Assessment of Awareness and Adaptation to Climate Change among Rainfed Farmers in Um Alqora Locality, Gezira State, Sudan

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Climate change represents the major challenge to Sudan agricultural production, economics and food security. Changes in temperature, rainfalls, water availability, increased outbreak of pest and diseases, land degradation, soil erosion, shrinking of grazing and cultivate areas, ongoing desertification and the other aspects of climate change have direct significant impact on agricultural production, productivity and cultivated crops of the country. Field survey was used to collect data from 100 rainfed farmers in Um Alqora Locality, Gezira State, Sudan by using the simple random sampling technique. The collected data were statistically analyzed and interpreted using percentage, frequency distribution and chi-square test. The results showed low percentage of agricultural extension contribution to awareness and adaptation to climate change among rainfed farmers in Um Alqora Locality, Gezira State, Sudan .It can be concluded that the contribution of agricultural extension was very weak in providing farmers with information, knowledge and skills on climate change and adaptation technologies in the Gezira State, Sudan which contributed to this incorrect situation. Thus, agricultural extension officers should be trained in all aspects of climate change and adaptation technologies, agricultural extension should build good linkages with rainfed farmers in the State, and considerable attention should be paid to the agricultural extension programmes for rainfed farmers in the State.

Abstract

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1. Introduction

In Sudan agriculture is the backbone of the economy and food security. As in developing countries the majority of Sudanese people lives in rural areas and depends on agricultural production as the main source of their income and food security. The country has two main agricultural sectors irrigated sector and mechanized or traditional rainfed sector. The traditional rainfed sector represents 60% of the total cultivated areas in the country (Siddig et al, 2011). Sorghum, sesame and millet are the main cultivated crops in this sector in addition to other crops such as sunflower, groundnut and cotton. The total yields of rainfed sector vary from season to season according to variability of rainfall. High percentage of Sudanese farmers was found in both traditional and mechanized rainfed agricultural sector.

Effect of climate change on African agriculture represents a major challenge to continental agricultural development including food security, nutrition and management (FAO, 2008). Climate change is one of the major challenges to Sudan agricultural sectors as in other sub-saharan African countries (Ifeanyi et al, 2012). Changes in temperature, rainfalls, water availability, increased outbreak of pest and diseases, land degradation, soil erosion, shrinking of grazing and cultivate areas, ongoing desertification and the other aspects of climate change have direct significant impact on agricultural production, productivity and cultivated crops of Sudan. The most suitable option to Africa to manage the impact of climate change is the adaptation, but the continent low adaptive capacity serves as major constraints facing its ability to adapt. These major constraints include limited financial resources and low technical awareness to adapt to climate change. Despite this unfavorable situation there are many adaptation strategies have been tried such as good agricultural management systems, drought resistant varieties and efficient irrigation systems (Nyong et al, 2006).

Information, knowledge and skills are important elements in farmer's awareness and practices to adapt to climate change. The capacity of farmers to adapt to climate change can be increased positively by the level of awareness about climate change in their communities (Idrisa et al, 2012).

Therefore agricultural extension has an important role to play in providing farmers with them

in order to keep suitable agro- ecosystem conditions needed for their agricultural production. Agricultural extension organizations therefore, should transfer appropriate adaptation practices and management techniques for farmers such as drought resistant crop varieties in addition to knowledge of cropping and management systems which have resilient to changing climate conditions (Davis, 2009). The main objective of this study was to assess the awareness and adaptation to climate change among rainfed farmers in Um Alqora Locality, Gezira State, Sudan.

2. Materials and methods

This study was conducted in Um Alqora Locality, Gezira State, Sudan. The total number of rainfed farmers in the locality for 2011/2012 growing season was estimated to be 1000. Ten percent of the population was selected using the simple random sampling technique in order to obtain a fairly accurate result with reasonable cost. The population was used to assess the awareness and adaptation to climate change among rainfed farmers in Um Alqora Locality, Gezira State, Sudan. A questionnaire consisting of five questions was constructed and the personal interview technique was used to administer the questionnaire. The collected data were statistically analyzed and interpreted using percentage, frequency distribution and chi-square test.

3. Results and discussion

3.1 Socioeconomic profile of rainfed farmers:

The age plays an important role on farmer's adoption of new technologies as known in the literature. The results showed that the majority of rainfed farmers (77%) were between 20 -50 years old which can be seen as the protective age categories (Table 1).

Table 1. Distribution of rainfed farmers according to their age category

Age category	No.	%
20-30	10	10
31-40	30	30
41-50	37	37
51-60	15	15
61 and above	8	8
Total	100	100

The education plays an important role on farmer's adoption of new technologies as known in the literature. The results showed that the majority of rainfed farmers (70%) were literate (Table 2).

Table 2. Distribution of rainfed farmers according to their education level

Education level	No.	%
Illiterate	18	18
Primary school	42	42
Secondary school	35	35
University and above	5	5
Total	100	100

The farm size plays an important role on farmer's adoption of new technologies. The results showed that the majority of vegetable farmers (56%) have farm size between 1 to 2 hectares (Table 3).

