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ASSESSING VARIOUS FORMS OF INDIGENOUS KNOWLEDGE USED BY THE COMMUNITY OF KENDU- BAY AS DISASTER BASED EARLY WARNING SYSTEM

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Abstract

Climate Change is possibly the eventual indicator of human's destruction to the world, even though not all countries contribute to this mess. The industrialized countries actions have triggered most of the climate effects presently experienced in the local communities. Such externalities make the local communities to suffer most from the present and the projected climate change extremes due to their connections to the natural world and their low resilience.

This study analyses the insights of the Kendu -Bay community with respect to the usage of Indigenous Knowledge as disaster based Early Warning System (EWS). The disaster investigated in this study is Drought risks. This study has Two objectives namely to: (i) assess the various forms of indigenous knowledge used by the community of Kendu-Bay as disaster-based Early Warning system and, (ii) determine the usage of both Scientific and Indigenous Knowledge in early warning and adaptation strategy to drought risks. The study was undertaken using qualitative research design consisting of Focus Group Discussions (FGDs), face-to-face interview and direct observations. The data collection instrument was the questionnaire. The data was collected in a purposive survey of 50 individuals who use the Indigenous Knowledge (IK) in farming activities. The data collected was narrative in nature and was analyzed using content analysis. The analysis specifically entailed identifying the major themes emanating from field notes which were then interpreted according to the study objectives. The study found a wide collection of IK used by the community to foretell the occurrence of drought such as plants *indicators, astronomical indicators animal indicators and insects. Some of the indicators based on plants and animals are easy to understand but those based on astronomical are difficult to understand.*

Introduction

Indigenous Knowledge (IK) is defined as a knowledge system involving ideas techniques, attitudes among others which a community has accumulated over time to support its survival, resilience and sustainability (Ouma, and Ogallo, 2010). It is anchored upon traditional cultures (Rao, *et al*., 2006, Ontiri *et al*., 2014).

Different communities in Kenya have a wealth of indigenous knowledge (IK) ranging from plants, animals and astronomical indicators that are passed down to generations. This knowledge is not documented and is overlooked whereas such community based practices exhibit a deep understanding on the coping strategies to disasters (Mwaura, 2008; Kelman and Glantz, 2009).

IK is initiated and driven by vulnerable communities who also control the whole early warning process (Baudoin*et al*., 2016). In this kind of system, communities know the crop types which are resilient to extreme weather events such as droughts (Maguire and Hagan, 2007; Kelman and Glantz, 2014).

Prior knowledge of possible dangers or problems gives one a tactical advantage otherwise known as 'forewarn is forearm'. As such EWS is defined as "the ability required creating and distributing appropriate information to empower the communities vulnerable to hazards to act appropriately in order to reduce harm or loss" (Garcia *et. al*, 2012).

In order to connote attempts to see into the future, different words are used such as forecasting, prediction, foretelling, anticipating and foretasting (Ininda, 1994). The majority of farmers in the rural areas do not depend on scientific forecasts even when the forecasts are available at nearby centers (Musembi *et.al* 2016). Such farmers doubt the accuracy of the scientific predictions due to lack of clarity, insufficient lead time given in the forecast, forecast arriving after farmers have made choices, inability of the farmers to understand the forecast and community norms.

Such impediments limit the usage of scientific forecast by the local farmers (Ouma and Ogallo, 2010).This then compels such farmers to rely on indigenous knowledge (IK) forecasts although they may be inaccurate.

Such challenges indicate a need for an alternative pathway of improving weather /climate dissemination techniques to the locals.

1.1 Objectives of the study

This study had two objectives namely to:

a) Assess the various forms of indigenous knowledge used by the community of Kendu-Bay as disaster-based Early Warning system
b) Determine the usage of both Scientific and Indigenous Knowledge in early warning and adaptation strategy to drought risks.

1.2 Study Area

The study was conducted in Kendu-Bay region of Homa-Bay County (Figure 1). Its geographical coordinate is 0.367°S and 34.650°E. The region experiences a bimodal rainfall during March, April and May (MAM) and October, November and December (OND) (Awange *et al.,* 2006,). There are two types of agriculture in the study area i.e. rain fed and irrigated agriculture. The crops grown under rain fed agriculture are maize, sorghum and cassava while the crops grown under irrigation include kales, bananas, tomatoes, water melons, onions among others.

