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Small holder farmers' knowledge and adaptation to climate change in the Rwenzori region

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Abstract

The Rwenzori region has in the past couple of years been on the local, national and international spotlight as a region already affected by climate change. Various studies in the Rwenzori region have indicated that agricultural products will be affected negatively by climate change. There is a plethora of reports and manuals about climate change adaptation and mitigation in climate change prone areas. Knowledge about climate change is an important factor in climate change mitigation and adaptation. This investigation aimed to investigate small holder farmer's knowledge and their adaptation strategies in the Rwenzori region. The study involved 745 participants who were carefully selected from mountainous/hilly areas, forested areas, lowlands and wetlands. The study employed the ethno-socio-ecological approach through which respondents were asked about various aspects of climate change. In order to keep this paper within the limits of the required length, only the aspects about what respondents understood about climate change, the indicators of climate change, the effects of climate change, the mitigation measures respondents used to adopt to climate change have been presented in this paper. Information from respondents was obtained through Questionnaires, Focus Group Discussions (FGDs) and individual face to face interviews. The investigation revealed that small holder farmers understood climate change in the context of changes in seasons of planting and harvesting crops. Small holder farmers mentioned tree cutting, forest burning, drying of wetlands and use of poor farming methods as causes of climate change. Poor crop yields, increase in incidents of famine, occurrence of floods, increase in pests and diseases, draught and lack of pastures, soil erosion were mentioned as some of the negative effects of climate change. Climate change adaptation strategies that smallholders said they used were mulching of gardens, planting trees, planting early mature crops, making terraces, and migration. The major challenges of adapting to climate change were lack of access to cheap tree seedlings, insufficient land and limited lack of knowledge of the changing climate. Although the respondents had a generally fair knowledge of climate change

its causes and effects, they could not easily make a sound connection between how their activities were linked to climate change and global warming. This investigation recommends intensification of education about climate change. Based on the findings that shortage of land, lack of viable alternative sources of income, and poor access to cheaper sources of energy have greatly contributed to human activities that increase climate change in the Rwenzori region, this investigation also recommends that agro-ecological practices should be promoted among small holder framers in the Rwenzori region. The implementation of watershed management by promoting eco-friendly water harvesting technologies in the Rwenzori region is also recommended.

Key words: Farmers, knowledge, adaptation, climate change, Rwenzori

Introduction

Background to climate change phenomenon

Climate Change according to the IPCC (2007) refers to the change in the state of climate that can be identified by changes in the mean and/or variability of its properties (including rainfall, temperature) and that persists over an extended period usually more that three decades caused by forces of nature or by human activity. This differs to the definition by UN Framework on Climate Change (UNFCCC) which refers to climate change as that change in climate that is attributed directly or indirectly to human activity that alters the global composition of the atmosphere and in addition to natural climate variability observed over comparable time periods. The latter definition is more inclined towards human activity as the main cause while the definition according to IPCC encompasses both human and natural causal effects. In this paper, the authors use parts of both definitions that emphasise the human dimension of climate change.

Climatologists attribute climate change to gradual increase in the average temperature of the earth over the last hundred years. This occurrence is called global warming. Global warming is said to be caused by emission of green house gases such as carbon dioxide and methane. There is a natural mechanism of absorbing gases from the atmosphere by trees. These are commonly referred to as carbon sinks. However, trees have been cut down in more numbers than being

planted. The emission of the greenhouse gases has mostly been witnessed more in countries that have very many industries. Interestingly the cutting of trees has been witnessed more in countries that have poor people whose source of living is mostly from natural resources like forests. A panel of climate change scientists called the Intergovernmental panel on Climate change (IPCC) has pointed out that human activities are changing the climate system and global temperatures are projected to increase with a range of 1.4 to 5 degrees centigrade during the period from 1900 to 2100.

