Exploration of Knowledge, Perception and Adaptation Strategies of the Mbita Fisher Community to CC/ CV

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Authors' contributions

This work was carried out in collaboration among all authors. Author RDLO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors CO and DA supervised and guided the study. All authors read and approved the final manuscript.

Original Research Article	

ABSTRACT

Decreasing livelihoods of fishers' communities is blamed on consequences of global warming and climate change impacts. Food security and livelihoods of the world's 36 million fishers and the nearly 1.5 billion consumers rely on fish for their dietary animal protein. Past studies concentrated on fisher communities and climate variability in marine waters and oceans; mainly investigating the impact of climate variability on fish distribution and production. Limited research has addressed the interaction between impacts of climate change on the fishing activities on inland and fresh waters such as in Lake Victoria and how the fishers are coping and adapting. This article discussion focuses on Lake Victoria shore location of Mbita where the livelihood activity of local community is fishing. The interactive field study was guided by these two research objectives to: Determine the fishers' knowledge and perception of climate change and variability in Mbita sub-county. Establish the effect of gender in climate change adaptive activities among the Mbita county fishers. The study used a constructivist epistemology and the mixed methods research design to help it achieve its findings. Yamane's formula (1964) is used to get the sample size of 388 respondents from a population of 13191 fishers. Primary data was collected through use of questionnaires, interview

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schedules for KII and FGDs. Secondary data collection was collected through reviewing of documented information, such as the fish catch data and climate (temperature/rainfall data) of Mbita for the last 30 years data to get the trend of these elements and to determine climate variability and change. Content validity of the instrument was done through experts; supervisors. Reliability was attained through test and re-test Data analysis was accomplished through use of computer based software (SPSS). Presentation was done in descriptive and inferential statistics. The findings were:-there was gender discrimination in access and control of key fishing resources which support adaptive activities that makes women more vulnerable to CC and CCV hazards and disasters. The study found that majority fishers had clear perception of CC but only 46% had knowledge of CC. The fishers relied more on indigenous knowledge and meteorological forecasts were too technical and considered irrelevant. The study further found that erratic variations in temperatures and rainfall were greatest stressors with statistical significant p-value = of 0.02. Wet seasons destroyed infrastructure, increased weather-borne diseases and endangered the fishers' lives while dry and hot season resulted in insufficient fish catches and near starvation food consumption. Statistically loss life and access to food were significant at p-value of 0.001 and p-value of 0.000 respectively. The study found that CCA requires access and control of factors of production which were traditionally under the control of male fishers making women more vulnerable and susceptible to surviving through *chamas* and table banking activities. Statistically access to and control was significant to adaptation at p-value of 0.000. The study concluded that lack of alternative livelihood opportunities/options is the major constraints to adaptation for people living in the Lake Victoria region escalated with limitation of skills outside fishing industry, limitation of other employable professional skills including lack of capital. The study recommends a transdiciplinary consientization of adaptive strategies which can translate into flexible and sustainable CCA gender inclusive livelihood activities. Future research should explore participatory action research on environmental influences affecting CCA by comparing findings across other beaches.

1. INTRODUCTION

Gender refers to masculinity and feminity; staying clear of biological differentiation. Basically gender is socially constructed roles stereotyped on men and women girls and boys. It is a central organizing principle of societies, and often governs the processes of production, reproduction, consumption and distribution. Many communities in Africa use biological gender as a development planning tool for accessing and controlling livelihood resources.

On the other hand, the importance of fish cannot be ignored. It is the main source of dietary protein for over 1 billion people worldwide. Global fisheries sector supported over 43.5 million people directly and over 200 million in associated fishery industries with the majority of these persons being in developing countries [1]. Fisheries employ around 10 million people is the only source of animal protein for over 20 per cent of the population in Sub Sahara Africa [2].

Globally fisheries are under intense pressure from habitat destruction, biodiversity loss, overfishing, pollution and ocean acidification and this situation is getting further complicated by the impacts of climate variability. Small scale fisher folk in the developing countries will be most vulnerable to climate change and variability due to high reliance on fisheries and poor adaptive capacity [3]. It further stressed that climate change and variability will have a significant and long-term risk to fisheries in many tropical developing countries particularly in Sub Saharan African ultimately undermining the benefits gained from the development of fisheries sub sector.

A number of studies have investigated the vulnerability and adaptive capacity of the fisheries dependent community to climate change and variability but there has been little emphasis at the local scale on how impacts of climate change and climate variability is affecting the lives and livelihoods of the majority of small-scale fisher folks, who make up more than 90% of the world's fishers and fish trade [4].

The Lake Victoria Basin supports a population of 40 million providing a variety of economic and development opportunities from fisheries and tourism [5]. This implies that all livelihood

opportunities around Lake Victoria are under threat due to a number of environmental problems including pollution of the lake, biodiversity loss, habitat destruction, soil erosion and new impacts of climate change and variability. The lake's shallowness, limited river inflow, demands on outflow and large surface area relative to its volume will also make it highly vulnerable to climate variability [6].

