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Research Article

Role of Community Based Organizations in Transferring Climate Change Information in Rwanda

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Abstract

Background and Objective: Climate change poses a threat for agriculture and development in Rwanda. The agricultural sector in Rwanda is the engine of economic growth and modernization. This study examines the role of community based organizations (CBOs) in transferring climate change information to farmers' communities in Rwanda. **Materials and Methods:** Three districts (Kirehe, Rwamagana and Ngoma) were studied and two active CBOs (RWIRRI and RADO) were selected for data collection. A total of 100 farmer households were interviewed. A focus group discussion of fifteen participants was conducted in the community. **Results:** The results showed that the CBOs played a good role in increasing farmers' awareness related to climate change and adaptation strategies. CBOs had built a capacity in the local communities regarding improved agricultural methods, climate variability and climate change effects. The adaptation strategies could improve the livelihood conditions of the communities. **Conclusion:** CBOs had played a role in increasing farmers' awareness and had built their capacity regarding to climate change and crops productivity.

Key words: Farmers' awareness, capacity building, adaptation strategies, crops productivity, CBO

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Rwanda is divided into five provinces: City of Kigali, Eastern province, Northern province, Western province and Southern province as presented in Fig. 1. This study focused on the Eastern province, which is located at 1°45' 00" S latitude and 30°30' 00" E longitude. It is the largest, most populous and the least densely populated of the five provinces of Rwanda. The lowly inclined hills and the dry valleys characterized the province, a long dry period (June-October), hot temperature and little rainfall. The monthly distribution of the rainfall varies from 1 year to another. The annual rainfall is about 827 mm/year¹. In this study, three districts of the Eastern province were studied: Kirehe, Rwamagana and Ngoma.

Kirehe district extends over a total area of 1,118.5 km² with a total population about 340,983 inhabitants; the relief of the district is that of a low plateau area. Kirehe District has 4 seasons/year making it possible to have two annual harvests on the same land area. Agriculture is strongly dependent on the rainfall².

Ngoma district covers an area of 867.74 km² with a total population about 338,562 inhabitants. It is part of the lowlands of the East, a region essentially dominated by hills with low slope, with an average altitude between 1400 and 1700 m amsl. The original relief is a plateau strongly dissected by tectonically movements of the quaternary that were progressively gullied by the erosion creating valleys and swamps. The annual average temperature is about 20°C. Ngoma experiences two rainy and two dry seasons. A short rainy season extends from October-December, a short dry season runs from January-February, a long rainy season from mid-February to mid-May and a long dry season from mid-May to early October. Generally, the dry season begins earlier and ends later compared to other regions of the country. The soil characteristics in Ngoma district are favorable for agricultural activities. In addition, the district of Ngoma has three lakes namely Bilira, Mugesera and Sake, which provides the region with a beautiful landscape that could attract many tourists if developed and advocated³. The district of Rwamagana is situated between 1°57'2,7" S latitude and 30°26'8" longitude with a total population about 310,238.

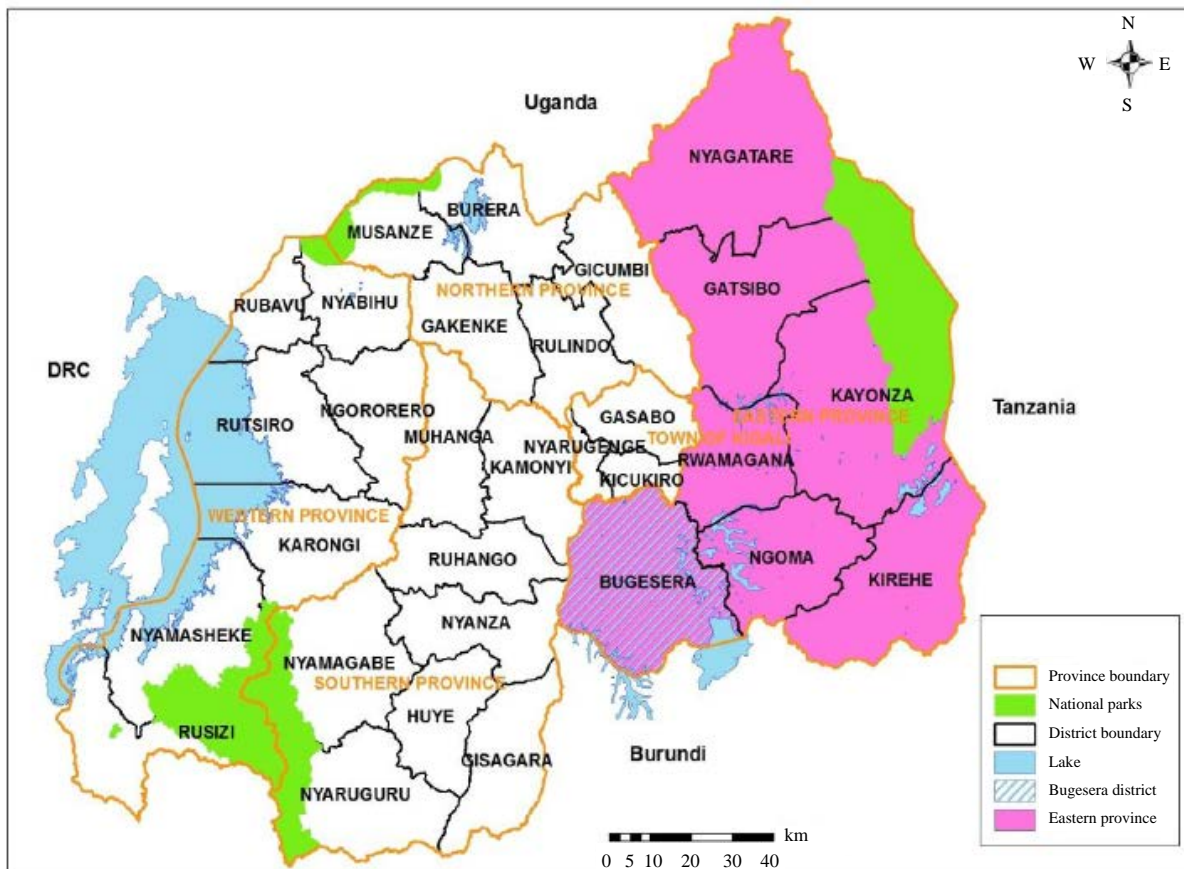


Fig. 1: Administrative map of Rwanda

The district is characterized, in general, by lowly undulating hills separated by valleys some of which are swampy and boggy. This topographical feature constitutes an important potential for modern irrigation system and mechanized agriculture. The climate of this district is mainly characterized by a moderate tropical climate.

