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ARTICLE

Gendered Perceptions of Climate Variability and Change among Local Communities Living around Queen Elizabeth National Park in Uganda

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ABSTRACT

Climate change affects both men and women which, in turn, shapes their varied and contrasting perceptions of climate variability and change. This paper examined the gendered perceptions of climate variability and change among local communities in Queen Elizabeth National Park in Uganda. The objectives are threefold: - identify climatic shocks faced by the local communities; examine the perceptions of men and women of climate variability and change; and to compare their perceptions with empirical meteorological data. This study employed both qualitative and quantitative methods, with data collected from 215 respondents using survey, interviews and focused group discussions. From the findings, indicators of climate variability and change included reduced flooding events, occurrence of human diseases, increasing crop pests and diseases, dry spells and intensity of rains. There was increasing significant temperatures while rainfall was declining. Both male and female significantly associated with increasing temperatures and reduced flooding events. While climatic shocks affected both males and females, the impact was more pronounced depending on distinct livelihood activities and roles and responsibilities undertaken. The study concluded that people's perceptions of climate change should be taken on by the government and integrated in the national climate programs that support people's livelihoods and survival mechanisms.

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1. Introduction

Scholarly debates and discourses on climate variability and change have increased in the recent time [1]. Climate variability and change is an environmental phenomenon that has attracted global concern and attention because of its wide ranging adverse effects on the livelihoods of local communities and economies of both developing and developed countries [2,3]. This appears to be the same situation in Uganda where climate variability and change has been identified as a growing impediment to development and resource productivity [4,5]. For instance, livestock death, occurrence of new livestock and crop diseases, reduction of biodiversity, increased deprivation of water and crop failure emanating from climate variability and change characterize many agro-pastoral communities in developing countries in sub-Saharan Africa including Uganda [6,7]. This state of vulnerability to climate shocks is worsened by heavy reliance on climate-dependent resources such as rain-fed agriculture and having low coping and adaptive capacities, coupled with multiple development challenges such as high population increase and poverty that require redress to protect the livelihoods of rural households [8,9]. Protected areas such as national parks and the local communities that live within and on the fringes of the parks are also affected by the changes in climate since they depend on the natural resources therein for their livelihoods [10]. At the same time, such resources, rooted in a highly dynamic ecosystem, are vulnerable to climate variability and change thus affecting the livelihoods of the local communities as well as the park's resources. Such constraints destabilize existing social relations between local communities and conservation goals of protected areas thereby creating contrasting perceptions of climate variability and change [10]. Whereas perceptions cannot be proved scientifically, they provide useful insights into the changes and the ensuing actions for dealing with climate variability and change [11].

In Uganda, protected areas including national parks continue to grapple with climate variability and change as it inhibits productivity and natural regeneration capacities of the resources therein [10,12]. It is evident that climate variability and change continues to disrupt the balance between people, wild life and the environment thereby rekindling conflicts between parks and people [12]. In turn, conservation and management of endangered species and habitats becomes a challenge. For instance, the melting glaciers on mountain Rwenzori in Rwenzori national park have reduced and the glaciers have melted causing floods and landslides in the surrounding areas leading to movement of birds, people and significant reductions in fragile ecosystems and species [13]. Such effects challenge and reverse the progress made towards achieving the sustainable development goals (SDGs) especially reducing poverty (SGD1) and gender inequalities (SDG 5) which affect all the other goals [14,15]. Therefore, to strengthen climate efforts, there is need to understand how men and women perceive climate variability and change.

While several studies indicate the importance of gender in climate studies [16-18], the main argument has been that gender and climate change issues are often treated in isolation [18-20], with limited attempts to bring these two interrelated issues together. A significant body of literature on gender and climate change indicates that both men and women perceive climate variability differently and this is informed by the specific gender roles and tasks to which they are assigned [21,22]. By the very fact that women engage in agriculture as a means to provide for their households, it denotes that any change in the climatic variables either directly or indirectly affects them and their households, and extent of their response is informed by the likely impacts [23,24]. Addressing climate change from a gender perspective ensures that the perceptions of both men and women are given equal weight in planning and decision-making [25]. But the existing gender studies have tended to focus on agrarian settings [10,11,26] and mountainous areas [13,27,28] excluding focus on local communities adjust to and living within the national parks. With a specific focus on communities in and adjacent to Queen Elizabeth national park in Kasese district, this paper first, identifies climatic shocks faced by the local communities. Second, examines the perceptions of men and women of climate variability and change. Third, compares their perception of climate variability and change with empirical meteorological data.

