AFR Scoping Study:
Assessment of Indigenous Knowledge to improve Resilience to Environmental and Climate Change
Case Studies from Kenya and Nigeria

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Section A: Introduction – Background Sketch of Region

1. Geographic background and historical context

This scoping study analyses how Indigenous Knowledge (IK) can contribute to improve resilience to environmental and climate change. While IK can be regarded as knowledge local communities have of their environment, there is no universally adopted definition of "indigenous peoples". The concept of "indigenous peoples of Africa" is controversial, as manifested in the deferred adoption of the Declaration of the Rights of Indigenous Peoples in 2006. The deferred adoption was due to objections in definitions by some African states but the UN General Assembly finally adopted the declaration in 2007.

There are two main understandings of indigenous peoples in Africa: Firstly, most African peoples can be considered indigenous based on their existence in the area before the colonial times. Secondly, in the current African context, the term "indigenous peoples" refers mainly to those groups whose culture, way of life, land rights, access to natural resources, and political influence are marginalised by other groups that dominate the nation state. The African Commission on Human and Peoples' Rights (2005, p.94) used the following characteristics as put forward by the World Bank (2001) to distinguish indigenous peoples:

- *"Close attachment to ancestral territories and the natural resources in those areas;*
- *Presence of customary social and political institutions;*
- *Economic systems primarily oriented to subsistence production;*
- *An indigenous language, often different from the dominant language;*
- *Self-identification and identification by others as members of a distinct cultural group" (World Bank, 2001)*

However, the World Bank (2005) tightened this definition by clarifying that the attachment of indigenous peoples to land is "collective," and by removing the reference to indigenous peoples as having primarily subsistence-oriented production.

Using the definition by the World Bank (2001), some examples of indigenous peoples are the Ogiek of Kenya, the San in Southern Africa, the Batwa of Central Africa, the Tuaregs of the Central Sahara and the Maasais of Eastern Africa. Important to note is that this report uses both understandings of indigenous peoples in Africa. Using data collected from case studies in Kenya and Nigeria, this study assesses how IK can contribute to improve resilience to environmental and climate change.

The Kenya case study:

Kenya (Figure 1) is located in East Africa astride the equator (5°N and 5°S) and covers an area of approximately 582,646km^2 with a population of about 37.2million people as at 2007 (The Kenya National Bureau of Statistics 2008). About half of the population live with less than US$1 per day. Kenya's climate ranges from alpine climate in the mountains, to humid tropical and arid in the lowlands, but as much as 80% of Kenya is classified as semi-arid and arid. Mean annual temperatures are generally high in the lowlands (24-30 ^{o}C) and low (<10) in the highlands (Sombroek *et al*., 1982). The rainfall regime in Kenya is mainly bi-modal with the first rains during March to May and the second rains during October to December. Kenya experiences recurrent droughts and floods and local people report that the glaciers on Mount Kenya, the second highest peak in Africa (5,199 m) are melting fast. About 75% of the population is active in agriculture. The official languages are Swahili and English, but there are many other languages spoken in Kenya.

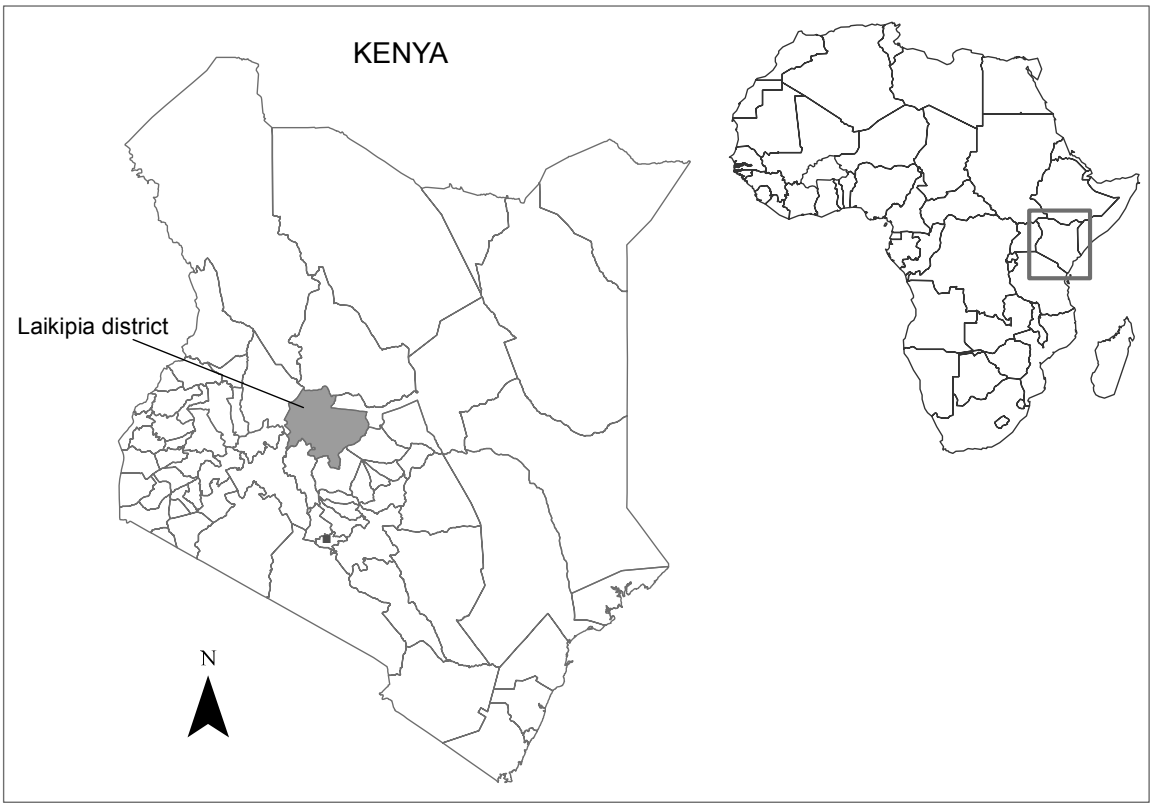

Figure 1: Map of Kenya showing location of the case study area

The methods of data collection were through expert and individual interviews using a questionnaire, focus group discussions and the study of literature. The information presented in this report from Kenya was collected at three levels of administration, namely at the national level, the district level, and the local level.

At the national level, an expert from a major government department was interviewed. To cover the district levels, district agricultural and livestock extension officers as well as NGO officers were interviewed. The interviewees are from various ethnic groups in Kenya such as Kikamba, Kikuyu, Turkana, Kalenjin, Luo, and Luhya. A focus group discussion was also carried out with this group because through their work they are in direct contact with farmers or pastoralists at the local level. The language of data collection was English interspersed in some cases with Swahili. At the village level, a focus group discussion was conducted with farmers of Sweet waters, a village near Nanyuki in Laikipia East district. The farmers are mainly Kikuyus. The language used in the discussion is Swahili with simultaneous translation to English. Further, an official of an NGO working in Western Kenya was interviewed. This methodological framework that covers these three levels of decision making allows integrating actor perspectives at different levels within the scope of a small budget. It also has the advantage of exposing how various actors and organisations at these different levels deal with environmental and climate change issues.

Since the respondents and participants hail from different parts of Kenya, only a description of the geographic and historic background of Sweet waters (Nanyuki area) is made here. Sweet waters is located in the Nanyuki area and is famous for the Sweetwaters Game Reserve run by Ol Pejeta Ranch. Both Nanyuki and Sweet waters are located in Laikipia East district. Before subdivision into Laikipia East and Laikipia West districts, Laikipia district had a population of 322,187 and covered an area of 9,229 sq km (Central Bureau Statistics, 2002). The Nanyuki area is on the Laikipia plateau and is about 2000 metres above sea level. The area is surrounded by Mount Kenya to the North east and the Abedares ranges to the east. The locality experiences two main seasons, the long rains in March to May and the

short rains from October to December. It receives about 400mm mean annual rainfall and belongs to the semi-arid areas of the district. Nanyuki area is characterised by warm temperatures during the day and cold temperatures at night. Mean temperature is about 20^{o}C but it is generally hot and windy during the day and cool during the night. Vegetation in the area, where still existing, is mainly grassland and shrubs.

Historically, the Maasais used the area for grazing in pre-colonial times. European settlers through the powers of the English colonial government forced the Maasais to migrate in 1911 (Duder and Youé, 1994), thus extending the white highlands – the highland areas occupied by the white settlers. The Maasais were allowed to stay only at Mugokodo reserve. After independence in 1963, the new Kenya government embarked on resettling the Africans through settlement schemes by buying land from white settlers that wanted to leave. Thus Africans, mainly Kikuyus and Merus, who were also displaced by the white settlers, were able to buy land and settled in this area. However, the plots of lands acquired were small and in addition to population increase and the marginal semi-arid environment, many households cannot survive only on farming. With time, the smallholders diversified their livelihoods into trading and working for the big ranches, large scale horticultural farms and the tourist resorts around Nanyuki.

