challenge that has a cross-cutting effect on all types of agricultural production in Central Africa is water scarcity (Sigha and Mafany, 2008). Climate change is the main reason for this shortage. This is very obvious in the Lake Chad basin where in less than three decades the surface area of water in the lake has reduced to about one tenth its original volume. This is a glaring example of how climate change is adversely affecting agricultural production.

Beside the unabated list of anthropogenic activities that continue to exert a potential pressure on the earth's limited resources and environmental services on this part of the globe, population increase is an emerging challenge to the African continent in the phase of climate change impacts (Katerere et al. 2009). According to Manyong et al. (1996), African researchers and their partners have as a duty to source appropriate innovative strategies in the areas of agricultural and indigenous practices that can help the people of the continent to adapt and cope with the exigencies of climate change.

For 40 years now, the Consultative Group for International Agricultural Research (CGIAR) has been a strong force to developing countries in the area of agricultural innovation (Lybbert and Sumner, 2010). CGIAR has been active in the identification and harnessing of indigenous and emerging agricultural technologies to enable developing countries adapt their emerging agricultural systems to a changing climate. These innovative paths will undoubtedly be achieved through the development and vulgarization of appropriate technology and services from the bench of research that can convert Africans' vulnerability to appropriate resilience, adequate adaptations and effective/efficient copping driving forces (Manyong et al. 1996).

In Central Africa, less than 28.9% of arable land is actually cultivated. Analyses of the cultivated crop areas show some disparity between agricultural zones. Over 30% of the rural population in this region derive their livelihoods from the livestock sector and globally represents 16% of the agricultural sector. The low contribution of the livestock production to the agricultural GDP is, partially, due to the prevailing production system which, for cattle (the dominant livestock species), is nomadism and transhumance.

Smallholders, using simple techniques account for more than two-thirds of all agricultural production in Central Africa. State farms (which are mostly found in Cameroon) are mainly engaged with export crops. Subsistence food crops (sorghum, maize, rice, millet, and cassava), are mainly grown in the grassland northern parts of Cameroon and CAR. Taro, yams, cassava, rice, banana, plantain, maize, potatoes, roots and tubers, avocado, beans, and okra, are grown in the forested southern parts and Equatorial Guinea and are traded largely outside the cash economy. Cash crops (palm kernels, cotton, cocoa, tobacco, rubber, banana, tea, coffee, palm oil and sugar cane), are largely grown in the southern parts of Cameroon, while cotton and groundnuts are grown in the north of Cameroon and CAR (IITA, 1992).

The dominant farming practice in the forest zones of Central Africa is the bush fallow pattern. This involves forest clearing and crop cultivation for 1 to 3 years after which land is left fallow over long periods to restore soil fertility. As the region's population rises, the fallow period is shortening. Mixed cropping, with as many as 10 crops planted together, or sequentially in a single field, is the norm, especially in the forest areas. This system supplies a nutritionally varied diet, as different crops mature successively over the year (IITA, 1992).

According to McCown (2002), innovative strategies in Central Africa, including decision support systems, which help make agricultural science more accessible, adaptive and useful for farmers, are carried out mainly by research institutions. Institute de Recherché Agricole et de Development (IRAD) in Cameroon for example has proposed intercropping techniques especially between some leguminous crops and cotton as a means of improving soil quality during short fallow periods as well as increasing forage production (Olina et al, 1998). Under this scheme, farmers are encouraged to adopt this technique especially as it is less labour intensive. However it requires regular rainfall which as a result of climatic changes has been erratic. Some techniques tested by IRAD are geared towards shortening and improving on the fallow period between cropping seasons. Genetically improved planting materials, new plant spacing and density are also being experimented. As a result of the enormous costs involved in these practices, local communities within their premise have been evolving local strategies for survival. Irrespective of the local nature of these evolved strategies by local farmers, it is important to identify on a general scale, evaluate the ones with good practices for climate change adaptations and document them for eventual vulgarization in the sub-region at large.

3. Methodology

3.1 Study Area

The area of study covers the three Central African countries of Cameroon (CAM), Equatorial Guinea (EG) and the Central African Republic (CAR). The population of the three countries totals about 28 million inhabitants and is unevenly distributed among the three countries.
The Central African Region has a tropical climate - humid in the south but increasingly dry towards the north. In the coastal areas, the average annual rainfall is about 4,060 mm while on the slopes of Cameroon Mountain and other peaks like Mt Bioko, rainfall is almost constant. In the semiarid northwest, annual rainfall measures about 380 mm. A dry season in the north lasts from October to April. The average temperature in the south is 25oC, 21oC on the plateau and 32oC in the north. The study area has ten agro-ecological zones with marked ecological diversity (IRAD, 2008). Its diversity is noticed in its climate, vegetation and soils.

3.2 Sampling

Sampling was done in the agro-ecological zones of the various countries. These zones show distinct ecological diversity with Cameroon having five, the Central African Republic three and Equatorial Guinea two. All the agro-ecological zones in CAR and EG are represented in Cameroon such that trends observed in Cameroon could be extrapolated to the other countries. As a result, Cameroon had more sample targets (600) than Central African Republic and Equatorial Guinea that had 200 each.

The study was carried in two phases. Phase one was a reconnaissance survey to make an appraisal of the particularities of the various agro-ecological zones and identify the agricultural practices, while phase two focused on the administration of questionnaires to respondents in the various agro-ecological zones.

3.3 Data collection technique

Purposive, stratified, random sampling methods and some selected Participatory Rural Appraisal (PRA) tools (semi-structured interviews , focused group discussions, seasonal calendars, activity profile, historical time line, questionnaires, visual assessments, and key-informants), were used for the collection of data on agricultural innovations and adaptations for climate change effects and food security in the region.

Semi-structured interviews and focused group discussions were used to source information from respondents that were unable to read and fill the questionnaires. Seasonal calendars were used to obtain information on the various crops and agricultural practices going on at different seasons. Activity profile sourced information on the various types of daily agricultural activities such as livestock, crop farming, or unconventional farming methods and farm management practices. Historical time line, aided in tracing the various agricultural strategies evolved over the past years in response to the erratic nature of climatic conditions. Visual assessment aided in the appreciation of what had been indicated by respondents.

3.4 Site Selection

The study area was purposively divided in to ten main zones distributed for each country as follows: Cameroon had five zones, Central African Republic three and Equatorial Guinea two

(IITA, 1992; IRAD, 2007). The division was based on the ecological and climatic peculiarities of each zone. In Cameroon, a total of 600 questionnaires were administered and 572 questionnaires were retrieved for analysis. The 200 questionnaires distributed in the Central African Republic were all retrieved while only 115 of the 200 questionnaires administered in Equatorial Guinea were recovered for analysis.

3.5 Selection of Respondents

Respondents were randomly selected from the following target-groups: crop farmers (market gardeners, cereal farmers, cash crop/permanent crop growers); animal husbandry (such as piggery and poetry); and non-conventional farmers (like bee keepers, Non-Timber Forest Products (NTFP) collectors, snail farmers).

3.6 Questionnaires Design

One set of questionnaires, divided into sections A to J were elaborated for the collection of data with each section focusing on the capture of data specific to various parameters as follows: A collected data on demographic parameters; B on man-power skills, development and specialisation of farmers; C on sources of finance of agricultural activities of farmers; D looked at farmers awareness and knowledge on climate change phenomenon in agriculture; E gathered information on the perceived causes of climate change; F looked at innovative strategies to climate change adaptation measures; G collected data on the problems encountered by farmers in adapting to the effects of climate change; H gathered information on food security issues; I looked at collaboration and networking; and J at performance of the system.

3.7 Analytical Procedure

Data was analysed using STATA statistical package.

4. Results and Discussion

The results are presented in a manner that allows for comparison of trends in the different countries. Where necessary, trends among agro-ecological zones for the respective countries are highlighted. In this section Cameroon, Equatorial Guinea and the Central African Republic where necessary have been respectively abbreviated as CAM, EQG and CAR.