2. Study Area

This study was focused on local communities living in and around Queen Elizabeth National Park (QENP) in Kasese district in western region of Uganda. This park is located between 0^{o} 12'S and 0^{o} 26N and 29^{o} 42'E and 30^{o} 18'E (Figure 1). The human population density surrounding the park was estimated to be 107 persons per km^2 and district population of 702, 029 [29]. The major economic activities are subsistence farming (growing of crops and livestock farming), fish farming, salt mining around lake Katwe and Kasenyi, bee keeping or forestry (tree growing) [29]. The park's ecosystem comprises savanna and grassland, wetland, lake and riverine [4]. The region normally experiences a bi-modal rainfall regime with the first beginning in March and ending in late May (MAM) and the second season beginning in September and ending in November (SON) with mean annual rainfall of 1250 mm and mean annual temperature

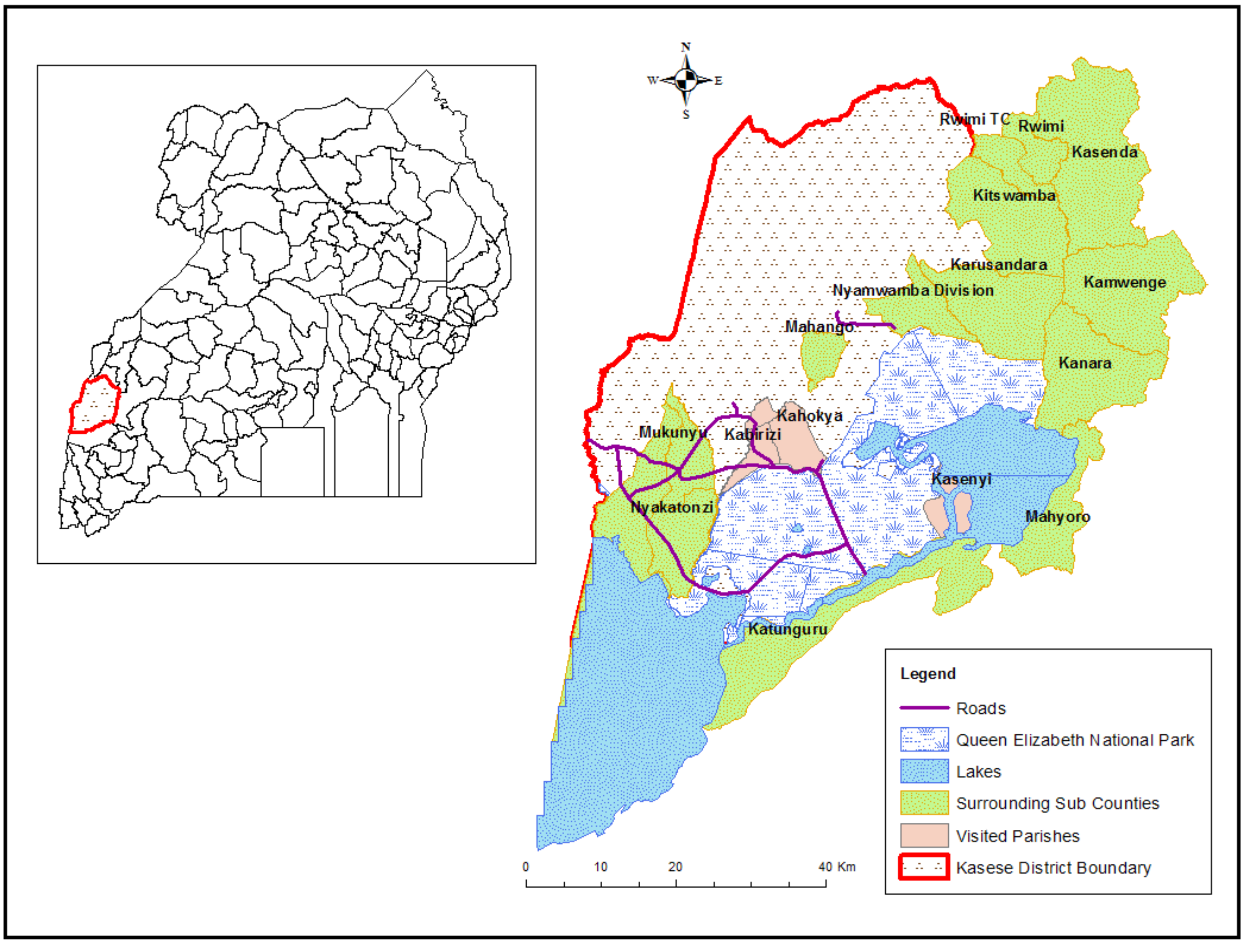

Figure 1. Map of Queen Elizabeth National Park showing the study sites.

of 22-25°C [30]. The rainfall varies due to its location along the equator and annual migration of the Inter tropical Convergence Zone [4,30].

3. Materials and Methods

3.1 Selection of Respondents-Household Surveys

The respondents were purposively selected from communities in and around Kasenyi, Katunguru, Lake Katwe and Kahokya parishes on assumption that all the households in each respective parish were involved in the same economic activities. However, the economic planner indicated that there are three dominant activities cross the study area as shown in Table 1 below. These are farming, salt mining and fishing. Since the number of participants in each of this activity was not well known, the sample size was derived by computing the minimum sample size required for accuracy in estimating proportions by considering the standard normal deviation set at 95 confidence level (1.96), percentage picking a choice or response (50%=0.5) and the confidence interval (0.05= ±5) [Mensah, 2014]. The formula is:

n = z 2 (p) (1-p)

c 2

Where:

z= standard normal deviation set at 95% confidence level

p=percentage picking a choice o response

c=confidence interval

Although a total of 250 respondents were purposively sampled from the four parishes with the guidance from the community officer. 215 copies of the questionnaires were filled and returned representing 86% response rate.