Agriculture and livestock are the main economic activities that are dominant in Kirehe², the soils are fertile for crops like banana, maize and beans. The marshlands are suitable for rice growing and fruits like pineapples, oranges and mangoes. These crops cover 64,500 ha. Banana plantation is mostly cultivated in the areas of Mushikiri, Gatore, Kirehe and Musaza where it covers 11,500 ha. Kirehe district cultivates maize on almost 25,000 ha in the swampy areas of the Akagera region in the sectors Kigarama, Nyamugari, Mahama, Mpanga and Nasho². The EICV3⁴ report reveals that, the mean cultivated land/household (in ha) is at 0.6%. The district indulges in trade with other districts that it shares the borders with especially in agricultural products like maize, rice, beans, banana and fruit products like pineapples, avocado which the district sells to the neighboring district of Ngara (Tanzania), where the district exports more than 4 t of fruits weekly. Extreme poverty rate is at 25.6% compared to 24.1% of the national average, the district has 8.5% of the wage farm employed people compared to 9.9% of the National average, Wage non-farm is at 7.0-16.9%. On habitat the EICV3 indicates that 94.5% people live in Imidugudu compared to 37.5% of the national average, 1.6% households with electricity as a source of lighting compared to 63% of the national average⁵.

In Ngoma, 86.1% of the population is economically active. Eight one percent of the Ngoma district population work in agriculture, while 73.5% at the national level. Most of the population (73.5%) works on their own farm against 61.8% at the national level. Women (83.2%) are much more likely than men (61%) to have their main job on their own farm (self-employed). Men by contrast are more than three times more likely than women to have their main job in the waged non-farm sector where they count for 15% gains only 4.9% for females⁵.

Agriculture is also the main source of income for 57% of the households against only 21% who's the source of income is wages, it is important to look at the assets for the agriculture production. Regarding the income from the agriculture products, 23.6% of the agriculture products in Ngoma district are sold compared to 20.9% sold at national level. This shows at what extent the agriculture is for subsistence rather than a market oriented agriculture. The main grown food crops in Ngoma district according to their importance order are dry beans (96.2%), cooking banana (92.1%), maize (90%), sweet

potato (84.4%), cassava (76.8%), peanut (45%) and rice (8.5%)⁵. The main fruit and vegetables cultivated in Ngoma district are fresh beans (92.2%), avocado (53.7%), papaya (41.3%) while the main export and cash crops are coffee (18.3%), sunflower (28.1%), cane sugar (24.6%) and pepper (12.6%). In general, 69.8% of households in Ngoma district raise livestock against 68.2% at national level. Concerning the different types of livestock, 40.1% of households are raising cattle, 1.5% of households have sheep, 61.1% have goats, 32.1% have pigs, 11.9% have rabbit and 62.4% have poultry. At national level these are 47.3, 15.7, 53.0, 24.1, 22.9 and 45.5%, respectively for cattle, sheep, goats, pigs, rabbit and chicken. Other industry of usual main job is trade (5.6%), government (4%), utilities and banking services (2.6%), Construction (1.3%), transport and communications (1.3%), mining and quarrying (0.5%)⁵.

In Rwamagana, agriculture and livestock are the main economic activities that employ over 80% of the population in rural areas and 85% at least practice traditional agriculture. Business related activities are also another economic activity that is practiced in the district mainly in some rural areas. The major crops of the district include bananas, rice, maize, pineapple and coffee. The district is rich in minerals (Cassitérite, Colombo tantalite and Wolfram) especially in parts of the sectors of Musha, Mwulire and Gahengeri. The infrastructure is somehow developed in this region with relatively big networks of roads that connect it to other districts and also to agriculture production areas, but most of them are in bad condition. Only 102 km of feeder road is in good condition. Regarding water transport, there are 5 small motor boats that provide navigation transport in lakes Muhazi and Mugesera. The EICV3 report⁴ reveals that, land use consolidation is at 7.4% compared to the national average of 11.5%, hill side irrigation is at 6.1% compared to national average of 3.0%, land under erosion control 88.3% compared to 78.1% national average. Through GIRINKA program, the district has distributed 6,168 cows to 14.3% vulnerable families 14.0% households have electricity subscriptions (20.4% EWSA), 58.3% of the population own mobile phones and 1.3% of the population own computers⁶.

Community based adaptation to climate change: Community based adaptation is a significant issue when it comes to the process of climate change adaptation^{7,8}. Besides, most adaptation efforts have been in favour of top-down approaches. Through theory and practice the term community based adaptation (CBA) has been reflected in different aspects such as community based local capacity building, participatory disaster risk reduction, community based adaptation and community based development efforts⁹. Although community based adaptation needs participation,

collective action, social capital, information access and local knowledge of risk management⁸. With the increase of climate change impacts, it was essential to have both adaptations types in place. Therefore, autonomous adaptation was not sufficient to address the impact of climate change. Collective adaptation measures affect the individual decisions and resilience to climate change by sharing risk, while it incorporates the long-term disaster management focusing on both scientific and indigenous knowledge⁷. Community-based adaptation (CBA) role is to ensure that the poorest people vulnerable to climate change can cope with changing conditions¹⁰ and to ensure that the community members are involved in planning, decision-making and evaluation. There are two types of participation, normative participation which bases on the rights and democracy given to people in participating into decision making process while pragmatic participation provides higher quality decision¹¹. In addition, participation can be defined as a 'building consensus' where all participants can live with the results and exchange of information. The role of participation was an effective mean to achieve greater adoption technologies among the target groups. It provides a high quality of information, meet the needs of local community and their priorities to provide a higher quality decision⁹. Several policy documents had given an attention to the participatory approach in order to promote climate change adaptation strategies. The United Nations Development Programme (UNDP) emphasizes grassroots level participation and Intergovernmental Panel on Climate Change (IPCC) focused adaptive capacity as the "active participation by concerned parties, especially to ensure local needs and resources"¹². Developing countries are more likely to be severely affected due to their vulnerabilities and related geographic, socio-economic contexts¹³. Adaptation to climate change risks will need to use bottom up approach starting with the lowest level as family up to government¹⁴. Effective community-based adaptation (CBA) tackle both the motivation of communities to take actions towards an adaptation scheme and understanding of climate change to minimize the risks, it is important to communicate the climate change issues with the communities¹⁵. The capacity of local communities/farmers to adapt to climate changing conditions is in a part of social capital. However there are other factors such as socio-economic conditions, governmental accountability and institutional. Thus, adaptation can comprise both spontaneous responses by affected communities, planned responses by governments and institutions¹⁴. There are methodologies that are used to evaluate the effectiveness of adaptive capacity. Jones *et al.*¹⁶ identifies and defines five asset and process-oriented

characteristics of local adaptive capacity (LAC) framework for evaluating the community adaptive capacity.