4.1 Demographic Parameters

Socio-demographic Characteristics of the Farmers

Table 1 shows the summary of the socio-demographic characteristics of farmers from the three countries. A total of 882 farmers took part in the survey, 572 from Cameroon, 115 from Equatorial Guinea and 200 from CAR.

Table 1: Socio-demographic characteristics of the farmers

Variable	CAM (n=572)		EQG(n=115)		CAR(n=200)	
Age of farmer	**Freq**	**Percent**	**Freq**	**Percent**	**Freq**	**Percent**
<=30	**36**	**6.3**	**24**	**20.9**	**26**	**13.0**
31-40	142	24.8	34	29.6	26	13.0
41-50	219	38.3	37	32.1	104	52.2
51-60	108	18.9	20	17.4	35	17.4
61+	67	11.7			9	4.4
Sex of household head						
Male	454	79.4	101	87.8	167	83.3
Female	118	20.6	14	12.2	33	16.7
Marital status						
Single	27	4.7	30	26.1	99	49.7
Married	485	84.8	71	61.7	85	42.6
Divorced	32	5.6	4	3.5	4	1.9
Widowed	28	4.9	10	8.7	12	5.8
Household size						
<=5	126	22.0	55	47.8	43	21.3
6-10	320	55.9	44	38.3	123	61.3
11+	126	22.0	16	13.9	35	17.4
Years of farming						
<=10	182	31.8	25	21.7	35	17.4
11-20	197	34.4	50	43.5	52	26.1
21-30	126	22.0	22	19.1	87	43.5

31+	67	11.7	18	15.7	26	13.0
Education level						
None	98	17.1	30	26.1	8	4.0
Primary	177	30.9	45	39.1	82	41.0
Secondary	239	41.8	33	28.7	109	54.5
Certificate	24	4.2	2	1.7		
Diploma	10	1.8	5	4.4	1	0.5
Other	18	3.2				

The proportions of farmers in the respective age categories was even in Equatorial Guinea and Cameroon while in CAR, slightly over 50% were in the age bracket of 41-50 years. Over 80% of the households in Equatorial Guinea and CAR are headed by males while less than 80% applies for Cameroon. The number of married farmers shows a dwindling trend from 84% in Cameroon, 62% in Equatorial Guinea and 43% in CAR. Over half of the farmers in CAR had attained secondary level of education; about 13 % above the situation in Cameroon. Only 28.7% of farmers in Equatorial Guinea had secondary level exposure.

Farm Ownership and Farm Characteristics

Over 90% of the farms are family or privately owned and operate as small groups in the three countries.

Table 2: Farm ownership and characteristics in Cameroon, Equatorial Guinea and CAR

Variable	**CAM (n=572)**		**EQG(n=115)**		**CAR(n=200)**	
Ownership of farm	**Freq**	**Percent**	**Freq**	**Percent**	**Freq**	**Percent**
Family/private	538	94.1	114	99.1	200	100
Foreign	23	4.0	1	0.9	0	0
Government leased	1	0.2	0	0	0	0
Joint venture	10	1.8	0	0	0	0
Farm coverage						
Part of large group	104	18.2	9	7.8	4	2.0
Small group	468	81.8	106	92.2	196	98.0
Size of the farm						
Small <5ha	446	78.0	114	99.1	196	98.0
Medium 5-20 ha	71	12.4	1	0.9	4	2.0
Large commercial >20ha	7	1.2	0	0	0	0
Other	48	8.4	0	0	0	0
Areas of farming focus						
Crops	512	89.5	114	99.1	193	96.5
Livestock/fisheries/poultry	145	25.4	19	16.5	195	97.5
Post harvesting handling/ agro-processing	25	4.4	0	0	1	0.5

Only Cameroon has large commercial farms with areas above 20ha. There is also an important presence of medium farms in the country. The rest, including those of Equatorial Guinea and Central Africa are less than 5ha. Some farmers are dealing in more than one area of farming with over 89% of the farmers participating in crop farming in the three countries. For the farmers that are dealing in livestock or fisheries/poultry the average number of livestock is 23(SD=41.7) in Equatorial Guinea as compared to an average of 6(SD=4.5) in CAR. Cameroon is the only country with a significant post-harvest facility of (4.4%).

Manpower, Skills, Development and Specialisation of Farmers

i) Extension Activities in Relation to Climate Change and Food Security

Provision of extension services is a key factor in increasing agricultural production as well as value addition. It was established that about 54% of the farmers had been visited by extension agents 12 months prior to the survey in Cameroon while 33.5% and 13% was observed for CAR and Equatorial Guinea respectively (table 3). On the kind of extension services provided to farmers in relation to climate change little has been done for Cameroon (29%) and CAR (33.5%) very little for Equatorial Guinea. Public shows to cause awareness about climate change were among the least focused on by the extension services.

Table 3: Distribution of extension activities related to climate change

Extension activities available	CAM	EQG	CAR
Demonstration / training on the use of adaptive measures (e.g. mulching) to cushion against effects of Climate change	167(29.2)	6(5.2)	67(33.5)
Visiting sites that are undergoing changes due to variations in climate	139(24.3)	1(0.9)	23(11.5)
Advisory services on farm management to reduce the effect of climate change	116(20.3)	2(1.7)	34(17.0)
Awareness creation on the effects/consequences of climate change	168(29.4)	15(13.0)	45(22.5)
Organizing public shows on changing climate	20 (3.5)	4(3.5)	14(07.0)
Excursion showing varying climate situations	19(3.3)	2(1.7)	7(03.5)
Field days where discussions on effect of climate change is discussed	40 (7.0)	14(12.2)	10(05)

ii) Specialised Training in Climate Change Adoption

CAR (32.0%%) has dispensed more specialised training in climate change adaptation than Cameroon (14.7%) and Equatorial Guinea(7.8%) while Cameroon presents more opportunities for staff development (18.0%) than CAR (9.5%).

Table 4: Specialised training in climate change adoption

Variable	CAM	EQG	CAR
Specialized training in climate change adaptation	84(14.7)	9(7.8)	64(32.0)
Family or farm workers have specialized training in climate change activities	26(4.6)	0(0)	39(19.5)
Opportunities for training staff/family members	103(18.0)	0(0)	19(9.5)

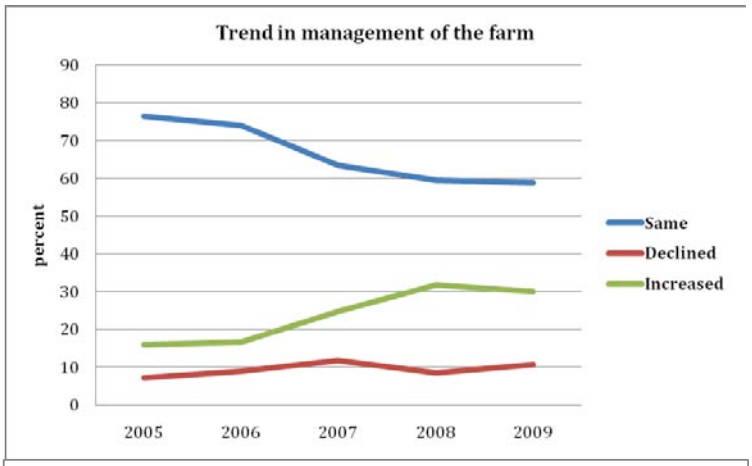
iii) Manpower Structure

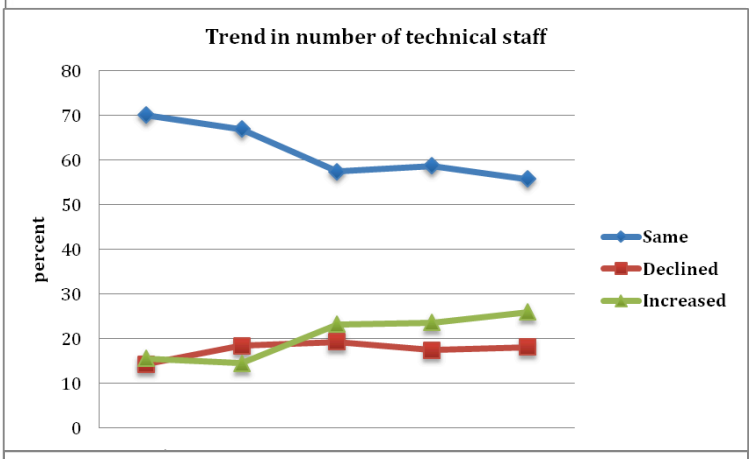
Data within the past five years on the management of farms and availability of technical staff and unskilled labour is presented in table 5:

Table 5: Manpower structure for farmers in Central Africa

Management	2005	2006	2007	2008	2009
CAM					
Same	76.5	74.1	63.4	59.5	59.0
Declined	7.3	9.1	11.8	8.6	10.8
Increased	16.1	16.8	24.8	31.9	30.2
EQG					
Same	85	85	85	77.5	77.5
Declined	15	15	12.5	12.5	12.5
Increased			2.5	10.0	10.0
CAR					
Same	92.2	92.2	86.1	92.2	99.4
Declined	7.8	1.1	2.2	7.8	0.6
Increased		6.7	11.7		
Number of technical staff					
CAM					
Same	70.1	67.0	57.5	58.8	55.8
Declined	14.3	18.5	19.3	17.5	18.2
Increased	15.6	14.5	23.3	23.7	26.0
EQG					
Same	62.5	67.5	75.0	75.0	75.0
Declined	30.0	30.0	22.5	22.5	22.5
Increased	7.5	2.5	2.5	2.5	2.5
Labourers					
CAM					
Same	61.4	56.2	47.7	42.6	41.9
Declined	11.7	12.4	14.5	15.4	16.0
Increased	26.9	31.4	37.8	42.0	42.1
EQG					
Same	87.0	87.0	80.9	79.1	73.9
Declined	13.0	11.3	10.4	7.0	7.0
Increased		1.7	8.7	13.9	19.1
CAR					
Same	100	100	99.4	100	100
Declined			0.6		
Increased					

Management practices and number of technical staff has slightly increased in all three countries (figure 1a & b).





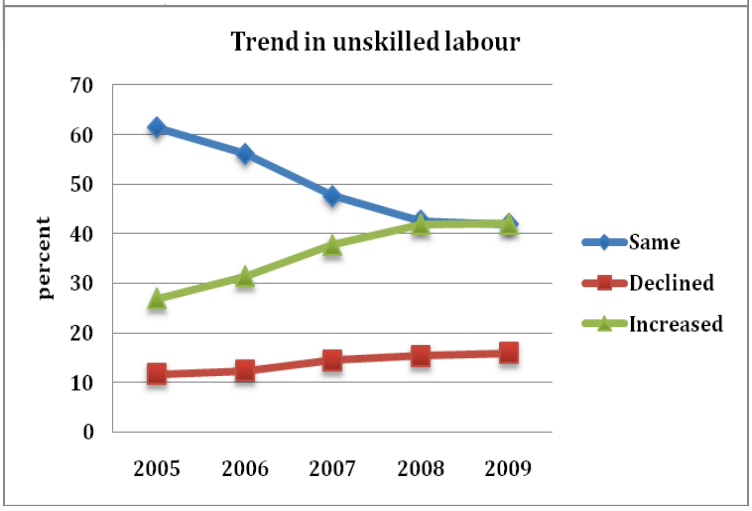


Figure 1: Trends in manpower structure for farmers in Cameroon, Central African Republic and Equatorial Guinea.

(a) Trends in management of farms revealing increased farm management practices

(b) Trends in number of technical staff showing increase number of technical staff

(c) Trends in unskilled labour depicting increase in number of unskilled workers
There is a significant increase in the number of unskilled workers (fig 1 c). This is explained by the fact that more and more people are getting involved in agriculture with a large number of them having no training.

4.2 Sources of Finance

The survey established that more than 90% of the agricultural funds in all the three countries are self generated capital (table 6). Cameroon has an important private sector involvement that contributes up to 17.9 % as loans to the farmers. In CAR, government subsidies financed 10% of the budget while in Equatorial Guinea, donor funding financed 15% of the budget for the reference time period.

Table 6: Sources of funding for agricultural activities

	CAM			EQG			CAR		
Source	**Mean(SD)**	**Range**	**n**	**Mean(SD)**	**Range**	**n**	**Mean(SD)**	**Range**	**n**
Self generated	94.7(16.0)	0-100	569	99.9(1.4)	85-100	115	99.2(6.7)	10-100	193
Government subsidies	8.5(13.7)	0-70	66				10	10-10	6
Private Sector (loans)	17.9(23.0)	0-75	81						
Donor Funded	8.1(16.2)	0-50	57	15	15-15	1			
Other (venture capital)		0.2(0.96)	0-5	36					

Data was collected on trends in funding from the self generated sources over the past five years in the three countries. The results are presented in table 7 below. In the three countries, self generated income was more likely to remain the main source of funding over the next five years.

Table 7: Trends (2005-2009) in Sources of Funding for Agricultural Activities

Source	**2005**	**2006**	**2007**	**2008**	**2009**
CAM					
Self generated					
Same	53.1	47.8	34.8	30.6	27.7
Declined	12.9	13.5	14.3	12.2	14.3
Increased	34.1	38.6	50.9	57.2	58.0
Government subsidies					
Same	47.1	40.9	36.1	34.2	31.5
Declined	34.3	40.9	47.2	48.0	45.2
Increased	18.6	18.2	16.7	17.8	23.3
Private Sector (loans)					
Same	42.0	43.5	42.3	37.7	31.9
Declined	31.9	31.9	38.0	37.7	40.3
Increased	26.1	24.6	19.7	24.6	27.8
Donor Funded					
Same	36.8	39.5	33.3	28.6	28.6
Declined	39.5	39.5	41.0	35.7	33.3
Increased	23.7	21.0	25.6	35.7	38.1

EQG					
Self generated					
Same	92.9	94.6	87.6	80.7	77.2
Declined	5.4	5.4	8.0	7.9	7.0
Increased	1.8		4.4	11.4	15.8
CAR					
Self generated					
Same	95.6	95.6	90.0	89.4	89.4
Declined	3.9	4.4	10.0	10.0	10.0
Increased	0.6			0.6	0.6

The farmers were asked the proportion of their farm budget that is directed toward solving the problems created by climate change. In Equatorial Guinea approximately 58% of the farmers have no budget allocated for climate change as compared to 97% in CAR. This implies that in both countries there are no budget allocations for problems created by climate change.

4.3 Farmers' Awareness and Knowledge on Climate Change Phenomenon in Agriculture

Trends in Climate Change Parameters

Farmers in all three countries where asked about changes they observed in some climate change parameters and how these changes impacted on schedules within the past five years. Overall, uncertainties in the onset of farming seasons, extreme weather events, and farming problems have increased within the past five years as shown in tables 8-10.

