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# The Role of Adaptation Mechanisms in Improving Livelihood of Small Holders in Bara Locality-North Kordofan State, Sudan

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#### Abstract

The current study was conducted in Bara Locality, North Kordofan State during 2013 - 2015. The objective of this study is to investigate and identify the role of adaptation mechanisms followed by Climate Change Project (CCP). The area has affected by climate change. The study has considered all villages covered by the project. Purposive sampling technique was used. A number of 106 respondents represent (12%) of sampling frame were selected. Primary data obtained according to scientific methods using well designed questionnaires following face-to-face interview, and focus group discussion. Statistical Package for Social Sciences (SPSS) version 10 was applied for analyzing the data and obtaining the results of concern using descriptive statistic and Chi-squire Test. Results of descriptive statistics revealsthat 53.8% of the respondents declared that the project had obvious contribution in horticulture, while 61.3% of the respondents indicated that the project had positive role in improving water resources, 98.6% of the respondents depicted that provision of alternative energy sources had strong contribution in environmental conservation. On the other hand results of Chi-squire showed significant differences among the respondents regarding to mechanisms adopted by the project comparing the pre-project period regarding the activities: traditional farming ( $Z^2 = 8.132$ . P = 0.004), horticulture ( $Z^2 = 8.627$ , P = 0.003), and rage and forestry ( $Z^2 = 5.4657$ , P = 0.0190). Finally many recommendations were drawn from the study among them; dissemination of alternative energy sources is highly encourage due to their positive role on environmental conservation and make use of solar energy in horticulture.

### **Keywords**

Adaptation Mechanisms, Climate Change, Livelihood, Sudan

### 1. Introduction

Sub-Saharan Africa (SSA) is considering being the most vulnerable region to current and future climate variability [11]. It suffers most from adverse consequences, which are often magnified due to their dependence on rain-fed for agriculture [6]. Although agriculture is the backbone of the Sudanese economy, the sector remains low productive and is hardly able to support food demands of the growing population [3], changes in climate system affects the development processes [1] particularly rural area. Pender (2008) notes that temperatures will rise; seasons will become warmer; monsoonal rain and will be more intense and more frequent; rainfall flooding and major droughts will increase; erosion will continue; and groundwater availability and food security will be affected [4]. Therefore climate change will have negative impacts on crop yields [9]. In climate change literature a lot of attention has been given to mitigation in general and that adaptation is still not at the same level of consideration [8]. Adaptation defined as adjustments in

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ecological and socioeconomic systems in response to actual or expected climatic stimuli, their effects or impacts [3]. In the rural areas of Sudan, women and men are highly dependent on agricultural crops and forest resources for their livelihoods, however, in the face of climate change; the ability of women and men to obtain these indispensable resources is reduced [10]. Adaptation reduces vulnerability to change, either by building adaptive capacity or by reducing exposure or sensitivity to climate change impacts [2]. Based on the above facts many organizations (governmental and nongovernmental) working in the field of environmental launched their programs to mitigate the causes of climatic change and build adaptations mechanisms for those residing in vulnerable area in Sudan with great scope for increasing the agricultural production. This study is reviewing the nature of adaptation process through application of some adaptation mechanisms followed by the project of climate change adaptation in Bara locality which represents the most vulnerable area in Kordofan region to enhance resilience of resident rural communities.

# 2. Objectives

The main objective of the current paper is to identify the role of some adaptation mechanisms followed by the climate change project in the study area for improvement small holder's livelihood. Specifically, to examine the effectiveness of these mechanisms for benefiting the respondents, as well as to explore the best mechanism for the current situation

# 3. Justification of the Study

Bara locality represents the highest vulnerable area to climate change in Sudan, due to many factors; increase in mean annual temperature, decrease of annual rainfall, increase in losses of vegetation cover, and failure of crops production. Those factors together contribute to adverse consequences on agriculture in general and on food security and poverty level of farmers in particular [11].

So this paper is an attempt to identify to what extent the mechanisms followed by the project have satisfied the requirements of improving livelihood of rural community, alleviate poverty, reduce desertification negative effects, and women empowerment through participatory approach.

# 4. Methodology

### 4.1. Study Site Description

Bara locality is located within latitudes  $12^{\circ} - 15^{\circ}$  N and  $30^{\circ} - 31^{\circ}$  E. The locality borders Jabret Elseikh from north, West Bara from west, Sheikan from south, and Umdam Hajahmad from the east (Figure1). Its area is 11850 square kilometers and 39729 households. The climate of the locality is semi-arid with low rainfall between 150-300mmper year.