The Nigeria case study

Nigeria (Figure 2) is located in West Africa north of the equator (4°15' N, 2°45' E and 13°55' N, 14°40' E) and covers an area of approximately 923 768 km^2. It has 140 million inhabitants. Nigeria contributes nearly 50% to the GDP of West Africa but depends mainly on the oil and gas sector. 70% of the population live with less than US$1 per day. About 22% (2005) of the population is active in agriculture (Federal Republic of Nigeria, 2006). Nigeria has a tropical climate in the south and a sub-tropical climate in the north. There are two main seasons, the wet and the dry season, which vary in duration from south to north. The rainy season in the south lasts from March to November and can be as much as 3,000mm. In the far north the average annual rainfall can be as little as 500mm. Humidity can be as high as 95% in the coast, with temperatures of 32ºC while the north is drier with day temperatures of about 36ºC and lower night temperatures. Average annual temperatures range from 30ºC to 35ºC in the lowlands and from 20ºC to 30ºC in the highlands. Nigeria also experiences recurrent droughts in the north and floods mainly in the south. Desertification and soil degradation are also widespread. The official language is English, but there are about 250 other languages spoken in Nigeria.

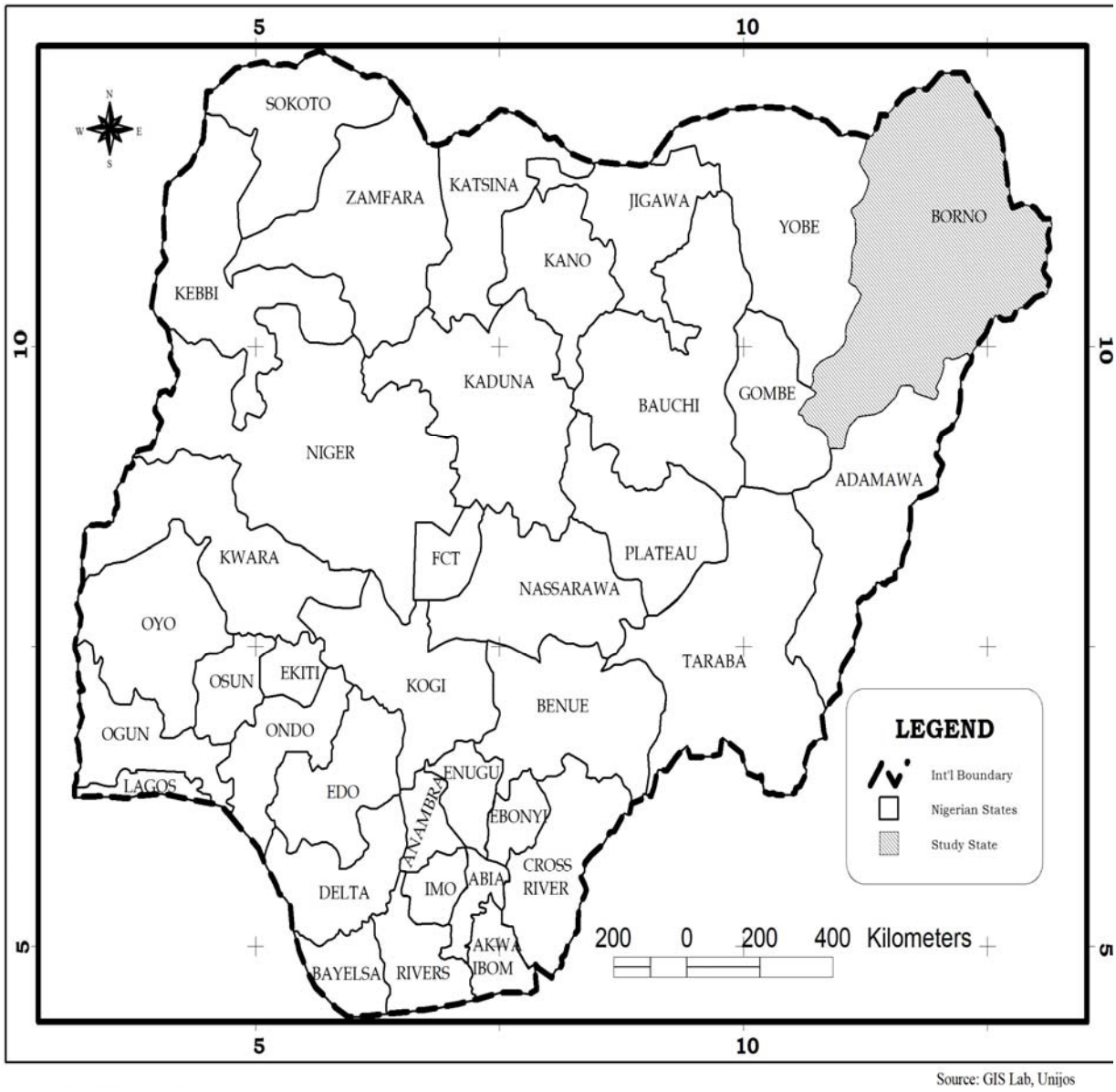

Figure 2: Map of Nigeria highlighting Bornu state

The Nigeria case study was conducted in Bornu state. Three villages were selected from Bornu State namely: Chingowa, Damasak, and Mai Mallamri (Figure 3). The major occupation of the people of the area is farming and pastoralism. The major tribes in Bornu include the Kanuri, Shuwa Arab, Maffa, Hausa, and Fulani. However, all of these tribes use Hausa as their communication language with other tribes. Crops grown include millet, sorghum, maize, groundnuts, sesame and cotton as a cash crop. Questionnaires were administered to 86 respondents. The Centre for Arid Zone Studies, Maiduguri, the Nigerian Meteorological Agency, Abuja, and Centre for Environmental Resources and Hazards Research, University of Jos were chosen based on their known involvement on climate change research for the institutional and government agency scoping exercise.

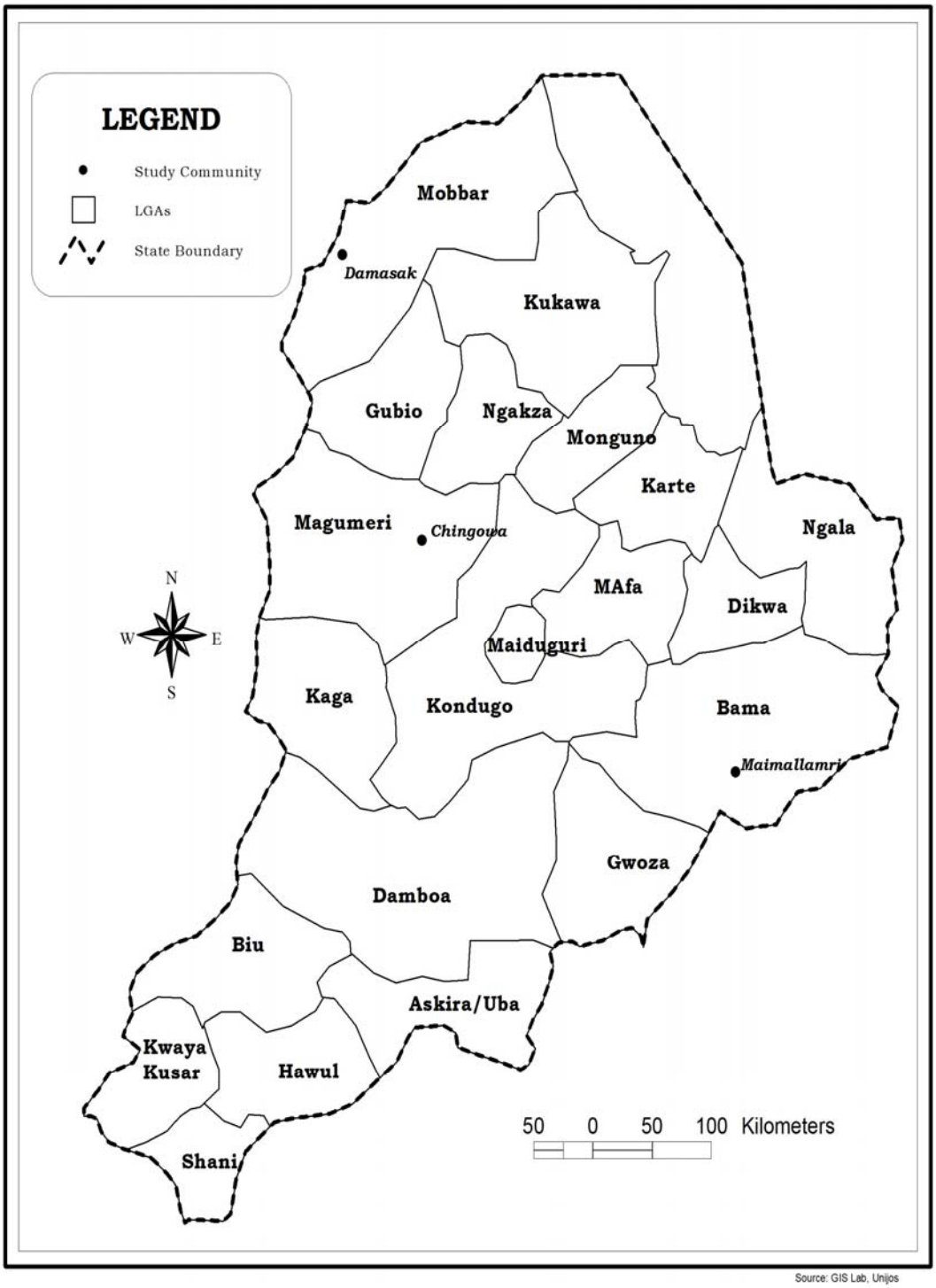

Figure 3: Study communities in Bornu state

2. Human resources

This section provides information on holders of IK and organisations that address IK related issues from various perspectives. These are categorised as follows:

Local peoples and their organisations: Some IK is common knowledge won through experience and transfer of knowledge and is accessible to a great majority of the local people. However, age and function in the community restrict access to other specialised IK. Elders by virtue of their age and experience hold more IK than the younger members of the community. Traditional healers and believers of African traditional religion hold other specialised knowledge that is not accessible to the public. Often such information is shrouded in secrecy and is difficult to access by non-members. Yet the richness of IK-based indicators known to the local people provides adequate information for monitoring environmental and climate change.

Government institutions: Various government departments have different levels of activities related to IK. The Kenya Meteorological Department (KMD) for example, is engaged in work aimed at understanding the IK used by the Nganyi rainmakers association in Western Kenya and how such IK relate to meteorological knowledge and techniques. In contrast, the Nigerian Meteorological Agency does not run a similar programme. The Ministries of Agriculture and Livestock in both countries are in close contact with the farmers and pastoralists. Where relevant, the extension officers encourage farmers and pastoralists to use IK. However, the approach to use of IK is not coordinated and is dependent on individual extension officers and their exposure to IK. Other government organisations (see Annex 1 and 2), especially those working on natural resources management and ecosystem services, support IK use through their collaboration with locals but only on a case to case basis.

Local and international Non-Governmental Organisations (NGO): A distinction can be made between NGOs that focus on preserving indigenous rights and cultures and those that use IK through their work with local people. The Indigenous Information Network (IIN) for example aims to empower indigenous peoples in Kenya and Africa through information sharing, dissemination and networking, cultural preservation, environmental conservation and advocacy, in issues such as land and human rights. It participates in several activities that affect indigenous peoples, like the UN Framework Convention on Climate Change (UNFCCC) conferences, the convention on biodiversity, the convention to combat desertification and various other conventions on environmental protection. Several such organisations like the IIN are organised under an umbrella organisation, the Indigenous Peoples of Africa Coordinating Committee that provides networking between the various indigenous peoples' organisations and bundle their resources for advocacy and representation at various international platforms.

Other NGOs like the Milirubushi Organisation of Kenya (MIBOK) and the Greenbelt movement apply IK in their work. This can be by using IK to protect forests. For example, MIBOK and the Green belt movement in collaboration with local groups apply IK in biodiversity conservation, tree planting and environmental protection.

International organisations: International organisations like the United Nations Environment Programme, World Bank, the United Nations Educational, Scientific and Cultural Organization and the New Partnership for Africa's Development conduct various activities either to support the documentation or to document and mainstream IK into development. The UNFCCC focal points such as the Meteorological departments are also exploring the use of IK for climate variability and climate change monitoring.

Thus in order to ensure the continued existence and use of IK, some organisations carry out various activities to mainstream IK into development (see for example: http://www.unep.org/ik; www.worldbank.org/afr/ik/default.htm;

www.unesco.org/most/bpikreg.htm#bp1; www.nepadst.org/platforms/ik.shtml; accessed 23.05.2008).

Academic institutions: In both Kenya and Nigeria, academic institutions are at the forefront of exploring IK and its contributions (see Annex 1 and 2) to building resilience to environmental and climate change. They conduct research on the use of IK by the local communities in agriculture and livestock production, in environmental management and climate monitoring, among others. Academic institutions analyse and document the IK used by the local communities they work with. Despite these efforts, IK is yet to be integrated into the education curriculum in most African countries and continues to be neglected in many development plans and projects.

In the following, the details of selected organisations and their use of IK for promoting resilience to environmental and climate change are elaborated.

3. Selected organisations and their work on environmental and climate change issues

3.1. Kenya

An in-depth analysis was carried out of IK use in two institutions, namely the Kenya Meteorological Department (KMD), a government department and the MIBOK - Milirubushi Organisation of Kenya, a local NGO. The information was derived through expert interviews.
The KMD is the major institution in Kenya that collects climate data and monitors weather and climate. The areas of interest of the KMD can be summarised under climate data management, climate variability and change, and disaster management. The first two areas have direct relations to IK while disaster management relates to the subsequent effects of climate variability and change. The department works with several government institutions at national, regional and local levels and is the contact institution of the World Meteorological Organisation in Kenya. As such, the institution is an important node for information and knowledge on climate variability and change. Examples of local communities they work with are the Nganyi Rainmakers in Western Kenya, Riat Community Resource Centre and the various District Disaster Management Committees.

The Milirubushi Organisation of Kenya (MIBOK) is active in the areas of biodiversity conservation, chemical- and waste management as well as implementing interventions to control the HIV/AIDS pandemic. Its biodiversity conservation activities are directly related to IK and climate change. These include tree planting and protection, promoting the use of organic manure on farms thereby enabling soils to absorb a lot of water. The NGO also promotes mixed cropping. It supports groups to establish beehives on trees thereby discouraging the cutting down of trees and indirectly conserving them. MIBOK works with community based organisations and local schools. The Kenyan Constituency Development Fund (CDF) funds the NGO. The major players doing work related to climate change in the same area with MIBOK are the Kakamega forest conservation network to conserve the Kakamega forest, the Isukha Heritage that has an arboretum of trees and community tree nursery groups. Other organisations doing work tangential to climate change in the area include the Red cross, although they come when a disaster has occurred, the government Ministries – Sports and Gender, the Kenya Plant Health Inspectorate Service – which the MIBOK official found to be good because they help arrest invasive plant species.

3.2. Nigeria

In comparison to Kenya, information on organisations in Nigeria that carry out activities related to IK is not readily available. Many government departments do not explicitly relate their activities to the use of IK. Most government departments have specific mandates and the lack of finances leads them to constrain their activities to what government defined as their core activities, hence excluding the integration of IK. However, the organisations do not hinder the use of IK by the communities. Many of the organisations that research on and document IK in Nigeria are mainly research institutions. These include among others, the

- African Resource Centre for Indigenous Knowledge, Nigerian Institute of Social and Economic Research, Ibadan.
- Centre for Indigenous Knowledge in Farm and Infrastructure Management, University of Agriculture, Makurdi.
- Centre for Indigenous Knowledge on Population Resource and Environmental Management, University of Nigeria, Nsukka.
- Nigerian Centre for Indigenous Knowledge, Ahmadu Bello University, Zaria.
- Yoruba Resource Centre for Indigenous Knowledge, University of Ibadan, Ibadan.

Based on this context, the focus of the Nigerian case study was shifted to how local communities use IK to improve their resilience to environmental and climate change and the role of research institutions. The Centre for Environmental Resources and Hazards Research, University of Jos carried out the fieldwork and provided the information integrated in this report.

Section B: Examples of IK for resilience building

1. Nature and scale of environmental change

The government organisations, NGOs and local people identify environmental and climate change through the following ways:

Increase in temperature: The respondents observed that day temperatures are higher and night temperatures are lower than earlier experienced. Some respondents attributed the higher temperatures to the effects of green house gases. Maize now takes fewer months to reach physiological maturity in higher altitudes due to increased temperature.

Changes in rainfall patterns, drought and flood frequencies: Rains were observed to start earlier or later than expected and the seasons are no longer distinct. According to the respondents, rainfall amounts were also decreasing, whereby in some seasons there is either too much rainfall or none at all. The observed increasing frequency of droughts was attributed to global warming. The unreliability of rainfall has increased and this is reflected in the variability of growing and planting dates, shortening of the rainy season and a significant southward displacement of all isohyets. Unusual and unexpected downpours have lead to sever flooding in recent years in the Sahel and in the semi-arid areas of Kenya.

Changes in the flora of the areas: The reduction of vegetation cover was attributed to the opening up of land for agriculture, dependency on fuel wood and charcoal. Respondents reported that deforestation has led to a decrease in biodiversity. For example, certain mushrooms have disappeared. Some respondents noted changes in weed species. Weeds, which were earlier found in hotter areas, are now growing in hitherto cooler areas. Certain valued medicinal plants have disappeared, as some herbs require greater rainfall amounts and have become increasingly scarce due to dryness. The change in the flowering of certain trees implies that such trees can no longer be used for predicting weather. The areas where maize can be grown have expanded. Maize now does better in higher altitudes than before due to increase in temperatures.