Mainstreaming community-based adaptation (CBA) in agriculture: As defined by Wright *et al.*¹⁷ climate change mainstreaming brought about the incorporation of climate change information into the public policy plans at all governing levels within all sectors by involving both public, private and civil actors. Mainstreaming involved the integration of information, policies and measures to address climate change into ongoing development planning and decision-making. Mainstreaming activities consider that climate risks projects are addressed and project activities and approaches are adjusted with the assumption that the project have a goal of poverty reduction, livelihood security, well being is improved for the targeted individuals and sustainability¹⁸. It was seen as making more sustainable, effective and efficient use of resources than designing and managing policies separately from ongoing activities^{17,19}. This mainstreaming is however different from community based adaptation where CBA goal is to build resilience to climate change²⁰. Mainstreaming climate change has identified as a way in which both adaptation and development can be addressed. However mainstreaming practices can have a different meaning to different people²¹. The reason behind mainstreaming is to ensure that the risks posed by climate change are reduced through the project activities by the stakeholders, this term is referred as "climate proofing" and also to ensure that project or program activities maximize their contribution to adaptive capacity of targeted populations without increasing the vulnerability, instead through the actions designed to build resilience¹⁸. 'Climate-proofing' has been criticised for failing to full address the major cause of vulnerability, it has failed to address the maladaptation and realization of the potential interventions to a successful resilience²². In climate-proofing the climate resilience was integrated at a later stage²³. On the other hand, a vulnerability or development-based view of adaptation incorporate a more understandable holistic approach in addition to climate-proofing, here the development approach are aimed to diminish the vulnerability by including all priorities for adaptation²⁴.

Why mainstream? The linkages between adaptation and development: Climate change adaptation and development have been managed in different areas²⁵. From United Nations Framework objective' of the UNFCCC, climate change adaptation emerged a response to withstand climate change impacts. Thus, adaptation emerged under global governance structures from discussions of climate change impacts and how they could be managed and this has developed into an

'impacts based' approach to adaptation²⁶. According to Klein²⁷, he defines it as 'technology-based' interventions such as dams, early-warning systems, seeds and irrigation schemes based on specific knowledge of future climate conditions. Integrating adaptation into development is often referred to as 'mainstreaming', which refers to integrating an issue into existing development, institutions and decision-making²⁰. Mainstreaming has a long history in both development and environmental policy²⁸. In relation to climate change, mainstreaming has been suggested as a key possibility to tackle adaptation and development together²⁹. Huq and Ayers³⁰ proposed a framework for mainstreaming at the national level. The context of the framework assumed that the international cooperation would be the mainly drive given that incentives for climate change adaptation planning at the time were generally externally driven¹⁹.

Problem statement: Agriculture is the engine of growing the economy and its modernization in Rwanda. The agriculture sector boosted Rwanda's GDP from 7.9% in 2007 to 11.4% in 2008³¹. The change in precipitation, temperature and extreme drought and floods events are the main characteristics of the climate. Farmers are most affected by the climate change impacts due to the timing, frequency and intensity of rainfall events and the rainfall distribution³². Temperature and precipitation have a strong relationship and this is likely to affect crop production. The decline of rainfall and increase of temperature will strongly continue to make crop production and livestock more vulnerable³³. Climate change poses a threat for the development in Rwanda¹. Recent projections revealed that the precipitation data are to vary more in comparison to temperature which is expected to vary slightly in 2050³⁴. The decrease of temperature could lead to a damage of the crop productivity especially in the high-altitude regions like the Eastern province. Previously, Rwanda has experienced a significant decrease in agriculture productivity due to climatic change conditions and this has affected food security, health and malnutrition throughout the country³⁵. Climate change impacts include periodic extreme events of flooding and droughts that has occurred and caused major socio-economic impacts and reduce economic growth in Rwanda. Major floods events occurred in 1997, 2006, 2007, 2008 and 2009, where rainfall resulted in infrastructure damage, fatalities and injuries, landslides, loss and damage to agricultural crops, soil erosion and environmental degradation. In some regions of the country especially Eastern province there has been periodic droughts, for example in 1999/2000 and 2005/6³⁶.

Managing climate change risks requires enhanced forms of actions and new systems to assess the adaptation options and strategies, there was a need for increasing farmers' productivity by building their capacity towards climate change adaptation³⁷ as the mitigation to climate change has been limited¹³. Mitigation strategies have got a huge attention, However, if greenhouse gas emission trajectories were lowered the climate change will continue to impact the human and natural system³⁸.

The Eastern province of Rwanda is highly affected by the droughts and it was confirmed also by the survey that was conducted in the eastern province about the 'community based climate change adaptive survey', drought was rated the top 23% among the other effects of climate change in the province. And this tend to be the most challenge that the eastern province is facing greatly, the population within the district feared that draught will continue to rise the food security issues and water crisis. Climate change implications on farmers were argued to be due to droughts and poor soils management, it was stated that the 2013 drought had frustrated farmers' agricultural productivity capacities¹. Information and capacity development are the important aspects that can help the community in adapting to climate change. The top down approach seems not be producing the effective results when it comes to managing natural resources and conserving the environment. The growing aspects are calling upon community based approach to adaptation. Community-based adaptation operates at the local level by involving the community that are vulnerable to the impacts of climate change, it identifies, assists and implements community-based development activities that enhance the local people capacity and knowledge to adapt to living in a riskier and less predictable³⁹. Rwanda has a current adaptation deficit; it is not adequately adapted to the existing climate risks¹. In eastern province 91% of the communities have not been directly consulted on climate change issues¹. This indicates that at least most of the climate change potential policies and interventions elude peoples' participation. This means there is a gap in policy related efforts aimed at citizens' inclusion in climate change policy making¹. The Government of Rwanda (GoR) has planned several policies and institutional responses to support smallholder farmer's adaptation to climate change and variability, one of the policies is to empower community based organization to enhance the appropriate climate change adaptation activities for sustainable development. However, the results on the ground are not clear on the role that community based adaptation is playing to enhance the adaptation strategies of the farmers in the Eastern province. This put into question the role of

community based organization in transferring the climate change information such as the adaptive strategies, mitigation measures and the effectiveness of community based organization in building the capacity of farmers in a bid to build their resilience towards the impacts of climate change and variability. As the main objective is to evaluate how effective is the community based organization, it is necessary to note that an effective community based adaptation (CBA) requires more than just understanding climate change impacts, but they also have to take actions to adapt and alleviate risks¹⁵.