Climate change and international development

Climate Change is emerging as one of the most important international development challenges of the 21st century. Africa was identified by the Intergovernmental Panel on Climate Change as one of most vulnerable continents to Climate Change and yet with the lowest capacity to adapt. Even though Africa is likely to suffer most from the impacts of Climate change, it contributes least to the Global warming. It is the developed countries in Europe and North America and middle income countries in Asia and South America that contribute large amount of emissions of the Green House Gases which cause global warming. This has mainly been through the emissions from industries, intensive farming through use of nitrogen fertilizers, and intensive animal farming. The United Nations formed a forum called UN Framework on Climate Change (UNFCCC) to tackle this development challenge and coordinate the interventions. International efforts to address the impacts of climate change in development agendas have been through the international fora such as Copenhagen summit of 2008, Bali summit, and Gleneagles Summit in 2005. The main bone of contention has been to persuade the countries that contribute most to global warming to contribute to the adaptive capacity of Africa by increasing their overseas Aid assistance (ODA) to the continent in relation to climate change. The commitment of industrialised countries like China to cut down the emission of Green House Gases has largely remained on paper. Very few tangible outcomes towards improving Africa's adaptive capacity to climate change have been released to this day. This has left Africa to grapple with the impacts of climate change.

Projected impact of climate change on development in Africa include disruption of human and animal health, access to water, food security, fisheries, tourism and many others. Increase of temperature in some parts of the continent has led to increased observation of to prevalence of disease vectors such malaria mosquitoes before. There has been recorded increase in the influx of these vectors in the East Africa highlands of Kenya. Evidence of Inter-annual fluctuations of Lakes has been observed after 1960s. For example after 1997 floods Lake Malawi rose by 1.8 metres and Lake Tanganyika by 2.1 metres probably owing to periods of intense droughts followed by increases in rainfall and extreme rainfall events. In many parts of Africa, farmers are experiencing prolonged droughts and / or floods. For example Ethiopia, and West Africa countries like Egypt that highly dependent on the River Nile for their livelihoods are likely to be affected by the extreme climatic changes. For example a rise in the level of River Nile is likely to cause flooding in the Nile Delta. A drop in the Level of the Nile due to droughts will affect the irrigation systems and the rural livelihoods of the farmers in the Nile valley. Climate change exacerbates already existing factors which range from a heavy dependence on rain fed agriculture in Africa to population increase and a decline in public spending on agriculture, related research and development assistance.

The impacts of Climate change in Africa are likely to be distributed unequally between genders. With reduced access to water in the rural areas, the distance women move to get water from the various water sources such as boreholes and shallow wells will increase. Many of these water sources have dried up and the cost of drilling new ones is increasing. Furthermore, with prolonged droughts and increase in their occurrence, the household food security has been affected. Women who in most African countries shoulder the burden of food production have been faced with another burden of malnutrition of the children. The increase of disease vectors mosquitoes has led to increase in prevalence of malaria in areas that were previously malaria free. This has had a profound impact on pregnant mothers and children below the age of 5.

Climate change phenomena in Uganda

Data from the State of the Environment report 2000/2001 showed that between 1943 to 1999, there was increasing climate variability in most regions of Uganda. According to the NAPA (2007), increased frequency, intensity and wide spread climate variability and climate change pose serious threat to food security and social economic development.

In the last few decades there was an increase in the frequency and intensity of droughts in Uganda. In a period of ten years from 1991 to 2000, Uganda experienced seven droughts (NAPA, 2007). The droughts were more severe in the Eastern and Northern regions with Arua being most affected. Districts in North-Eastern Uganda have experienced an increase in droughts. This has resulted into dependency on food aid for over 10 years due to crop failure year in and out. Furthermore, the droughts have led to unprecedented migration of pastoral communities. However, this has resulted into water related sever conflicts with the neighbouring agricultural communities of North-Eastern Uganda. Occurrence of extreme torrential rains resulting into floods have been observed in Teso region in 2007 led to loss of property and destruction of farm lands resulting into displacement of people. Roads became impassable, bridges were destroyed and prevalence of water borne diseases was very high.