Table 1. Selected respondents

Parish	Village	Dominant economic activity	Sample
Kasenyi	Mwalo	Salt Mining	29
Lake Katwe	Katwe	Salt Mining	30
Katunguru	Kasubi	Fishing	51
Kahokya	Kikorongo	Farming	105
Total			**215**

3.2 Data Collection

Both primary and secondary sources of data were used in this study to understand gendered perceptions of climate variability and change and how the rainfall and temperature trends related with perceptions of men and women.

Primary data

A designed and pre-tested open semi-structured questionnaire supported by an interview guide was used to solicit information on climatic shocks faced by the local communities and perceptions of men and women regarding climate variability and change. The pretesting was meant to confirm the reliability and validity of the questionnaire before administering it to the communities. In addition, six focused group discussions (FGDs) comprising an average of 16 persons (an almost equal representation of male and female) of different age categories were conducted in the selected communities to validate the information from the questionnaire survey. The focused group respondents, who were selected with guidance of the local council chairpersons, dwelt on climatic shocks, perceptions of climate variability and the most affected social group by climatic changes. Seven key informant interviews were conducted with local village and parish leaders (3), Sub-county Community Development officer (1), District Environmental Officer (1), District Fisheries Officer (1) and officials from Katwe Information Centre (KIC). The information collected included climatic shocks faced by the local communities, observed changes in the community as well as cross validating the information provided by respondents during focus group discussions.

Secondary data

To understand both rainfall and temperature trends at seasonal and annual scales, historical daily rainfall and temperature data for the period 1981-2016 were obtained from the Uganda National Meteorology Authority (UNMA) and quality controlled using the recommended World Meteorological Organization (WMO) guidelines.

3.3 Data Analysis

Primary and Secondary data analysis

The questionnaire responses from the household survey were coded and results entered into Statistical Package for Social Scientists (SPSS) to create a data file that generated descriptive statistics in the form of graphs, tables and chi square test for significance which were presented for discussion. Qualitative data from focused group discussions and interviews responses were transcribed, sorted and synthesized through a qualitative coding process and clustered into themes and later presented as narratives. To perform seasonal and annual rainfall and temperature trends, the daily rainfall and temperature data were analyzed using simple linear regression analysis with graphical methods (i.e a line graph) to illustrate the temporal trends of the time series of rainfall and temperature accordingly. Regression was used method was used because only weather data at weather station level (point data) was available. Additionally, linear regression is a popular parametric method recommended for trend analysis of climatic variables [31]. Other formats such as gridded data for the study area were not available where other methods such as spatial maps would have been used. This study considers the simple linear model equation below:

$$\hat{y}_i = a + bx_i$$

Where $i = 1, 2, \Lambda\ , n$

x is a known with precision independent variable, b is the slope of the line and a is the y-intercept.

4. Results

4.1 Demographic Characteristics of the Respondents

Table 2 shows the demographic characteristics of the 215 households interviewed. Of the respondents, 61% were males and 39% were females. Majority of respondents are engaged in farming (49%) (Crop production & livestock rearing), salt mining (27%) and fishing (24%). This finding agrees to the traditional nature of livelihoods in rural areas. Traditionally, rural livelihoods are based on crop production and rearing of livestock as the dominant sources of livelihoods though supported by other economic activities [29]. About 90% of the respondents were below 60 years which were within the productive employment age of active service while those above 60 years were meant to be retired from active labour. From the survey, 68% were married compared to the 17% that were single, while 6% widowed and 9% were divorced. Nearly half of the respondents (53%) had primary education, who are expected to understand the study problem while only 15% had tertiary education though the levels of education were unevenly distributed. Various reasons can be used to explain the variations in education attainment. However, poverty which leads to early marriages and its resultant effects was cited by the respondents in the focused group discussions as the greatest causal factor. The average household size was 6 persons while the majority of households (51%) had 1 to 5 persons. The findings suggest that there are still some larger households in the rural area. The reason behind this is that house size has a significant influence on household adaptation to climate change as proved by several researches [32,33].

Table 2. Demographic Characteristics of respondents

Parameter	Category	% response
Sex	Male	61
	Female	39
Age	18-35	39
	36-59	51
	60 years and above	10
Marital status	Married	68
	Single	17
	Divorced/separated	9
	Widowed	6
Education level	Non-formal	12
	Primary	53
	Secondary	20
	Tertiary and above	15
Household size	1-5 people	54
	6-10 people	33
	More than 11	13
Livelihood Activity	Farming	49
	Salt mining	27
	Fishing	24

4.2 Empirical Evidence on the Basis of Meteorological Data

Rainfall and temperature data were analysis to determine the trends in the values at both seasonal and annual scales. This was meant to compare whether the empirical data capture the trends as reported by the community members from the household survey and focus group discussions.

4.2.1 Rainfall Trends

Results for March April May (MAM) rainfall season indicated noticeable periodic variations in the rainfall amounts with a positive trend (gradient=0.632) though the increase in MAM rainfall was not significant since R^2 was very low (0.64%). On the other hand, September October November (SON) rainfall season results depicted more increase in rainfall amount compared to the MAM season with a positive trend (gradient=1.2) and R^2 (3.34%) though not statistically significant. On an annual basis, it is observed that there was an increase in rainfall amount from 1981 to 2016 with (gradient=2.20) though the increase was not significant given R^2 (2.8%) was low (Figure 2). This implies that the increment in amount of rainfall received is relatively small to create an impact.