Changes in the fauna of the areas: The respondents observed that certain animal species have also disappeared in their areas. Millipedes have disappeared due to decreased soil moisture, increased temperatures and changes in land use. Certain birds no longer frequent the areas. Safari ants have disappeared in many places while wild life is increasingly encroaching on farmlands.

Changes in incidence of diseases: The increasing temperature has led to the spread of malaria to areas where they were hitherto unknown or less prevalent. For example, people complained that mosquitoes are prevalent in altitudes where there were not 10 years ago. In Western Kenya, a heavy infestation of jiggers among communities was reported. The communities attribute such changes in the environment to change in temperatures that

caused a lot of dust and increased breeding of jiggers. Ticks are also now prevalent in areas where there were not twenty years ago indicating that such areas are getting hotter.

Other environmental changes: Various environmental changes have been observed. Rivers that were initially perennial have become seasonal. There is less water in the rivers, and seasonal rivers dry up due to deforestation or cutting down of the riparian vegetation that otherwise used to protect the river from excessive evaporation. Increased desert encroachment is reported in Bornu state, Nigeria, while in both case study areas, the degradation of water, soil, biodiversity, and forest resources, which support the normal functioning of ecosystem, are reported.

1.1. Levels of scientific understanding of IK, environmental and climate change

Activities carried out by the KMD to address environmental and climate change involve analysis of historical climate data to see whether there are any trends and explaining the reasons for any trend. KMD's partner communities attribute such changes in their environment to cutting down of trees, cultivation up to riverbanks and population pressure. In order to increase their resilience to environmental and climate change, such communities plant drought resistant crops, advocate for reforestation, terrace their lands, and create awareness.

KMD informs local people about climate change through the media and when carrying out awareness campaigns by mainly referring to things that never used to occur, but are now observed. For example, mosquitoes were rare in Nairobi and in the Central Highlands but they are now plenty. Such imparted knowledge creates awareness based on which KMD introduces some adaptation strategies to the communities. According to the KMD official, the best persons or institutions to carry out this knowledge transfer-work at the community level are the government administration and elders with support from scientists.

IK related-activities that KMD promotes among the communities it works with include seasonal rainfall prediction and efforts to understand the IK and develop a scientific explanation. KMD incorporates IK for resilience building at community levels through the involvement of the people (elders) that hold IK and are respected in the community. The reasons for incorporating IK at community level is because it is what the communities understand and one has to understand local culture prior to introducing anything new so that implementation becomes easier if the process is community owned.

To increase the participatory process and enhance IK adoption at community and household levels, there is need to start off by documenting IK, to look for ways of how it can be passed over from generation to generation and to provide resources for the process. At national levels this entails the government to provide resources to tap IK, while at regional and local levels, communities need to be involved to document the IK and how it has been used. There is also need to carry out a feasibility study to see if the scientific recommendations for mitigation and adaptation are in line with IK. Further there is need to assess the scientific basis of IK and infuse it in adaptation strategies at local levels.

The communities in Kenya and Nigeria witnessed changes in their environment and climate. For example, in Sweet waters, Kenya, years back, there used to be plenty of rainfall and it was regular, however, currently, there is erratic rainfall in the area that is coupled with too much sunshine (definition by the community). In the Nigeria case studies, the villagers reported a decrease in rainfall quantity, time of onset, delayed time to recharge underground water, delayed stream flow, and increase in the frequency of drought events as being related to climate change.

In the following, the perspectives of government and NGO officers are illustrated. The government and NGO officers interviewed identified IK to be experience-based knowledge, transferred from generation to generation, part of community culture, and not documented or

validated by scientific data. They found that the use of IK can improve resilience to environmental and climate change through various ways. These can be through use in forecasting hazards like drought, and protecting forests by banning the cutting of trees. However, it was acknowledged that various factors constrain the use of IK, among which are the following: Education and Christianity adversely affect the use of IK as many educated people regard IK as not validated knowledge. Since IK is related to traditional religion, Christians have been trained to shun anything unchristian hence, many Christians have an ambivalent attitude towards IK.

1.1.1. Government- and NGO-officers' own perceptions

About 67% of the officers believe the use of IK not to be outdated, 25% consider IK practice outdated while 8% had no idea. Most agreed that IK was used mainly in the past years, and that in the recent past there has been an increased erosion of IK and its use. They attributed various reasons to the erosion of IK among which are the following: the breakdown of social institutions for passing on IK; the non-documentation of IK, which constrains its use by the public; and the failure to integrate IK with modern science. IK remains excluded in the education curriculum and the youth perceive it to be outdated. However, in cases where IK has become popular such as with medicinal plants, IK has become commercialised to an extent that fake experts in traditional medicine have emerged thereby compromising the quality of the IK disseminated.

However, most participants found IK use to be effective in their daily activities. While 17% disagree that IK is effective in their daily lives, 58% opined that the IKs they use are effective, 17% strongly agree while 8% did not have an idea. The participants were mainly of the opinion that the effects of climate variability and change are more prominent now than in the past due to factors like deforestation.

The participants opined that the effects of environmental and climate change have recently increased because of increasing unsustainable human activities. There was general agreement that the incorporation of IK into climate change policies can lead to development of effective adaptation strategies that are cost effective, participatory and sustainable. However, most participants were unsure whether the intensified use of IK will decrease the impacts of environmental and climate change while 30% believe that intensified use of IK can decrease the effects of environmental and climate change.

2. Examples of IK in use for adaptation

Environmental and climate changes are not occurring in isolation but with social, economic and political changes. In addition, such biophysical changes are progressing in unprecedented ways and rates such that reducing environmental change and mitigating climate change are inadequate to ameliorate the impacts of the already observed changes. Thus, adaptation is one important approach to deal with the adverse impacts and opportunities arising from environmental and climate changes. As local peoples have used IK through generations to adapt to variable environmental conditions, IK offers various information for use in adaptation to environmental and climate change.

Local people and organisations monitor their environment and rainfall characteristics, based on which they adapt their practices. They observed an increase in variability of growing and planting dates, the drying up rivers that were initially perennial and the recurrence of climate extremes more frequently than before. Monitoring can be through the following ways:

Observing changes in flora: The flowering and fruit production of trees are used to predict weather patterns. For instance, local people interpret an above average fruit production of the Mango tree as indicative of drought. The early flowering of Acacia indicates a below normal rainfall season while the timely flowering of some plants like Acacia mellifera, or Erythrina indicates that the rainfall season is near.

Monitoring fauna: Local people interpret the presence, movement and behaviour of animals as indicator for various weather changes. For example in Kenya, some white birds (name unknown) are observed when rains are about to start. The movement of ants, the rhythmic singing of the tree lyrax, the jumping up and down of cows and their calves, the nesting of weaverbirds, or croaking by frogs/toads are signs of the onset of rains. The movement of bees or butterflies to an area indicates rain while bees and butterflies tend to migrate from areas with no rainfall. The “reading of the intestines” of slaughtered livestock is used to forecast hazards related to the environment like droughts or social developments like wars and clashes. Other IK-based indicators used to predict rainfall onset and intensity are the observation of stars, changes in wind direction and through divinations.

Diversification in crop production: Based on the information derived through monitoring their environments, local people adapt to environmental and climate change by adapting their practices. For example, in both Nigeria and Kenya, people practice mixed cropping by planting several different crops like tubers, legumes and cereals on the same farm-plots to reduce the risk of crop failure due to rainfall variability and to improve food security. Growing drought resistant crops, traditional crops like millet and sorghum, roots and herbaceous crops, although no longer widely practiced were traditional ways of coping with and adapting to rainfall variability. Agro-forestry provides multiple uses like food and fodder production while protecting soil and water resources. Although crop diversification may be seen as a direct response to climate change, farmers diversify also in order to maximize yields. In both Kenya and Nigeria, cropping practices are adapted to the changed and changing conditions. Farmers prepare their land early to take advantage of the onset of rains and to avoid low crop yield. They use organic manure on farms to increase food production while at the same preventing erosion and eutrophication of water masses, thereby contributing to climate change adaptation. Farmers also adopt early maturing crop varieties as a climate change response in order to harvest crops early before the rains retreat. Those who are nearby water sources irrigate their crops. Other practices like zero tillage and mulching are no longer widely used due to use of crop residues to feed livestock.

Diversification in livestock production: Diversification of risks is also practiced in livestock production whereby a variety of animals like poultry, cattle, donkey, camel, sheep, and goats are kept both as a measure of adaptation to climate change and maintaining yields. Livestock that is adaptable to the environment like goats and camel are kept. Herd movement is another adaptation but this practice is increasingly being constrained due to changes in land tenure. However, herd sedentarization is not currently practiced as a measure of adaptation but adopted for reasons of caring for weak livestock, lack of capital, and lack of pasture. During droughts livestock is sold and the income derived used for investments (mainly in livestock), and purchasing food. However, the traditional attachment to livestock implies that people sell their livestock as a last resort, when the livestock have emaciated and their market value depreciated.