1.1 Problem Statement

Past studies of nexus of climate change and fishing livelihoods have had differing focuses, Odhiambo, focused on effects of weather and climate variability affected fishing activities and fishers' adaptive capacity in Mbita Sub County using survey method [7]. His finding was that weather and climate variability had significant effect on fishing and livelihood activities, however he did not explore the gender construct. Sidi studied the adaptive capacity to climate change and food security among artisanal fisher folk in Rorya District, Tanzania using mixed methods [8]. Her study found gender inequalities and disparity in access to and control to resources and education which accounted for disparities in adaptive capacities of the target study community but did not interrogate the implications of culture in these disparities. Most inland fisheries are under intense pressure from overfishing, poor management practices, pollution and introduction of alien species [9]. The current study interrogated the influence of gender on climate change adaptation by the fisher community in Mbita, Homa Bay County, Kenya. Lake Victoria Basin is home to a population of 40 million persons yet over the last four decades the region has faced a number of environmental problems which could jeopardize the stability of their livelihoods.

1.2 Study Objectives

i.   Determine the fishers' knowledge and perception of climate change and variability in Mbita by gender.
ii. Determine the influence of gender in the current coping / adaptation to CV/ CC among the fishers in Mbita.

2. LITERATURE REVIEW

2.1 Gender and Climate Change

Gender is a socially constructed on roles, responsibilities and opportunities between men and women which governed by local societies and their cultures. In contemporary times gender has become a developmental planning tool for resource access and distribution as well as of organizing communities in traditional societies. It governs the processes of production and reproduction, consumption and distribution of resources [10]. In relevance to this study gender differentials are expressed in terms of access and control of climate change adaptive resources among fishers in the study area.

2.2 Fishers' Knowledge and Perception of Climate Change and Variability

Knowledge is a background factor that influences a person's attitude toward a certain behavior and thus a clear perception and scientifically correct knowledge of the causes and impacts of climate change is imperative for successful adaption to the effects of a changing climate [11]. When people are equipped with the knowledge of the changing weather patterns and understand that extreme weather events will occur more often, they will be able to debate the issues with their families and communities and discuss the risks and possible courses of actions to enable them adapt more effectively [12].

2.3 Fisher Communities Coping and Adaptation Strategies

The ability of individuals and communities to adapt to climate change depends on their vulnerability, exposure and adaptive capacity [13]. Studies have illustrated that fishers adapt to the impacts of climate variability and change in various ways. When faced with declining yields, income and food security, fishers may seek alternative resources. For example on the Lake Malawi area the fishers cope by diversifying into farming and pastoralism while others migrated in response to the decrease in fish catches [14].

3. CONCEPTUAL FRAMEWORK

The operationalization of the conceptual framework brings a holistic approach to comprehending the influence of gender on climate adaptation by the fishers in Mbita. The framework identifies that climatic and non-climatic elements influence fish, fishing activities and fishing livelihoods from the volumes of catches, varieties caught, the catching, processing and marketing of the fish. The outcome of this complex situation interacts with the dynamics of gender which used here as a differential planning tool that is strictly observed by the local cultural norms and values within the

fisher community. These norms mediated with gender interface interact differently with perception and knowledge; livelihood activities and resource access and control accounting for the different levels of vulnerability. Navigating to sustainable livelihoods requires the participatory community processes reinforced with collaborative learning.

3.1 Area of Study

The study focuses on Mbita in Home Bay County, a small, rural town located along the shores of Lake Victoria, near the southwestern border of Kenya, located on a peninsula, with water on three (3) sides and surrounded by picturesque islands between latitudes 0° 21' and 0° 32' south and longitudes 34° 04' and 34° 24' east [15]. The projected temperature increase in the Lake Victoria Region (3 to 4°C) by the end of this century a state that would further affect the region's rainfall regime [6]. This coupled with dwindling fish stocks due to overfishing will increase the pressures on the fishers' livelihoods.

3.2 Study Design

The study used mixed methods research design. The mixed method enables researcher to complement qualitative approaches with quantitative ones in order to allow for more complete interrogation of the study variables [17].

3.3 Target Population

The study targeted 13191 who are scattered across the Rusinga and Mbita [18].

3.4 Sample Size and Sampling Procedure

The sample size was calculated using Yamane's formula [19]: At 95% confidence level and p =0.05, size of the sample should be n=N/1+N(e2) where, N is the population size and e is the level of precision. In using this formula to get a sample number from our population, in which N =13,191 with ±5% precision. Assuming 95% confidence level and p =0.05, we get the sample size of 388.