The overall objective of this research was to examine the role of the CBOs in transferring climate change information and building a sustainable knowledge to the local farmers. To achieve this objective, the following were the main tasks:

- To determine the major climate change impacts on the Eastern province communities, especially the farmers
- To determine the methodologies used by community based organization to deliver climate change adaptation information to the farmers in the Eastern province
- To evaluate the effectiveness of community based organization in building the local adaptive capacity
- To identify the challenges faced by community based organization in delivering climate change adaptation information to the farmers
- To determine the perception of the farmers towards community based organization and community based adaptation

MATERIALS AND METHODS

Sampling design and methodological approach: This survey study entailed reviewing targeted community who has joined the CBOs and those who have not joined, the Ministry of Agriculture and Livestock (MINAGRI) and the community based organizations. The study focused on community responses in climate change and how they perceived the advantage of having community based institutions in place. There was a deliberate assessment of indigenous knowledge of communities concerning climate change impacts, vulnerability and adaptation. This entailed analysis of community perceptions, attitudes on the adaptation and mitigation measures, but the focus of the study was to assess how effectively were the community based organizations in place transferring climate change information and adaptation strategies. Animal and crop farmers around in the studied communities were organized in groups which were gender sensitive and then interviewed. Socioeconomic impact of

climate change involved assessment of various livelihood capabilities of the households (intra- and extra-household dynamics) in the study areas. This included the information on climate change adaptation strategies that was provided to the farmers in order to ensure that food security and livelihood were not threatened. The study also included questions on what were the benefits that have been analyzed after joining the community based organization and the perception of those that have not joined them. Hence the study analyzed the challenges of community based organization in dispensing information. The paper evaluated the role played by Government of Rwanda through the Ministry of Agriculture and Livestock (MINAGRI), either technical or any other support to the community based organization or to the farmers. Methods used in the study included the use of the check lists using the Participatory Rural Appraisal (PRA) tools such as focused group discussions (FGD), key informant interviews, semi-structured interviews and ranking. The study was based on quantitative and qualitative data analysis as it involved discretion and interpretation of the research findings. Data were categorized under the themes, analyzed by in line with the objectives of the thesis. Tentative themes were identified namely; the community understanding of climate change, the socioeconomic impact, vulnerability and adaptation information provided to the community through community based organization and challenges faced by CBOs in transferring climate change information. The study employed participatory rural appraisal (PRA) family of approaches, methods and behavioral stimulating tools that enabled community members to express and analyse the realities of their lives and conditions amidst climate change. The tools used were of a wide range of visualization methods for group-based analysis to deal with spatial and temporal aspects of climate change social-economic feature and problems. Therefore, PRA tools provided a structure and many practical ideas that stimulated local participation in the creation and sharing of new insights about climate change mitigation and adaptation. Another methodology that was employed in this study was the local adaptive capacity (LAC) framework to access the adaptive capacity of the local and this was used to quantify the effectiveness of community based organization.

Organizing the study: This survey was conducted in Eastern province of Rwanda because the area is highly subjected to drought, four districts were selected. A total of 100 farmers were interviewed. A focus group discussion was also conducted in the community that involved fifteen participants. In addition, an interview to the community based organizations leaders in the area was conducted where

8 participants were selected. Another 8 officials that worked with the Ministry of Agriculture and Livestock were also selected. The activity process took 2 weeks of fieldwork since April 25th till the 15th of May.

Questionnaires: Eighty questionnaires were distributed randomly to those who have joined CBOs and 30 were distributed to those who have not joined in the four selected districts. Eight questionnaires were filled by the community based organization leaders (RWIRRI) and other 8 questionnaires were administered to the Ministry of Agriculture and Livestock in Rwanda (MINAGRI). For the purposes of elimination of bias, the respondents were randomly selected within each group. There was back translation of questionnaire; the original questionnaire was written in English and during interviews it was translated into Kinyarwanda.

Document review: To understand the context of the problem and suggest feasible recommendations, this study used some reviews of certain documents the international and national policy documents including literature on the existing policies in the country on climate change adaptation, extent to which vulnerable people's issues were integrated in broad government policies and programs.

Data collection

Focus group discussions (FGDs): Participants from community farmers were organized in a group of 6-8 people at each study site. Each group presented its views in an open environment. Comparisons on emerging issues were drawn. Focus group discussions were conducted to get a diversity of answers and experiences that were harmonized in this study report. Focus group participants had been interviewed earlier as key informants. The considered tools encouraged learning by doing and teamwork spirit of PRA and the procedures were transparent. For the same reason, 5 series of open meetings were held in the sequence of the study activities. Given the context of this kind of study, the following key tools complemented FGDs:

Semi-structured interviews with key informants: This mainly targeted community based organization leaders and ministry of agriculture officers. Their views, observations and experiences about the research problem were sought. Face to face interviews were carried out with respondents who participated in the study as key informants.

Seasonal and historical indigenous interpretations: Time trends in weather and farming were sought from the indigenous knowledge about rainfall and drought seasonality. Citizen's knowledge about seasonality, water scarcity, disease trends, myths and perceptions about climate, migrations in search of water, conflict and stress times at water points was documented among other events. The collected data were edited for accuracy, completeness, uniformity and consistence. Data had been analyzed before, during and after data collection based on the main study themes. Quantitative data analysis was done using excel. Each form of data entry excel worksheet looked like each page in the questionnaire. This helped to enter data precisely from surveyed questionnaires into an Excel sheet then converting it to tables for analysis. Before the data entry, the written questionnaires were crosschecked by the interviewers to minimize missing information and to ensure that every interviewer understood the questionnaire well. After data entry, the data set was checked once more to minimize any mistyping mistake.

RESULTS AND DISCUSSION

Climate change impacts on the Eastern province farmers' communities: All respondents were asked whether they have heard about climate change before this study. Interviewers explained in a simple way the meaning of climate change and the characteristics as: "long-term changes in the weather/climate especially a change due to an increase in the average atmospheric temperature: Leading to unpredicted rainfall and drought seasons. Afterward questions were asked relating to climate change to understand people's views and perceptions about the notion of climate change. The first question that was asked concerned if they have ever heard climate change before. Answers showed that 84% of total respondents have heard about climate change although some of them they could not explain the causes or the characteristics of it, while 16% had not ever heard about climate change. These results were observed from all participants whether they have joined community based organization or not. Farmers in the study area testified that they have observed several changes in recent years. For those who did not understand climate change, they were asked to say on how the weather was in the last 30 years and what has changed. The community testified that there has been a shift in the rainy seasons and that the droughts have increased. It was also noted during the focus group discussions that the community seem to be aware and understands the changes