In Karamonja tick borne diseases has been reported resulting into higher incidences of nagana and sleeping sickness. Climate change induced escalation in the epidemics of pests and diseases have been reported in many districts in both livestock and crops as major causes of low productivity. For example grasshopper epidemics in katakwi in 2005 that destroyed cereal crops, armyworms in Tororo and Pallisa districts. Increases in environmental temperatures have been experienced in highland areas

Around Lake Victoria region, the average maximum and minimum temperatures have been rising since 1950 (Zake and Kaggwa, 2007). Receding and falling water levels of Lake Victoria and River Nile in the last 5 years have had negative effects on hydro power generation leading to power rationing. In 2006, the water level of River Nile was to a record low level.

In South-western Uganda, prevalence of diseases such as malaria has been observed in some districts that were previously free of such diseases. Foreexample, in Kabale was historically known to be free of malaria. Kabale district had cold temperatures that could not favour the breeding of plasmodium parasites that cause malaria. Between 2001 and 2003 as a result of increase in average temperatures, Kabale and Kannugu districts had a high number of patients suffering from malaria.

In mid-western Uganda, the melting of the ice caps of the Rwenzori Mountain ranges has been one of the most notable effects of climate change. This could have an impact on revenue generation from tourism. In addition to economic and ecological effects of recession of glaciers on the Rwenzori Mountains, also political effects may occur. For instance, River Semuliki has changed course and it has shifted for over a kilometre into Democratic Republic of Congo. This may result into border conflicts between Uganda and Democratic Republic of Congo (Oxfam, 2008). There has been a noticeable increase in floods being observed in Rwebisengo County on river Semuliki in Ntoroko district in the last 5 years.

The Uganda government has established a Climate Change Unit in the Ministry of Environment to coordinate the interventions and spearhead the policy advocacy efforts related to climate change with support from the Danish government. Mainstreaming climate change in water development and agricultural research are some of the outcomes so far.

Motivations for this investigation: the case of the Rwenzori region

Given that the Rwenzori region is a fragile ecosystem, susceptible to effects of climate change and global warming commands attention to the future of its people. This calls for immediate attention to climate change adaptation strategies in the Region. The Rwenzori region is highly vulnerable to climate change due to; 1) Geographic location (characterised by arid grazing zones such as Butuku and Kasese and mountainous areas which receive heavy rains), 2) Strong dependency of the area's population and economies on agriculture, and 3) limited use of modern technologies such as improved crop varieties, fertilisers, mechanisation and

irrigation. These factors make the agricultural productivity in the Rwenzori region vulnerable to climate variability and climate change.

A comprehensive review of climate change adaptation strategies in Africa revealed that constraint to effective adaptation of climate change information in most parts of Africa is the lack of a comprehensive baseline understanding that characterizes climate change issues in a particular area. Previous studies on climate change in the Rwenzori region have focused on the assessment of the impact of climate change on mountain biodiversity and aquatic ecosystems. Yet, climate change also affects the rural people who heavily depend on rain fed agriculture and natural resources from the immediate environment, for survival and livelihood.

Therefore, it was against this backdrop that it was deemed necessary to carry out an in-depth investigation on various socio-economic and ecological aspects that affect climate change adaptation strategies by communities in the Rwenzori region. The study investigated the implications of climate change phenomena on communities whose culture and social-economic activities heavily depend on the immediate environment. The study identified knowledge and practices associated with climate change adaptation. The feasibility of various climate change adaptation strategies in the Rwenzori region was also investigated. Information presented in this paper could serve as a basis for “participatory adaptation” proposed by UNDP (2007) as a proactive rather than a reactive management strategy to climate change risk.