The size of farms under rain fed agriculture is about one ha per household and is vulnerable to recurrent episodes of drought. On the other hand, farm sizes under irrigated agriculture are slightly larger i.e. over one ha of land. The irrigated agriculture is conducted in a project called 'Kimira Oluch Irrigation Scheme 'This study is focused on the rain fed agriculture in which the farmers (both men and women) rely on the rainfall on the long rains during March, April and May (MAM) in growing of crops. This project covers five locations namely N.E Karachuonyo, N.Karachuonyo, Central Karachuonyo, Kamser Nyakongo.

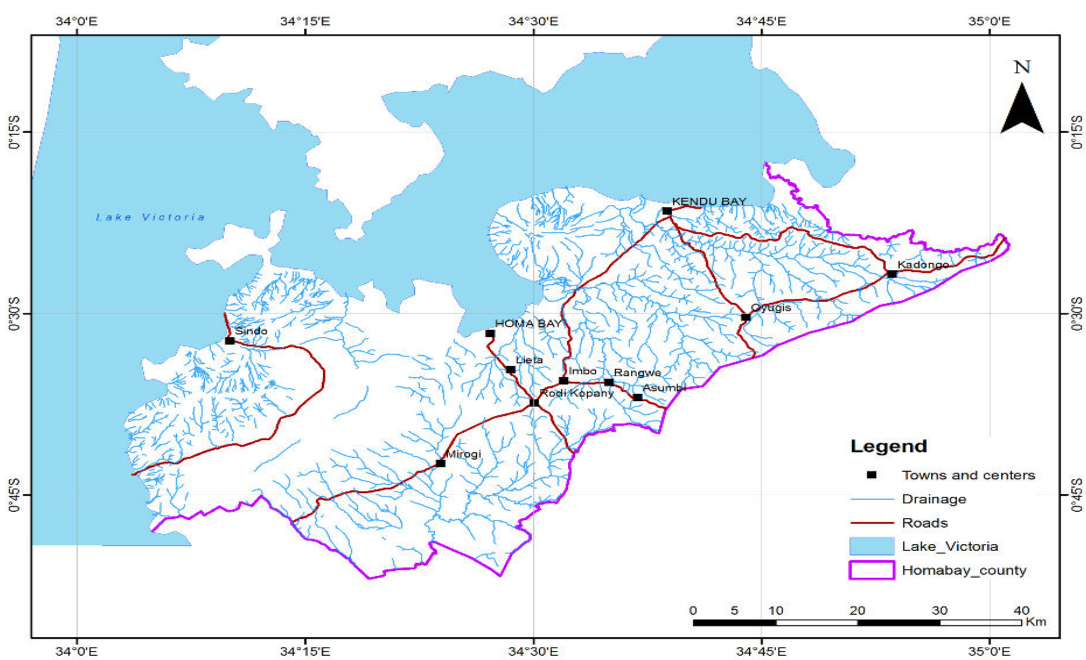

Figure 1: Map of the study area (Source: Author)

2.0 Data collection methods

The study was approached from qualitative paradigm to find various forms of Indigenous Knowledge, adaptation strategies to drought risks and to understand the barriers to adequate access to climate change information.

Data collection methods included Focus Group Discussions, Questionnaire Survey, Literature review and photographs.

2.2 Literature Review

This involved the review of publications on Indigenous Knowledge indicators to extreme weather events, historical trends on climate variability and adaptation strategies to drought risks.

2.3 Questionnaire Survey

The specific interrogations on the forms of Indigenous Knowledge (IK) are reflected on the questionnaires: question; PART III. Fifty (50) questionnaires were administered and one Focused Group Discussion (FDG) comprising of 8people conducted in the study area. This was done between 15/04/2016 to 29/04/2016. The questionnaires were structured with both open and close-ended. The issues included in the questionnaires were: The age of the respondents, education level, gender, Constraints faced in accessing the weather information, Forms of community Indigenous Knowledge, farmer's perception of rainfall characteristics, commonly experienced disasters and adaptation Strategies to drought hazards.