Table 8: Trends in uncertainties in the onset of farming season in Central Africa from 2005 to 2009

	2005	2006	2007	2008	2009
Unusual early rains that are followed by weeks of dryness					
Same	48.0	44.7	29.5	19.1	15.9
Declined	19.6	19.1	21.9	18.0	20.7
Increased	32.4	36.2	48.6	62.9	63.4
Erratic rainfall pattern					
Same	37.8	34.3	23.5	15.4	13.9
Declined	23.5	23.0	18.3	14.4	13.9
Increased	38.7	42.7	58.2	70.2	72.2
Delay in the unset of rains					
Same	37.6	32.3	24.3	13.5	12.1
Declined	31.8	35.7	33.3	23.3	26.5
Increased	30.6	32.0	42.4	63.2	61.4
Long period dry season					
Same	37.3	33.9	26.1	13.1	8.1
Declined	16.1	19.3	17.1	12.6	14.3
Increased	46.6	46.8	56.8	74.3	77.6
Long period of rainfall					
Same	35.4	32.0	24.6	16.3	13.9

Declined	43.4	42.7	49.4	55.1	55.7
Increased	21.2	25.3	26.0	28.6	30.4
Short period of rainfall					
Same	42.5	39.0	32.3	23.7	19.7
Declined	21.3	23.0	19.0	16.7	18.3
Increased	36.2	38.0	48.7	59.6	62.0
Reduced harmattan					
Same	65.4	61.8	58.9	51.7	46.6
Declined	17.8	19.4	19.3	20.7	21.2
Increased	16.8	18.8	21.8	27.6	32.2
Long period of harmattan					
Same	59.9	56.3	54.3	50.0	42.8
Declined	22.8	23.0	20.9	18.5	24.8
Increased	17.3	20.7	24.8	31.5	32.4

Table 9: Trends in extreme weather events in Central Africa from 2005 to 2009

	2005	2006	2007	2008	2009
Thunderstorms					
Same	51.2	48.8	43.9	36.9	33.1
Declined	29.4	29.2	28.3	25.2	25.5
Increased	19.4	22.0	27.8	37.9	41.4
Heavy winds					
Same	43.2	39.6	33.6	23.5	18.2
Declined	27.5	27.5	27.0	19.9	20.7
Increased	29.4	32.9	39.4	56.7	61.1
Incidence of dust covering the atmosphere					
Same	49.0	46.7	42.6	34.9	26.8
Declined	16.4	16.5	15.4	13.6	10.5
Increased	34.5	36.9	42.0	51.5	62.6
Flooding					
Same	49.7	48.2	45.0	43.0	40.5
Declined	36.1	36.1	37.4	38.1	39.9
Increased	14.2	15.7	17.6	18.9	19.5
Drought					
Same	33.4	34.8	27.8	18.6	14.0

Declined	11.5	9.6	8.9	8.3	9.2
Increased	55.0	55.5	63.3	73.1	76.8
Erosion					
Same	47.9	47.3	42.6	37.4	35.7
Declined	19.6	18.5	18.7	18.3	19.4
Increased	32.5	34.2	38.7	44.3	44.9
Heat waves					
Same	43.4	39.7	36.5	26.3	24.9
Declined	14.2	14.2	11.5	10.0	9.8
Increased	42.4	46.1	52.0	63.7	65.3
High Sun intensity					
Same	34.1	31.2	23.8	14.9	11.7
Declined	11.7	11.6	7.6	6.2	6.0
Increased	54.2	57.2	68.7	78.8	82.3
Heavy rainfall					
Same	29.0	26.1	19.3	15.9	12.7
Declined	40.9	40.8	45.9	43.2	43.9
Increased	30.1	33.1	34.8	40.9	43.4
Desertification or loss of forest resources					
Same	27.0	27.1	13.4	9.3	8.8
Declined	11.3	11.1	8.5	7.8	7.5
Increased	61.8	61.8	78.1	82.9	83.8
Volume of sand encroachment					
Same	62.6	61.4	55.5	50.4	46.9
Declined	23.0	23.7	23.3	20.3	21.3
Increased	145	14.8	21.2	29.2	31.8

Table 10: Trends in the increase in farming problems in Central Africa from 2005 to 2009

	2005	2006	2007	2008	2009
Disease incidence					
Same	31.9	31.6	18.3	11.7	9.6
Declined	15.5	14.6	16.4	10.6	8.9
Increased	52.6	53.8	65.3	77.7	81.6
Weed infestation					
Same	36.5	36.9	29.0	22.8	20.0
Declined	16.8	15.4	13.9	11.1	10.7
Increased	46.7	47.7	57.2	66.1	69.3
Soil infertility					
Same	35.9	34.6	26.1	20.0	18.0
Declined	23.4	24.1	24.6	24.1	24.8
Increased	40.7	41.4	49.4	56.0	57.2
Drying up of streams / rivers					
Same	32.5	32.4	27.2	17.9	15.3

Declined	11.2	11.3	10.8	9.0	10.4
Increased	56.2	56.3	62.0	73.1	74.3
Overflowing of streams / rivers					
Same	35.2	35.7	28.8	20.9	18.5
Declined	49.2	48.6	51.3	56.4	56.1
Increased	15.6	15.8	19.9	22.7	25.5
Farm yields					
Same	38.8	37.2	25.3	16.4	17.0
Declined	31.3	31.8	39.1	49.5	49.6
Increased	29.9	31.1	35.7	34.1	33.5
Land slides					
Same	48.0	47.2	45.7	43.6	41.0
Declined	40.9	40.2	40.2	42.1	41.0
Increased	11.0	12.6	14.2	14.3	17.9

Knowledge about Climate Change

The survey assessed the knowledge and perceptions about climate change and its effects. In Cameroon it was revealed that out of the 572 farmers interviewed 295 (51.6%) had heard of climate change. The farmers were further asked if they think that climate change affects their farming activities. 312 (54.6%) answered in the affirmative .This implies that more than half of the farmers had knowledge of climate change and its effects. Further analysis by agricultural zones reveal varying levels of awareness about climate change and its effects. For example, farmers residing in agricultural zone three and four in Cameroon are the most knowledgeable about climate change and its effects on farming activities while those residing in agricultural zones one and two of the same country are the least knowledgeable (table 11).

Table 11: Knowledge and perceived effects of climate change in Cameroon by agricultural zones.

	Frequency	Knowledge about climate change	Effects of climate change on farming activities
Agricultural zones		**Number (%)**	**Number (%)**
1	119	26(21.9)	18(15.1)
2	61	11(18.0)	10(16.4)
3	60	45(75)	56(93.3)
4	212	156(73.6)	159(75)
5	120	57(47.5)	69(57.5)

All the respondents interviewed in CAR had knowledge of climate change compared to the 54% in Equatorial Guinea and the 51.6% observed in Cameroon. A higher proportion of

respondents in Equatorial Guinea (89.8%) had information on effects of climate change on farming activities compared to the 74% for CAR and the even smaller 54.6% for Cameroon.

Table 12: Knowledge and perceived effects of climate change in CAR and Equatorial Guinea

Country	EQG (n=108)	CAR (n=172)
Knowledge about climate change	58(53.7)	172(100)
Effects of climate change on farming activities	97(89.8)	127(73.8)

Respondents in the three countries showed differences in their thematic descriptions for climate change. About 30% in Equatorial Guinea related their definitions to abusive cutting of trees, 24% defined it in terms of bush fires and 27% defined it in terms of drought. In CAR, definitions related more to changes in prevailing weather conditions of the region. In Cameroon descriptions were a combination of what was observed in both CAR and Equatorial Guinea.

The farmers were further asked if they had noticed any other changes in their environments within the past five years. The commonly mentioned change was decrease in vegetation cover and wildlife in the three countries (table 13).