Methods used in this study

The study was carried out in five districts (Kyenjojo, Kabarole, Bundibugyo, Kasese, and Kamwenge) that constitute the Rwenzori region. The study employed the Ethno-socio-ecological approach. A total of 745 respondents were engaged in structured individual interviews and 100 respondents were interviewed using Focus Group Discussions. The study area was clustered into four distinct geographical features namely the lowland areas; mountainous areas; forest/protected areas and the wetland areas. Sub counties within these districts were stratified as a second stage sampling strategy and two sub counties selected per district and per geographical clustering characteristics. The distribution was 19% from Bundibugyo,

22% from Kabarole, 16% from Kamwenge, 12% from Kasese and 22% from Kyenjojo district. It's important to note that the districts described above include the new districts carved out these ones. The study involved respondents from 75 selected sub counties comprised 279 villages (see table 1.1).

Table 1.1: Number of respondents sampled from villages, parishes and sub counties

Clustered Areas	Village	%	Parish	%	Sub county	%	Respondents	%
Low land areas	70	25.1	42	24.3	17	22.7	197	26.4
wet land areas	53	19.0	48	27.7	25	33.3	194	26.0
Forest land areas	83	29.7	42	24.3	14	18.7	170	22.8
Mountainous	73	26.2	41	23.7	19	25.3	184	24.7
Total	279	100	173	100	75	100	745	100

Results

Demography of the respondents

Almost half of the respondents (49%) lived near forests and wetlands. The majority of the respondents (53%) were male. Ages of respondent ranged from 17 years to 80 years. The highest level attained by respondents also ranged from primary level to degree level. The majority of the respondents engaged in other income generating activities. Table 1.2 shows different economic activities of respondents sampled.

Table 1.2: Other sources of livelihoods of small holder farmers sampled

Activity	Frequency	Percent
Crop farming only	397	53.3
Crop farming, Business and cattle keeping	18	2.4
Crop farming and business	198	26.6
Crop farming and cattle keeping	101	13.6
Business and cattle keeping	5	0.7
Cattle keeping only	7	0.9
Crop farming and salary/wage	19	2.6
Total	745	100.0

A variety of economic activities engaged in by respondents is an indication of diversification of activities that is expected in communities responding to effects of climate change. Engagement in multiple sources of income is often cited as a climate change adaptation mechanism because it down scales the risk by distributing it across economic activities. For example in case the crop farming is affected by drought then one could resort to business. Those that depend on only one source of livelihoods become more vulnerable to the effects of climate change.

Smallholder farmers' understanding of climate change

Table 3.1 shows how respondents described climate change. Climate change was described differently by different respondents. The most common descriptions were in the context of weather and atmosphere, change in seasons especially seasons of planting and harvesting crops, and occurrence of extreme weather conditions such as drought and rainfall.

The descriptions of climate change varied among different respondents with differing levels of formal education. For example, a respondent whose highest level of education was primary level said climate change meant rain falling in months when sunshine was expected or the sun shining when rainfall was expected. One respondent whose highest education was ordinary level education defined it as;

“a change in weather conditions of an area in a period of 25 years and above”

Table 1.3: Local people's description of climate change

Meaning of climate change	No of respondents	Percent
Change of weather/atmosphere	335	45.0
Change of seasons (seasonal calendar, planting seasons)	248	33.3
Prolonged draught	33	4.4
Prolonged rainfall	29	3.9
Prolonged rainfall and draught	80	10.7
Wind	6	0.6
None response	15	2.0
Total	745	100.0

Source: survey data 2010

Another respondent whose highest education level was ordinary level regarded climate change in almost a similar way as the respondent whose highest education level was primary level. The former perceived climate change to mean a phenomenon when rain is more than sunshine or when sunshine is more than rainfall.

To one respondent with a bachelor's degree, climatic change meant "*extreme weather conditions*".