4.2.2 Temperature Trends

Overall, there was a significant increase in the annual temperature trends (Maximum, Mean and Minimum temperatures) (Figure 3a-3c) in the study area for the period 1981-2016 more especially with the minimum temperatures. This means that the warm climate is likely to have significant effect on occurrence of climate extreme events such as drought.

4.3 Climatic Shocks Faced by the Local Communities

In this study, changes in biophysical environment were considered shocks since they affected agriculture, salt mining and fishing. Although there are seven variables of weather (temperature, precipitation, cloudy (type and cover), wind (speed and direction), humidity and air pressure, Government agencies such as Uganda National Meteorological Authority (UNMA) emphasizes rainfall and temperature and their manifestation as the most important variables in the field of climate sciences to help trace extent and magnitude of climate variability and change [34]. Therefore, the study concentrated on rainfall and temperature because the study area is highly dependent on rain-fed agriculture and so these variables helped explain various socioeconomic problems. Thus climatic shocks faced by the community are presented in Figure 4.

Across the livelihood activities, the study findings revealed that reduced flooding events, occurrence of human diseases, increasing crop pests and diseases, increasing dry spells, and increasing intensity of rains were the most noteworthy climatic shocks across the livelihood activities. However, reduced flooding events (35%) and occurrence of human diseases (28%) was outstanding among salt miners while increasing crop pests and diseases (32%) and increasing dry spells (26%) was outstanding among the farmers. Likewise, increasing intensity of rains was outstanding among fisher folks. The above responses were confirmed by the focused group discussions and key informant interviews conducted. For instance, salt miners observed that 1986 and 1994 were the most noted years where their salt pans were flooded leading to major reduction in salt extraction and