Planting of trees: An adaptation is to encourage tree planting in relation to cultural activities: MIBOK promotes the planting of Dombeya burgessia (Olulundu), a plant that candidates for circumcision usually hold. Knowing that such a plant is needed for the circumcision ceremonies makes the community not to cut it but plant and nurture it. Other actions used to adapt to environmental change is to protect forests by elders. The community elders could curse a forest and this would prevent the community from encroaching/harvesting from the forest.

Tree planting and maintaining forest cover is a measure of adaptation that also mitigates climate change. Sacrifices by the old respected persons in the society, ensured that some trees were highly respected and therefore could not be cut at all costs. However, currently, people have deviated from such beliefs and such respected trees are cut for other uses. The emergence of modern state laws and the lack of integration of traditional laws have

weakened the effectiveness of such traditional laws. For example, in Sweet waters village, riparian vegetation used to be left along the rivers to ensure that the rivers did not dry up. Currently, the trend is different, as most farmers near the rivers farm their land up to the river and the riparian vegetation is cleared to create space for farming. This has led to massive erosion along the rivers, reduced river flows, high evaporation and drying up of rivers. The situation is similar in the Nigeria case study areas where changes from traditional to state land tenure regimes have led to excessive use of certain pastures leading to degradation. Activities carried out by MIBOK to stop environmental and climate change in the Kenya study area includes tree planting campaigns in schools and churches as well as at household and community levels. They support communities in using IK through promoting the use of herbal medicines rather than conventional medicines. Through apiculture, the NGO ensures that people do not cut down trees (owing to the respect by the community for such trees). Trees that are preferred by bees for honey production are not cut and serve multiple purposes by producing food, protecting forests and soils. Women smear houses with cow dung to reduce the spread of jiggers and small insects, while medicinal plants are used to treat both human and livestock diseases.

Migration: Migration is another measure used for generations to adapt to changing living conditions. People from the drier areas used to move to areas with water and pastures and areas where they could offer their labour in exchange for food. These modes of migration have evolved to current rural urban migration whereby farmers and herders from the rural areas switch to other professions in the urban areas. They remit the incomes they earn to their families in the rural areas to re-invest in livestock or to purchase seeds for farming.

Rainwater and runoff harvesting: To adapt to water scarcity, people harvest rainwater and dig wells to access groundwater. The local people also know that certain trees grow where the groundwater table is high and thus plan the location of community wells nearby such trees.

Traditional conflict management: Local peoples have also experienced an increase in conflicts over access to resources like pastures and water, which become scarce during droughts. To address these tensions and conflicts local institutions manage such conflicts and ensure that access to resources is equitable under conditions of scarcity.

Other uses of IK for adaptation to environmental and climate change: In Kenya the efficiency of IK-based practices have been improved, for example, through up-scaling energy conservation practices such as '*Maika*' made of cow dung, to energy saving devices that utilise few or little firewood. However, women are more concerned with these IK-based activities (fuel wood) but it is the duty of men to plant more trees for firewood and other uses. Hence, men need to be encouraged to do so.

Some IK-related community practices do not foster adaptation and are discouraged. For example, MIBOK in Kenya does not support the cutting down of old big trees for '*Makenga*' death and burial of an old man, excessive feasting at funerals that predispose the relatives left behind to unsustainable exploitation. Thus a differentiation of those IK that are still viable under current biophysical and socio-economic conditions is crucial.

2.1. Gender-specific nature of IK and adaptation

Men, women and children, due to the roles and duties they have in the communities, use IK to adapt to environmental and climate change in different ways. These duties determine the kind of IK that the gender categories hold.

Women traditionally have the roles of cooking, house keeping, farming and caring for the sick. Due to shortage of firewood women use cow dung as fuel for cooking. To ensure access to cooking fuel, they do not cut the trees but only harvest the twigs and thereby conserve the trees. In order to reduce cooking fuel consumption, they also use mortar and

pestle to reduce the sizes of some grains such as maize to make the grains cook faster thereby reducing fuel needs. Certain crops like sweet potatoes are known as “women crops”. Such crops have low market values but can feed the whole household under conditions of food scarcity like in drought periods. Women also grow drought resistant crops like millet to ensure household food security. Millet is not only drought tolerant but can store for long without using conventional insecticides against storage pests. Women use traditional pesticides like cow dung and ashes in building and decorating houses and thereby keep the house dry and warm while killing some pest like jiggers through suffocation. In their role in caring for the sick, women have knowledge of medicinal plants and herbs for treating various human and livestock ailments. For example, they collect soils from a mole or rodent anthill and smear it on a child’s body to treat measles. Alternatively, *Muratina* (a traditional brew in Kenya) is used to treat the same disease in children.

Men hunt animals, herd livestock, farm and carry out various functions in the community. In their role as hunters, they know how to track wild animals. They know the features of livestock that make them suitable for crossbreeding. They also know the locations in their region where pastures are available for livestock. Mainly men practice rainmaking and predict seasonal conditions. For example, they observe some trees species like the Meru oak in Kenya and use the leaves to forecast weather. Men offer sacrifices on behalf of the community and intercede for the community in cases where traditional rules have been broken. For example, it was prohibited to cut *Mugumo* trees and people associated such tree species with the gods. In cases where such rules were broken, men had to intercede for the community. In their role as traditional news broadcasters, they use horns (*Coro* in Kenya) for broadcasting news in a certain manner to community members.

Youths used IK in hunting, herding and collecting wild fruits. The participants of the focus group discussions in Kenya reported that children trapped birds using 'Obulimbo' natural gum released from a particular tree. Since the gum from the tree was valued, such trees were not cut down. Children and youth also had knowledge of indigenous fruits, and where and when they are to be found. Often in cases of food scarcity due to droughts and floods, children collect wild fruits to cope with such climatic hazards. Further examples of the various ways that men, women and children use IK in the case of Sweet waters village are listed in Table 1.

Table 1: Sweet waters village: Types of IK-based agricultural measures employed

Type of IK-based agricultural measures used	Uses	Participation		
		Men	Women	Youth
Mexican marigold	Repellent to aphids	√	√	√
Onions	Repellent to aphids and other insects	√	√	√
Tobacco (*Mbake*)	Used to stop and destroy the rodents and moles (when the moles and other rodents would eat the tobacco roots, they would be poisoned and die)	√	√	√
Waatha (unidentified euphorbia species plant - see Picture 1 below)	Treatment of east coast fever (ECF) or *Ngae* in Kikuyu	√	√	√
Kitchen ashes	Preservative of various grains for a period of about 3 months till the next planting season	√	√	√
Marerema (vegetation)	Treatment of *ndigana* (constipation) in livestock	√	√	
Teprosia species (*mweru*)	Treatment of ticks in livestock (served the same purpose like the Triatix® pesticide sold in shops)	√	√	
Stinging nettle (*atha*)	Treatment of multi-vitamin deficiencies in animals, Treatment of milk fever disease in dairy animals	√	√	
Aloe Vera	Treatment of wounds in humans, Treatment of tonsils, flu and malaria In poultry, the plant is used to treat coccidiosis	√	√	√


Picture 1: Unidentified euphorbia species plant

3. New ideas to put into practice

IK is knowledge that evolves as the living conditions of local peoples change. As such, local people are continuously adapting their knowledge and should be involved in planning adaptation measures, as this will allow tapping some of the IK they use.

The participants identified various barriers and challenges to using IK in environmental and climate change mitigation and adaptation. These include the lack of documented evidence of IK; the increasing difficulty to transfer the knowledge from one generation to the other for preservation; the lack of introduction of IK into the education curriculum; the preformed attitudes by different people, and the lack of funding to implement programmes on IK documentation. In addition, the local respondents perceive that extension services from the government and related institutions would hinder passage and training on good IK technologies, like planting trees and organic farming. The following were identified as existing and new ways to put IK into practice:

Create awareness about scientific understandings of climate change to local people: Despite the difficulty to explain what Science means by climate change to local peoples, it is necessary to find ways to explain climate change in a language and manner that rural and urban people understand. Thus, informing the people about the definition of climate change

and operational aspects as defined by the world (for example, as in the UNFCCC) and finding local explanations can be one way of sensitizing more people on climate change.

Capitalise on local traditions to enhance adaptation to environmental and climate change: Until now, IK and the way it is used to protect the environment have been neglected in modern state public administrations. Capitalising on local traditions can be a viable way to protect the environment. For example, MIBOK uses this approach in the Khuvasali valley: Malava forest is a Kenyan government forest and surrounding communities encroached on the forest and were evicted. They sought refuge on the lower slopes of Khuvasali valley in Kakamega North district to derive their livelihoods. In the process, they cut all vegetation thereby exposing the ground to soil erosion. Consequently, a mudslide occurred and killed many people. The unrecovered bodies in the Luhya customs are supposed to be remembered. Thus, MIBOK intends to capitalise on this belief to conserve the whole stretch of the hill by planting trees and expand on many other areas in the region.