Vegetation cover characterized with high density cover about 80% from the area such as acacia species, Merakh, etc. as well as shrubs. The state comprises a number of soil types, the two major and most extensive and dominating types being the sandy (qoz) soils and the clay soils almost using for garden plantation.

The variation of climatic zones and different soil types is reflected in the main economic activities of the inhabitants in the study area, which are based on integration of rainfall agricultural activities, horticultural activities, and animal production; the rainfall activities includes crop farming such as Millet, sesame, cowpea etc. When the horticultural activities represent in vegetables crops such as onion, tomatoes, okra, leaf crops, pepper. As in other parts of the Sudanese Gum Arabic Belt, gum Arabic from Acacia Senegal is a predominant component of the customarily practiced subsistence household farm system in the study area [7]. The most livestock activities include animal keeping.

#### 4.2. Sampling and Data Collection Technique

Bara locality was selected as study area. All villages covered by the project were selected using purposive sampling technique. Due to homogeneity of the community (12%) of sampling frame, 885 households were selected, a number of 106 respondents represent were selected according to the pervious percentage (Table 1). Primary data obtained according to scientific methods using well designed questionnaires following face-to-face interview, and focus group discussion, while secondary data were obtained using references and relevant sources.

**Table 1.** Shows the villages' name, total number of households in each village, % sample size, and number of HH in the sample.

Village name	Total No. of HH	No of HH in sample size	% sample size
Fouga	55	6	12
Shagelnoum	210	25	12
Umnabak	173	21	12
Alhamra	57	7	12
AbudalmElaama	82	10	12
MashgatElajous	172	21	12
Elehamrat	136	16	12
Total	885	106	12

Source: Field survey 2014

#### 4.3. Data Analysis

The questionnaires were coded and fed to computer and Statistical Package for Social Sciences (SPSS) version 10 was used descriptive statistical analysis in term of frequencies and percentages. Chi-square test was also used to investigate if there any significant differences between the variables of the study. The results finally presented in tables.



Figure 1. Location of the study area in North Kordofan State.

# **5. Results and Discussion**

The results of demographic variables revealed that 68% of the respondents were female and 56.6% were illiterate comparing to the total percentage of illiterate in the locality 30%. On the other hand 50% of the respondents farming represent the main occupation (Table 2). In Sudan, women as the primary field worker and have limited access to adaptation mechanisms [5].

<b>D.</b> Characteristics	-	Frequency	Percentage
Condor	Male	33	31.1
Gender	Female	73	68.9
	Illiterate	60	56.6
Education	Read and write	33	31.1
	Grade	13	12.3
	Farming	53	50
Occupation	Grazing	38	35.8
	Business	15	14.2

Indicating by SPSS; descriptive statistic, frequency, Source:Field survey 2014

Table 3. Effects of climate change on different sectors.

Effect climate of change on;	Frequency		Percentage	
	effect	Not effect	Effect	Not effect
Environment	64	42	60.4	39.6
Immigration	70	36	66	34
Traditional farming	75	31	70.8	29.2
Horticulture	37	69	35	65
Livestock	68	36	64.8	34.2
Forest	74	32	69.8	30.2
Total	106		100	

Indicating by SPSS; descriptive statistic, frequency, Source:Field survey 2014

Due to positive effects of climatic change on the environment presented by 60% of the interviewee, the immigration indicated by 66% from the respondents and 70.8% indicated that the climatic change have significant effects on traditional farming, forest69.8% and range (Table 3). The role of the project in reducing the effects of climate

change in the area regarding water supply presented by 82.1% (Table 4), meanwhile 53.8% indicated that they have adaptation method regarding to horticulture and water supply (Table 5). The explanation could be that the dynamic of integration is mostly in the hands of international actors. Then, these efforts are carried out without any consultation or participation of the ministry in charge of climate issues, at any of the national, provincial or local levels.

**Table 4.** Distribution of the respondents according to their perception towards the role of the projects in bridging the cap of climate change for different sectors.

Role of the project in bridging the cap	Frequency		Percentage	
	Strong	Weak	Strong	Weak
Traditional farming	46	60	43.4	56.6
Horticulture	73	33	68.9	31.1
Livestock	78	28	73.6	26.4
Forest	62	44	58.4	41.5
Water	87	19	82.1	17.9
Total	106		100	

Indicating by SPSS; descriptive statistic, frequency, Source:Field survey 2014

*Table 5.* Distribution of the respondents according to access of adaptation mechanism after intervention of the project for different sectors.

Sector		Frequency	Percentage
Found		57	53.8
Horticulture Not found	49	46.2	
Found	Found	57	53.8
Water Not found		49	46.2
Total		106	100

Indicating by SPSS; descriptive statistic, frequency, Source: Field survey 2014

For the studying the performance of production before and after the project intervention, the results revealed that the high production regarding horticultural activities throughout pre-project was found that with okra 81% and after project was found with potatoes 89.6% (Table 6). While in traditional farming results were found that watermelon presented by 77.8% pre-project and cowpea presented by 79.4% after projects (Table 6).