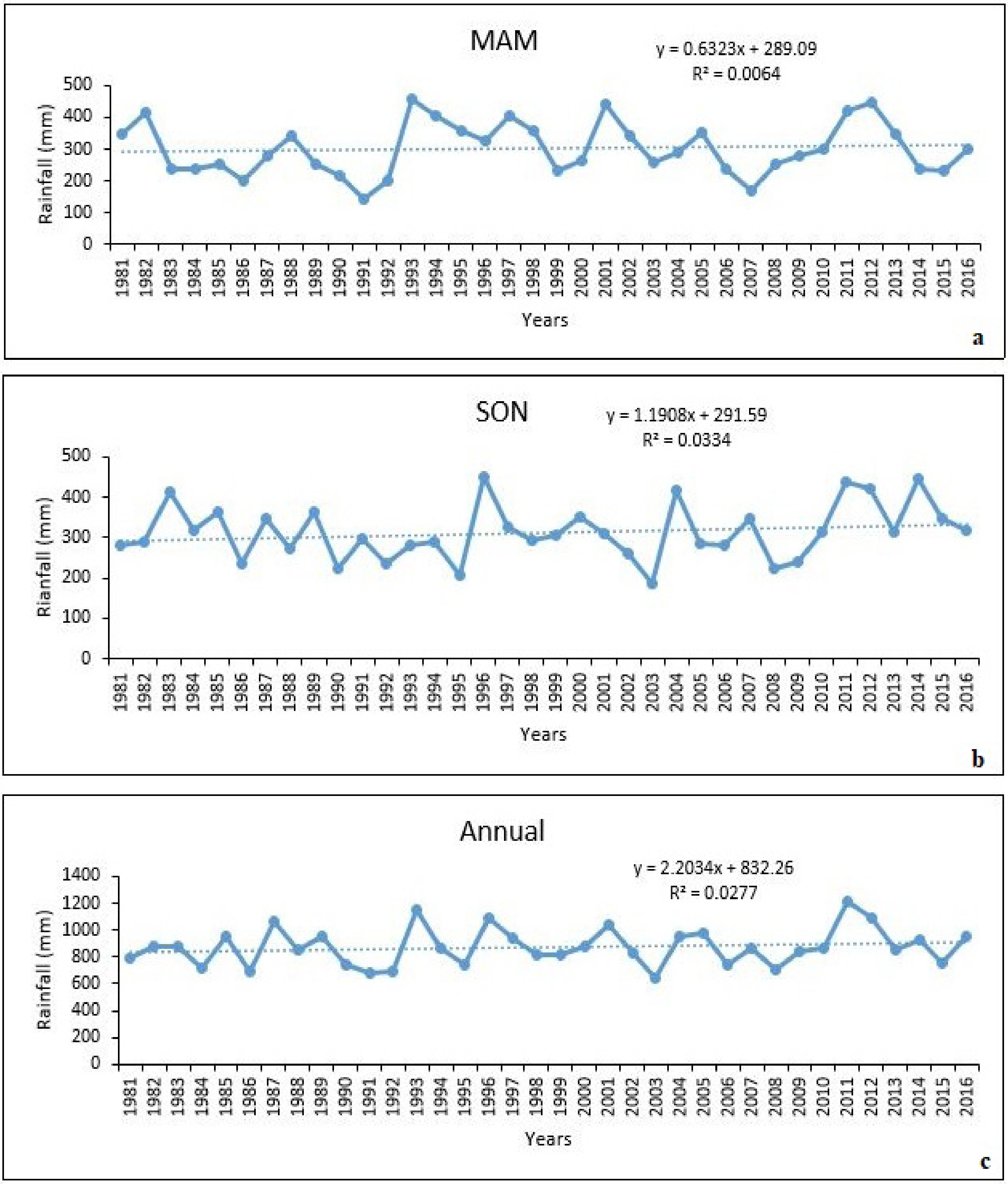

Figure 2. a. MAM seasonal rainfall for Kasese from 1981-2016. b. SON seasonal rainfall for Kasese from 1981-2016. c. Annual rainfall for Kasese for the period 1981-2016.

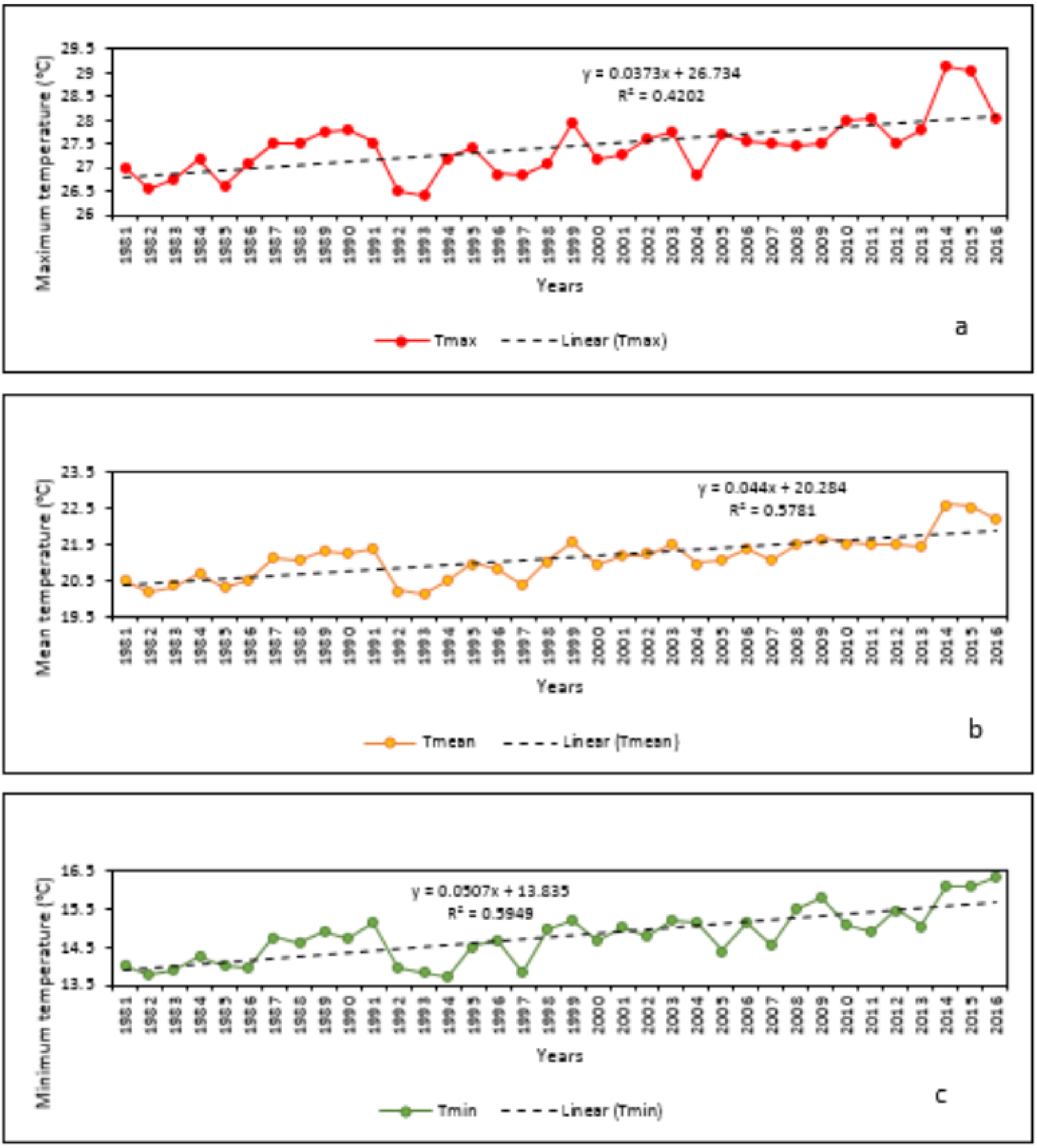

Figure 3. Temperature trends for Kasese district from 1981-2016

production. Furthermore, outbreak of water borne diseases like cholera and bilharzia were common as well severe skin irritations due to constant contact with water. On the other hand, farmers revealed that it was common for crops to be scorched due to the increasing dry spells and as a results crop yields harvested were reduced. The fisher folks complained of increasing intensity of rains.