3.5 Data Collection Procedures

The researcher obtained all required permits from the graduate school of UoN. Quantitative data was collected using semi structured questionnaires while qualitative data was
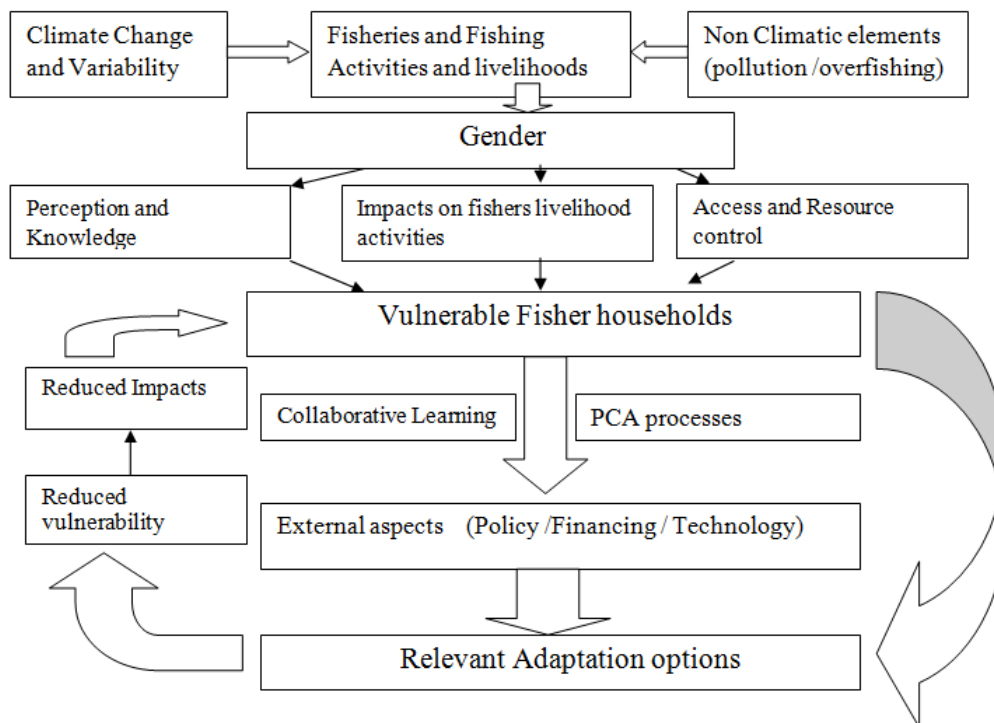

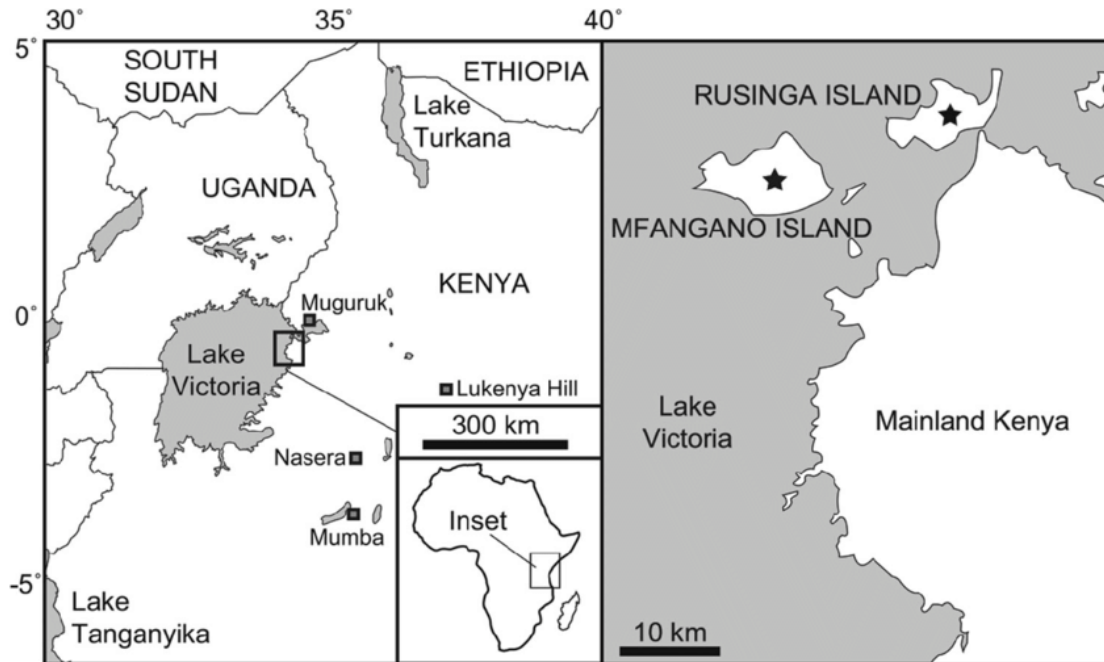**Fig. 1. Conceptual framework by researcher 2019**

Fig. 2. Map of study area [16]

collected using FGDs and KII interviews. Secondary data consisting of published peer reviewed scientific articles focusing on climate variability and change perceptions, impacts of climate variability and change on fisheries, adaptation in the fisheries sector will be consulted. Meteorological data from the Meteorological station in ICIPE to get the temperature and rainfall trends and data on fish production will be accessed from the Fisheries Department in Homa Bay Fisheries office and the BMU offices in Mbita will be analyzed to give further insights into the study.

3.6 Data Analysis and Presentation

Data was analyzed using computer supported software SPSS and presented in descriptive statistics while qualitative data was analyzed thematically and presented in prose.

4. FINDINGS AND DISCUSSION

4.1 Socio-demographic Characteristics of the Respondents

The study found that 65% of the respondents were male while 35% were female. On age distribution, 3% were <19 years of age; 32% were between 19-28 years of age; 40% were between 29-38 years of age; 16% were 39-48 of

age; 5% were 49-58 and 1.9% of them 59+ years.

On marital status, it was found that 25% were single; 55 of whom were males and 22 females; 39% of the married 80 males and 37 females; 9% of the sample were divorced 11 females and 4 males; 19% of the sample were separated 23 were females and 11 males and 9% of the sample were widowed/widowers 15 were males and 13 females.

On education level of the sampled fishers the study found that 4% had no education at all: of these 7 were male and 4 females; 51% had primary education 93 males and 62 were females; 39% attained secondary education 84 were males and 36 females; and 7% had acquired some tertiary education of whom 17 males and 3 females.

