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Perceived impacts of climate change among rural farmers in Imo State, Nigeria

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The study analyzed the impacts of climate change among rural farmers in Imo State, Nigeria. Specifically, it ascertained the socioeconomic characteristics of the farmers, their level of awareness of climate change, the perceived causes of climate change and the perceived impacts of climate change. Multistage sampling technique was used to select a sample of 100 farmers for the study. Data were collected using structured questionnaire. The data were analyzed using frequency counts, percentages, mean score and bar charts. Results showed that a greater proportion (40.6%) of the respondents knew a little about climate change. Also, it showed that gas flaring (M = 2.07, S.D = 1.94), violation of local customs (M = 2.01, S.D = 1.83) and natural phenomenon (M = 2.00, S.D = 1.83) were perceived as causes of climate change. The result further showed that declining crop yields (49.0%), declining soil fertility (17.0%), drought events (17.0%) and increased heat wave (15.0%) were the perceived impacts of climate change on agriculture in the study area. It was recommended that relevant, timely and up-to-date information on climate change should be provided to the farmers to boost their adaptive capacity to climate change.

Key words: Climate change, impacts, rural farmers, Imo State, Nigeria.

INTRODUCTION

Climate change is one of the most topical environmental issues of this century. Though, it is not possible to predict precise future climate conditions, but the scientific consensus is that global land and sea temperatures are warming under the influence of greenhouse gases and will continue to warm regardless of human interventions for at least the next two decades (Intergovernmental Panel Climate Change, IPCC, 2007).

Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity (IPCC, 2007). It could also be defined as any significant change in measures of climate lasting for an extended period. This include changes in average weather conditions on earth, such as change in average global temperature, as well as changes in how frequently regions experience heat, droughts, storms, floods and other extreme events (Climate Change Information Resource, CCIR, 2004). According to the Ministry of

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Environment of the Federal Republic of Nigeria, MOE FRN (2003) climate change has become a global issue in recent times, manifesting in different climate parameters including cloud cover, precipitation, temperature ranges, sea level and vapour pressure.

The main causes of climate change have been attributed to anthropogenic (human-induced) activities (IPCC, 2007). Human activities such as the burning of fossil fuels and changes in land use like deforestation release greenhouse gases (GHGs) into the atmosphere which increases the already existing concentration of these gases. According to the South African Confederation of Agricultural Unions, SACAU (2009), the main GHGs are carbon dioxide, methane and nitrous oxide which account for 80, 14 and 6% of the total GHG emission, respectively.

Climate change is projected to have numerous and varied impacts on the environment and human lives. However, such impacts depend on the extent of adaptation, rate of temperature change and socio-economic conditions (IPCC, 2007). This implies that some sectors, systems and regions will more likely be affected than others but the impact will vary depending on system's sensitivity and adaptive capacity. Developing countries such as in Africa despite their least contributions to GHG emissions are increasingly expected to face climate-related threats. This according to Oli and Alec (2009) is as a result of their dependence on climate sensitive sectors (rain-fed agriculture, fishery), poverty and its history of resource, political and ethnic conflicts.

Such impacts include changes in wind patterns and precipitation, contraction of snow and sea ice, very likely increases in frequency of hot extremes, heat waves and heavy precipitation increases in high latitudes and likely decreases in most subtropical land regions (IPCC, 2007). These impacts are projected to affect agriculture, water availability, coastal areas and human health, thus affecting all natural and man-made systems to an extent (SACAU, 2009).

According to Ekong (2003), agriculture is the most dominant occupation in the rural areas. It constitutes the backbone of most African economies, making the largest contribution to GDP and the biggest source of foreign exchange, accounting for about 40% of the continent's foreign exchange earnings (Eva, 2009). However, it is considered as the sector most threatened by climate change in sub-Saharan Africa where there is low capacity to adapt (Shah et al., 2008). Eva (2009) maintains that climate change will exacerbate the existing challenges already facing the sector such as urbanization and industrialization, population increase, degradation of resources and insufficient public spending for rural infrastructure and services.

As posited by Ziervogel et al. (2006), impacts of climate change on agriculture include limited supply of rainfall and drying out of water sources, scarcity of grazing lands, shortage of dairy products, and loss of wild plants for gathering, migration of grazers, poor harvest and livestock losses among others. These problems would aggravate the stresses already associated with subsistence production, such as isolated location, small farm size, limited resources, informal land tenure etc (IPCC, 2007). These will make small-scale farmers in the rural areas particularly vulnerable to the risks of climate change.