It was also noted that respondents who had not attained any formal education made descriptions to explain the meaning of climate change rather than succinct definitions. In other words these respondents did not have definitions of climate change. One respondent was quoted verbatim;

"In this village when I planted my crops in July, expected rain, it did not come instead draught came and dried all my crops. In October it started, I again planted. Now it rained abnormally and eventually all the crops rotted in gardens and up to the present day it has never stopped raining heavily. I think that is climate change"

The relationship between the respondents' view on climate change and geographical characteristics of their residence was investigated. This was to find out if the

relationship was by chance (one off occurrence) or there was regular events that had a consistent pattern. There is a positive and significant relationship between respondents' view from low land, mountainous areas, forested areas with change of weather/atmosphere, change of seasons (seasonal calendar, planting seasons) and prolonged drought. This also implies that the extreme weather events were not occurring by chance or one off event but there was regular pattern that was closely associated with the geographical area and the changes in weather, seasons and prolonged drought.

The understanding of climate change by respondents was informed by different sources of information. Respondents revealed that their understanding of climate change was from personal observations (78%), radios and news papers (13%), community/village meetings (3%), sensitisation at community level (3%) and elderly people (3%). The newspapers as sources of climate change information indicate the relevance of education in terms of reading and writing with regard to dissemination of climate change information. Radios and news papers show that mass media is a critical source of information on climate change. Oral tradition through elderly people is vital source of information. This could play a critical role on indigenous knowledge and adaptation to climate change.

Small holder framers' knowledge about causes of climate change

There were many causes of climate change mentioned by respondents. The most commonly reported causes of are tree cutting, forest burning, drying of wetlands and water bodies, poor farming methods. Sixty two percent of the respondents acknowledged that they contributed to climate change. The activities they engaged in that caused climate change that were mostly mentioned included cutting trees, destruction of the wet lands, burning bushes, and planting of trees.

Some respondents who attributed climate change to planting trees revealed that trees "pull" rainfall which causes land slides and flooding of areas as indicators of climate change. Such an understanding could further aggravate the effects of climate change because farmers will avoid planting trees in order to avert landslides.

Religious beliefs play a role perception on issues of climate change. Some respondents thought that they contributed to climate change by not praying to God/god. Such people may simply pray to God and expect that the effects of climate change will be spiritually ameliorated.

Some respondents were more articulate about the causes of climate change as a result of their activities. They mentioned that their activities such as burning bushes and reclaiming wetlands increased greenhouse gases in the atmosphere. They explained that burning of bushes and destruction of wetlands leads to emission of carbon dioxide into the atmosphere hence global warming. Burning of bushes respondents said was inevitable because fire helps in clearing of land for cultivation and to enable fresh grass for livestock to grow. However, it was observed that this practice was common among communities farming close to the game parks and other protected areas and wetlands.

Inevitable use of fire as an ecological tool to control weeds is unfortunate because it aggravates vulnerability of the region to climate change. Studies on carbon concentration in different ecosystems show that wetlands store more carbon than twice the amount in all forests.

Smallholder farmers' knowledge about the effects of climate change

According to small holder framers sampled, climate change had both good and bad effects. Respondents revealed various negative effects of climate change. The commonly mentioned negative effects of climate change were poor crop yields, more frequent occurrence of famine, floods and soil erosion, increase in pests, diseases, and drought, reduced availability of pastures, and soil erosion. The occurrence of floods mostly especially in the lowlands could be due to soil erosion which could have resulted from the destruction of wetlands, deforestation, bush burning, cutting of trees especially in the mountainous areas.

The activities done in one land use area can have an effect on another area in the same watershed. The activities in mountainous, forest and wetlands can have a negative effect in the lowlands. For example, soil erosion leads to silting of the

rivers in the low lands hence reduced water levels in the rivers. This could explain the constant flooding of river Semuliki and Nyamwaba because the water channels are filled with soil from the mountains. With time, due to poor ground water recharge, the water levels will reduce. Climate changes will lead to negative effects faster.

The most common positive effects of climate change were; increased crop yields, increase in availability of pastures and increase in availability of water for cattle during rainy periods, increased milk production in animals especially in low land and near wetland areas. Increased milk production improves livelihoods for the pastoralists.

Strategies used by local people to adapt to climate change in the Rwenzori region.