Table 1: Effects of climate change

Variables	District						Total
	Rwamagana		Ngoma		Kirehe		
Effects of climate change	N	%	N	%	N	%	
Drought	15	42	10	33	17	48	42
Floods	2	6	2	7	1	3	5
Unpredicted rainfall seasons	10	29	8	27	8	23	26
Extreme hot temperature	5	14	6	20	8	23	19
More diseases	1	3	3	10	1	3	5
Damage of public utilities (roads)	2	6	0	0	0	0	2
conflicts	0	0	1	3	0	0	1
Total	35	100	30	100	35	100	100

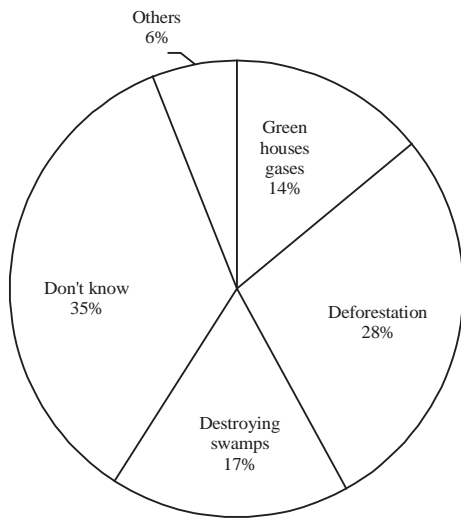


Fig. 2: Causes of climate change

that were happening and the farmers that were within community based organization emphasised that within these organization they have learnt a lot about climate change. However, few among those that had not joined community based organization seem to understand well this concept. These results show a good improve compared to the survey that was conducted in 2014¹, which showed that only 57% were aware about climate change, which can be attributed to the effects of strengthening the climate change organizations in the Eastern province.

Perceptions of respondent on the causes of climate change:

When asking if you know the causes of climate change, respondents were asked also to list some of what they think were the causes. Data in Fig. 2 showed the distribution of responses to the question.

This indicated that there was an insufficient knowledge about climate change and a lack in climate change awareness, which might be because Rwanda doesn't have a big

contribution in green houses gases emissions. However, during the focus group discussion, it seemed that farmers had not been informed about the direct causes of climate change even though the community. This put into question the role of community based organization in disseminating information regarding climate change causes. It should be noted that an effective adaptation should include information regarding the causes, adaptation long-term adaptation strategies, like information on the cause of climate change and how it should be mitigated or how the causes can be minimized.

Already experienced climate change effects:

The interviewers first explained some of the likely events that were associated by the climate variability and climate change. Events such as flooding, droughts and diseases were explained. The interviewers explained how extreme climate events can have a serious impact on the environment and society, including loss of life, property and livelihoods. Interviewers had to explain to respondents that a change in climate leads to changes in the frequency, duration and intensity of droughts and floods and will test capabilities of society's resilience. Thereafter, respondents were asked to give answer (Yes/No) whether they have felt the impact of extreme weather event. Eighty eight percent of the respondents have felt the impact of extreme weather events while 12% do not notice any changes. Table 1 shows the specific extreme events claimed by the respondents.

According to the findings, drought was rated 42% as the major climate change effect felt in the province. Respondents during the FGDs showed their worries that drought will continue to rise and that this can lead to food insecurities and water crisis. The farmers argued that the implications of climate change were due to the prolonged droughts and unpredicted rainfall. Season changes-hotter temperatures and rain patterns changes: Unpredicted rain fall was ranked the second (26%) followed by temperature increase (19%).

During the focus group discussions, the observations were made. The main challenges were noted. Firstly, the local community claimed that they had observed the decrease in precipitation amount. Secondly, they observed the unpredictability of rain fall patterns and the cultivation seasons has changed. However, it was observed that the community based organizations that were in place were playing a key role in facilitating the communities to access the information regarding of rainfall season. The respondent said that: ' We waited to be told if they should cultivate or not'.

Effectiveness of community based organization in transferring climate change information and the perception of community farmers on the CBOs:

The respondents that have joined CBOs were asked to tell their views and what they perceive as an advantage in being or working within a community based organization. There were two active community based organizations in the targeted districts; RWIRRI and RADO, the respondents were randomly chosen as long as they belong to any of these organizations. The first question was: Why did they choose to work with the community based organization? Here the respondents were given a room to state what motivated them to join or what were the advantages of working with the organization. The second question that the respondents were asked was to say yes or no if their productivity has increased or if they have seen any change since they joined CBOs. After that question, they were asked to explain how exactly their productivity has increased. On another hand, respondents who don't work with these organizations were asked to say why they didn't join.

As illustrated by Fig. 3. During the FGDs the respondents emphasised that the organization had provided them with trainings and information on farming especially under the pressure of climate changing conditions.

When the respondents were asked whether their productivity has increased or not after joining the community based organization, 90% said yes while only 10% said that they don't see any increase in their productivity. Here we either say that there is another fact of their productivity not to increase but a large number agreed and stated the facts to support their answers, Fig. 4.

Here the farmers stated that, before joining their productivity was limited to the consumption at home and this was due to the loss of crop production because of climate variability conditions that were actuating and they had no knowledge. However, after getting the knowledge on how to cultivate and being educated about climate variability and know when to cultivate they could increase their productivity.

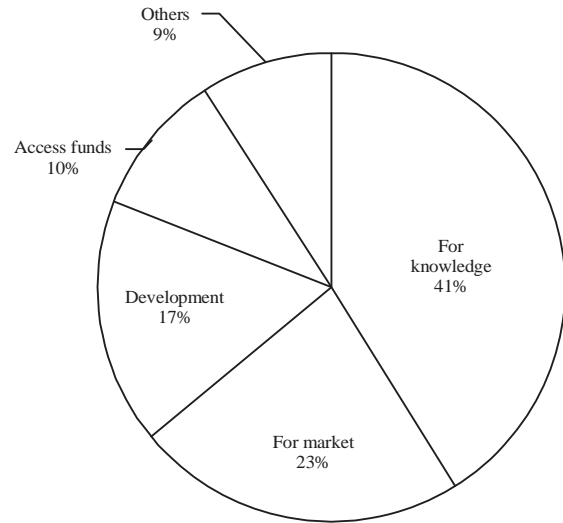


Fig. 3: Why did you choose this organization?

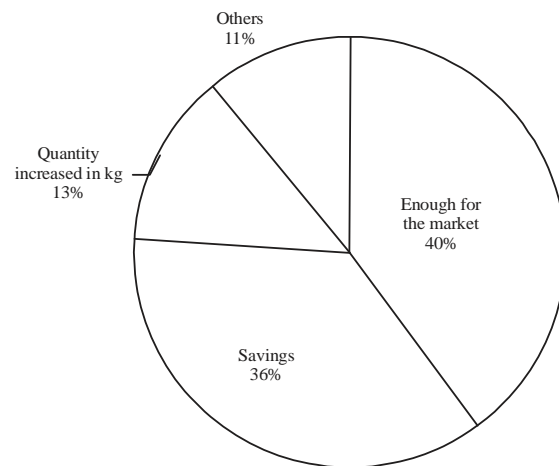


Fig. 4: How do you explain your productivity increase?