On household's headship the study found that 64% were male headed; 32% female headed and only 4% child headed. Concerning household size, the study found that 57% of the sampled households of whom 112 were males and 63 females were living with between 0-3 people in their houses; 40% of whom 82 males and 41 females were living with 4-7 people in the household but 3% reported that they were living with 8+ people in the same household.

4.1.1 Livelihoods and livelihood activities

The study found that 67% of the sampled fishers solely depended on fishing as their main source of livelihood 134 male and 70 female. The study established that next dominant source of income was mixed cropping and fishing accounting for 23% of the respondents made of 48 males and 23 females; 6% of the respondents engaged in livestock rearing distributed in 13 males and 4 females and 4.5% of the sampled fishers engaged in other activities of whom 6 were males and 8 females.

On roles taken in the fishing activities 9% the respondents owned or made boats disaggregated into 19 males and 8 females; 45% of the respondents were either fishermen/boat crews and were all males. While 34% composed of 79 females and 26 males engaged in fish marketing.

On the duration of time the respondents, 21% of the sample reported that they had been involved in fisheries for <5 years; of these 43 were males and 21 females; 44% of the sample had been in fisheries for a period of 6-9 years in distribution of 85 males and 49 female; 20% of the sample had been in fisheries for between 10-14 years in distribution of 38 males and 24 females; 10% of the sample had been in fishing for between 15-19 years distributed into 21 males and 8 females and 6% of the fishers stated that they had been in fishing for a period exceeding 20 years.

On estimates of monthly incomes; 53% of the respondents comprising of 99 males and 62 females made (0- 4999) Ksh a month; 26% of the respondents comprising of 56 males and 24 females made (5,000 – 9,999) Ksh a month; 11% of the sampled fishers made 10, 000 - 14999 Ksh a month in the distribution of; 5% comprising of 24 males and 9 females made (15,000 to 19,999) and 5% of the respondents made of 9 males and 7 females made Ksh 20,000/- plus in month.

4.2 Knowledge and Perception of Fishers towards Temperature and Rainfall Changes

4.2.1 Observed changes in temperatures in the last 10 years based on perception

Perceptions elicited divergent responses from the respondents concerning perception temperature and rainfall patterns over a period of 10 years. 68% of the respondents comprising of 139 males and 69 females agreed that they had observed seasonal increases while 74% of the respondents comprising of 148 male and 78 females appeared not to have noted any marked decreases. 4% comprising of 9 male 4 females were categorical that they observed decreases in the annual temperatures. The men who actually went finishing had the clearest notion of changes in temperature.

4.2.2 Observed changes in rainfall in the last 10 years during

Responding to changes on rainfall onset trends, 93% of the respondents reported that the onset had become unpredictable over the last ten years and this made it challenging on their livelihood a planning. 93% of the respondents said the onset of rains were consistently later than expected out these, 68% of the respondents explained that the rains would come late and was much higher than expected associated with havoc to fishers. Overall, 89% of the respondents made of 183 males and 90 females confirmed that rains have become more erratic and that there had been consistent change in rainfall pattern associated with flash floods and devastating weather disasters.

From the FGDs respondents demonstrated that they were fully aware that climate is changing and rainfall becoming low and inconsistent with unpredictable onset dates and haphazard distribution; the temperatures were becoming increasingly higher. The fishers observed that extreme weather events such as droughts and floods are the most important climatic stressors with negative impacts on their households. Extremes of temperatures and occurrence of flash floods translated into decline in fish catch, sizes and types.

4.3 Scientific Climatic Trends in Mbita Division between 1987-2017

Presented below are graphical image constructed from 30 year period climatic raw data sourced from ICIPE Meteorological station. This was a critical indicator for confirming the phenomenon of weather and climate variability in the region as can be seen on the graphs displayed below.

4.3.1 Monthly rainfall trend from 1987 to 2017

The rainfall data showed that Mbita experiences two rainy seasons, the long rainy season

between March to May and the short rainy season from October and December. Fig. 3 illustrates that the month of April had the highest amount of rainfall over the years recording an average of 360 mm while July recorded the lowest rainfall over the years with an average of 98.4 mm.

4.3.2 Annual rainfall trends from 1987 to 2017

For the 30 years under consideration 1987 to 2017 showed a highly variable trend of rainfall as shown in Fig. 4 There was an overall decrease in annual rainfall by 5.1 mm during the period (Table 2). From 1987 to 1988 the rain showed an increasing trend from 900-1000 and a rise between 1989 -1990 before a sharp fall in 1991 before leveling back in 1993. Thereafter the rainfall was highly variable with rises and falls in annual totals till 2017 as shown in Fig. 4. The irregularity in rainfall pattern from these records points a clear indication to weather and climate variability with some years like 1997, 2002 and 2006 have exceptionally high average rainfall of over 140 mm, while others have lower than 100 mm.

Table 1 presents the statistical analysis in which the monthly average rainfall for this period under observation was 215.5 mm while the annual average rainfall was 237.7 mm. for the same period. The monthly mean rainfall over the 30 year period showed a decrease by 13.92 mm over the period while the annual average rainfall showed a decrease of 5.1 mm over the period.

This was an indication that the area is already experiencing rainfall variability between the long and the short rainy seasons.

4.3.3 Temperature trends

In this subsection the average monthly and annual temperatures trends of Mbita Sub County are presented and interpreted to explain scenarios of temperature variability in the study area.