FGDs are group discussions normally organized to examine a specific set of topic (Kerlinger, F. N. 1969). The FGD was selected purposively using gender and lasted for 2 hours. Photographs were also taken to document the community engagement moments including challenges during the field work.
The sample size was determined by equations (1) and (2) below:

2.3.1 Sample size determination

The sample size was determined using the standard sample size calculation formula (equation 1). In this formula, at95% confidence level, 50% of the target population assumed to have characteristics of interest with a Z-statistic of 1.96 (Stranger *et al*, 2007). The sample size is shown in equation 2 below:

$$n = \frac{N}{1+NP^2} \quad \text{---} \quad (1)$$

Where; n- desired sample size, N-population sample and p is 0.05. That is;

$$n = \frac{57}{1+57(0.05^2)} = 50 \text{---} \quad (2)$$

The respondents comprised of households from Kendu-Bay Division.

2.4 Data analysis

Data collected was narrative in nature and analyzed using content analysis. The object of analysis was questionnaires transcripts. Sections of the questionnaires on forms of Indigenous Knowledge Systems and coping strategies were assigned weighting factors which were then coded and analyzed using SPSS. By systematically evaluating texts i.e. (documents, oral communications etc.), valid interpretation of the scenario under considerations was made (Hancock *et al*., 2000))

3. Results and discussions from objective I

This section contains findings from the field research on assessing various forms of indigenous knowledge used by the community of Kendu-Bay as disaster-based Early Warning system. The issues that were addressed in this section include:

-Forms of Indigenous Knowledge (IK) Early Warning systems

-Community risks

- Gender and Education levels of respondents

3.1 Forms of Indigenous Knowledge (IK) Early Warning systems

The study found many forms of IK used by Kendu- Bay community to foretell the occurrence of drought. The IK indicators involve the use of plants, astronomical bodies, and animals. The indicators are summarized in Table 1below:

Table 1: Forms of Indigenous Knowledge (IK) Early Warning systems

Indicator	**Behavior**	**Implication**
Plant indicators	-The folding up of leaves ie Mimosa plant(*Mimosa pudica*) -The appearance of water Lily plant (*Nymphaea)* -Shedding off the leaves i.e. fig tree*(Focus carica)*	-This portends a dry period -signals the rainfall onset -it shows the oncoming rainfall
Animal indicators	- croaking of frogs(*Africana spp*) - Hippos(*Hippopotamus amphibious)*migrating to the river banks -Appearance of winged termites(*Formicidae*) commonly called 'Kumbe Kumbe' -Spiders(*Araneae*) building their webs - Birds flying close to the ground -Safari ants moving uphill from the valley from the valley.	- The starting of wet season is depicted by croaking while the dry season is represented by decrease in the croaking - severe flooding - Drought -Rainfall is near - High rainfall/flooding - Impending rains associated with the floods
Astronomical Indicators	-The sighting of the moon	-When the moon is clearly seen at night, this shows a dry spell -When the moon cannot be clearly seen at night, this shows a lot of moisture in the atmosphere depicting the onset of rains.
Other indicators	-The occurrence of the whirlwinds "Kalawusi" - Dark cloud (Cumulonimbus clouds)	-signifies dry days - Large amount of rainfall

	cover over the lake 'Nyakoi' - Strong winds during the rainy season	- Dry spells

About 70% of the respondents cited plants and changing cloud cover as a common IK indicators used by the Kendu-Bay community to foretell drought occurrences. This is probably due to the visibility of their phonological changes.

Some farmers monitor the changing cloud patterns and are able to determine the actual start of rains. Dark clouds cover over the lake known as 'Nyakoi' in the morning portends large amount of rainfall in the same day.

Other IK indicators used by the community are displayed in figure 2 below:

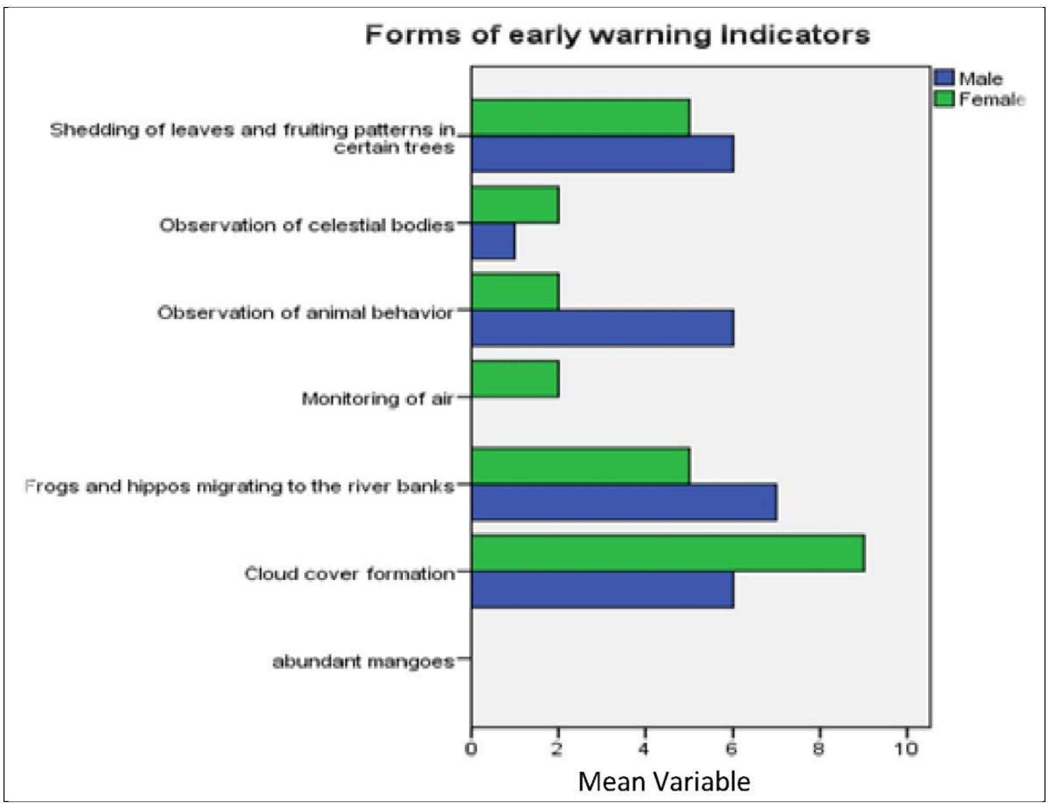

Figure 2 Forms of Early Warning indicators

3.2 Kind of Risks

The respondents were divided based on gender (male and female). The two groups identified drought as a major risk that threaten agricultural activities in Kendu Bay region. The perception of risks due to drought was found to be higher across gender (Table 2)

Table 2: Risks identified in Kendu-Bay

Type of risk	Male	Female
Drought	17	13
Flood	6	1
Too much rainfall	0	0
Early rainfall	1	3
Late rainfall	2	0
Crop diseases and pests	3	6
Landslide	0	0
Earthquake	0	0
Strong wind	0	1

3.3 Gender Education Level of the Respondents

The majority of the respondent's which were interviewed were men (52%). The remaining percentage was for females (48%). Nearly 82% of the respondents were aged 32 years or older. The education level varies from Standard seven (7) to University but the larger percentage of the respondents had O- level education.

3.4 Results and discussions from objective II

The issues discussed here are: perceptions on Indigenous Knowledge and Scientific Knowledge, Scientific and Indigenous Forecast Development, options for effective communication of warning advisories, coping and adaptation strategies to drought events.

3.4.1 Community perceptions on both Indigenous Knowledge and Scientific Knowledge

In order to understand rainfall patterns and other extreme climatic events in Kendu- Bay, 60% percent of farmers use Indigenous Knowledge. This study thus found number IK indicators from the respondents which are used to predict the dry and wet seasons. Some of the indicators used to predict the wet seasons are: frogs croaking at night, appearance of cumulonimbus clouds in the morning and evening, safari ants moving uphill from the valley, the appearance of water Lily, and appearance of winged termites (*Formicidae*) commonly called 'Kumbe Kumbe'.

On the other hand the indicators that portends dry spell include the following: the occurrence of the whirlwinds, presence of red clouds at sunset, strong winds coming with rain in a storm, appearance of fog in the morning and appearance of winged termites (*Formicidae*) commonly called 'Kumbe Kumbe'(Okonya & Kroschel, 2013).

The problem with scientific forecast was cited to be too broad and communicated in statistical language (below or above normal) which is not understood by the farmers (Musembi and Cheruiyot, 2016). On the other hand, the respondents noted some of the impediment with the indigenous knowledge such as being associated with the sorcery, restricted to a few experts, information stored in oral memory. Table 3 gives Perceptions on Indigenous and Scientific Knowledge forecasts.