Table 13: Other climate change issues observed

	CAM (n=572)	EQG(n=115)	CAR(n=200)
Change	**Freq (%)**	**Freq (%)**	**Freq (%)**
Vegetation cover and wildlife amount is decreasing	404 (70.6)	111(96.5)	187(93.5)
Increase in the number of some pests / diseases	244(42.7)	0	2(1.0)
Decreased frequency of extreme weather events	120(21.0)	1(0.9)	159(79.5)
Vegetation cover and wildlife amount is increasing	89(15.6)	2(1.7)	77(38.5)
Decrease in the number of some pests / diseases	70(12.2)	0	21(10.5)

Perceived Causes of Climate Change

The farmers were asked to give their opinion on the cause of the rainfall pattern and temperature change in their countries. Under rainfall patterns as a cause of climate change, farmers in Equatorial Guinea commonly reported deforestation which was endorsed by 39%, followed by bushfire and deforestation mentioned by 35%. Farmers in CAR commonly mentioned deforestation and pollution which was endorsed by 69% of the farmers. In Cameroon the main culprit for change in rainfall patterns and temperature was deforestation (>50%). Under the temperature domain of climate change, farmers in Equatorial Guinea commonly mentioned bush fires and cutting trees endorsed by 60% while those in CAR mentioned deforestation and pollution which was endorsed by 65% of the farmers.

Table 14: Causes of Climate Change in Central Africa

Cameroon	Freq (%)	Equatorial Guinea	Freq (%)	CAR	Freq (%)
		Rainfall pattern			
Deforestation	412 (72)	Bush fires	18(15.6)	Deforestation	31(31.0)
Bush fires	98 (17)	Bush fire & deforestation	40(34.8)	Deforestation & Pollution	69(69.0)
Drying water bodies	62(11)	Deforestation	45(39.1)		
		Drying water bodies	12(10.4)		

Temperature					
Deforestation	327(57)	abusive cutting of trees	26(22.6)	Deforestation	32(34.8)
Deforestation & Pollution	200 (35)	bush fires	20(17.4)	Deforestation & Pollution	60(65.2)
Bush fires	45(08)	bush fires & cutting trees	69(60.0)		

Innovative Strategies for Climate Change Adaptation
Data generated for this section was not only through the structured questionnaires because the design of the questionnaires could not allow for an adequate elucidation of the innovative strategies. Most of the data was therefore generated through focused group discussions and observations of the personnel on the field. It is for this reason that statistical tables are not presented in this section.

Late planting
In the event of delayed rainfall in most zones, crop farmers engaged in late planting for a month and repeated planting of crops in response to the erratic rainfall. This was an innovative strategy for maize, millet and Cucurbitaceae (Cucumeropsis edulis) and other cereal crop cultivators.

Blocking of drainage
In most rice farms in the northern plains of the study area, prolonged dryness compelled farmers to block drainage outlets in order to maintain some degree of water logged/moisture within the farms.

Grazing on Leftover Straw and Harvest of Animal Droppings
Continuous eruption of conflict between rice farmers and cattle grazers over the use of available land has led to a system where rice farmers allow grazers to feed their cattle on left over straws after harvest. In return, droppings from grazing cattle aid in fertilization of farms. This innovation has contributed to reduced socioeconomic conflicts between the farmers and grazers in the Fadama plains of Cameroon which is characterized by seasonal variations in precipitation. Livestock farmers use high nutritional content trees for fencing providing another source of animal feed.

Multiple Cropping and Planting with Different Maturity Period
Food crop farmers have developed multiple cropping and planting of species that mature at different periods so as to compensate for the late maturing species, crop failure and ensure continuous food supply. In Monomodal agro-ecological zones of Cameroon rotational cropping is practiced with maize harvested in July, August and September, followed by land preparation for beans planting.

Wood Ash application
During land preparation and planting, farmers apply wood ash on the soils as a local insecticide to prevent the destruction of the germinating seedlings.

Urban Cropping
Limited availability of post harvest preservation techniques undermines the supply of food and vegetables from the rural settlements to the urban areas. Most urban households have replaced flower gardens with small scale gardens that act as source of vegetables. Furthermore, ornamental trees are now giving way to fruit trees and permanent crops like plantains. Formerly market gardeners used to nurse seedlings in the last two weeks of September to transplant them in the first two weeks of October. Faced with the exigencies of climate change (especially prolonged rains), today, the nursing period has moved from the

last two weeks of September to the last two weeks of October with effective transplanting of seedlings in November. Digging and opening of irrigation channels is done in the drier months of December and January.

Other Strategies

Shade trees: Perennial crop farmers (palms, cocoa, coffee etc) confronted with the problem of prolonged dry spells are now leaving shade trees in their farms to screen their plants from the sun.

River bank farming: Cocoa and coffee farmers are concentrating new farms along river beds as a means of guaranteeing moisture supply during dry seasons. Palm farmers prune their farms and use the pruned leaves as mulch a practice that helps the palm trees survive through long dry periods.

Aeration and Treatment: Most micro organisms that attack cocoa and coffee pods proliferate during prolonged rains. Farmers use fungicides to curb on the microbial load of the farms. Regular cleaning of farms increases aeration, contributing reduced microbial load in these farms.

4.4 Problems Encountered by Farmers in Adapting to the Effects of Climate Change

Poor Access to Information Source Relevant to Adaptation

About 51% of the farmers in Cameroon felt that poor access to information sources relevant to adaptation was a serious problem to significantly impact on their ability to adapt to the effects of climate change while in CAR 56% thought the contrary. In Equatorial Guinea, the trends even out (table 15).

Table 15: Poor access to information source relevant to climate change adaptation in Central Africa

Strategy-15	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	90(55.90)	28(17.39)	43(26.71)	161
EQG	40(34.78)	43(37.39)	32(27.83)	115
CAM	82(15.41)	179(33.65)	271(50.94)	532

Type of Land tenure System Practiced

Table 16 below shows that farmers in all three countries did not seriously consider the type of land tenure system practiced as a challenge in adapting to the effects of climate change.

Table 16: Type of land tenure system practiced in Central Africa

Strategy -16	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	117(73.58)	21(13.21)	21(13.21)	159
EQG	43(36.44)	40(38.98)	29(24.58)	111
CAM	252(55.88)	112(24.88)	87(19.29)	451

Ineffectiveness of Indigenous Strategies

More than half of the farmers CAR and about 41% in Cameroon felt ineffectiveness of indigenous strategies was not a serious problem to adapting to the effects of climate change (table17). About 27% of the farmers in the three countries viewed it as a serious challenge.

Table 17: Ineffectiveness of indigenous strategies in Central Africa

Strategy-17	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	90(55.90)	28(17.39)	43(26.71)	161
EQG	40(34.78)	43(37.39)	32(27.83)	115
CAM	193(40.80)	148(31.29)	132(27.91)	473

Traditional Beliefs/ Practices

The traditional beliefs and practices generally do not undermine the use of adaptive strategies by farmers in Central Africa. On the contrary most farmers consider it to be of very little importance in climate change adaptation (table 18).

Table 18: Traditional beliefs /practices do not allow use the adaptive strategies

Strategy-18	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	126(91.97)	7(5.11)	4(2.92)	137
EQG	82(71)	26(23)	07(6)	115
CAM	344(75.94)	70(15.45)	39(8.61)	453

Lack of Financial Resources

Farmers in all three countries indicated that lack of financial resources very seriously undermined measures by farmers to adapt to the effects of climate change (table 19). A small percentage (<10%) considered lack of finances as a not too serious problem.

Table 19: Lack of financial resources as a problem encountered in adapting to the effects of climate change

Strategy -19	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	1(0.5)	48(24.0)	151(75.50)	200
EQG	11(10.78)	31(30.39)	60(58.0)	102
CAM	20(3.72)	111(20.63)	407(75.65)	538

Poor or Low Extension Services

Poor or low extension was endorsed as a very serious problem encountered by farmers in adapting to the effects of climate change by farmers in Equatorial Guinea and Cameroon. However, almost an equal proportion of farmers recognized it as a serious problem (table 20).

Table 20: Poor or Low extension services a barrier to adapting to the effects of climate change

Strategy-20	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	58(32.58)	90(50.56)	30(16.85)	178
EQG	30(20.09)	53(46.09)	32(27.83)	115
CAM	116(23.58)	231(46.95)	145(29.47)	492

Limited access to Improved Crop Varieties
Limited access to improved crop varieties is primarily a problem (35-61%) to all farmers in the region (table 21).