Some participants highlighted that organic farming is an adaptation practice that is not widespread in Africa. In their opinion, promoting organic farming could be a good step in avoiding use of herbicides that subsequently pollute the environment and further predispose it to climate change effects.

Most pastoralists in the Sahel use certain trees like gum Arabic that withstands climate extremes such as drought as source of pasture for animals until the rains sets in for natural vegetation to grow. These trees could be planted in large numbers in reforestation projects since they are indigenous and serve multiple purposes.

Traditionally, in the Sahel as well as in East Africa, pastoralists were in partnership with farmers. Pastoralists used to agree with farmers to let their herds graze crop residues in the farms and in exchange, their livestock deposit the dung in the farm plots thereby improving the fertility of the soil before the cultivation of crops. This form of symbiotic relationship between the pastoralist and the farmers should be resuscitated.

Revive traditional institutions: Traditional institutions that managed conflicts between pastoralists and farmers need to be revived as environmental and climate change implies a scarcity of resources with likely increases in resource conflicts. Strengthening such traditional courts can minimise frequent conflicts between pastoralists and farmers.

Create awareness about IK: Creating forums to share the knowledge and lobbying for relevant legislation to support IK use are possible ways to increase awareness about IK. Creating forums for sharing of IK, sensitization on IK use in adaptation to climate change, and training communities on ways to disseminate the IK they hold are some other ways.

Promote participation of local people in development: In order to enhance the use of IK, the participants suggest involving the community (youth, male/female, old) in development planning and implementation. Old people and others who hold IK could be encouraged to share their knowledge with others, thereby demystifying IK. To promote the use of IK by the youth, it was suggested to document and institutionalise IK.

Document and monitor IK: The participants in this study highlighted the need to document IK and test its capacity to replicate outcomes. They suggest that experts in sectors concerned should first monitor the results of IK-based forecasts before adopting them. It was argued that documenting IK would also broaden its access by the public since it is not general knowledge and currently, not everyone has access.

Mainstream and institutionalise IK: In order to serve for adaptation, IK needs first to become an accepted institution. Since not all the local people practice IK, there is need to identify practitioners, institutionalise their knowledge and roles and provide funds for monitoring and

evaluating the IK they hold. Institutionalising IK can increase its acceptance by the public and subsequently its use in adaptation to environmental and climate change. Developing policies on how IK can be used in various sectors would quicken its adoption by private and public institutions.

Integrate IK with modern science: It was discussed that a conscious effort should be made to harmonise IK and modern science without prejudice. This can be achieved by integrating IK in the school curriculum, combining it with meteorological forecasts or using it in agricultural extension. It was observed that the recent erratic behaviour of weather makes it difficult for both scientists and holders of IK to forecast weather. Integrating information from both knowledge spheres could reduce errors in forecasting. Extension officers on their part need to understand how and when local people use certain IK to be able to elucidate how the IK that local people use fit with pastoral and farming practices that the extension services are promoting. In pastoral areas, government can embark on mobile veterinary health care services for livestock keepers on their migration routes or locate clinics at strategic points to render services, since migration has been a strong IK-based adaptation measure.

Conduct research on the reliability of IK: The participants called for research on the reliability of IK. They argued that although certain IK-based indicators correctly forecast certain weather events, the actual nature of the link between such IK–based indicators and their predicted outcomes have not yet been analysed. For example, the movement of Safari ants indicates onset of rains and the reason behind this link need to be analysed.

Certification to offer specialised IK services: The participants suggest that there should be some form of certification for those that offer specialised IK services, like herbalists and rainmakers. Such experts of specialised IK should prove that they are actually, what they claim to be. Such certification can reduce the infiltration by conmen and ensure the quality of specialised IK provided. It will also ensure that the information from the holder of IK is the information transmitted to the public, thereby enhancing the transparency of IK.

The participants found that there are benefits in sharing existing IK strategies with other people in other regions. Through coming together, a forum for sensitising and encouraging one another in use of IK can help address the poor reputation of IK among certain circles as being primitive and outdated. Working with other groups to exchange information on IK at national level and international levels can serve as a platform for the adoption of IK methods that are attractive (feasible). Through sharing, the adoption and use of IK can also be promoted. The participants suggest to document, test and adopt similar IK for use in a broader scope.

There will be benefits in sharing existing IK strategies with other people in other regions to deal with climate variability, for example by comparing notes on whether there is convergence of ideas and conserve the knowledge as well as learning from one another. However, no policies specifically enhance IK use for climate change issues in Kenya.
In addition, there were comments that different plants have different uses in different communities and that IK is community specific (unique), according to local customs and believes. As such, the benefits of using them in other places were perceived to be limited. The transferability of IK was found to be problematic, as IK tends to be community-specific. However, respondents suggested that if monitoring parameters exist, exchange of IK might be possible as certain IKs like organic agriculture can be embraced anywhere in the world.

Section C: Responses to value of workshop

The various roles and positions of the participants seem to influence their opinions on the value of an international workshop that brings together individuals to discuss the issues of how best to increase local resilience to environmental and climate change. Despite concurring on the benefits of exchanging IK-related information with others, the KMD officer sees no need for such an event. The officer notes that such issues are already well

articulated through Inter-governmental Panel on Climate Change and it is a matter of downscaling them to the local level. The officer proposes that increasing resilience to environmental and climate change would best be handled at the local level through a government initiative as government is also represented in the United Nations Framework Convention on Climate Change and other multilateral environment agreements. The Kenyan government can create incentives for climate change mitigation at all levels of development, for example, by challenging and facilitating the District Disaster Management committees to bring on board communities to develop appropriate mitigation procedures. In order to effectively enhance the contribution of IK to increase the resilience of communities, support is needed to document environmental changes that have taken place over time and if possible, to publish them. With regard to increasing resilience to climate change, support is needed to gather relevant climate data and carry out analyses to detect any climate change signals.

In the Nigeria case, information point to the fact that there are already many government and research institutions dealing with or mandated to deal with the issues of climate change. As such the need for such a workshop is found to be less than the need to improve outreach to the local communities. IK could be integrated in some of their programmes without necessarily interfering with the environment created by the government agencies. It was suggested that agricultural extension can be reinvigorated with a strong integrated IK component.

The MIBOK official in Kenya values an international event that brings together individuals to discuss how best to increase local resilience to environmental and climate change as it would encourage sharing of ideas and dissemination, and enhance information flow among the locals, thus encouraging them to embrace IK. He suggests that the Kenyan government create incentives for climate change mitigation and adaptation by providing finances that can fund climate change-oriented activities, capacity building and awareness creation. Through payment for forest services - those farmers that conserve forests/trees are paid from funds collected from payment for forest service. In order to enhance the contribution of IK to building the resilience of communities to environmental and climate change, the NGO requires support in the form of donor funding for activities such as tree nursery operations, organisation of planting and nurturing.

Most farmers report that the promotion of IK can only be successful if each individual farmer practices IK on their farms. Other people could copy such practices over time. The farmers in Kenya and Nigeria are willing to implement IK especially if seedlings of indigenous tree species that can survive in their areas are provided. The introduction of other activities that go hand in hand with tree planting (like bee keeping), would encourage most farmers and individuals to plant trees on their farms. They also report that should there be training and creation of awareness about IK, it could greatly improve the implementation of such technologies. However, they want all the stakeholders to be involved in order to achieve efficient sharing and exchange of information about IK. In this regard, they suggest the funding of interested groups that would implement IK and especially, to provide incentives for such farmers and groups to use and exchange the IK that they hold.

Section D: Conclusion

This small study on the potentials of IK to improve resilience to environmental and climate change shows that at all levels, - national, district and local -, that actors are aware of their changing environment and climate. They also practice IK, albeit at different intensities of use and are convinced of the benefits of using IK to improve resilience to environmental and climate change. However, there is still a lot of doubt as to the truth of IK. They suggest that documenting the existing IK is a first step to understanding this knowledge and making it available to the public.

Although the relevance of African IK to sustainable development is becoming widely accepted, the lack of formal mechanisms to disseminate and adapt this knowledge, among other factors, threatens its continued existence. The major mode of transferring IK in Africa through oral tradition, from the older generation to the younger generation, is at risk of disappearance. This is due to changes in the socio-culture of many African societies. These changes are the increasing rural-urban migration, the increasing value accorded western-cultures and the diminishing direct contacts with the natural environment.

The study also shows that IK is not general knowledge, meaning that there are people in the community – elders, local experts – who hold this knowledge. Because these knowledge holders are not easily forthcoming to divulge their knowledge, practices associated with IK are shrouded in secrecy, which does not augur well for the acceptance of IK in the public. The participants of this study suggest that by recognising these holders of IK and institutionalising their knowledge, IK can become a transparent knowledge that can be comprehended and reconstructed.