4.4 Gendered Perceptions and Knowledge of Climate Variability and Change

4.4.1 Gendered Understanding of Climate Variability and Change

Climate change is a complex phenomenon that is perceived differently by males and females based on

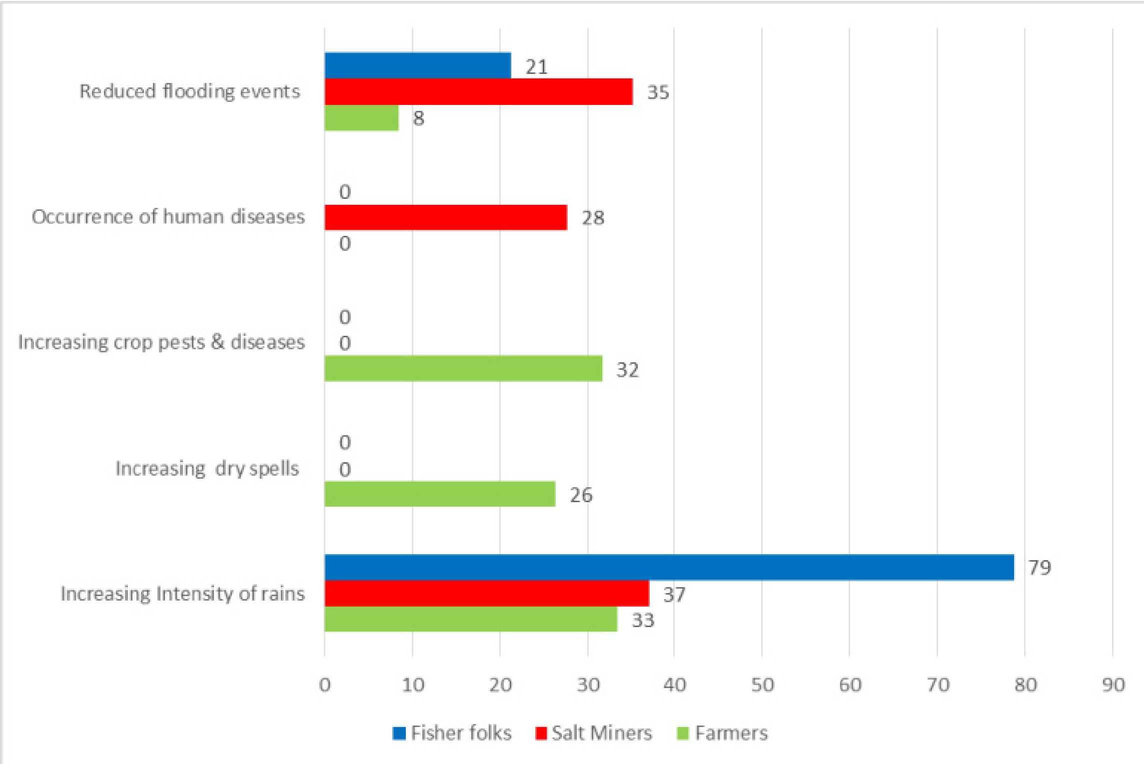

Figure 4. Community Climatic Shocks

associated events, roles and responsibilities. Respondents were asked about their perceptions of climatic shocks over the last 10 years and how these had evolved over time. Both male and female respondents mainly perceived climate change in terms of increasing dry spells, increasing temperatures, increasing intensity of rains and reduced flooding events (Table 3). However, a significant association was noted by both males and females with increasing temperature which affected the growth of crops and reduced flooding events.

4.4.2 Most Affected Social Group across the Livelihood Activities.

From the survey results obtained, the shocks affected both males and females (Figure 5). The males were more affected by increasing dry spells (30%) and increasing intensity of rains (30%) while females were more affected by increasing temperatures (21%). On the other hand, however, group discussions revealed that females were more affected by climatic changes compared to males. For instance, discussions among the fisher folks in Katunguru

Table 3. Gendered perceptions of climatic changes based on livelihood activity (% response)

Climate change indicator	Sex of respondent	Farming	Salt mining	Fishing	Statistics		
					X_2	df	P-Value
Increasing dry spells	Male	28	31	33	2.764	2	0.251
	Female	27	30	33			
Increasing temperature	Male	28	7	2	95.133	2	0.000****
	Female	27	11	0	55.711	2	0.000****
Increasing intensity of rains	Male	28	32	32	0.771	2	0.680
	Female	27	30	33			
Reduced flooding events	Male	15	31	32	38.776	2	0.000****
	Female	18	29	33	11.283	2	0.004****