Table 21: Limited access to improved crop varieties as a barrier to adapting to the effects of climate change in Central Africa

Strategy -21	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	46(29.30)	56(35.67)	55(35.03)	157
EQG	11(10)	67(60.91)	32(29.09)	110
CAM	85(18.35)	211(45.47)	168(36.21)	464

Lack of Access to Improved Livestock Breeds
Lack of access to improved livestock breeds is viewed as a serious barrier to adapting to the effects of climate change by about 44% of farmers in Cameroon and Central Africa and by 21% in Equatorial Guinea.

Table 22: Lack of access to Improved Livestock breeds as a barrier to adapting to the effects of climate change

Strategy -22	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	27(33.33)	18(22.22)	36(44.44)	81
EQG	30(41.10)	27(36.99)	16(21.92)	73
CAM	75(26.69)	82(29.18)	124(44.13)	281

High Cost of Improved Crop Varieties
High cost of improved crop varieties emerged a serious problem in the entire region (table 23).

Table 23: High cost of improved crop varieties as a problem encountered by farmers in adapting to the effects of climate change

Strategy -23	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	50(33.78)	40(27.03)	58(39.19)	148
EQG	6(5.45)	40(36.6)	64(58.18)	110
CAM	69 (15.40)	147 (32.81)	232 (51.79)	448

Non-availability of Storage Facilities
Non-availability of storage facilities was a very serious problem encountered by farmers in adapting to the effects of climate change in the region, (table 24).

Table 24: Non-availability of Storage Facilities as a barrier to adapting to effects of climate change

Strategy -24	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	35(23.65)	46(31.08)	67(45.27)	148
EQG	8(19.25)	59(52.21)	46(40.71)	113
CAM	87 (19.25)	175 (38.72)	190 (42.04)	452

Absence of Government Policy on Adaptation

As table 25 shows, absence of government policy on adaptation is a problem in CAR, Cameroon and Equatorial Guinea.

Table 25: Absence of government policy on adaptation as a barrier to adapting to the effects of climate change

Strategy-25	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	30(17.96)	48(28.74)	89(53.29)	167
EQG	38(33.63)	46(40.71)	29(25.66	113
CAM	98(20.72)	156(32.98)	219(46.30)	473

Non-availability of Credit Facilities

More than half of the farmers view non-availability of credit facilities as a problem encountered by farmers in adapting to the effects of climate change in the region (table 26).

Table 26: Non-availability of credit facilities as a barrier to adapting to the effects of climate change

Strategy-26	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	7(4.38)	54(33.75)	99(61.88)	160
EQG	11(9.57)	43(37.39)	61(53.04)	115
CAM	47(10)	162(34.47)	261(55.53)	470

Limited Knowledge on Adaptation Measures

Limited knowledge was perceived as a challenge in Central African Republic (53%).

Table 27: Limited knowledge on adaption measures as a problem encountered by farmers in adapting to the effects of climate change

Strategy-27	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	16(11.03)	77(53.10)	52(35.86)	145
EQG	52(46.02)	50(44.25)	11(9.73)	113
CAM	111(26.18)	202(47.64)	111(26.18)	424

Poor Response to Crises Related to Climate Change by the Government Agencies and Interest Groups

A large number of farmers in the Central African Republic (61%) underscore poor response to crises related to climate change by the governments agencies and interest groups to be a problem. This is the same case with Cameroon (43%) while most farmers in Equatorial Guinea do not consider it as a serious problem (46%) – table 28.

Table 28: Poor response to crises related to climate change by government agencies and interest groups as barrier to adapting to the effects of climate change

Strategy-28	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	15(9.32)	48(29.81)	98(60.87)	161
EQG	51(45.54)	44(39.29)	17(15.18)	112
CAM	101(22.3)	161(35.4)	191(42.96)	453

Risk of Adaptation

Table 29: Risk of adaptation as a barrier to adapting to the effects of climate change

Strategy -29	Not serious	Serious	Very serious	Totals
CAR	55(41.04)	46(34.33)	33(24.63)	134
EQG	28(25.78)	64(56.64)	21(18.58)	113
CAM	119(28.47)	193(46.17)	106(25.36)	418

High Cost of Fertilizers and Other Inputs

High cost of fertilizer impinges on the ability of farmers to adapt to the effects of climate change in Central Africa as the ratings in all three countries are above 53%.

Table 30: High cost of fertilizers and other inputs as barrier to adapting to the effects of climate change

Strategy-30	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	22(12.36)	34(19.10)	122(68.54)	178
EQG	8(7.34)	42(38.53)	59(54.13)	109
CAM	42(8.99)	110(23.55)	315(67.45)	467

High Cost of Irrigation Facilities

High cost of irrigation facilities affects efforts to adapt to climate change in the Central African Republic more (53%), Cameroon (41%) and Equatorial Guinea (42.84%).

Table 31: High cost of irrigation as a barrier to adapting to the effects of climate change

Strategy-31	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	42(30.60)	22(16.06)	73(53.28)	137
EQG	42(42.84)	28(32.56)	16(18.60)	86
CAM	112(28.64)	100(25.58)	179(45.78)	391

Farmers in Equatorial Guinea, Cameroon and Equatorial Guinea are faced with non-availability of farm inputs as shown in table 32 below.

Table 32: Non-availability of farm inputs as a problem encountered by farmers in adapting to the effects of climate change

Strategy-32	Not serious	Serious	Very Serious	Totals
Country	Number (%)			
CAR	46(32.62)	54(38.3)	41(29.08)	141
EQG	14 (12.39)	63 (55.75)	36 (31.86)	113
CAM	97 (23.1)	175(41.67)	148(35.24)	420

Non-availability of Processing Facilities

Non-availability of processing facilities is a problem in Central Africa and this has been corroborated by the percentage of farmers who endorsed this assertion (table 33).

Table 33: Non-availability of processing facilities as a problem encountered by farmers in adapting to the effects of climate change

Strategy-33	Not serious	Serious	Very serious	Totals
Country	Number (%)			
CAR	44(32.12)	63(45.99)	30(21.90)	137
EQG	6(5.45)	48(43.64)	56(50.91)	110
CAM	87(21.22)	195(47.56)	128(31.22)	410

Inadequate Knowledge on How to Cope with Effects of Climate Change
Inadequate knowledge to cope with effects of climate change is a serious problem in all three countries (table 34).

Table 34: Inadequate knowledge to cope with effects of climate change in Central Africa

Strategy-34	Not serious	Serious	Very Serious	Totals
Country	Number (%)			
CAR	29(18.01)	65(40.27)	67(41.61)	161
EQG	30(27.03)	59(53.15)	22(19.82)	111
CAM	84(18.26)	212(46.09)	164(35.65)	460

Non-availability of Farm Labour
Farm labour is understandably a very serious problem in Equatorial Guinea because of their small population. Though the Central Africa Republic and Cameroon have relatively large populations it still remains a serious problem (table 35).

Table 35: Non-availability of Farm labour

Strategy-35	Not serious	Serious	Very Serious	Totals
Country	Number (%)			
CAR	78(48.45)	62(38.51)	21(13.04)	161
EG	11(10.09)	46(42.20)	56(47.71)	
CAM	140 (30.91)	166(36.74)	147(32.45)	453

High Costs of Farm Labour

Equatorial Guinea has the highest proportions of farmers citing high cost of farm labour as problem faced by farmers in adapting to the effects of climate change (table 36).

Table 36: High costs of farm labour

Strategy-36	Not serious	Serious	Very Serious	Totals
Country	Number (%)			
CAR	62(36.05)	71(41.28)	39(22.67)	172
EQG	11(10.0)	44(40.0)	55(50.0)	110
CAM	109(23.04)	156(32.98)	208(43.97)	473

Food Insecurity

No distinction (per country) is made on the discussion of the outcome on food security issues in Central Africa because similar trends were observed in all three countries. Farmers were asked how often in the last one year they had had problems satisfying the food needs of their households. Figure 2 shows, 30% of the farmers sometimes had problems satisfying the food needs of their households.