Table 3. Distribution of rainfed farmers according to size of their rainfed land

Farm Size/ha	Frequency	%
1- 1 -2	25	25
2- 3- 4	20	20
3- 5 and above	55	55
Total	100	100

3.2 Farmer's awareness on climate change:

Climate change has several phenomena vary from place to place according to many factors. The results should that the majority of rainfed farmers were aware of climate change and reported some phenomena of climate change occurred in their area which include increasing in weeds density, pests and diseases , temperature ,and decreasing in rainfall and crop production in addition to the emergence of new weed varieties as shown in table (4). The result of this study agrees with results obtained by Nhemachena et al (2006) who found that the farmers in Zambia, Zimbabwe and South Africa are aware about climate change and detected increasing in temperature, changes in the timing of rainfall and frequency of droughts. Also the result of this study is in line with results obtained by Juana et al (2013) and Anyoha et al (2013) who reported that the majority of farmers in Sub- Saharan Africa and Umuahia South Area of Abia State, Nigeria are aware of climate change phenomena such as changed in temperature and rainfall.

3.3 Use of climate change adaptation technologies:

Rainwater harvesting:

Rainfed farmers were used different types of traditional rainwater harvesting methods such as plowing and high tillage which were used to store water in the field after each rain through all the rainy season in order to help them in their temporary storage of rainwater in the field. The results revealed that the majority of farmers in Um Alqora Locality

(73%) did not use any modern water harvest technology (table 5). The result of this study is in line with results obtained by Akpoikpe et al (2010) who found that the majority of respondent farmers in Sudanian areas (North Benin, Togo and Ghana with southern Burkina and Niger) did not adopted the use of plowing as soil water management adaptation technology.

Use of organic fertilizers:

Organic agriculture plays an important role on facing climate change and contributes significantly to sustainable food security for rural people by reducing emissions of greenhouse gases and sequestering carbon dioxide from the atmosphere in the soil and plant biomass and minimizes energy consumption. Organic agriculture can help farmers to adapt to climate change through prevention of nutrients and water losses, preserving seeds and crop diversification and minimizing risks as a result of stable agro-ecosystems, reasonable crop yields and lower production costs. Organic agriculture did not use manufactured nitrogen fertilizers because this will increase the emission of nitrous oxide. The results showed that the majority of rainfed farmers in Um Alqora Locality (90%) did not use any chemical fertilizers or pesticides (table 5).

The result of this study is not in line with results reported in IFOAM report (2009) on case studies on organic agriculture contributes to climate change adaptation, the African case. This report mentioned that some organic agricultural practices have been adopted by farmers in Ethiopia, Burkina Faso Kenya, Egypt and Ghana and contributed significantly as climate change techniques in these countries.

Cultivation of new crop varieties:

Climate change has direct affect on cropping systems, thus adapting food production systems to rapid change in climate conditions are important to local and global food security. In some cases rainfed farmers will need to cultivate new crop varieties as adaptive method to reduce the losses in yield of existing crops which can be resulted from the variability of climate conditions. The results showed that the majority of rainfed farmers in Um Alqora Locality (86%) did not cultivate new crop varieties (table 5). The result of this study is not in line with results obtained by Nhemachena et al (2006) and Tafesse et al (2013) who found that the majority of respondent farmers in Zambia, Zimbabwe, South Africa and Ethiopia were adopting some adaptation techniques such as cultivating of different crop varieties and changing sowing and harvesting dates.

Cultivation of early maturing varieties:

Also in some cases, rainfed farmers will need to cultivate early maturing crop varieties or drought resistant crop varieties as adaptive methods to avoid the variability of rainfall. The results showed that the majority of rainfed farmers in Um Alqora Locality (51%) did not cultivate early maturing crop varieties (table 5). The result of this study agrees with results obtained by Anyoha et al (2013) who found that the majority of crop farmers in Umuahia South Area of Abia State, Nigeria were adopting the cultivation of early maturing varieties.

Changing sowing date of cultivated crops:

Changing sowing date of cultivated crops can be used as adaptive method to cope with climate change .Such changes in sowing date will help in avoiding high temperature, pests and diseases and variability of rainfall,…etc. The results showed that all of rainfed farmers in Um Alqora Locality (100%) did not change the sowing date of their cultivated crops (table 5). The result of this study is in line with results obtained by Akpoikpe et al (2010) who found that (50%) of respondent farmers in Sudanian areas (north Benin, Togo and Ghana with southern Burkina and Niger) did not changed their cultivated crop varieties. Also the result of this study is not in line with results obtained by Nhemachena et al (2006) and Tafesse et al (2013) who found that the majority of respondent farmers in Zambia, Zimbabwe, South Africa and Ethiopia were adopting some adaptation techniques such as cultivating of different crop varieties and changing sowing and harvesting dates.

Use of post-harvest techniques:

The use of post harvest techniques will assist farmers to reduce crop losses during harvest and storage and increase their income and food security. The results revealed that the majority of farmers in Um Alqora Locality (90%) did not use any improved post-harvest techniques and depending only on the traditional techniques (table 5). The result of this study agrees with results reported by Halos-Kim (2013) who found that crop post handling in Africa is still done using traditional methods.

