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Climate Change Knowledge Gap in Education System in Kenya

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Abstract – Kenya, like other countries in the Horn of Africa, is severely affected by climate change. Droughts interposed with floods are recurrent climatic features particularly in the dry lands of the country. Climate extremes have not only led to low agricultural production but have also destroyed all other sectors of the economy such as tourism and industrialization rate. Droughts are the main contributing factor to high poverty levels having over 70% of the Kenya populace directly or indirectly depending on rain-fed agriculture. Understanding of the climate issues is therefore crucial in averting any climate related risks. To realize economic development the government of Kenya has invested heavily on education, which is viewed as a central input in the development process. In Kenya's Vision 2030, quality education as one of the priority sectors under the social pillar. Literacy level in Kenya stands to 87.5%. Unfortunately, the high literacy level has not translated to economic development as poverty levels stands at 47%. This study therefore sought to examine the climate change knowledge gap in the Kenya's education system. Specifically, the study sought to establish the place of climate studies in the Kenya's education system and also to establish the level of knowledge of climate change related issues among the Kenyan university students. The sample population included students from all university faculties in two public universities. A total of 108 students were sampled, 54 from each university. Almost all students (96.3%) were aware of changes in climatic patterns. In regard to the long rains (primary growing season in Kenya), 51.9% of the students observed reduction in rainfall events while 40.7 observed an increase. Rainfall amount was observed to be decreasing by 55.6% of the students. Increase in temperatures was observed by 70.4% and was attributed to increasing number of hot days. Despite the importance of climate change knowledge to the courses undertaken at the universities only 7.4% of the students wanted the climate change studies to be taught in universities. Majority (33.3%) of the students wanted the course to be taught at primary level only. The common mitigation strategy known by majority of the students was afforestation and reforestation. The study identified two main factors that led to scanty knowledge of climate change: (i) negative attitude towards agriculture which was seen as the main sector affected by climate change and (ii) bias in the integration of climate science content in Kenya's education system. To achieve the vision 2030 where education is aimed at enhancing both agricultural and industrial productivity, the study recommended an integration of climate science course in all subjects taught in schools, colleges and universities or introduction of climate change as a standalone subject at all levels of learning.

Keywords – Climate Change, Kenya Education Systems, Mitigation Measures.

I. INTRODUCTION

Africa, and particularly the Greater Horn of Africa (GHA), is one of the areas in the world that experience the severest impacts of climate change. The rate of warming is higher than the global average and is likely to continue to rise [1]. Episodes of severe droughts and floods that cause devastating effects have made regular news in the recent past. The effects are sometimes irreversible, at least in the short-term, resulting in destitution among the natives. In sub-Saharan Africa (SSA), for instance, approximately 96% of the cropland is under rain-fed agriculture [2]. The low rainfall amounts in the 1970s and 1980s impacted negatively on food production in the arid and semi-arid lands [3]. The economy of most African countries, which relies on primarily on agriculture, is in turn dependent on rainfall performance. According to [4], agriculture accounts for up to 40% of the Africa's total Gross Domestic Product (GDP), about 60% of total export earnings and absorbs about 65% of the labour force.

In Kenya, droughts which are usually interposed with floods, particularly in the arid and semi-arid lands (ASALs) are the main environmental threats to rural livelihoods. Over 70% of the Kenya populace live in rural areas having rain-fed agriculture as their main source of livelihood. Unfortunately, droughts are now a perennial problem with chronic vulnerability being concentrated in the ASALs. Droughts have not only affected agriculture but also have destroyed all other sectors of the economy such as tourism and industrialization growth rate. Famine cycles have reduced from 20 years (1964-1984) to 12 years (1984-1996), then to two years (2004-2006) and now yearly i.e. 2007/2008/2009/2010/2011 [5]. In a continent where agriculture is the engine of economic growth for many countries, dynamics in climate patterns cannot be underestimated and therefore need to be understood by all the stake holders in order to avert or mitigate climate-related risks.