The villagers who are mostly farmers are not educated, compared to the government and NGO officers and the representatives of the organisations interviewed. A surprising finding is that despite their level of education, the educated government and NGO officers still had a profound knowledge of IK-practices. However, it cannot be concluded that IK is as widespread as demonstrated by these group. The persistence of IK remains a challenge as the younger generation hold less of this knowledge. This challenge was also identified by the participants and they have suggested various measures to counter this development.

The opinion of the participants on the value of a workshop hints at the importance of working with existing institutional frameworks to assess the potentials of IK to improve resilience to environmental and climate change. Thus, it is important to consider the formal government organisational structures as it is government institutions that largely shape the living conditions. These aspects are important especially in getting IK into various policies. This study shows that very few national policies have aspects defining the place of IK.

The process of collecting data for this study has been informative. People do not really want to talk about IK. They believe in it but at the same time, they do not. The question of what IK is, and its relation to traditional beliefs and religion, was a topic of discussion. It was also a difficult topic to approach as one does not just ask another person, tell me what you know about IK. The approach used here was with examples from the natural environment, if people noticed any changes, how things were before and how such changes in the environment were monitored and interpreted in the past. That way the researchers could collect the data analysed for this report. Finally, this report covers only a small part of Africa. Similar studies are needed to examine the use of IK for building resilience to environmental and climate change in other parts of Africa.

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Annex 1: Organisations working on environmental and climate change issues in Kenya

Name	Location	Type of institution	Aims of the organization	Connections to other organizations in region, national, international	Deal directly with climate change issues	Deal indirectly with climate change issues	Funding	Other kinds of work engaged with	Grassroots partners	Future work/plans relevant to climate change
Kenya Meteorological department http://www.meteo.go.ke/	Nairobi and districts	Government department	Provision of meteorological and climatological services; Research and training in meteorology, climatology and related fields	WMO, various national and district level government bodies	Climate variability and change, disaster management	Data Management	Kenya government	Information dissemination on weather and climate	Several, e.g. Nganyi Rainmakers in Western Kenya; Riat Community Resource Centre; District Disaster Management Committees	Several KMD activities
Ministry of Agriculture www.statehousekenya.go.ke	Nairobi and districts	Government department	Agricultural development	Several	Agro-meteorology, drought tolerant crops, Extension services	Livelihoods security, agricultural policies	Kenya government	Information dissemination	Several, farmer and pastoral groups	
Ministry of Environment-NEMA www.statehousekenya.go.ke www.nema.go.ke	Nairobi and districts	Government agency	Environmental management	Several	Preventing environmental degradation, environmental impact assessments	Environmental policies	Kenya government	Information dissemination	Several	Maintain healthy environment
Ministry of Water and Irrigation www.statehousekenya.go.ke	Nairobi and districts	Government department	Management of water resources	Water resources management, irrigation	Water policies	Flood control and land reclamation	Kenya government	Capacity building	Several	Maintain sustainability of water resources
CETRAD www.cetrad.org	Nanyuki	Research and training	Research and training (capacity building)	Several – Kenya government, District authorities, Research	Research and training e.g. River water abstraction, Coping with climate	Research and training e.g. Enhancing food and livelihood security	Kenya government, Swiss government, Others	Awareness creation and diffusion of farm technologies	Several	Increase research on adaptation to climate change

				partnerships with universities in East Africa and Europe	variability and change					
Ministry of Livestock development www.statehousekenya.go.ke	Nairobi and districts	Government department	Livestock development	Several	Livestock and rangeland management, extension services	Livestock diseases control	Kenya government	Information dissemination	Several	Livestock management and development
Egerton University, Department of Environmental Science	Njoro	Academic institution	Research and training (capacity building)	Research partnerships within and outside Kenya. Consulting	Research and training on several environment issues, environmental impact assessments etc.	Research and training	Kenya government; International research grants	Participatory rural appraisals – training and practice	Several	Various themes in environment and climate change monitoring, adaptation and mitigation
Reconcile www.reconcile-ea.org	Nakuru	NGO, Research and training	Research and training (capacity building of local communities)	Research institutions and advocacy groups	Legal research on environmental and natural resources	Conflict over natural resources, policy research, advocacy	Unknown	Networking on environment and natural resources	Several	Legal research on environmental and natural resources
Green belt movement www.greenbeltmovement.org	Nairobi	NGO, Women's civil society organization	Tree planting, environmental protection	Several	Planting of trees	Environmental protection, biodiversity conservation	Unknown	Empowering women	Women and women's groups across East Africa	Plant one billion trees worldwide
Office of the president-drought management programme	Nairobi	Government institution	Drought monitoring	Several, all districts	Drought monitoring	Food security	Kenya government, world bank	Information dissemination, networking	All arid and semi-arid districts	Reducing drought impacts
Famine early warning system www.fews.net	Nairobi	NGO	Prediction and response to famine and food insecurity	Several in Africa	Rainfall analysis, satellite data analysis	Famine and food insecurity, related policies	USAID			
JKUAT www.jkuat.ac.ke	Juja/Nairobi	Academic institution	Research and training (capacity	Several	Agricultural research	Food security and livelihoods research	Kenya government; International	Training	Several	

			building)				research grants			
Catholic Relief Services www.crs.org/Kenya			Livelihood security, governance, HIV-Aids, Education	Several		Food and livelihoods security	Various	Information dissemination	Several	
KARI			Research and training (capacity building of local communities)		Agro-meteorology, irrigation management, drought tolerant crops	Food and livelihoods security	Kenya government; International research grants	Information dissemination	several	
ILRI www.ilri.org	Nairobi	Research and training	Improving agricultural systems in which livestock are important	Part of the Consultative Group on International Agricultural Research (CGIAR) centres.	Pastures, livestock diseases and climate variability and change	Livestock diseases management, poverty alleviation	Several private, public and government organizations	Information dissemination, capacity building	Several	Biosciences, smallholder diary policies
University of Nairobi www.uonbi.ac.ke	Nairobi	Academic institution	Research and training (capacity building)		Climate change and climate variability, CDM, vulnerability, adaptation, resilience	Livelihoods research	Kenya government; International research grants	Capacity building	Several	
Moi University www.mu.ac.ke	Eldoret	Academic institution	Research and training (capacity building)	Several	Agricultural research, drought tolerant seeds, GHG	Livelihoods research	Kenya government, International research grants	Capacity building	Several	
Water Board of Laikipia	Nanyuki	Government department	Water management	Several	Water use	Information dissemination	Kenya government	-	Local groups and residents	Sustainable water supply
MIBOK - Milirubushi Organisation of Kenya	Kakamenga	NGO	Community mobilisation and development	Local organisations	Biodiversity conservation, tree planting	Information dissemination	Local groups in Western Kenya	Information dissemination HV-AIDS	Kenya constituency develop-ment fund	Biodiversity conservation, tree planting

National Museums, Kenya	Nairobi	Government department	Documentation / Archives	Several		Documentation of local IK-based indicators	Kenya government	Archives	Several	
Indigenous Information Network www.indigenous-info-kenya.org	Nairobi	NGO	Information dissemination, research	Several Community based organisations	Environmental conservation	Information dissemination	Private donations	Human rights, advocacy, gender, cultural preservation	Several CBOs	
Indigenous Peoples of Africa Co-ordinating Committee (IPACC), East Africa	Nairobi	NGO	Information dissemination, Advocacy	Umbrella organisation	Environmental conservation	Information dissemination	Through members, grants	Human rights, advocacy, gender, cultural preservation	Several indigenous organisations	

**Other organisations like the UNDP, UNEP, UN-Habitat etc. also do work related to climate and environment change in Kenya*

Annex 2: Organisations working on environmental and climate change issues in Nigeria