It is important to identify the various impacts of climate change in vulnerable communities, which will enable the determination of the extent of risks posed by the changing climate on their dominant occupation (that is, agriculture) as well as enhance the development, streamlining and up scaling of adaptation strategies. This is further necessitated by the fact that impacts of climate change are location-specific and these have to be determined in order to develop comprehensive and suitable adaptation strategies which will capture vulnerable communities in developing countries. It is against this backdrop that the following research questions are being asked: what are the perceived causes of climate change and what are the perceived impacts of climate change in the study area?

Purpose and objectives

The overall purpose of the study is to identify the perceived impacts of climate change among rural farmers in Imo State, Nigeria. Specifically, the study sought to:

1. Determine the socio-economic characteristics of the farmers;
2. Ascertain the awareness of climate among the farmers;
3. Identify perceived causes of climate change in the study area; and
4. Identify perceived impacts of climate change in the area.

METHODOLOGY

The study was carried out in Imo State, which is among the five states in the Southeast geopolitical zone of Nigeria. It lies within latitude 4° 45′ N and 7° 15′ N and longitude 6° 50′ E and 7° 25′ E and covers an area of about 5100 km^2. It is divided into three political zones namely Owerri, Okigwe and Orlu and comprises 27 LGA. The population of the state stands at 4.8 million people (Federal Republic of Nigeria Official Gazette, 2007). Rainfall distribution is bi-modal with peaks in August and September. Variation in annual rainfall is between 1900 and 2200 mm. Temperature is uniform in the state with mean annual temperature of about 20°C. The annual relative humidity is 75% and the state lies within the rainforest agro-ecological zone. The major economic activity of the people is farming which confirms the predominance of rural communities in the state. Major crops grown include maize, cassava, yam and cocoyam while major livestock kept are goats, sheep and poultry (Umunakwe, 2011).

All farmers in the state constituted the population for the study. Multi-stage sampling technique was used to select the sample. The

first stage comprised the purposive selection of one LGA from each of the three political zones in Imo state based on peculiar vulnerability factors which include flood, erosion, oil exploration and other natural disasters. The second stage comprised the purposive selection of one autonomous community from each of the three LGAs based on the vulnerability factors above. The third stage involved the purposive selection of three villages from each of the three autonomous communities based on vulnerability factors mentioned above. The fourth stage comprised the purposive selection of 12 farmers from each of the nine villages. Overall, 108 farmers were used for the study. Data for this study were collected using a structured questionnaire and interview schedule and were validated using face and content validity.

To ascertain the level of awareness of climate change, respondents were asked to indicate their knowledge of climate change and their responses were measured on a nominal scale of Know a lot = 4, know = 3, know a little = 2 and don't know = 1. The percentages of the observations on the scales were determined. To ascertain the perceived causes of climate change, a list of possible causes of climate change obtained from literature and field observation were provided and the respondents' perception were measured on a 5 point likert type scale. These are, To a Great Extent = 4, To Some Extent = 3, To a Little Extent = 2, To a Very Little Extent = 1 and To No Extent = 0. The mean score was determined by adding up all the values of the scale to obtain 10. Then, it was divided by the number of values, that is, (10/5) to obtain 2. Items with $M \geq 2$ were regarded as perceived causes of climate change in the study area. The perceived effects of climate change were ascertained by providing a list of possible effects of climate change obtained from literature and personal observations and respondents were asked to indicate the ones they perceive as effects. Data obtained were analyzed using percentage distribution, mean statistics and bar charts.

RESULTS AND DISCUSSION

Age

Data in Table 1 show that majority (61.5%) of the respondents were between the ages of 41-56 years while a very small proportion (1.8%) was 73 years and above. The mean age of the respondents was 50.51 years. This implies that the respondents were still within active and productive ages and can be efficient in agricultural production. In addition, their mean age suggests that they have sufficient knowledge and experience pertaining their environment and would be able to give vital information regarding climate change. According to IPCC (2007) any event is considered as climate change if it has occurred consistently for at least a period of one decade. Therefore, the mean age of the respondents which is above one decade would have enabled them observe such events.