**** $P < 0.005$

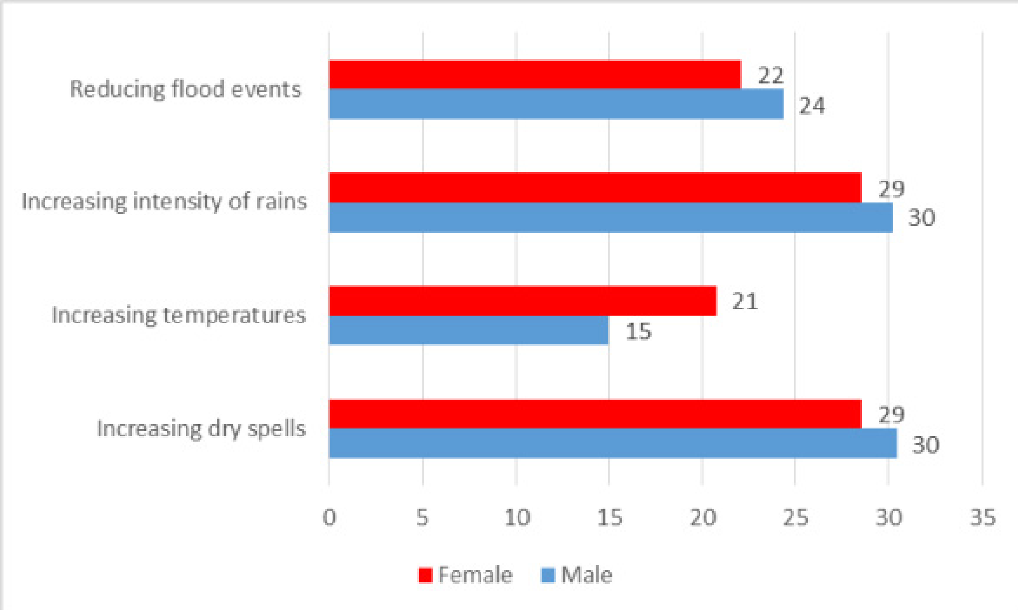

Figure 5. Most affected social group

parish revealed that women were the most affected by climate variability and change due to land use restrictions accorded to national parks and limited livelihood alternatives. While male fisher folks temporarily shifted to salt mining or informal activities including local drivers for tourists, mechanics, and motorcycle taxis. Similarly, farmers agreed that women were most affected because they depended on rain fed agriculture and so any variations in climate resulted into poor crop production.

4.4.3 Gendered perception on causes of climate variability/change.

Climate variability and change causes were categorized into 5 options; human causes, natural causes, human and natural causes, climate change does not occur and no sufficient evidence to support climate change claim, and assigned 5-likert scale where; Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree responses signified the level of agreement of their perception would fetch and thereafter, mean score (WMS) was computed and ranked accordingly (Table 4). The results showed that both male and female perceived climate change to be caused by both human and natural factors (70.7%) because they scored the highest weighted mean score of 4.66 and ranked 1st. This suggested that climate change was understood by respondents as human own doing and some part of natural occurrence. However, with the indication of more human activities, respondents perceived more of human activities (74.9%) to be causing climate change than natural causes (66.0%). Secondly, climate change was perceived to be caused by natural causes with weighted mean score of 4.52 implying that, second to human activities, the ecological environment was equally depreciating leading to increase in climatic

Table 4. Gendered perception on causes of climate variability/change

	Level of agreement (Frequency (%))							
Attitudinal Statement	SA	A	U	D	SD	Mean	Rank	Decision
Climate Change is caused by human activities	161(74.9)	38(17.7)	14(6.5)	0(0)	2(1)	4.65	2nd	Agree
Climate Change is caused by natural factors	142(66.0)	43(20.0)	29(13.5)	1(0.5)	0(0)	4.52	3rd	Agree
Climate change is caused by both human and natural factors	152(70.7)	54(25.1)	8(3.7)	1(0.5)	0(0)	4.66	1st	Agree
Climate change is not occurring	2(0.9)	0(0)	7(3.3)	180(83.7)	26(12.1)	1.94	4th	Disagree
There is no sufficient evidence to support climate change claim	1.0(0)	10(0)	7(3.3)	3(1.4)	205(95.3)	1.08	5th	Disagree

change conditions with 66.0% of the respondents strongly agreeing it was equally causing climate change. The fourth and fifth perceptions were disregarded by the respondents because majority disagreed (83.71%) and strongly disagreed (95.3%) respectively with the statements that climate change was not occurring and there was no sufficient evidence to back that claim.

4.4.4 Gendered Perceptions of Seasonal Changes.

Rainfall and temperature were noted by both male and female to have changed across the three livelihood activities. For that, with improvements from the author, seasonal calendars were derived from the focused group discussions (FDGs) in respect of each livelihood activity (Table 5). According to the salt miners, March-April and September -October were the wet months, therefore, carried out fishing and business during the rainy seasons as an alternate livelihood. The rest of the months (May, June, July, August, November, December, January and February) were considered dry so extracted salt.

Similarly, the fisher folks shared the same sentiments of seasonal variability and emphasized March-April as the wet months. However, fishing and business was carried out throughout the year since fishing was less affected by the seasonal variations. Both male and female farmers noted two farming seasons (March and August-September) with unpredictable and reduced rainfall which resulted into increased dry seasons. Additionally, the farmers agreed that March was the new planting season for food crops.