Table 3: Perceptions on Indigenous and Scientific Knowledge forecasts

Scientific Knowledge	Indigenous Knowledge
Most farmers readily use scientific forecasts	Most farmers were not ready to use IK forecast because they associate them with magic.
Free sharing of knowledge	Knowledge is restricted to a few IK experts since it confers status to the society.
Warning messages are not personal	Warning messages are personal
Experts are well educated	Most of the IK experts have no formal education
The information is stored in books, computer files etc.	Information is stored in oral memories.

3.4.2 Scientific Forecast Development by the Kenya Meteorological Department

Procedures to develop scientific forecast:

1) The past and the present weather are previewed i.e. cloud development, whether it was sunny or cloudy.
2) Different charts are analysed such as Isallobaric (to see the regions with pressure fall or rise), rainfall charts (for spatial rainfall distribution) and synoptic charts that shows the position of high and low pressure systems including ridges, troughs and the associated weather.
3) Synopsis-The observed pressure tendency (increase or decrease) in pressure .The satellite pictures are examined to look at the streamlines at different levels such as 925mb, 700mb and 500mb. The winds are also superimposed on the streamlines to identify the position of highs and lows and their movement. Other weather elements observed by the satellite pictures are rainfall, humidity and the type of clouds. The stability condition of the atmosphere is also identified from the ascent data i.e. K. Index, CAPE (Convective Available Potential Energy) among others. The satellite pictures are then compared to the Global models i.e. Regional Specialized Meteorological Centre (RSMC), UK Met office among others.
4) The forecast is then made based on the synopsis on the expected weather development.

3.4.3 Indigenous Knowledge Forecast Development

The IK experts rely on plants, animals and astronomical indicators in order to give the weather forecasts.Table4 shows the usage of plants and non-plants indicators in IK forecasting.

Table 4: the usage of plants and non-plants indicators in IK forecasting

IK indicator	Indicator sigh	Lead time of rainfall onset	Season to which the indicator is used
Acacia (*Fabaceae*)	New leaves	Anytime	Short rain
Dragon flies(*Anisoptera*)	numbers	Any time after the insect almost touch the ground	Short rain
Sunset point	Homa-Hills	Drought event	-

3.4.4 Options for effective communication of warning advisories

The respondents suggested that for effective dissemination of Early warning, there is need for public participatory scenarios through barazas at least twice (2) in a season whereby IK and conventional forecasters come together to discuss weather in open forum. In this case, the consensus will be reached since the standard nomenclature in reporting the weather will be known.

Currently such forums do not exist in the county. Consequently, the community characteristics were cited as a deterrent to early warning information. Some of the issues cited were: risks aversion, community norms, relationship to assets, and political landscape among others.

4. Coping and adaptive capacity

Identifications of adaptation and coping strategies were derived using the lens of various forms of Indigenous Knowledge used by the community of Kendu-Bay as disaster-based Early Warning (Speranza et al., 2010). The major disaster identified in this region is drought which is the variability component of climate system.

The major economic sectors that are affected by the impact of climatic change are: water resources, agriculture and energy (*Awange et al.*2007). The implication of the said impacts of climate change are lingering food shortages, poverty and energy. The frequency and severity of droughts and food insecurity in the region or parts of it require strong adaptation strategies which are actually site specific.

Drought affects food production thereby precipitating food shortages in the region. In this paper, Coping and adaptive capacity are used as a proxy to deal with the recurrent episodes of drought. Adaptation and coping strategies are meant to improve food production in the future. Table 5 below gives a summary of coping strategies to drought hazards in Kendu-Bay.

As an adaptation strategy to the decreasing rainfall amount, the farmers already plant drought resilient crops such as sorghum, cassava and millet (Awange, *et.al.* 2007. The discussion on the coping and adaptation strategies showed that livelihood diversification was a major pathway for adaptation among the respondents (Figure 3). However, the major deterrents cited by the respondents in relation to coping and adaptation are: culture (resistant to change with time), poverty and huge cost of health care.