4.3.3.1 Monthly temperature trends

Temperature recordings for the period showed that the minimum temperatures over Mbita were fairly constant oscillating between 17 and 19°C throughout the year with July as the coolest month with the average temperatures of 17.8°C as shown in Fig. 5. The average maximum monthly temperatures however exhibited a bimodal pattern with high temperatures in January peaking in February and March before coming down in April through to August; then rising again in September to peak in October and November at temperature ranges of 29°C to 30°C.

4.3.4 Average annual temperature trends

The yearly temperature distribution over the thirty year period presents patterns of unstable cycles for both the maximum and minimum temperatures as per Fig. 5. The maximum temperatures from 1987 to 2017 showed irregular cycles of rising and falling of
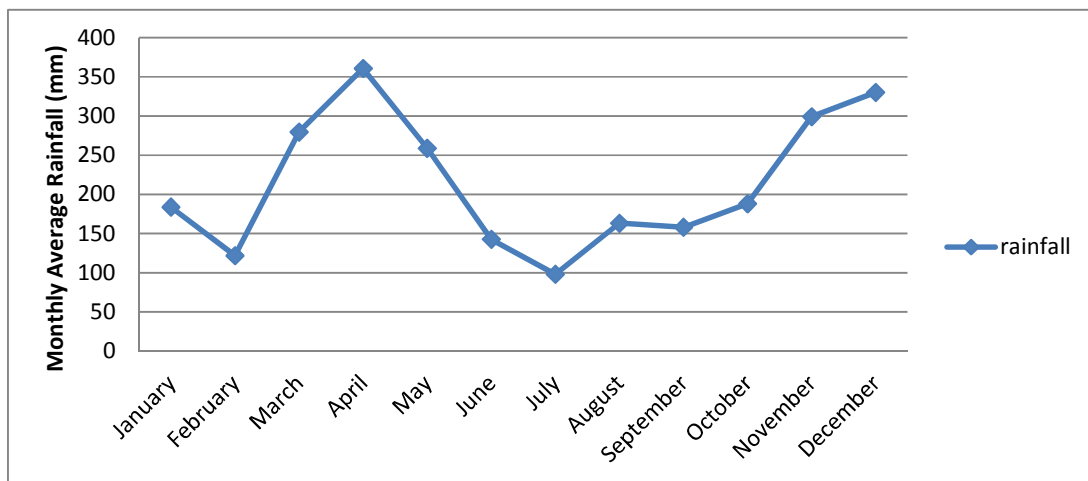

Fig. 3. Average monthly trends of rainfall data for Mbita (From 1987 to 2017)
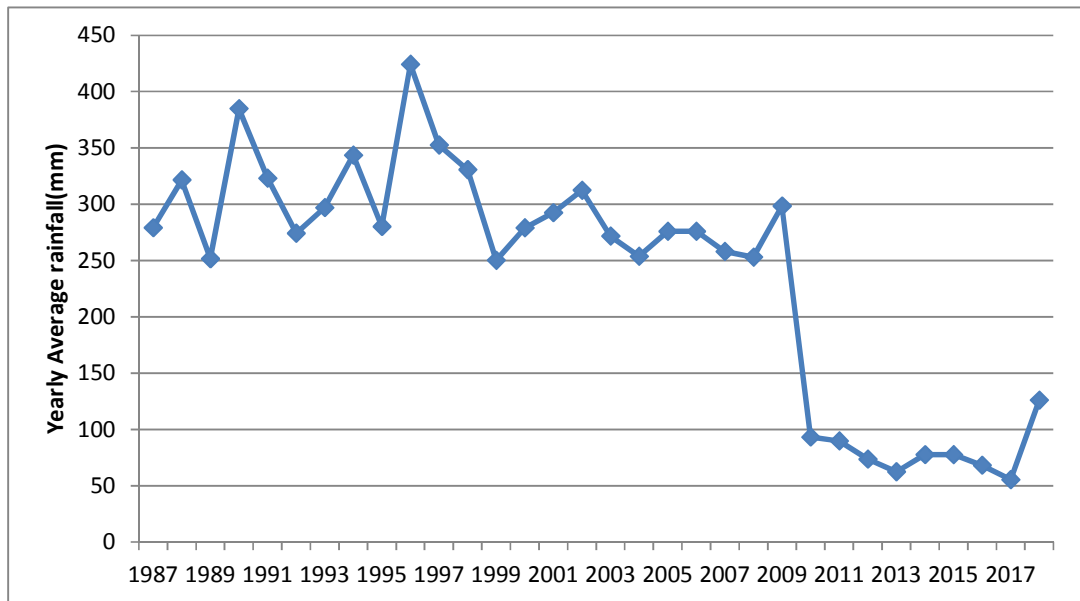*Source: Mbita ICIPE Meteorological Station*

Fig. 4. Average annual rainfall trends for Mbita: 1987-2017
Source: Mbita ICIPE Meteorological Station

Table 1. Analysis of rainfall data from 1987 to 2017

Rainfall	Monthly	Year
Mean (mm)	215.5	237.7
Standard deviation (mm)	86.7	107.4
Trend (mm /year or month)	0.01	0.02
Total change calculated from the trend (mm/30 years)	**-13.92**	**-5.1**