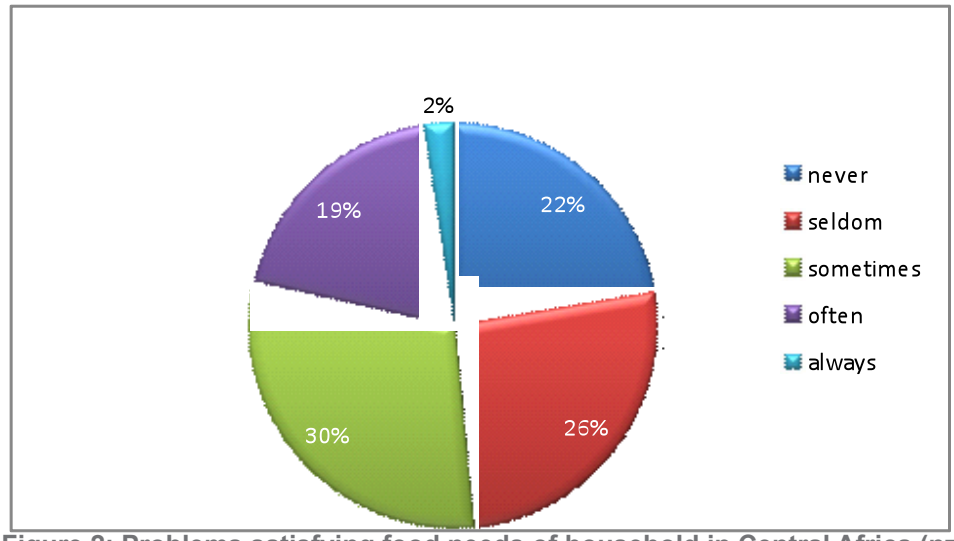


Figure 2: Problems satisfying food needs of household in Central Africa (n=833)

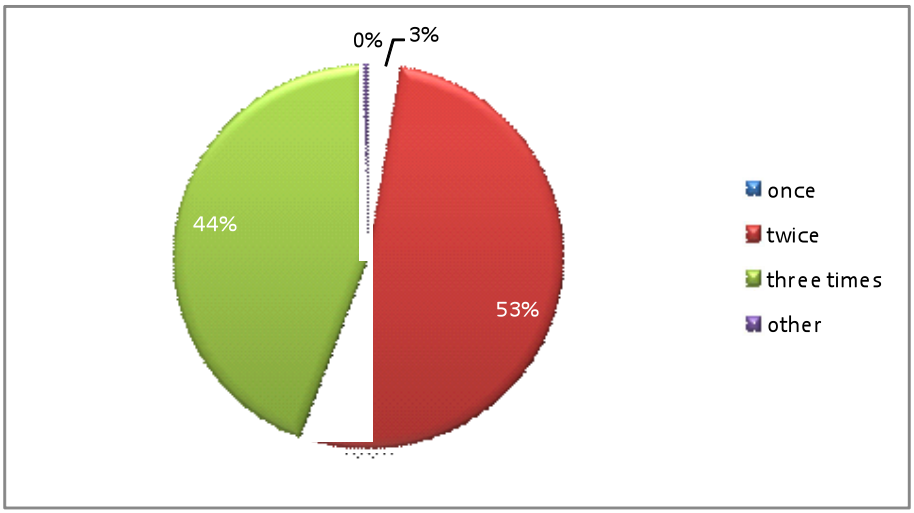


Figure 3: Number of times households feed in a day (n=833)

Farmers were further interviewed on how many times their households fed in a day and majority endorsed three times a day (figure 3).

The farmers were asked to compare the current food situation of their respective households with the situation one year ago , for 38% of the farmers, the situation was worse than now (figure 4).

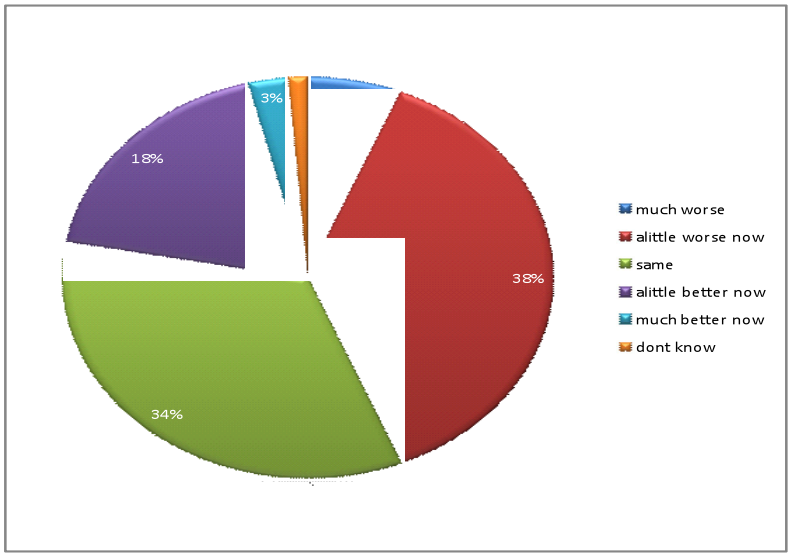


Figure 4: Current food situation compared with the situation one year ago in Central Africa

Performance of the System

The farmers were asked to rate their farm's ability to adapt to climate changes in the local or international environment. More than 60% of the 720 farmers that responded to this question rated their farm performance as being good to excellent (figure 5).

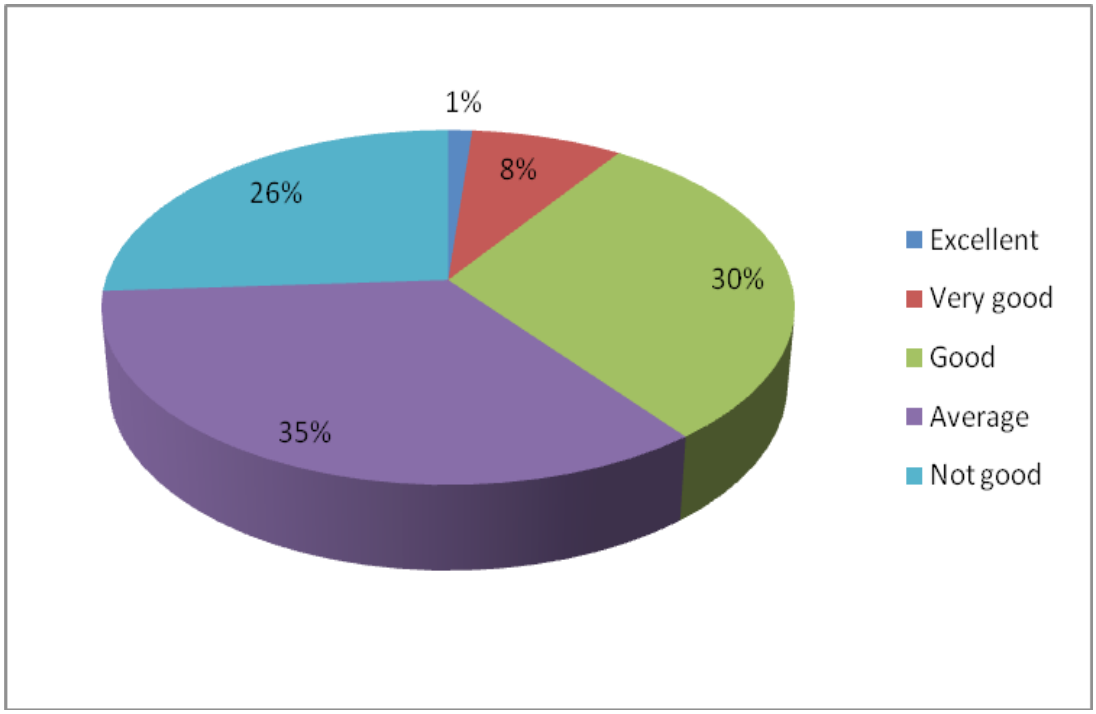


Figure 5: Farm performance in Central Africa

Despite the average nature of farm performance, farmers believe that with an increase in their capacity and man power development as indicated in Figure 6 their efforts and application of local methods will transform their present average stage to a probable good and excellent situation if complemented by sound research and technological innovations.