Sex

Data in Table 1 show that majority (55.7%) of the farmers were male while the remaining 44.3% were female. This reflects the dominance of male farmers in the study area. Studies have revealed that women are marginalized in most societies in developing countries (Ekong, 2003; Igbokwe, 2005; Ani, 2004) and this limits their access to natural resources such as land thus affecting their involvement in agriculture. This marginalization could limit their access to agricultural services. For example, Holmes and James (2008) observed that in spite of the high ratio of agricultural extension staff to farmers in Ethiopia, female farmers still have limited access to extension services. This could increase the vulnerability of the farmers to climate change.

Marital status

Entries in Table 1 show that majority (70.7%) of the farmers were married while 20.8, 6.6 and 1.9% were widowed, divorced and single, respectively. Marriage could provide farmers with a supply of family labour, which is cheaper and readily available and also enhances the sharing of agricultural information and knowledge. According to Nnadi et al. (2012), marriage encourages complementarities of efforts among farming households. This could promote adaptation among farming households.

Educational qualification

Results in Table 1 show that majority (99.10%) of the farmers had one form of formal education or the other while the remaining 0.9% had no formal education. It could be inferred from this that literate farmers dominate the study area though the level of literacy differed. The acquisition of formal education will increase the receipt of information on climate change, leading to a broader knowledge of it. According to Agbamu (2008), the acquisition of formal education promotes the adoption of improved agricultural technologies.

Household size

Data in Table 1 show that majority (52.9%) of the farmers had household sizes of between 6-10 persons. Others were 39.6 and 7.5% for household sizes of 1-5 and 11-15 persons, respectively. The mean (M) household size was seven persons. This shows that the farmers had fairly large households which could supply them with cheaper family labour. Large households would encourage diversification of enterprises by farmers thus increasing their productivity and income. It would also minimize expenses especially on labour. A study by Nnadi et al. (2012) confirmed that households in Imo State, Nigeria are fairly large.

Secondary occupation

Entries in Table 1 further show that majority (50.0%) of the farmers engaged in trading as a secondary

Table 1. Distribution of respondents according to their socio-economic characteristics (n = 108).

Socio-economic characteristic	%	M
Ages (Years)		
25-40	21.2	
41-56	61.5	
57-72	15.5	50.51
73 and above	1.8	
Sex		
Male	55.7	
Female	44.3	
Marital status		
Single	1.9	
Married	70.7	
Widowed	20.8	
Divorced	6.6	
Educational qualification		
No formal education	18.5	
Primary school attempted	3.2	
Primary school completed	18.9	
Secondary school attempted	27.4	
Secondary school completed	19.8	
OND/NCE	11.3	
HND/First degree	0.9	
Household size (Persons)		
1-5	39.6	
6-10	52.9	
11-15	7.5	7
Primary occupation		
Farming	65.1	
Hunting	1.9	
Trading	24.5	
Government worker	8.5	
Secondary occupation		
Farming	9.4	
Trading	50.0	
Driving	3.8	
Masonry	1.9	
None	34.9	
Farming experience (Years)		
1-10	49.8	
11-20	27.4	
21 and above	22.4	14.30
Farming system		

Table 1. Contd.

Crop production	61.3	
Livestock production	7.5	
Mixed farming	31.2	
Major crops grown		
Cassava	65.2	
Maize	7.5	
Yam	22.6	
Cocoyam	4.7	
Major livestock kept		
Poultry	21.7	
Goat	12.3	
Sheep	8.5	
Pig	0.9	
None	56.6	
Farm size		
< 1 ha	66.5	
1-1.9 ha	32.0	1
2 ha and above	1.5	

Source: Field Survey Data, 2011.

occupation while 9.4, 3.8 and 1 .9% indicated farming, driving and masonry, respectively as their secondary occupations. Rural people have been observed to diversify their means of livelihood as a way of adapting to climate change (Roncoli et al., 2010). Diversification of livelihood activities helps farmers to cope with climate change especially in the event of collapse of on.

Farming experience

Data in Table 1 show that a greater proportion (49.8%) of the respondents had engaged in farming activities for a period of 1-10 years. Also, 27.4 and 22.4% had been into farming for 11-20 years and 21 years respectively and above respectively. The mean farming experience was 14.30 years. This means that the respondents have practiced farming for a fairly long period of time enough to observe changes attributable to climate change. The period is also enough for the farmers to observe the effects of the changing climate. According to IPCC (2007), any change should be observed for at least one decade before it could be said to be climate change.