1.1 Education System in Kenya

Education plays a central role in the development process. In cognizant to the important role of education in enhancing socioeconomic development, the government of Kenya has been provided free primary education and subsidized secondary education. In addition, the number of universities has grown from 4 in 1990 to 67 universities in 2013 [6]. As a result, the estimated literacy level in 2010, defined as percentage number of citizens above the age 15 years who can read and write, stood at 87.4% [7]. As envisaged in the Kenya's Vision 2030, quality education is one of the priority sectors under the social pillar aimed at transforming Kenya into middle income country and

providing a high quality of life to all its citizens by 2030 in a clean and secure environment.

The current Kenya's education system, dubbed as the 8-4-4 system, was introduced in 1986 to replace the 7-4-2-3 system. Under the 8-4-4 system, students undergo eight years of primary, four years of secondary and four years of university education. The objective of the system was to produce self-reliant individuals who are well equipped with life skills. To meet the ever changing demands, the government has reviewed the curriculum from time to time. In secondary section for instance, the curriculum has been revised twice reducing the minimum number of examinable subject from the initial ten at the beginning of the 8-4-4 system to the current seven while in primary schools the examinable subjects have been reduced from nine to five. Universities in Kenya offer varied courses ranging from Arts to Science-based. Students are admitted to undertake degree courses of their choice after completion of secondary school education.

Unfortunately, the high literacy levels 87.4% in Kenya have not translated to economic development since poverty level stands at 47%. Citing Africa, [8] attributes this to limited studies to measure importance and relevance of education in economic development process. In Kenya, [9] attributes the mismatch between literacy levels and economic development to the very little empirical research on the effectiveness of educational initiatives. It is against this background that this study sought to examine the role played by the education system in enhancing the understanding of climate change among the students since environmental challenges, particularly droughts, pose the greatest threat to the Kenya's economy.

II. OBJECTIVES OF THE STUDY

The general objective of the study was to examine the climate change knowledge gap in the Kenya's education system. Specifically, the study sought (i) to establish the place of climate change studies in the Kenya's education system, and (ii) to establish the level of knowledge of the climate change related issues among the university students in Kenya.

III. METHODOLOGY

Data for this study was obtained between January and February 2013 from undergraduate students who were in their final year of study from two universities in Kenya. Stratified random sampling methods were used in selecting the sample population. Schools and faculties formed the strata. In selecting the students, the study used multi stage sampling. Whereas all the schools and faculties were used, departments in the schools and faculties were sampled. From the departments, students in their fourth of study were randomly selected. A total of 108 students, 54 from each university were administered with questionnaires. Data for Kenya education system and curricula was largely from secondary sources.

IV. RESULTS

The economy of Kenya is driven by agriculture. Over 70% of the population depends directly or indirectly on agriculture with the dependency increasing in the ASALs where approximately 95% of the household income is from agricultural activities. Unfortunately, changes in climatic patterns have greatly affected agricultural practices (planting, sowing, harvesting and even yields) in most part of the country. In the ASALs, for instance, frequent droughts and floods have led to not only chronic famines and hunger but also dwindling of the pastoral economy [10] posing the greatest threat to rural livelihoods. The importance of climate change knowledge is therefore vital for sustained agricultural development and economic growth in Kenya.

4.1 The place of climate change education curricula in Kenya

In primary school curriculum, climate content was taught under Science and Social Studies subjects only. At this elementary level, aspects of weather and climate were taught at all levels starting from standard 1 (or level 1) to standard 8 (or Level 8). The content related to climate included: elements of weather and instruments, regional climates and vegetation types, and the solar system. The science of climate change, which is taught in standard eight, only highlights the basic causes of climate change and their effects on human activities. At secondary school level, climate studies were taught under the Geography, Biology and Agriculture. Much of the climate studies are taught under Geography. Climate-related were covered in Form 1 (or Level 9) under the subtopic weather and in Form 2 (or Level 10) under the subtopic Climate. In Form 1, the subtopic, Weather, largely covered weather elements and instrumentation while in Form 2, aspects of climate change such as global warming, causes of climate change and regional climates were taught. Whereas the primary goal in Biology was to explain how greenhouse gases (which causes climate change) act as pollutants, under Agriculture, the main focus was how various elements of weather affect agricultural production. In both Biology and Agriculture, these aspects of weather and climate were covered in Form 1.