Source of information on climate change and adaptation technologies:

Farmers can obtain agricultural information from many sources; on the other hand agricultural extension organizations can provide farmers with the needed information, knowledge, skills and new practices using many suitable agricultural extension communication methods such as field visits, demonstrations, field days, mobile phones, radio and television. .The results showed that the main sources

of information on climate change and adaptation technologies for farmers in Um Alqora Locality is their Family, friends and neighborhoods (table 5). The result of this study is in line with results obtained by Adebayo et al., (2012) who reported that (77%) of respondent farmers in Adamawa State, Nigeria had no contact with agricultural extensionists. Also the result of this study also agrees with results obtained by Juana et al (2013) who reported that the majority of farmers in Sub- Saharan Africa had no access to extension services. A similar result by Anyoha et al (2013) showed that only (30%) of crop farmers in Umuahia South Area of Abia State, Nigeria were acquiring information on climate change from extension agents.

3.4 Chi-square test:

Chi-square test was used to test the association between selected socioeconomic characteristics (education level and farm size) of rainfed farmers and their use of climate change adaptation technologies. The result showed that there was a significant association (at 1% level) between the education level, farm size of rainfed farmers and the low number of them who used the climate change adaptation technologies. This result insures that the education level and farm sizes are positively affected the low number of rainfed farmer`s information on climate change and adaptation technologies.

Table 4. Distribution of rainfed farmers according to their awareness about climate change.

Phenomena	Yes		No	
	No.	%	No.	%
Increasing in weeds density	87	87	13	13
Increasing in pests and diseases	93	93	7	7
Decreasing in rainfall	100	100	100	100
Decreasing in crop production	100	100	100	100
Increasing in temperature	83	83	17	17
Emergence of new weed varieties	80	80	20	20

Table 5. Distribution of rainfed farmers according to their use of climate change adaptation technologies

Technology	Yes		No	
	No.	%	No.	%
Water harvesting	27	27	73	73
Use of organic fertilizers	10	10	90	90
Cultivation of new crop varieties	14	14	86	86
Cultivation of early maturing varieties	51	51	49	49
Changing sowing date of cultivated crops	00	00	100	100
Use of improved post-harvest techniques	90	90	10	10

Table 6. Distribution of rainfed farmers according to their source of information on climate change and adaptation technologies

climate change phenomena and adaptation technologies	Source of information									
	Family, friends and neighborhoods		Radio		Television		Agricultural extensionist		Others	
	No.	%	No.	%	No.	%	No.	%	No.	%
Increasing in weeds density	86	86	0	0	1	1	00	0	0	00
			0	0	4	4		0	0	
Increasing in pests and diseases	88	88	0	0	0	0	12	1	0	00
			0	0	0	0		2	0	
Decreasing in rainfall	92	92	0	0	0	0	8	8	0	00
			0	0	0	0			0	
Decreasing in crop production	90	90	5	5	0	0	5	5	0	00
					0	0			0	
Increasing in temperature	80	80	3	3	7	7	10	1	0	00
								0	0	
Emergence of new weed varieties	79	79	1	1	4	4	6	6	0	00
			1	1					0	

Water harvest	100	100	0	0	0	0	00	0	0	00
			0	0	0	0		0	0	
Use of organic fertilizers	85	85	5	5	1	1	00	0	0	00
					0	0		0	0	
Cultivation of new crops	90	90	1	1	0	0	00	0	0	00
			0	0	0	0		0	0	
Use of early maturing varieties	80	80	0	0	0	0	20	2	0	00
			0	0	0	0		0	0	
Changing sowing date of cultivated crops	77	77	0	0	0	0	23	2	0	00
			0	0	0	0		3	0	
Use of post-harvest techniques	65	65	0	0	0	0	35	3	0	00
			0	0	0	0		5	0	

Table 7. Chi-square test for the association between selected socioeconomic characteristics (education level, farm size) of rainfed farmers and their use of climate change adaptation technologies

Technology	Education level	Farm size
	No.	No.
1- Water harvesting	27	27
2- Use of organic fertilizers	10	10
3- Cultivation of new crop varieties	14	14
4- Cultivation of early maturing varieties	51	51
5- Changing sowing date of cultivated crops	00	00
6- Use of improved post-harvest techniques	90	90
Significance	.000	.000

Significance level 0.01 or less

4. Conclusion and Recommendations

From this study it can be concluded that the contribution of agricultural extension was very weak in providing farmers with information, knowledge and skills on climate change and adaptation technologies in the Gezira State, which contributed to this incorrect situation. In order to enable rainfed farmers to cope with and adapt to climate change in the state, the authors recommends the following:

1- Agricultural extension officers should be trained in all aspects of climate change and adaptation technologies.

2- Agricultural extension should build good linkages with rainfed farmers in the State.

3- Considerable attention should be paid to the agricultural extension programmes for rainfed farmers in the State.

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