With the access to funds and fertilizers they could sell some of their products. Thirty two percent of respondent said that they now can be able to save and can do some other projects aside. During the FGDs the local community said that their livelihood conditions has improved as a results of productivity increase, while they can be able to have enough for the market they can pay the healthy insurance (Mituelle), some said that now they have sent their children to schools and others can build houses other households necessary items. And this was because they could work with these organizations and get knowledge and support for their agriculture activity. Eastern province highly depends on agriculture as the sources of income. On another hand, the farmers that had not joined any organization were asked about the reasons that prevented them from joining. Seventy seven percent of the respondents

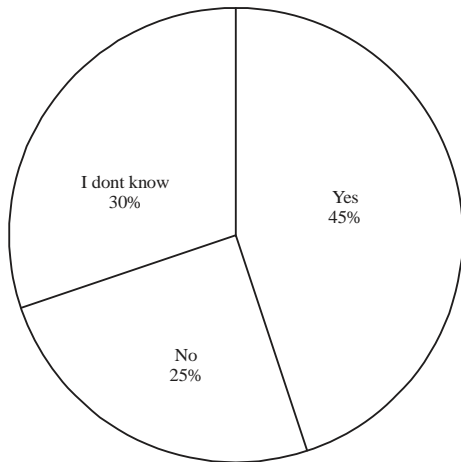


Fig. 5: Do you think there is an advantage of joining the organization?

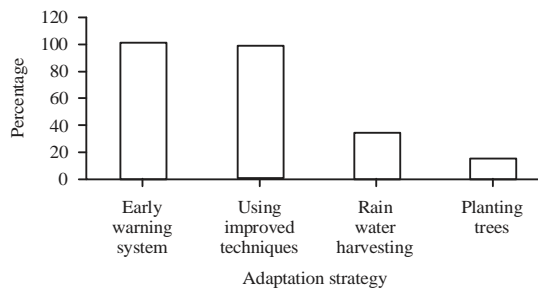


Fig. 6: Climate change adaptation information and adaptation strategies provided by CBOs

did not join due to the lack of information and knowledge about the organizations while 23% due other factors. During the discussion, respondents who did not join seemed as they have not been communicated about the organizations because of the small awareness efforts of these organization to reach all the community. Figure 5 presents the farmers’s opinions regarding the advantages that can be gained by joining the CBOs. During the focus group discussions farmers who did not join show how they perceived the CBOs would help and that they would like to join though some of them did not show any interests at all. The community based organizations and the government should communicate with all farmers and provide them with information necessary to understand how important working within community based organization would be.

Adaptation strategies and information that are provided to the community by the organizations: The study also investigated what are the transferred adaptation strategies and information of climate change that the community based

organizations active in the study areas provided to the community. Focus was on a community response to climate change adaptation and information that are provided to reduce the vulnerability of climate change on agriculture that results into vulnerability of socio-economic and natural resource systems. This is intended to assess capacity and potential of community based organizations in building the community capacity to withstand climate change impacts.

Respondent were asked specifically to say if the following strategies or information are provided by the community based organization. This question intended to identify adaptation actions on the ground. Figure 6 shows the distribution of the responses. Respondents could select more than one strategy.

As illustrated in Fig. 6, all of respondents 100% said that they have been given the early warning system. They stated that since they joined the organization they were given an information about weather forecast and the time of plantation. The respondents agreed that this has been helpful compared to when they could not be able to access such information and it could lead to destruction of their crops due to the climatic condition variability. Also 98% said that the community based organizations have been providing them with cultivation techniques that have increased their production. During the focus group discussion, the local community said that they have been able to access the fertilizers and improved seeds, due to the cooperation of community based organization with the Ministry of Agriculture and Animal Resources, the community was educated on the improved techniques of irrigation. When the respondents were asked if the CBOs have thought them about afforestation there were few respondents 12% did mention that they received such information. So, from this study the adaptation and information strategies’ response to climate change should include both short term and long-term adaptation strategies. However, community were provided by early awareness and improved techniques but a question of sustainability should be tackled. “Good” adaptation requires consideration of immediate and long-term vulnerability in climatic and developmental terms, there is little point in quest of adaptation to climate risks without knowing how social and economic trends make people vulnerable, people’s needs³⁹. Yet based on the research that was done in this district before, only 7% of respondents used modern farming methods (fertilizers, modern/improved seeds)¹. This indicates that the community based organizations have done well in raising an awareness and sensitizing the adaptation strategies to the community.

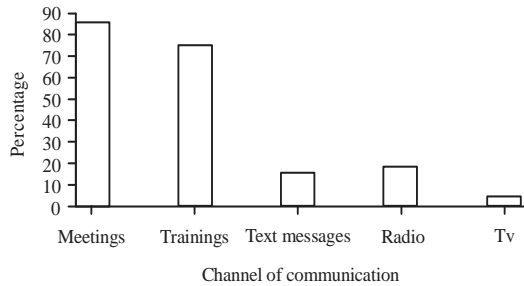


Fig. 7: Climate change information and adaptation channel of communication

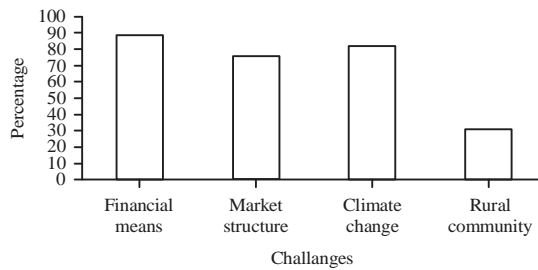


Fig. 8: Challenges faced by community based organization in transferring climate change information

Methods used in transferring climate change adaptation and information strategies to the farmers:

Both questionnaire respondents and focus group discussions were asked to mention the channels CBOs use to transmit climate change information and adaptation strategies. The key respondents were specifically asked to tick which means they have been receiving the information. They unanimously agreed that a broad range of channels of communications helped in learning as indicated in Fig. 7.

Meetings 85% and trainings 75% were rated as the top channels that the rural farmers receive information about climate change with. While text message and radio were rated as the last means of communication with TV that got only 5%. With the discussion done with the Ministry of Agriculture and Animal Resources staffs that works closely with community based organization, they mentioned that daily weather text messages, radio and TV were provided to the farmers. It is a great thing that these communities choose the communication means of face to face where they can interact with farmers and provide all the information. However, it become trick on the communication of weather forecast. Face to face would not be sufficient to provide such information, another effective means like texts on the phone would be more effective. Obviously, communication on climate change is one among many factors. Raising awareness and discussing an issue does not directly result in behaviour change or policy

action. Other factors, especially policy options, windows and barriers, come into play. Therefore, for communication to be effective in providing all the necessary information it must be supported by policy, economic and infrastructure changes that allow concerns and good intentions to be realized.