Table 5: Coping strategies to drought

Number	Type of coping strategy	Number of respondents	Percentage (%)
1	Migration	1	2
2	Offering and prayers	4	8
3	Livelihood diversification	21	42
4	Drought resistant crops	8	16
5	Mixed cropping	7	14
6	Disposal of assets	2	4
7	Harvesting of wild fruits	1	2
8	Food storage and preservations	6	12

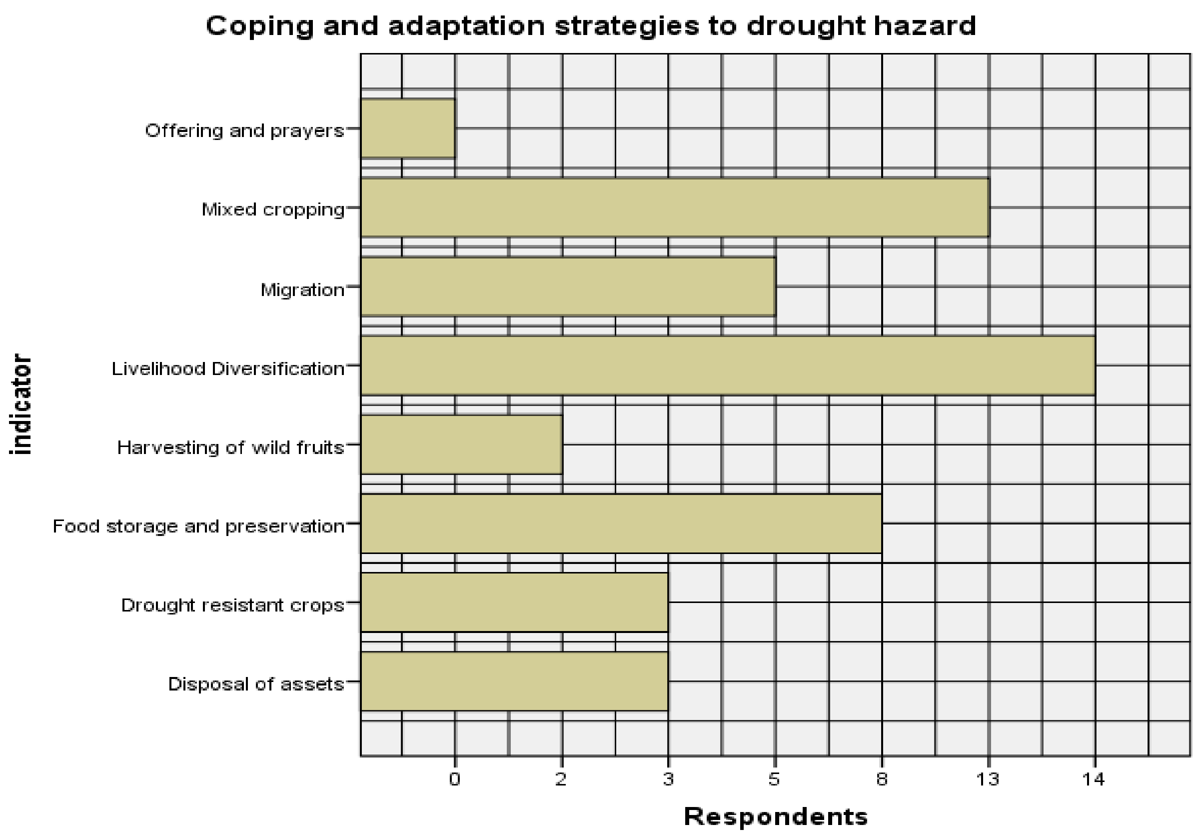

Figure 3: Coping and adaptation strategies to drought events

4.1 Conclusions

The Indigenous Knowledge (IK) indicators used to forecast weather range from plants, animals and astronomical indicators. IK indicators were classified into two broad categories i.e. indicators for wet and dry spells. Some of the indicators like the appearance of winged termites (*Formicidae*) commonly called 'Kumbe Kumbe' fall in both classes. For accuracy of forecasts using this indicator, there is need to combine several indicators to give the desired forecasts.

The scientific forecast was cited to be too broad and communicated in statistical language (below or above normal) which is not understood by the locals. Nevertheles, some farmers who use them correctly have demonstrated some benefits.

4.2 Recommendations

There is need to harness synergies between IK and Scientific Knowledge systems to upscale drought forecasting in Kendu-Bay region of Homa-Bay County. This will then provide an opportunity for farmers to explain to the meteorologists the kind of climate information they need. This being the case, the forecasts will be repackaged to suit local needs since IK will learn from science vice versa.

The paper further recommends the integration of the role of Indigenous Knowledge in Climate Change matters. The IK need to be documented and protected for sustainability and also the documentation process should consider gender and the knowledge holders.

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Appendix: Photo for Focus Group Discussion in Kendu-Bay (Source Field work, 2016)