Table 5. Seasonal Calendar

Livelihoods	Seasonal activities	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Salt Miners	Extraction of salt, Fishing and Business			 						 			
Fisher folks	Fishing Business												
	Land preparation (Digging)												
	Planting												
	Weeding												
Farmers	Harvesting												
	Processing (Drying)												
	Storage												
	Marketing												

5. Discussion

Overall, the findings of the household survey, focus group discussions as well as rainfall and temperature data showed observable climatic changes in the study area. Other studies undertaken in Uganda similarly revealed that the country was experiencing climate variability and change which has marked effects on food availability and on the income of agriculture-dependent households [35-39]. Empirical evidence from secondary data (1981-2016) showed that although increasing rainfall trends were observed for the March to May (MAM) and September to November (SON) seasons and annual rainfall, the trends were insignificant. Likewise, findings by Mwaura & Okoboi [37] and Kisauzi *et al.,* [40] indicated that a decline in rainfall received in Uganda and the trend was not statistically significant. Furthermore, monthly values of rainfall indicated a shift in the rainy seasons which Cook, & Vizy [5] attributed to the solar heating maxima in the equinox season. The decrease in rainfall especially during the MAM results in significantly drier conditions which are not optimal for crop production [41].

On average, temperatures have been increasing significantly especially minimum temperatures. According to Nimusiima [8], increase in temperatures lead to increased evapotranspiration and hence water stress for crops and animals while studies by Kaggwa [42] indicated that increased temperatures in Kasese district were responsible for increased floods where the ice cap on mountain Rwenzori had melted. Other studies that perceived temperatures to be increasing included Bomuhangi [43] in the Mt. Elgon Eastern Uganda and Nsubugua & Rautenbach [44] for the whole of Uganda.

More so, respondents identified reduced flooding events, occurrence of human diseases, increasing crop pests and diseases, increasing dry spells and increasing intensity of rains as major climatic shocks faced in the area. These are in agreement with other study findings reported in the Benguela marine areas [45]; Central Africa [46]; rural Bangladesh [47]; Western Uganda [48], areas adjacent to Kidepo Valley and Mt. Elgon National Park, across agro-ecological zones [9] as well as the cattle corridor [8] and Teso sub region [40]. With regards to understanding climate variability and change, both male and female respondents perceived climate change in terms of reduced flooding events, occurrence of human diseases, increasing crop pests and diseases, increasing dry spells and increasing intensity of rains (Table 3). However, a significant association was noted by both males and females with increasing temperature which affected the growth of crops and reduced flooding events. This can be justified by the direct negative effect increasing temperatures have on agricultural productivity and fish availability. These finding were similar to studies by [27,41,49,50]. Although studies by Merino [51] and Narloch [52] argue that projected fish demands can be achieved despite the changing climate, Timmers [53] indicated that fish were also vulnerable to climate change. In contrast, salt formation thrives better with higher temperatures intercepted with a few rains. A study conducted by Kasedde [54] revealed that increased pond solution layer temperature increased the evaporation flux hence leading to increased salt production rate.

Results also indicated that climatic shocks affected both male and female across the livelihood activities. However, males were more affected by increasing dry spells and increasing intensity of rains while females were most affected by increasing temperatures. Studies by Ngigi *et al.,* [55] showed that men were affected by increasing intensities of rains while Owusu, *et al.,* [56]; Twyman *et al.,* [57] revealed women to be affected by heat waves caused by high temperatures. The difference in perceptions could be due to the distinct livelihood activities, roles and responsibilities that are undertaken by men and women in society [27,55,58]. For instance, group discussions revealed that women were into climate sensitive activities such as agriculture and salt mining and had limited livelihood alternatives [59-62]. As such any slight variations in climatic parameters affected their earnings and the impact trickled down at household level. This has been supported by studies from [63-65].

Generally, human and natural factors were considered as major causes of climate variability and change. However, human activities were perceived to be the major causes of changes in climatic conditions. Kisauzi's study [40] in Teso sub region Eastern Uganda, reported human activities such as tree cutting/destruction of vegetation as a major cause of climate variability and change. Gendered perceptions on understanding of climate change was linked to changes in rainfall and temperature. Both farmers and fish folks perceived the seasons to have changed. In light of the climatic changes, March had become the new planting season for food crops while August-February for cash crops such as cotton among the farmers. This justified the change in planting season (early planting) as a coping strategy to climate change. On the other hand, fisher folks pointed out March as a dry month. Using the MAM seasonal rainfall outlook, onset was expected around Mid-April till late May to early June [66]. More so, the same report indicated that Kasese district has experienced isolated light rains since 2014 with April as the peak of steady rains [66]. The reason for the contradictions would be based on temporary shifts in livelihood activities which were carried out in different seasons.

6. Conclusions

The study concluded that climatic changes were observed in the study area. The increment in rainfall received has no impact while the significant increase in temperatures was likely to have significant effect on occurrence of climate extreme events such as increasing dry spells. The most notable indicators of climate variability and change included reduced flooding events, occurrence of human diseases, increasing crop pests and diseases, increasing dry spells and increasing intensity of rains. Both male and female significantly associated with increasing temperatures and reduced flooding events. While climatic shocks affected both males and females, the impact was more pronounced depending on distinct livelihood activities and roles and responsibilities undertaken. Both male and female agreed that climate change was majorly caused by human activities and natural occurrence. Overall, people's perceptions of climate change should not be disregarded but taken on by the government and integrated in the national climate programs that support people's livelihoods and survival mechanisms.

Conflict of Interest

The authors have not declared any conflict of interest.

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