Challenges facing community based organization in transferring climate change information and adaptation strategies:

There were two active CBOs in the study area (RWIRRI and RADO), 8 respondents were picked from each organization based on their position and were interviewed. A question was asked to the staff members of community based organizations to enumerate the challenges that they face while transferring climate change information and adaptation strategies. The first question was about receiving any external assistance. The second question was to write all the challenges and to state the strategies that they have put to overcome those challenges. The answers were illustrated in Fig. 8. The community based organizations were asked to say whether there were existing challenges from working with the rural community.

Financial means was rated 88% as the top challenge faced during the dissemination of climate change information. Although these organizations stated that they were funded by other organization such as MINAGRI, NGO and private sector, finance is still a limiting factor to provide all the adaptation strategies and climate change information to the rural communities. Market structure was another major factor, the community staff said it was difficult to deal with the market fluctuations and the delay of buyers. This affect the rural community productivity as some of the crops may get destroyed if stayed long. However, adaptation strategies were not enough if sustainability was left behind, the community organization should put in place storage mechanisms techniques that rural community can use to withstand the delays of buyers and protect their productivity to the fluctuation of the market. Few of the member 5 of the respondent claimed that working with the community is also a challenge, like when they introduce a new technology the community tend to be in favour of their traditional behaviour. However, the community based organization should base on the indigenous knowledge some time the challenges were too big to be handled traditional instead there is a need of a new technique. However, community-based adaptation takes the approach of adaptation as development⁴⁰. Responding to the concept that adaptation was locally based, it addresses the locally and contextually specified nature of climate change vulnerability because it takes place at local levels where people encounter impacts, build adaptive capacity and

respond. Community-based approach consider that adaptation strategies were generated through participatory processes, involving local stakeholders and development and disaster risk-reduction practitioners, rather than being restricted to impacts-based scientific inputs.

The community based organization have put in place relative strategies to overcome these challenges. CBA encounters barriers at both national and sub-national levels, approaches or policies may be needed to overcome these gaps at different scales¹⁷. During a meeting, they said that they were linking the farmers into cooperatives and get them an insurance company. The population increase puts pressure on farmers to increase yield, community based organization were providing improved seeds varieties and access to fertilizers to the farmers as an incentive to switch from traditional crops to maize production. According to the respondent, following the drought event that occurred in 2014 A season, more than 4000 farmers from Kirehe district and another district Bugesera however it was not on targeted study area received insurance pay-out totalling 42.1 million RWF. The first and new agricultural insurance scheme in Rwanda is said to be the initiative of Syngenta Foundation for Sustainable Agriculture's (SFSA) Kilimo Salama¹. Community based organizations said that this can be the best option for farmers to reduce losses due to bad weather. They claimed that this can reduce the challenge of crop destitution as the insurance companies can take care of it. During this study, it was also noted that this insurance was only limited to maize farmers only, however there were plans that it will be extended to other farmers.

Rwanda Society Insurance (SORAS) Company had insured a total of over 200 million RWF through Kilimo Salama weather index insurance project, enabling and following up smallholder farmers to verify their losses like droughts they have experienced in 2013 season. The new insurance estimates farmers' losses by comparing daily rainfall measurements from satellites to the amount of rain a crop requires over a season. On another hand, CBOs were putting in place potential methods to fight with climate change such as irrigation systems. However, they should focus also on long term adaptation strategies.

Role of the ministry of agriculture and animal resources MINAGRI: During an interview with MINAGRI staff members of environment and climate change who work closely with the CBOs, they have been asked to state what they perceive the role of CBOs is. They said that CBOs help to provide services at the local level and directly support government services. CBOs

help to implement the government policies at grassroots level. They added that the farmers' organization is a most effective way of transferring climate change information they serve as an engine of local development whereby, each single development initiatives should pass through these local structures. When they were asked to state the role played by the ministry in delivering effective information, the answer was that they built their capacity in term of technical skills not managerial skills as irrigation technologies, water harvesting systems, improved seeds, investments, funding and awareness. In its turn, the Ministry explained that while working with the community based organization managerial skills were found to be a big challenge. MINAGRI has developed an effective way to communicate with the farmers through the support of World Bank; MINAGRI has developed Environmental and Social Management Guidelines (ESMG) which focuses on Grievance Review Mechanism. Now MINAGRI is establishing a call center and again there is "ask MINAGRI" where farmers can ask Minister of Agriculture any questions.

CONCLUSION

This study concluded that CBOs had played a role in increasing farmers' awareness related to climate change adaptation strategies. CBOs had built capacity level of local community on the improved agriculture methods to withstand climate variability and climate change effects. However, there was a coordination problem among local government, NGO, civil partners and vulnerable communities in working together. Therefore, governmental and non-governmental initiatives should promote technical assistance, training activities and take steps to provide communication tools to the vulnerable farmers.

SIGNIFICANCE STATEMENTS

This research aimed to generate information that would be useful to the different stakeholders at the community and national level on how to dispense and implement climate change information to form adaptation strategies. This knowledge would help in building their resilience and establishing a sustainable agriculture sector to ensure food security. The research results will enable the government and decision makers to achieve the sustainable development goals. This research will also help researchers and authorities to do more investigations in order to bridge the gap between farmers and governmental institutions.