At the university, very few syllabi, if any, had incorporated the aspects of climate or climate change. In most universities, climate content was largely taught under Geography, Agriculture and Environment related subjects. Fortunately, few universities in Kenya had started courses focusing mainly on climate change. This included: Maseno University which has a department of Climate Change and Development, University of Nairobi which has the Institute for Climate Change and Adaptation, Kenyatta University under the School of Environment Science and a few other universities. The emphasis on the climate and climate change content reduced with progression on the level of education in education system in Kenya.

4.2 Students perspective on changes in climate in their home counties

All students were aware of changes in climatic patterns particularly with regard to rainfall and temperature. While all (100%) of the students acknowledged having changes in rainfall patterns in their home counties, 88.9% said the same for temperature with 11.1% indicating no changes in temperatures. The most common change in temperature (observed by 70.4% of the students who indicated changes

in temperatures) was increase in temperatures. This was associated with increase in the number of hot days. About 18.5% and 11.1% who stated that temperature had decreased or had no change respectively. Table 1 shows observed changes in rainfall occurrence during the long rains which is the primary planting season in most parts of the Kenya.

Table 1: Observed changes in rainfall and temperature by students

Rainfall status	Long rainfall (MAM) season (Indicators)				
	Amount (%)	Events (%)	Intensity (%)	Onset (%)	Cessation (%)
Increased	37.0	40.7	59.3	Early: 33.3	Early: 55.6
Decreased	55.6	51.9	33.3	Late: 59.3	Late: 25.8
No change	7.4	7.4	7.4	No change 7.4	No change 18.6

With regard to the long rains, the primary growing season in Kenya, which fall in March, April and May (MAM), 59.3% observed late onsets, 33.3% observed early onsets while 7.4% observed no changes in the onsets in their respective counties. Delays in cessation of the MAM rains were observed by 25.8% of the students. About 55.6% stated that the MAM rains ended earlier than usual while 18.6% observed no changes in cessation of the long rains. MAM rainfall events were observed to be decreasing by 51.9% of the students while 40.7% and 7.4% observed increase and no change in rainfall events respectively. About 59.3% observed increase in the number of high intensity rainfall events, 33.3% observed reduction while 7.4% observed no changes. With regard to MAM rainfall amounts 37% of the students observed an increase, 55.6% observed reduction while 7.4% noted no changes.

4.3 Climate knowledge gaps among the university students

The challenges of climate change cannot be underestimated due to its role as a major threat to economic development as it affects all sectors of the economy. To realize economic growth and development, understanding of climate change related issues is important to all stakeholders and particularly to the main actors. Among these actors are the university graduates who are trained in order to transform the economy of the country both at local and national levels. The Kenya's Vision 2030 places education as one of the key pillars for industrialization by 2030 and thus all university academic programmes are designed in a manner geared towards achieving Vision 2030 goals. To underscore the importance of climate change knowledge for economic development, 81.5% of the students acknowledged the relevance of the knowledge to the diverse courses offered at the universities for sustained economic development. However, the study established a gap with regard to climate change knowledge amongst the university students as explained in the following sections.

4.3.1 Access to climate information

The most common form of climate information that students had access to was weather forecast. Over half of the students received weather forecasts every day, 22.2%

weekly, 3.7% fortnightly, 18.5% monthly and 3.7% received no information at all. Weather information was obtained through various mediums which largely included television, internet and newspaper. Each of these mediums was accessed by at 14.8% of the students. This was attributed to the fact that students watched television, accessed internet and read newspapers regularly. Radio as a medium disseminating climate information was not common providing information to only 3.7% of the students. Students listened to entrainment radio stations, which rarely broadcasted climate related information. Other than weather forecast, about 55.5% of the students had knowledge about existence of historical meteorological data. Historical rainfall data only was known to 18.5% of the student, 14.8% knew about the existence of both rainfall and temperature historical data, 11.1% knew about temperature data only, 7.4% knew about temperature, clouds and rain while 3.7% knew the existence of temperature and cloud data only. However, over 90% of the students had no interest on climate information. This was attributed to the fact that about 44.4% of the students were not conversant with the terminologies used in weather forecasting such as "below normal" or "near normal" rainfall and also climate information was viewed as only relevant to farmers.