Name	Location	Type of institution	Aims of the organization	Connections to other organizations in region, national, international	Deal directly with climate change issues	Deal indirectly with climate change issues	Funding	Other kinds of work engaged with	Grassroots partners	Future work/plans relevant to climate change
Senate Committee on Environment and Ecology	Abuja	Government, Policy commission	Developing and steering policy issues on environment and ecology	Several		Policy	Nigerian government	Information dissemination		
Federal Ministry of Environment, Housing And Urban Development	Abuja	Government department	Environmental protection and natural resources conservation and management	International national and state levels	Environmental pollution	Desertification, drought impacts, mining, land degradation	Nigerian government	Information dissemination, capacity building		
Federal Ministry of Agriculture and Water Resources	Abuja	Government department	Development of agriculture, management of related natural resources to achieve sustainable food security and production of agric. raw materials	International national and state levels		Agricultural production and food security	Nigerian government	Information dissemination, capacity building		
Nigerian Meteorological Agency, ABUJA	Abuja	Government department; Ministry of aviation	Meteorological and climatological services	WMO, Several others	Climate variability and change, disaster management	Data management	Nigerian government, international	Information dissemination, capacity building		
Centre for Environmental Resources and Hazards Research, University of Jos	Jos	Academic institution	Research and training (capacity	International and local	Climate change adaptation	Environmental management	International (START, AIACC)	Capacity building		Continued research

http://www.unijos.edu.ng/			building)				International (CIDA, EU)			
Centre for Arid Zone Studies University of Maiduguri http://www.unimaid.org/center_for_aridzone_studies.php	Maiduguri	Academic institution	Research and training (capacity building)		Climatology, meteorology and hydrology; Drought	Desertification and soil degradation		Capacity building		Continued research
Building Nigeria's Response to Climate change Project http://www.nigeriaclimatechange.org/recentdev.php	Ibadan	NGO	Enhancing capacity at the community, state and national levels to implement effective adaptation strategies, policies and actions.	Canadian International Development Agency	Climate change adaptation	Data management	Canadian International Development Agency	Capacity building		
Ministry of Energy www.mpr.gov.ng	Abuja and across Nigeria	Government department	formulate and monitor policies, regulations, standards and codes for the development of the nation's energy resources	International national and state levels		Energy production	Nigerian government	Information dissemination		
Various universities across Nigeria	Academic institution		Research and training (capacity building)		Climatology, meteorology and hydrology, droughts and floods					Continued research
National Emergency Management Agency http://www.nema.gov.ng/index.htm			Disaster management			Disaster management, emergency relief				

Annex 3: List of participants – interviews and group discussions

Name	Organisation	Position	Email	Address	Telephone	Fax	District
ORGANISATIONS							
Peter Ambenje	Kenya Met Dept	Snr Assistant Director	ambenje@meteo.go.ke; omash01@yahoo.com	Box 30259 - 00100 Nairobi		020-3876955/ 3877373	Nairobi
GOVERNMENT AND NGO OFFICERS							
Aggrey Okunda	MIBOK	Forester	aggreyokunda@yahoo.com		735964557/ 0724356360	020-3550654	Kakamega
Kariuki Newton Nyaga			dipokajiado@yahoo.com	Box 130, Kajiado			Kajiado
S.K. Bett				Box 4 Kabarnet	0720-324231		
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Jacob Ndirangu			githigin2001@yahoo.com	Box 20626 - 00100 Nairobi			Nairobi
Gitonga A. Mbijiwe			mbijiweg@yahoo.com	Box 580 - 60600 Mana			
Mungere J. G			mungereg@yahoo.com	Box 481-10400 Nanyuki			Laikipia
Musiu Cosmas Musyoki							Machakos
Njoka			joste2005@yahoo.com	P.O. Box 210 Chuka			Meru
Joyce S. Nthuku				Box 2 Embu			Embu
J. R. Chomba				Box 86 Embu			Embu
Onyango Maria Adhiambo							

Annex 4: List of participants – Sweet waters village

					Source of livelihood	
No.	Name	Sex (m/f)	People in HH	No. of people under 18	Husband	Wife
1	Jane Simon	F	2	1	Not applicable	Farmer
2	Joseph Muchemi	M	5	3	Farmer	Farmer
3	Juddy Wanjira	F	4	2	Employed	Farmer
4	Agnes Thathi	F	9	2	Farmer	Farmer
5	Grace Wanjohi	F	6	1	Farmer	Farmer
6	Mari Kariuki	F	5	3	Farmer	Farmer
7	Rachael Njoki	F	7	4	Farmer	Farmer
8	Jane Gathama	F	7	1	Farmer	Farmer
9	Kimathi John	M	3	1	Employed	Employed
10	Nicholas Mwangi	M	3	1	Employed	Employed
12	Benson Mwangi	M				
11	Sarah Ogalleh	F	3	0		Employed

Annex 5: A short historical profile of Sweet waters village

Year	Event/ Major Changes	Perceived Problems	Solutions
1992- 1996	Continued Shortage of rainfall that caused drought	▪ Death of livestock ▪ Lack of food (food insecurity) for most households	▪ Cultivation of food crops by most households ▪ Relief food from government ▪ Selling of livestock ▪ Buying fodder for the livestock ▪ Rearing of sheep that is more drought resistant and suitable for the area ▪ Borehole sinking
1997	El Nino rains that caused bumper harvests for most households (most households became food secure)	▪ Erosion of the farms	
2000	Persistent drought	▪ Death of livestock due to diseases ▪ Lack of food for households ▪ Some insects that ate any green vegetation	▪ Use of drugs and herbicides to kill animal pests and vegetation pests ▪ Enhance food security among the households ▪ Some farmers cannot afford to treat sick animals or infested crops so they leave the animals and plants to survive or die from the infestations.
2001-2007	Moderate rains in the area that resulted in bumper harvests for most households	▪ None	
2008	Low and erratic rainfalls	▪ Lack of fodder for livestock	▪ Cultivation of food crops and introduced tree species for fodder
Comment	Lack of water is a major issue in the area. The community depends on a communal borehole that is currently non functional		

Annex 6: Village resources of Sweet waters

Type of Resource	Current State	Use	Control	Perceived Problem	Perceived Solution
Borehole	Spoilt, not functional	Major water source for community	The community	▪ All community members expected to contribute Kshs. 50 (US$ 0.70) for repairs and maintenance. However, some members are unable to raise that amount due to increasing poverty trends ▪ Drought that threatens growth of livestock and vegetation (food crops) ▪ Diseases such as blight and aphids that attack crops at any given season and time of crop growth ▪ Millipedes currently have infested the vegetation in the area	▪ Members to pay monthly contribution for maintenance of the borehole ▪ Buy drugs and chemicals (herbicides) such as Ridomil® ▪ Spraying to destroy the pests (however, not all farmers can afford the herbicides and pesticides, thus this is limited to those that can afford)
Beans	Good (growing)	Domestic consumption and next season's source of seeds	Both husband and wife		
Maize	Good (usually not destroyed by diseases, only by drought)	Domestic consumption and next season's source of seeds for planting	Both husband and wife		
Potatoes	Good	Domestic consumption and next season's source of seeds for planting (normally attacked by millipedes)	Both husband and wife		

Annex 7: Conflicts related to environment and climate change in Sweet waters

Existing types of conflicts	Actors involved	Mechanisms of resolving the conflict (coping strategies employed)	Possible future conflicts	Impact of climate change and solution
Pasture land (occurs when one's animals strays into the neighbour's land)	Neighbours in dispute	Negotiate with neighbours (those afflicted and the owner of animals)	▪ Pasture land may constitute a major source of conflicts in future ▪ A drought resistant crop (see Picture 1) is proving to succeed (take over) the vegetation in the area	▪ Reduce number of livestock reared ▪ Zero grazing of livestock
Water conflict (as a result of dried seasonal rivers) affecting the whole community	Community	Payment of maintenance fees for the borehole	▪ Water use conflicts	▪ Increased water problems that may result in less income generation especially from livestock, since livestock would have to be reduced. This would likely increase poverty among the households while at the same time predisposing the environment to further environmental degradation

Annex 8: Land tenure, land use patterns and climate change in Sweet waters

Type of land use	Reason for the land use choice	Impact on climate (Comments)	Perceived Problems and coping strategies	Perceived Solutions (IK oriented if possible)
Mixed farming* (various crop mixes and livestock)	Food security and increment of survival of crops in order to increase food security	May indirectly contribute to reduce environmental degradation that may consequently reduce further impacts of climate change	Too small pieces of land that leads farmers to devise mixed farming as a way of survival	Improved mixed farming and use of right technologies such as conservation agriculture

*Mono-cropping is impossible in the area owing to the small pieces of land owned by farmers. Most of the community members have bought small pieces (sizes) of land.

Annex 9: Energy Use and relationship (Impact/effects) to climate change

Source of energy	Where its obtained from	Current problems and coping strategies	Future problems	Solution (If possible, IK oriented)
Firewood	Goti's (foreigner's) farm. Currently, there is none due to cutting down of trees	Lack of firewood due to exhaustion from source. Most community members used to fetch firewood from Mr. Goti's farm. However, the trees have been exhausted and so far, they have no other reliable source of firewood. Presently, the community scavenges for firewood from various sites (on irregular basis) The community uses saw dust as a source of fuel for cooking	All the other sources of fuel may be exhausted and the fact that water is limiting, means that even keeping livestock would limit availability of cow dung as a source of fuel for cooking. Sawdust would also be a problem owing to the timber scarcity and high costs.	To plant trees on the farmers' farms and any available public land.
Saw dust (*mura*)	From carpenter's shops	Sometimes unavailable		
Cowdung (*mai ma ngombe)*	From farmers (individual farms)	Smelly and produces a lot of smoke if not dried properly		
Charcoal	Bought from charcoal dealers although it is very expensive. One bag of charcoal costs KSH. 800.00 (ca. US$ 11)	Expensive and sometimes unavailable		