**Table 6.** Distribution of the respondents according to production of horticultural and traditional farming before and after intervention of the project for different sectors.

Horticulture		Frequency	Percentage
Olm	Before	86	81
Окта	After	20	19
D ( )	Before	11	10.4
Potato	After	95	89.4
Traditional farming			
Cowpea	Before	22	20.7

Horticulture		Frequency	Percentage
	After	84	79.4
XX7 4 1	Before	82	77.8
watermeion	After	24	22.2
Total		106	100

Indicating by SPSS; descriptive statistic, frequency, Source:Field survey 2014

Improvement of farmers livelihood represents one of the most objective of the project of climate change adaption, thereby the priority of this project is to provide respondents by cash horticultural crops, in this regards the results indicated that tomatoes was found to be the most contributes crops to improve livelihood status among the respondents as indicated by 54.9%, while 77.4% indicated that water supply to home consumption improved and become sufficient after project and 66% of them said that water supply become satisfied to the whole area(Table 7). Also the results extend to show that 69.8% of the respondents were perceived gas as source of energy instead of charcoal and firewood, and 98.6% assumed that provision of gas cylinders were contribution positively to environment conservation(Table 8).

**Table 7.** Distribution of the respondents according to contribution of crops in improving livelihood status.

Crops	Frequency	Percentage
Tomatoes	58	54.9
Potatoes	31	29.2
Okra	17	16
Total	106	100

Indicating by SPSS; descriptive statistic, frequency, Source:Field survey 2014

**Table 8.** Distribution of the respondents according to sufficient services before and after project intervention and therole of alternative energy for environment conservation.

Services		Frequency	Percentage
Water	Before	24	22.6
	After	82	77.4
Gas cylindered	Before	32	30.2
	After	74	69.8
The role of alternative energy	Positive	104	98.6
	Negative	2	1.4
Total		106	100

Indicating by SPSS; descriptive statistic, frequency, Source: Field survey 2014

The results of chi-square test indicated that there were significant differences among respondents towards the effects of the project intervention regarding traditional farming, horticulture, and range resources ( $Z^2 = 8.132$ , P=.004), ( $Z^2$ =8.627, P=.003), and ( $Z^2$ = 5.457, P=.019) respectively (Table 9, 10, and 11).

**Table 9.** Chi-square for significant differences between the means followed for adaptation regarding to traditional farming before and after project intervention.

Means follows for adaptation to climate	After project intervention			Total	C:-
change regardingtraditional farming		Found	Not found	10121	51g.
Before project intervention	Found	12	25	37	
		28.7%	63.2%	34.9%	
	Not formal	7	62	69	.004
	Not Iouna	71.3%	36.8%	65.1%	
Total		19	87	106	

 $\leq 0.05 =$  significant, indicating by Chi-square Test, Source: Field research (2014)

Table 10. Chi-square for significant differences between the means followed for adaptation regarding to horticulture before and after project intervention.

Mains follows for adaptation to climate	After project intervention			Total	- -
change regarding traditional farming		Found	Not found	Total	Sig.
Before project intervention	Found	16	3	19	
		28.1%	6.1%	34.9%	
	Not found	41	46	87	.003
		41.9%	93.9%	65.1%	
Total		57	49	106	

 $\leq$  0.05 = significant, indicating by Chi-square Test, Source: field research (2014)  $Z^2\!\!=\!\!8.627$ 

Table 11. Chi-square for significant differences between the means followedfor adaptation regarding to forest before and after project intervention.

Mains follows for adaptation to climate	After project intervention			Total	S:a
change regarding forest		Found	Not found	Total	Sig.
Before project intervention	Found	12	4	16	
		23.5%	7.3%	15.1%	
	Not found	39	51	90	.019
		76.5%	92.7%	84.9%	
Total		51	55	106	

 $\leq$  0.05 = significant, indicating by Chi-square Test, Source:Field research (2014)  $Z^2$  = 5.457

# 6. Conclusion and Recommendation

The study concluded that some mechanisms followed by the respondents and compatible with the projectactivities were traditional farming, forest, and range resources while the mechanism found not to be compatible with horticultural and water supply accordingly the study come out to recommend that more attention should be paid to traditional farming through providing suitable agricultural innovation, expansion and adoption of using solar energy for sustain water supply thereby increasing vegetables production, also provision of gas cylinders for rural communities have positive effects regarding environment conservation.

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 $Z^2 = 8.132$ 

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