4.3.2 Knowledge of global and national responses to climate change

There are a number of responses focusing on mitigation of climate change at global, regional and national levels. Despite having much publicized climate change meetings such Conference of Parties (COPs) in both electronic and print media in Kenya and the frequent updates of such meeting, the knowledge of various climate change responses was limited to students. Over 60% of the students didn't know any of global, regional and national responses to climate change. On average, only 25.2% knew about the global responses (Table 2).

The knowledge of the responses towards different global responses varied as follows: Kyoto protocol 40.7%; COPs 25.9% and Intergovernmental Panel on Climate Change (IPCC) 25.9%, Clean Development Mechanism (CDM) 22.2%, Montreal Protocol 14.8%, Reducing Emissions from Deforestation and Degradation (REDD) 29.6%, National Adaptation Programmes of Action (NAPA)

33.3%, UN Framework Convention on Climate Change (UNFCCC) 44.4%, Joint Implementation 3.7% and Carbon trading 11.1%. At national level, an average of 39.5% of the students knew about efforts and responses to climate change in Kenya (Table 3). The IGAD Centre for Prediction and Application (ICPAC) was known to 44.4%, while Drought Monitoring Centre, Nairobi (DMCN) and National Climate Change Response Strategy (NCCRS) were known to 40.7% and 33.3% respectively.

4.3.3 Knowledge on climate change mitigation strategies

The most common climate change mitigation strategy known by all students was afforestation and reforestation. About 73.2% of the students argued that trees "attract rainfall" thus mitigating climate change. The knowledge about the role of trees in carbon sequestration was very scanty amongst students. Similarly, the link between greenhouse gases and global warming was not clear to about 64.5% of the students. Terms like carbon sequestration, carbon footprints and carbon trading were unknown to 89.3% of the students. Other mitigation

measures mentioned by less than 5% of the students were: control of greenhouse gas emission, use of energy efficient appliances and agro-forestry. The distinction between climate change adaptation and mitigation measures was not clear amongst students. As such, when asked to identify the mitigation measures against climate change, students stated irrigation, early planting and planting of drought resistant crops.

Despite the gap in climate change knowledge particularly on mitigation aspects and the strong recommendation by all students that the climate change content should be a compulsory subject in Kenya, only 7.4% of the students wanted the course to be taught only at university level. Majority of the students (37%) recommended for the subject to be incorporated in the curriculum at primary school level, 25.9% at secondary schools, 7.4% in intermediate colleges and 7.4% in all other levels expect in the universities. Only 14.9% of the students recommended for inclusion of the subject in the curricula of all levels of education in Kenya (Table 4).

Table 2: Knowledge of various global responses to climate change

	Kyoto Protocol (%)	COPs (%)	IPCC (%)	REDD (%)	UNFCCC (%)	Carbon Trading (%)	CDM (%)	Montreal Protocol (%)	JI (%)	NAPA (%)	AVG (%)
Yes	40.7	25.9	25.9	29.6	44.4	11.1	22.2	14.8	3.7	33.3	25.2
No	59.3	74.1	74.1	70.4	55.6	88.9	77.8	85.2	96.3	66.7	74.8

Table 3: Knowledge of national responses to climate change among students

Responses	ICPAC (%)	NCCRS (%)	DMCN (%)	Average (%)
Yes	44.4	33.3	40.7	39.5
No	55.6	59.3	66.5	60.5

Table 4: Level at which climate change studies should be included in the curricula in Kenya's education system

	Introduction of climate change studies in the curricula (%)	Academic levels					
		Primary (%)	Secondary (%)	College (%)	University (%)	Other levels except universities (%)	All levels (%)
Yes	100	37.0	25.9	7.4	7.4	7.4	14.9
No	0	63.0	74.1	92.6	92.6	92.6	85.1