Various strategies (Table 1.4) were used by respondents to overcome the effects of climate change. Twenty percent of the respondents said they planted trees as a strategy of overcoming the effects of climate change. Other highly mentioned strategies were mulching (19.7%), use of terraces (17.5%) and planting favourable crops (10.5%).

Table 1.4: Strategies for adapting to climate change

Adaptation strategy	No. Responses	Percentage
Planting trees	109	20.4
Mulching	105	19.7
Shifting to other locations	77	14.4
Planting favorable crops	56	10.5
Irrigating crops	50	9.4
Use of terraces	93	17.5
Selling cash crops and buying food crops	28	5.2
Spraying animals	23	4.3
Channeling water	21	3.9
Use of pesticides	21	3.9
Storing food for the future	18	3.4
application of fertilizers	16	3.0
Replanting where crops were destroyed	15	2.8
Planting resistant crops	15	2.8
Alternative business	14	2.6
Control ploughing	11	2.1
Mixed farming	6	1.1
Others	25	4.6

Others include planting crops near rivers, not burning bushes, early weeding of crops, consultation of traditional rain makers, use of herbs, and fetching water for animals.

Most of the adaptation strategies will also help in mitigation of climate change. Tree planting, conservation of wetlands, mulching increase the storage of the green house gases and limit their emission. Making terraces, soil conservation increase the ability of the region is coping with changes in rainfall distribution reducing the negative effects of high surface water runoff in the lowlands.

These strategies can be part of environment conservation and disaster risk reduction but also contributes to climate change adaptation. Migration is being used as coping mechanism. Having a good energy policy such as increased access to electricity

would greatly reduce the high energy needs that have led to deforestation. The effectiveness of the rural electrification and charging affordable electricity tariffs would have a huge impact on adaptation. However growing crops in the wetland would not be a good adaptation but a bad one leading to emission of gases

Factors that hindered small holder farmers from adapting to climate change

Respondents revealed that they encountered several challenges in attempting to adapt to climate change. Some of the strategies commonly mentioned by respondents were lack of cheap tree seedlings, insufficient land, and limited knowledge on appropriate adaptation technologies. Insufficient land is a result of population growth. This was proved during the triangulation in the focus group of farmers' group in Kamwenge district. Through a focus group discussion, the farmers in Nkoma and Mahyoro sub counties in Kamwenge district proved their case by giving a narration of events starting 1970s. According to the farmers, there were a lot of forests with sparse population in 1970s in these sub counties, the areas experienced a lot of migrants mainly Bakiga from Kabale and Bufumbira. That where as the Batooro depended on hunting for livelihoods which kept forests, the Bakiga came in big numbers, started cultivating and cleared a lot of forests. The area now is densely populated as people are having small plots of land.

Lack of access to cheap tree seedlings indicates that some of the pledges by international organisations such as UNFCCC to provide funds for developing countries to improve tree planting as an adaptation strategy have not been realised at the local level. Also lack of knowledge about appropriate adaptation strategies signify limited access to information about climate change adaptation by farmers in the Rwenzori region.

Conclusions and recommendations

This investigation has found that there was fair knowledge of climate change its causes and effects among the sampled small holder farmers. Majority of the small holder farmers lack an understanding of how their activities are connected to climate change and global warming. This means that provision of environmental conservation education not only limited to local issues but also national and global

issues so that local people can understand that their activities not only impact on the local environment but also a wider area.

Although it is assumed that better understanding of the effects of climate change may lead to better mitigation and adaptation, the results of this study showed otherwise. Some people continued to engage in activities that predispose the area to climate change even when they were aware of the effects of their activities on the climate of the area. Shortage of land, lack of alternative economic activities, and limited access to cheaper alternative sources of energy other than fuel wood were mentioned by respondents as some of the root factors that drive them to conduct activities that are not sustainable to the environment. This suggests that an understanding of driving forces behind local people's actions is required prior to proposing and implementing climate change adaptation strategies. In addition, there are key information gaps which need to be filled, such as the nature and extent of environmental education that people receive.

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