Farming system

Data in Table 1 reveal that majority (61.3%) of the farmers were into crop production while the remaining 31.1 and 7.5% were mixed and livestock farmers, respectively. This finding still attests to the fact that farmers in the study area diversify their enterprises. As observed by Rancoli et al. (2010), farmers in rural Kenya integrate crop and livestock production as a measure to cope with the changing climate.

Crops grown

Data in Table 1 also show that majority (65.2%) of the farmers cultivated cassava while 22.6, 7.5 and 7.4% cultivated yam, maize and cocoyam, respectively. Fundamentally, this result shows that the farmers cultivate more than one crop. The dominance of cassava in the area could be as a result of its ability to withstand adverse climatic conditions. Manyong et al. (2000) reported that cassava has the ability to survive suboptimal conditions such as drought and low soil fertility. However, the cultivation of other crops by the farmers could be seen as measure taken to cope with adverse climatic conditions considering the risks and uncertainties facing agricultural production.

Livestock kept

Entries in Table 1 show that majority (56.6%) of the farmers kept no livestock while 21.7, 12.3, 8.5 and 0.9%

Table 2. Mean distribution of respondents according to perceived causes of climate change (n = 108).

Causes of climate change	M	S.D
Bush burning	1.14	1.404
Use of excessive chemicals in farming	1.24	1.583
Deforestation	1.20	1.444
Overgrazing	0.76	1.239
Burning of fossil fuels	1.22	1.615
Indiscriminate use of generators to provide electricity	1.22	1.537
Depletion of ozone layer	1.30	1.646
Gases released from industries	1.93	1.890
Natural phenomena	2.00*	1.830
Violation of local customs	2.01*	1.860
Crude oil spillage	1.67	1.803
Swamp rice production	0.87	1.388
Gas flaring	2.07*	1.938

* Perceived causes of climate change. Source: Field Survey Data, September 2011.

kept poultry, goat, sheep and pigs, respectively. Globally, livestock contributes about 40% to the agricultural GDP and constitutes about 30% the agricultural GDP of developing countries (World Bank, 2009). However, the non-participation of majority of the farmers in livestock production could be attributed to the increasing costs and risks involved in the enterprise. According to Moyo and Swanepoel (2010), the increasing risks and uncertainties related to climate change and associated shocks add another dimension to changes observed in livestock production.

Farm size

Data in Table 1 further reveal that majority (66.5%) had less than 1 ha farm size while 32.0 and 1.5% had 1 to 1.9 and 2 ha, respectively. The mean farm size was 1.0 ha. This shows that the farmers were predominantly small landholders which is in conformity with the assertion of the African Fertilizer Summit (2006) that small holder farmers cultivate between 0.8 to 1.2 ha of land. This could be attributed to the declining availability of land for agriculture due to urbanization and increasing population and consequently lower farmers' productivity.

Level of awareness of climate change

Data in Figure 1 show that a greater proportion (40.6%) of the farmers knew a little about climate change, 31.1 and 6.6% knew and knew a lot about climate change, respectively. The figure further shows that a significant proportion (21.7%) of the farmers does not know about climate change. The limited knowledge about climate change among the farmers could be as a result of their inability to access scientific information on climate change which could be attributed to inadequate number of extension staff in the area (Onyeneke and Madukwe, 2008). This may hamper their ability to adapt to climate change thus leading to poor agricultural harvests. According to Aklilu (2002), information about climate change is largely confined within the academia and research institutions thus limiting their availability to end-users.

Perceived causes of climate change

The mean scores of the respondents in Table 2 show that gas flaring (M = 2.07), violation of local customs (M = 2.01) and natural phenomena (M = 2.00) were perceived as main causes of climate change by the farmers in the study area. This perception may have been influenced by their limited access to scientific information on climate change which strengthens their reliance on personal observation and experience as sources of information on the phenomenon. As reported by (GoZ-UNDP/GEF, 2010) majority of the public in developing countries are yet to be properly and adequately informed about climate change. Similarly, Aklilu (2002) observed that information about climate change is still confined within the academia and research institutions in developing countries and consequently limiting local people's access to such information. The unavailability of proper information on climate change will hamper the adaptive capacity of rural farmers, consequently worsening the growing cases of food insecurity and famine in the region.