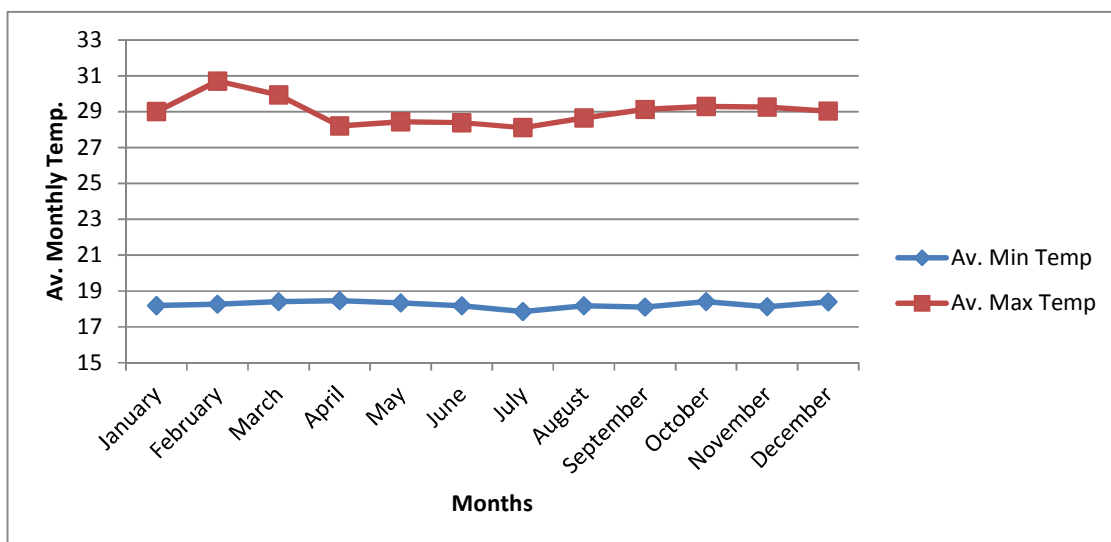*Source: Mbita ICIPE Meteorological station*

Fig. 5. Average monthly temperature trends data for Mbita: 1987-2017
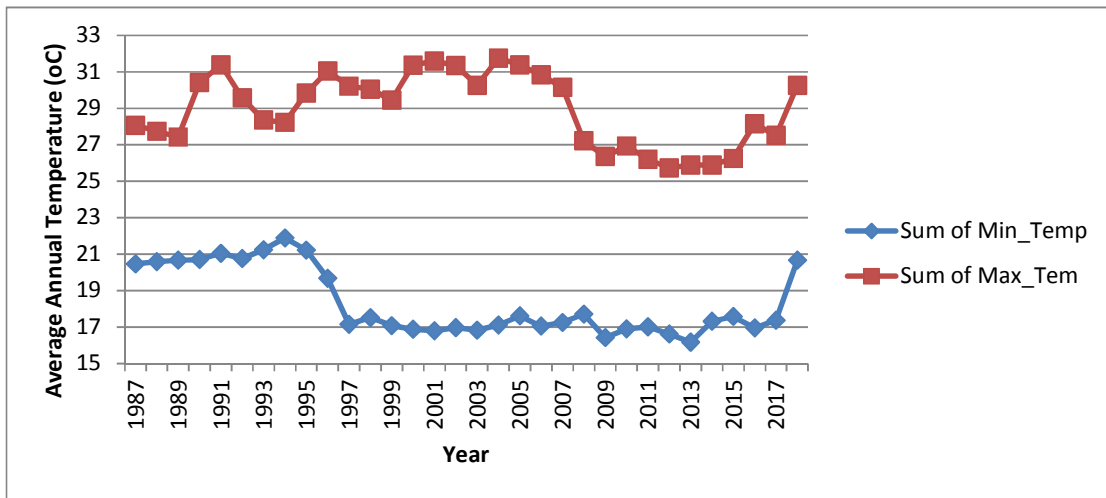*Source: Data from Mbita ICIPE Meteorological Station*

Fig. 6. Yearly trend of temperature data for Mbita: 1987-2017
Source: Data from Mbita ICIPE Meteorological Station

Table 2. Statistical temp analysis

Temperatures	Monthly		Yearly	
	Min	**Max**	**Min**	**Mix**
Mean (°C)	18.2	29.0	18.3	29.0
Standard deviation (°C)	0.35	1.4	1.8	2.0
Trend (°C/year or month)	0.01	0.04	0.974	0.09
Total Change calculated from the trend (°C/30 years)*	**-0.17**	**-0.68**	**0.89**	**0.60**

Source: Based on data from the Mbita ICIPE Meteorological station 1987-2017

temperatures as illustrated above while the minimum temperatures showed a gentler curve staying steady between 1987 till 1992 where there was a slight warming and a fall till 1997 where the temperatures were fairly consistent until 2012 where they have been rising consistently.

The temperature trends displayed in (Table 2) for Mbita between 1987 and 2018 shows a variable trend, for the monthly minimum temperatures had fallen by 0.17°C while the maximum monthly averages went down by 0.68°C. The minimum and maximum annual temperature showed a rise with the minimum annual temperatures having risen by around 0.89°C and the maximum annual temperatures by 0.60°C. The warming trend in the area was however non-significant and indicated climate variability. This finding is consistent with Kenya Meteorological Department (KMD) report that appeared in (GOK, 2010) stating that the trend of minimum temperature from 1960 has been increasing by 0.8 - 2.0°C, while the maximum temperature has been increasing by 0.1 - 0.7°C in the Lake Victoria region.