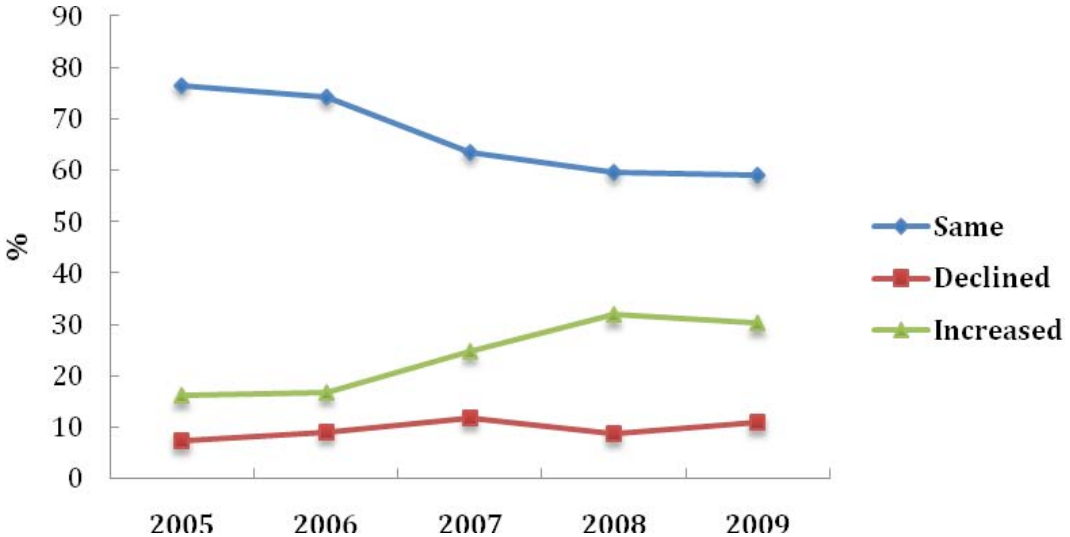


Figure 6: Indigenous farm management, performance and productivity in Central Africa.

5. Conclusion

The erratic nature of environmental conditions coupled with limited availability of genetically modified varieties, low level of extension staff, capacity training, high cost of pesticides and insecticides, as well as limited availability of a well structured irrigation systems and poor national strategies to combat the perils of climate change are enormous. In a bid to sustain food security, localities have been developing innovations that are proving successful but proper scientific research on these innovative technological developments remain the only way forward for an efficient fight against climate change perils and food security.

6. Recommendation

- The government should establish fictional policies and put in place incentives subsidies and bonuses to communities that identify and bring into light new strategies that can effectively combat the perils of climate change and improve food security.
- Capacity building workshops on tested and approved innovated strategies in the area of permanent cropping, market gardening, and livestock disease control method should be organized each year by all stakeholders comprising farmers, researchers, agricultural related institutions and policy makers at the end of every agricultural season to update national data on innovative strategies that can effectively combat climate change and food security.

References

Adams, A., (1999). At Home with Holistic Management: Creating a Life of Meaning. Allan Savory Center for Holistic Management, Albuquerque, New Mexico.

ATPS News. (2009). ATPS host socialization of Science and Technology and innovations Workshops, Issue 25. 19pp.

ATPS, (2009). Shaping the future of Science, Technology and Innovations in Africa. A report on the fourth African Youth Forum on Science and Technology (AYFST) steering committee meeting and Launch of the Youth Innovation Programme (YICAN). Mombassa Kenya,47pp.

Challinor, A.J., Ewert, F., Arnold, S., Simelton, E., Fraser, E., (2009). Crops and climate change: progress, trends, and challenges in simulating impacts and informing adaptation. J. Exp. Bot. 60, 2775–2789.

Garcia, A.G.Y., Hoogenboom, G., Guerra, L.C., Paz, J.O., Fraisse, C.W., (2006). Analysis of the inter-annual variation of peanut yield in Georgia using a dynamic crop simulation model. Trans. ASABE 49, 2005–2015.
Heifer project International Cameroon, Annual Report 2008-2009 (2009).. Securing Livelihoods. 33pp

IITTA. Annual Report (1992).. Ibadan, Nigeria: International Institute of Tropical Agriculture.
Keating, B.A., Carberry, P.S., (2010). Emerging opportunities and challenges for Australian agriculture. Crop and Pasture Science 61, 269–278.

Lal, H., Hoogenboom, G., Calixte, J.P., Jones, J.W., Beinroth, F.H., (1993). Using crop simulation models and GIS for regional productivity analysis. Trans. ASAE 36, 175–184.

Locatelli, B., Kaninen, M., Grockhaus M., Coffeer, C.J.P, Murdiyarso, D. and Santoso, H. (2008). Facing an uncertain future. How forest and people can adapt to climate change. CIFOR, Jakarta, 86pp.

Lybbert, T and Sumner (2010). Agricultural Technologies for Climate Change Mitigation and Adaptation in Developing Countries

Manyong. V.M, Smith. J, Weber. G.K, Tagtap. S.S and Oyewole. B. (1996). Macrocharacterization of agricultural systems in Central Africa: An overview. Resource and Crop Management Research Monograph. No .22 IITA. 55pp

McCown, R., (2002). Changing systems for supporting farmers' decisions: problems, paradigms, and respects. Agricultural Systems 74, 179–220.

MINADER Regional Delegation Extreme North (2008). Rapport annuel DRADER/EN champagne agricole 2008 Papier

MINEF, (1994). Diagnostic général de la situation de l'environnement dans la province de l'Adamaoua. Document de base. PNUD/ GTZ/ BM. 143 p.

Olina J.P., Mathurin, M. Patrick, M. (1998). Amélioration et Gestion de la Fertilite des Sols Cultives. Rapport d'activites 1997: Convention IRAD/DPGT

Savory, A., Butterfield, J., (1999). Holistic Management: A New Framework for Decision Making. Island Press, California.

Sigha, L.N., Mafany G.T. (2008) Vulnerability assessment of freshwater resources to climate change in Central Africa. UNEP.

Soler, C.M.T., Sentelhas, P.U., Hoogenboom, G., (2007). Application of the CSM-CERES maize model for planting date evaluation and yield forecasting for maize grown off-season in a subtropical environment. Eur. J. Agron. 27, 165–177.

Sultan, B., Baron, C., Dingkuhn, M., Sarr, B., Janicot, S., (2005). Agricultural impacts of large-scale variability of the West African monsoon. Agric. Forest Meteorol. 128,93–110.

Urama, K., Fancis,J., Momanyi, M., Ochugboju, S., Ominde, A., Ozor, N. and Manners, G. (2009). Agricultural Innovations for Sustainable Development: Contribution to finalist on the African Youth in Science Competition. .ATPS, Vol 1 Issue 1 Nairobi, 121pp.

Urama, K., Fancis,J., Momanyi, M., Ochugboju, S., Ominde, A., Ozor, N. and Manners, G. (2009). Agricultural Innovations for Sustainable Development: Contribution to finalist of the African Women in Science Competition. ATPS, Nairobi vol. 2 isssue 1 129pp.

WWF (2001). The ten most vulnerable ecosystems of the world. www.earthdive.com.

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