Combustion of fossil fuels has been reported as one of the major causes of climate change (SACAU, 2009). A study by Egbule (2010), reported that natural gas is still being flared in the Niger Delta region of Nigeria and local

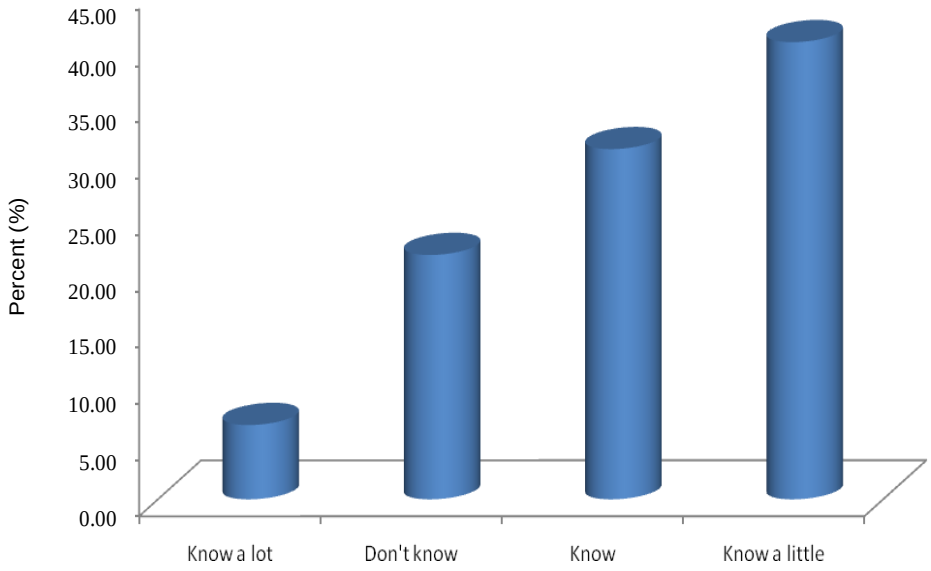

Figure 1. Level of awareness of climate change. Source: Field Survey Data, 2011

people there perceived it as among the causes of climate change. Flaring of natural gas emits GHGs into the atmosphere, thus increasing their concentration and leading to more warming effects.

The farmers also perceived climate change as a natural phenomenon. It is a common notion among local people that climate pattern varies naturally and they attribute it to the will of God. They strongly contend that climate is not stable so also are the weather elements like rainfall, sunshine and others. Though, climate variability is natural, scientific reports have shown that it is worsened by the emission of GHGs into the atmosphere (IPCC, 2007). This as a result exerts adverse influences on the ecosystem.

The farmers further perceived climate change to be because of the violation of local customs. This is common in the rural areas where people attribute any disaster or mishap in their environment to the anger of the gods. They hold the view that certain evil deeds incur on the people the wrath of the gods which sometimes can persist for generations. According to them, such wraths can alter the usual pattern of climatic and weather elements which will affect adversely the means of livelihood of the people especially agriculture which has a close relationship with climate. For example, some communities in the Igbo society believe that incest or adultery can cause the land in the area to be infertile thereby leading to poor harvests. Some others believe that failure to offer sacrifices to the gods of the land before planting can provoke the gods leading to the cessation of the rain. This however is in agreement with the findings of Kelbessa (2007) that African local people associate climate change to such issues as the violation of local customs, the wrath of gods, the end of the sinful generation and natural phenomenon.

Perceived impacts of climate change

Figure 2 shows that a greater proportion (49.0%) of the respondents perceived declining of crop yields was taken as the major impact of climate change on agriculture. Moreover, 17.0, 17.0, 15.0, 10.0, 5.0, 5.0, and 5.0% were perceived as declining soil fertility, drought events, increasing heat wave, high incidence of weed, changes in rainfall intensity and pattern, increasing incidences of pests and diseases on crops and excessive rainfall, respectively. This finding is in line with the report of a survey by Hassan and Nhemachena (2008) that increasing temperature, declining precipitation, changes in the pattern of rainfall and drought events are becoming more frequent.