4.3.5 Causes of climate change

From the FGDs the fishers perceived climate change to be caused by a range of factors which were broadly categorized into three clusters: In agreement with scientific understanding; in contradiction and those who didn't know the cause. Most respondents were in the 1st cluster which included human activities, destruction of vegetation/trees, poor farming practices while category; 2nd cluster of responses believers of super natural forces/God.

4.3.6 Sources of information

Responding to sources of CC information in interactive sessions the respondents stated they mainly relied on their personal experience to monitor and forecast the local weather and climatic conditions as they believed this was the most precise and accurate means. The change indicators included animals (frog, ant, crow, cowbird, and fish); atmospheric and celestial and astrological bodies (the moon, sun, stars rainbow, clouds, and the wind, and lake conditions).

Table 3. Statistical significance of perception of the fishers to climate change

Perception	Agree		Don't Know		Disagree		p-value
	Male (Yes%)	Female (Yes%)	Male (Yes%)	Female (Yes%)	Male (Yes%)	Female (Yes%)	
Rise in annual temperature	70.56	65.71	29.44	30.48	0	3.81	0.021***
Lowering in annual temperature	6.6	11.43	22.34	21.9	71.07	66.67	0.345
Hotter during hot months	71.07	80.95	25.89	17.14	3.05	1.9	0.171
Hotter during cold months	62.44	50.48	32.49	36.19	5.08	13.33	0.020***
Rainfall comes earlier	5.13	0.95	10.26	9.52	84.62	89.52	0.176
Rainfall comes later	89.74	96.19	4.62	0.95	5.64	2.86	0.123
Total rain higher than usual	62.37	64.76	30.93	29.52	6.7	5.71	0.9
Rain more erratic	83.76	84.76	13.71	12.38	2.54	2.86	0.939

Statistically the fishers agreed to having seen a rise in the annual temperatures due to climate change with a significant p-value = 0.02. This is a clear indication that change in climate was causing rise in annual temperature according to the fishers. A similar trend was also seen on if climate change led to hotter weather during cold months which gave a significant p-value of 0.02 an indication that the fishers thought climate change had led to hotter weather during cold months. Although climate change had some effects on all the other variables such as; lowering of annual temperature, hot weather during hot months, earlier rainfall, and later rainfall, total rain that is higher than the usual one, and a more erratic rain, the effects were not statistically significant registering A p-value < 0.05

Other than their interpretation of natural phenomena the fishers also stated that they sourced and received most climate related information mainly from the radio, because of its easy access, as it is even on the phone an item just about anybody owns; they mainly tuned into (Ekialo Kiona Suba Youth Radio, Sunset FM, Ramogi FM; and Rusinga FM).

4.3.7 Relevance/use of information

Most of the fishers did not think that the information they received was beneficial as the broadcasts were in expert language was not relevant to their fishing activities. Asked what kind of information they would like to receive, the fishermen were interested in short-term forecast of wind direction and movement of water currents.

4.3.8 Perceptions of the future climate

Responding to the projected perception of CC, the older fishers were pessimistic because they held the view that CC is a natural phenomenon beyond human control and therefore they have to be accepted as normal for they believed strongly that there is very little people can do about it. Some women fishers also expressed a fatalistic view of the world coming to an end and extreme weather being one of its many progressive indications. The majority of fisher respondents were in consensus that the weather patterns will only continue to worsen.

4.4 Findings on Objective 2

Which sought to establish the adaptation strategies of the fisher community in Mbita. The study found completely gendered adaptive activities which were consistent with roles men and women played in fishing as part of their livelihoods.

4.4.1 Shifting fishing time

The majority 56% of the respondents 168 being males and 4 females had shifted their fishing times. During the rainy weather they went fishing early in order to reduce risks associated with afternoon storms.

4.4.2 Fishing for longer time periods of time

Just 46% of the respondents comprising of 139 males and 3 females stated that they fished for longer time going into deeper waters during dry seasons compared to earlier times when fishers were fewer. On using modified fishing nets 40% of the respondents said that they changed fishing nets and boats to catch any size and type of fish; changing of boats was necessitated to cope particularly with strong winds. Boat owners invested on bigger engines and more fuel to go further into the lake and enabled them better catches.

4.4.3 Marketing adaptation

The majority 28% of the respondents comprising of 46 males and 40 females reported selling fish to only big buyers in effort to sustain their market while 33% of the respondents composed of 34 males and 67 females processed fish before selling it to small buyers for a higher prices.

4.4.4 On use of savings and selling of assets to sustain their livelihoods

The majority 55% of the respondents reported they used their saving to sustain their household when fish catches dropped. While 34% of the respondents made of 78 males and 26 females resorted to selling their assets to sustain their livelihoods during the times of acute fish shortage. From FGDs across the beaches sampled, the female fishers reported that they obtained permission from men to sell/it the men who actually sold the property as *bonafide* owners of what families owned culturally.

4.4.5 Migratory fishing

Only 41% of the respondents comprising of 103 males and 21 females said that they had migration to places/beaches with more fish intermittently. From FGDs across beaches, the study found that males temporarily migrated to other beaches or even to other lakes to cope with climate variability which reduced fish catches; they also migrated to calmer and better fishing waters like Lake Turkana and Uganda waters. The few females who migrate between fishing sites did it to buy fish for resale and particularly when there was not enough fish at the beaches where they were and had to meet tender orders from their regular customers.