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REFERENCES

1. NBDF., 2014. Community based climate change adaptation project. Nile Basin Discourse Forum (NBDF), Choice Social Enterprise Africa, Kigali, Rwanda.
2. Kirehe District, 2013. District development plan (2013-2018). Kirehe District, Kirehe, Rwanda.
3. Ngoma District, 2013. District development plan (2013-2018). Ngoma District, Ngoma, Rwanda.
4. NISR., 2010. Integrated household living conditions survey (EICV3) district profile East-Ngoma. National Institute of Statistics of Rwanda (NISR), Kigali, Rwanda.
5. NISR., 2011. Statistical year book 2011. National Institute of Statistics of Rwanda (NISR), Kigali, Rwanda.
6. Rwamagana District, 2013. District development plan 2013/2014-2017/2018. Rwamagana District, Rwamagana, Rwanda.
7. Wilbanks, T.J. and R.W. Kates, 1999. Global change in local places: How scale matters. *Climatic Change*, 43: 601-628.
8. Bryan, E. and J. Behrman, 2013. Community-based adaptation to climate change: A theoretical framework, overview of key issues and discussion of gender differentiated priorities and participation. CAPRI Working Paper No. 109, February 2013, International Food Policy Research Institute (IFPRI), Washington, DC., USA.
9. Karim, M.R. and A. Thiel, 2017. Role of community based local institution for climate change adaptation through participatory approach in Teesta Riverine area of Bangladesh. *Climate Risk Manage.*, 17: 92-103.
10. Reid, H., M. Alam, R. Berger, T. Cannon, S. Huq and A. Milligan, 2009. Community-Based Adaptation to Climate Change: An Overview. In: *Participatory Learning and Action 60: Community-Based Adaptation to Climate Change*, IIED (Eds.). Russell Press, Nottingham, UK., pp: 11-33.
11. Reed, M.S., 2008. Stakeholder participation for environmental management: A literature review. *Biol. Conserv.*, 141: 2417-2431.
12. Few, R., K. Brown and E.L. Tompkins, 2007. Public participation and climate change adaptation: Avoiding the illusion of inclusion. *Climate Policy*, 7: 46-59.
13. Roberts, D., 2013. Cities OPT in while nations COP out: Reflections on COP18. *S. Afr. J. Sci.*, Vol. 109, No. 5/6.
14. Ebi, K.L. and J.C. Semenza, 2008. Community-based adaptation to the health impacts of climate change. *Am. J. Prev. Med.*, 35: 501-507.
15. McNaught, R., O. Warrick and A. Cooper, 2014. Communicating climate change for adaptation in rural communities: A Pacific study. *Regional Environ. Change*, 14: 1491-1503.
16. Jones, L., E. Ludi and S. Levine, 2010. Towards a characterization of adaptive capacity: A framework for analyzing adaptive capacity at the local level. Background Note, December 2010, Overseas Development Institute, London, UK.
17. Wright, H., S. Vermeulen, G. Laganda, M. Olupot, E. Ampaire and M.L. Jat, 2014. Farmers, food and climate change: Ensuring community-based adaptation is mainstreamed into agricultural programmes. *Climate Dev.*, 6: 318-328.
18. Huxtable, J. and N.T. Yen, 2009. *Mainstreaming Climate Change Adaptation: A Practitioner's Handbook*. CARE International, Ha Noi, Vietnam, Pages: 58.
19. Ayers, J.M. and S. Huq, 2009. Supporting adaptation to climate change: What role for official development assistance? *Dev. Policy Rev.*, 27: 675-692.
20. Booth, C. and C. Bennett, 2002. Gender mainstreaming in the European Union: Towards a new conception and practice of equal opportunities? *Eur. J. Women's Stud.*, 9: 430-446.
21. Dalal-Clayton, B. and S. Bass, 2009. A guide to environmental mainstreaming. International Institute for Environment and Development (IIED), London, UK.
22. Ayers, J., N. Kaur and S. Anderson, 2011. Negotiating climate resilience in Nepal. *IDS Bull.*, 42: 70-79.
23. Pervin, M., S. Sultana, A. Phirum, I.F. Camara and V.M. Nzau *et al.*, 2013. A framework for mainstreaming climate resilience into development planning. IIED Working Paper, International Institute for Environment and Development (IIED), London, UK., November 2013.
24. Klein, R., 2010. Mainstreaming Climate Adaptation into Development: A Policy Dilemma. In: *Climate Governance and Development*, Ansohn, A. and B. Pleskovic (Eds.). World Bank Publications, Washington, DC., USA., ISBN-13: 9780821379943, pp: 35-52.
25. Ayers, J., S. Huq, H. Wright, A.M. Faisal and S.T. Hussain, 2014. Mainstreaming climate change adaptation into development in Bangladesh. *Climate Dev.*, 6: 293-305.
26. Ford, J., 2008. Emerging trends in climate change policy: The role of adaptation. *J. Climate*, 3: 5-16.
27. Klein, R., 2008. Mainstreaming Climate Adaptation into Development Policies and Programmes: A European Perspective. In: *Financing Climate Change Policies in Developing Countries*, European Parliament (Eds.). Directorate-General Internal Policies, European Parliament, Brussels, Belgium, pp: 38-51.

28. Ross, A. and S. Dovers, 2008. Making the harder yards: Environmental policy integration in Australia. *Aust. J. Public Admin.*, 67: 245-260.
29. OECD., 2009. Integrating Climate Change Adaptation into Development Co-operation: Policy Guidance. OECD Publishing, Paris, France, ISBN-13: 9789264054950, Pages: 194.
30. Huq, S. and J. Ayers, 2008. Streamlining Adaptation to Climate Change into Development Projects at the National and Local Level. In: *Financing Climate Change Policies in Developing Countries*, European Parliament (Eds.). Directorate-General Internal Policies, European Parliament, Brussels, Belgium, pp: 52-68.
31. Bizimana, C., F. Usengumukiza, J. Kalisa and J. Rwirahira, 2012. Trends in key agricultural and rural development in Rwanda. The Ministry of Agriculture, Kigali, Rwanda.
32. Bignaut, J., L. Ueckermann and J. Aronson, 2009. Agriculture production's sensitivity to changes in climate in South Africa. *S. Afr. J. Sci.*, 105: 61-68.
33. Mbilinyi, A., G.O. Saibul and V. Kazi, 2013. Impact of climate change to small scale farmers: Voices of farmers in village communities in Tanzania. ESRF Discussion Paper No. 47, Economic and Social Research Foundation, Tanzania.
34. Muhire, I. and F. Ahmed, 2016. Spatiotemporal trends in mean temperatures and aridity index over Rwanda. *Theoret. Applied Climatol.*, 123: 399-414.
35. Mutabazi, A., 2010. Assessment of operational framework related to climate change in Rwanda. Rwanda Environment Management Authority, Kigali, Rwanda.
36. Ngabitsinze, J., A. Mukashema, M. Ikirezi and F. Niyitanga, 2011. Planning and costing adaptation of perennial crop farming systems to climate change: Coffee and banana in Rwanda. International Institute for Environment and Development (IIED), London, UK.
37. FAO., 2008. Climate change and food security: A framework document. Food and Agriculture Organization of the United Nations, Rome, Italy, pp: 1-93.
38. McNamara, K.E., 2013. Taking stock of community-based climate-change adaptation projects in the Pacific. *Asia Pac. Viewpoint*, 54: 398-405.
39. Moser, S.C. and L. Dilling, 2008. *Creating a Climate for Change: Communicating Climate Change and Facilitating Social Change*. Cambridge University Press, Cambridge, UK., ISBN-13: 9780521049924, Pages: 576.
40. Ayers, J. and T. Forsyth, 2009. Community-based adaptation to climate change. *Environ.: Sci. Policy Sustain. Dev.*, 51: 22-31.