The perception on declining soil fertility is in agreement with the model result which projects a reduction of suitable land for rain-fed agriculture and crop production. In Southern Africa, it is projected that this reduction could lead to net crop revenues dropping by as much as 90% (IPCC WGII, 2007).

Similarly, the perception on declining crop yields also is in line with the projection that climate change would reduce the production of maize in southern and western Africa, while decreases in North Africa's wheat yields could increase famine (Warren et al., 2006). Furthermore, Fischer et al. (2002) reported a general decline in the production of most subsistent crops e.g. sorghum in Sudan, Ethiopia, Eritrea and Zambia. In addition, climate change is expected to impact negatively on agricultural production by increasing risks of exposure to new pests and disease variants (Ensor, 2009). The knowledge of climate change impacts on agriculture will enable farmers adopt technologies that will reduce these impacts.

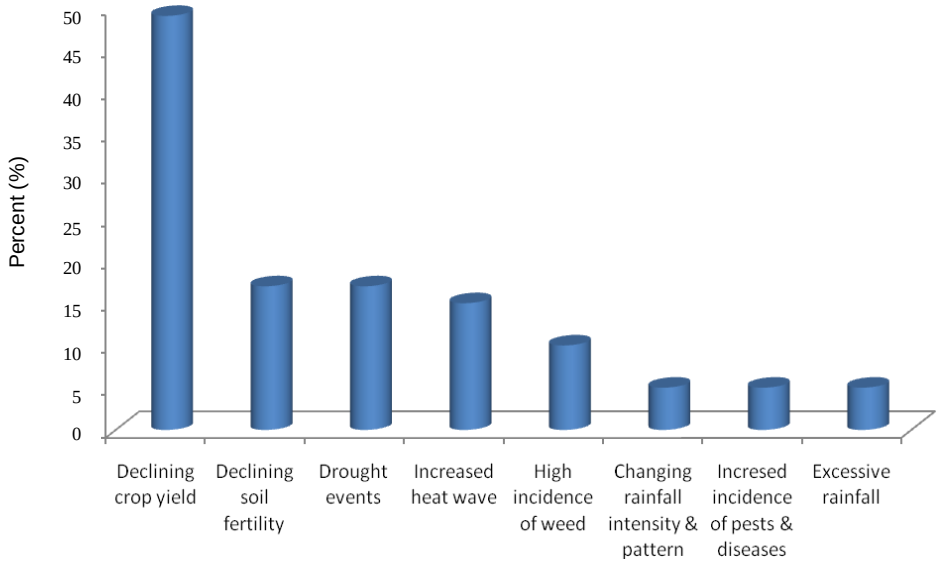

Figure 2. Perceived impacts of climate change.

Conclusion

Rural farmers have observed the occurrence of climate change. However, their knowledge on the causes is still limited in the sense that it is more local than scientific. For example, it was perceived as a natural phenomenon and a punishment by the gods. This implies that local farmers still have inadequate access to information on climate change and this could hamper their adaptive capacity, thus worsening food insecurity situations. Poor capacity of the extension organization to disseminate climate change information could have contributed to this. Furthermore, the impacts were mainly felt on agriculture which is their major occupation. Climate change has continued to exert negative influences on agricultural development in developing countries. Hence, the attainment of food security has remained very impossible. Agriculture relies on the climate more especially in developing countries. Therefore, any change in the climatic conditions will have significant effects on agricultural production.

RECOMMENDATIONS

Following the findings made in the study, the following recommendations are made:

1. Relevant and up-to-date information on climate change should be made available to farmers. However, to ensure the provision of relevant information to the farmers, their information needs regarding climate change should be first determined to ensure that information provided to them is useful. Furthermore, to ensure the speedy and timely provision of this information, devices that are fast, cover a wide range of information users and cost-effective like the ICTs should be incorporated into extension service delivery and climate change adaptation programmes. The provision of climate change information through mobile phones and telecentres will facilitate the accessibility of information by rural farmers.
2. Sensitization campaigns should be mounted in rural areas to educate farmers on climate change. ICTs such as radio and television considering their potentials such as speed, number of people covered and cost-effectiveness should widely be used in the campaign on climate change.
3. Systems of agriculture and improved agricultural packages designed to help farmers adapt to climate change should be made available to the rural farmers. This may include improved crop varieties and livestock breeds, farm inputs and credit facilities.

Conflict of Interest

The authors have not declared any conflict of interest.

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