4.4.6 Other Adaptive Strategies

From FGDs the study found that most of the fishers had adopted multiple occupations/alternative livelihoods to deal with reduced fish catches and subsequent lower incomes. These included farming/livestock and

poultry rearing, small businesses like running bars/hotels/selling second hand clothes, betting/selling harvesting sand, firewood and seeking formal employment in hotels. Plates 1 - 4 show some activities the fishers engaged in inn response to the changes they have experienced.

Plate 1. Boda Boda riding

Plate 2. Sale of livestock

Plate 3. Firewood for fish processing fish

Plate 4. Sand harvesting

**Table 4. Determination of statistical significance of the Fishers communities coping/
adaptation strategies to CC in Mbita**

Climate change adaptation	Male (Yes%)	Female (Yes%)	p-value
Shifted fishing time	83.5	3.8	0.000***
Fish for longer time period	69.2	2.8	0.000***
Fish further away than before	67.7	3.8	0.000***
Changed fishing nets/boats	56.7	7.6	0.000***
Catch any fish species	45.8	2.9	0.000***
Sell to big buyers	22.9	38	0.676
Process and sell to small buyers	17	63.8	0.000***
Received help from family members	20.12	48.98	0.000***
Used savings to sustain household	44.2	74.3	0.074
Sold assets to sustain livelihood	45.3	35.2	0.000***
Migrated places to places	51.2	20	0.001***

As represented in the table the adaptive and coping strategies used by fishers were gendered and roles stereotyped on cultural approval of the local community. Shifting of fishing time was practiced by 83.5% of male respondents and only 3.8% female respondents with a statistical significance of p-value of 0.000; confirmed that only the males did the actual fishing the 3.8% females who were in the shifting fishing were boat owners and could influence decision of where to go fishing. Again fishing for a longer time as a coping/adaptation to CC strategy was adapted by 69.2% male respondents while only 2.8% female counterparts were into longer time fishing adaptation with a statistical significance of p-value of 0.000. On fishing further away than before was practiced by 67.7% of the male respondents while only 3.8% of their female counterparts who were boat owners practiced it giving a statistical significance of p-value of 0.000. On changing their fishing nets/boats; 56.7% male respondents practiced with only 7.6% of their female counterparts who hired male fishers had taken this up because most of the fishing equipment is owned by the male fishers with women owning more processing equipment, this was statistically significant with a p-value of 0.000. When asked if they had resorted into catching any fish species as a coping and adaptation strategy; 45.8% of the male fishers respondents agreed with this while only 2.9% of their female counterparts agreed with this, this was statistically significant with a p-value of 0.000.

Processing and selling to small buyers as a coping and adaptation strategy was practiced by 63.8% of the female respondents while only 17% males practiced this with a statistical significance of p-value of 0.000. Receiving support from family members as a coping/adaptation strategy

was reported by 20.12% of the male respondents 48.98% of their female counterparts explained that they survived from family members support with a statistical significance of p-value of 0.000; asset sale as CC adaptation strategy practiced by 45.3% male respondents while 35.2% of female headed households said in extreme situations they sold assets with a statistical significance of a p-value of 0.000 and migratory fishing was used by 51.2% of the male respondents and 20% female respondents with a statistical significance of p-value of 0.001. Selling of big fish to big buyers and using of savings to sustain households by the fishers as ways of coping and adaptation strategies were not statistically significant at p-values > 0.05.

5. CONCLUSION AND RECOMMENDA-TIONS

5.1 Conclusion

The fishers in Mbita Division were fully aware of weather and climate variability which they were already experiencing with negative impacts on their fish dependent livelihoods and erratic predictions and abrupt seasonal variability made impossible to predict seasonal changes. Whereas the Mbita fishers' community received scientific weather information from local radio stations that relied on meteorological forecasts, they considered it irrelevant and relied on their indigenous and personal interactive experiences with wind patterns and position of stars in the sky which supported traditional systems to monitor and forecast using flora and fauna changes.

The study found that adaptation/coping strategies and activities in Mbita were gendered and culturally stereotyped in fishing activities and responsibilities giving men more adaptive options

than women. It was found that fishers' households adapted during extremes through us of savings, sale of family assets or engagement in multiple occupations/alternative livelihoods eg running of bars/hotels/selling second hand clothes mainly by women and betting/selling harvesting sand, and harvesting /selling of firewood for men.

The fishers had limited applicable adaptive alternatives as shifting fishing sites and using twin engine boats would have been climate smart options of adaptive fishing but had cost implications the majority of fishers could not afford the county government must mainstream fisher livelihood as part of sustainable development agenda.

5.2 Recommendations

Mbita fishers community require a well institutionalized gender inclusive, trans-disciplinary multi-sectoral community based livelihood inclusive network to support the fishers and other local livelihoods through workshops and training on adaptive responses which are community owned in collaboration with local research organizations and universities.

On the whole the fishers for institutionalized CC adaptation pathways which will formulate and mainstream at all beaches sustainable fishing there is need to reduce fishing frequency and numbers of fishermen and boats sustainable livelihood activities in the entire County of Mbita.

CONSENT AND ETHICAL APPROVAL

As per international standard or university standard guideline participant consent and ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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