V. DISCUSSION

Changes in climatic patterns and the subsequent effects on livelihoods were evident among the university students. The observation on increasing rainfall intensity, decreased number rainfall events and shifts in rainfall seasons, to a large extent, agreed with the findings of the IPCC. The study established that the timing of planting season had changed with rainfall onset coming late in most of the most of the areas. In addition, the length of growing season had reduced due to late onset and early cessation of the rains. Much of this knowledge was largely acquired through personal experiences and interaction with their immediate environments with little knowledge gained from formal education. As a result the scientific background on and responses to climate change remained scanty amongst the students. The study attributed the gap

in the scientific knowledge of climate change in part to the failure of the education system in Kenya and partly to the negative attitude towards agricultural practices among the students. The Kenya education curricula concentrate the climate change content in the lower levels of education system and in very few subject areas. In Kenya, like in other parts of Africa, no clear guidelines or comprehensive research have been done on the most appropriate level(s) when the climate change content should be introduced into the curricula. Similarly, no studies have been carried out to ascertain the relevance of the climate change knowledge in day to day activities of a population. Reference [8] observes that in as much as the debate on the best level is still on in the world, such debates have not yet begun in Africa. Whereas the World Bank and other international development organizations observe that the most appropriate is the elementary level, some researchers view higher levels as the most relevant.

At secondary school level in Kenya, the subjects where climate change was taught were optional. This included Geography (weather and climate), Biology (ecology), and Agriculture (crop production). Unfortunately, the all these subjects were elective and not compulsory at this level. This implied that a student could undergo through secondary education without taking any of these subjects hence missing out on climate related knowledge. Unfortunately, the number of students taking Geography, where climate content was largely taught, had declined steadily over the years (Figure 1). A similar declining trend was observed for Agriculture (Figure 2).

Agriculture which employs over 70% of the population in Kenya and contributes to about 30% of the GDP is one of the economic sector that is worst affected by climate change in Kenya. Unfortunately, the attitude towards agriculture remained negative particularly among the

students and therefore to many of the students, the knowledge of climate change was perceived to be important mainly to farmers. The main reason cited by the students as to why climate change courses needed not to be introduced in the curricula of intermediate colleges and universities was that the form of farming – rain fed - mostly affected by climate vagaries was for the uneducated poor. Students felt that farming was for people with low levels of education and therefore the climate change content should be taught at primary and secondary schools. Amongst the graduates, farming was not given much priority and therefore teaching aspects of climate change added no or very little value at university level. To underscore this, students argued that scrapping off Agriculture subject, as a distinct subject, in primary school was an indication of low priority accorded to agriculture by the government.

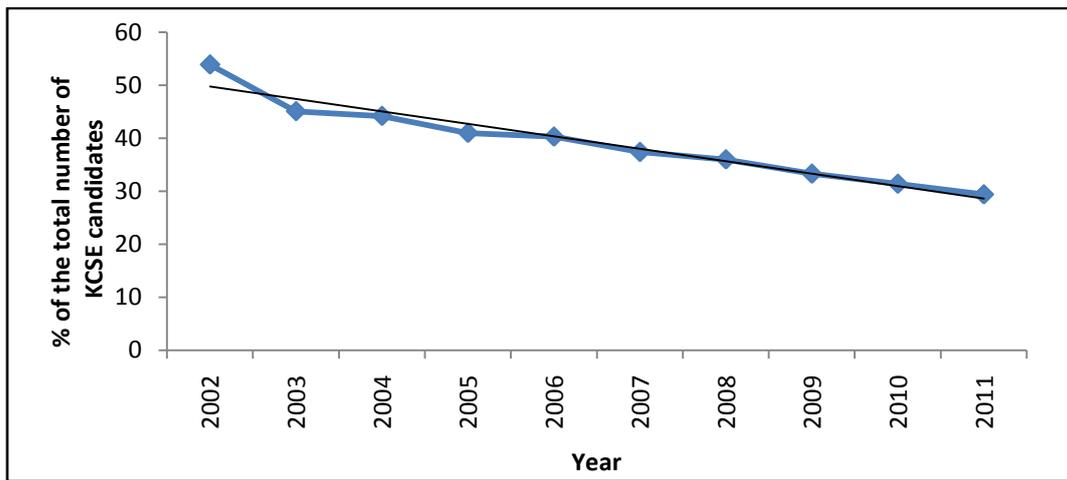


Fig.1. Percentage number of student who sat for KCSE Geography examination (2002-2011) [11]

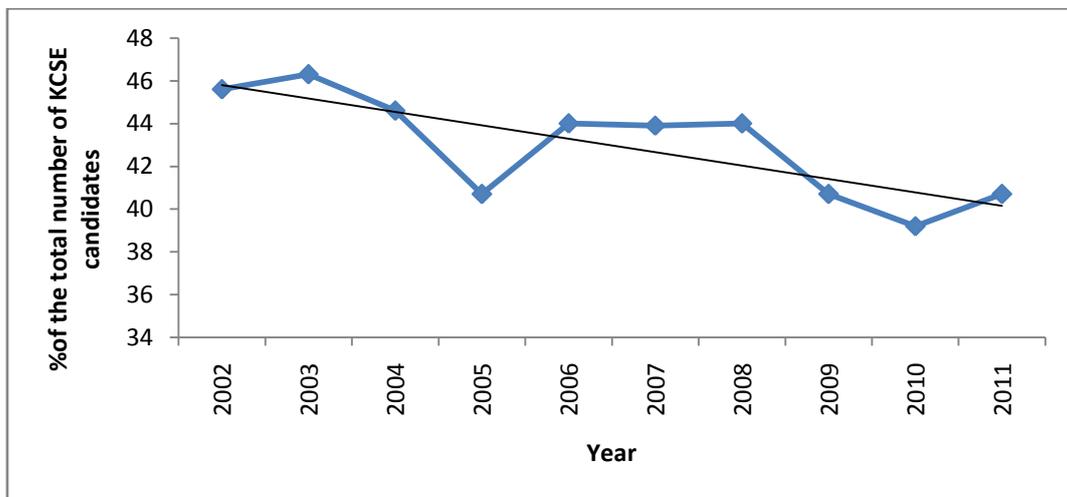


Fig.2. Percentage number of student who sat for KCSE Agriculture examination (2002-2011) [11]

VI. CONCLUSION

The effect of climate change on economic development is not a new phenomenon. However, the effects have been increasing with increasing frequency and severity of the climate extremes. Agricultural sector which accounts for

30% of the country's GDP, is the worst affected and therefore the knowledge of the effect of climate change is common amongst the Kenyan populace. Despite the fact that Kenya economy is largely agri-based and climate extremes pose the major challenges to its development, little of the climate content was incorporated in the Kenya's education system. Much of the content was

concentrated at elementary levels of education and diminished as the level increased. Less emphasis of the content was put at secondary, colleges and universities levels. A huge gap therefore exists in the education sector with regard to climate change content and there is need for it to be addressed in order to realize the objective of the Vision 2030.

RECOMMENDATIONS

To enhance the understanding of climate change and its impact on the economy, the gap in the education system need to be closed. This will ensure that all citizens, whether learned or not, fully understand climate change issues and its direct or indirect effects on their day to day activities. To achieve this, the study recommended the following:

1. With regard to school curricula, climate change content should be integrated at all levels. At secondary, intermediate and tertiary institutions, climate related course should be made compulsory, either as common course or as a topic that runs throughout the levels within the compulsory subjects in the curricula. This calls for review of the curricula in Kenya's education systems. As such
2. There should be regular updates on climate information particularly during the main programmes on television and radios. Currently, weather forecast is aired on the television at the end of prime news. Unfortunately, very few people watch the prime news to the very end and therefore miss out on these updates. A revised timing of the weather forecast from the very end of the prime news to in between or at the beginning would be more appropriate.

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AUTHOR'S PROFILE

Dr. Huho, J. M.

was born in Kitale, Transnzoia County in Kenya where he undertook part of his primary school education before moving to Naivasha in Nakuru County. He graduated with a Bachelor of Arts degree in Geography and Kiswahili in 2002, Master of Arts in Geography and PhD in Geography (with a bias towards climatology) from Maseno University, Kenya in 2005 and 2011 respectively.

Dr. Huho started teaching at the university as a Graduate Assistant in 2003, became an Assistant Lecturer in 2005 and a Lecturer in 2009. Currently he is a Senior Lecturer in the department of Geography in Karatina University, Kenya. He has expertise in Geographic Information System (GIS) and Remote Sensing (RS). His area of research is impacts of climate change in rural livelihoods and the adaptation strategies.