Gendered impact of climate change among paddy farmers of Kahama District, Shinyanga Region-Tanzania

ABSTRACT

The study presents the findings on the research which examined gendered impacts of climate change among the paddy farmers of Kahama District, Shinyanga Region. Specifically, the study assessed gendered desegregated effects of climate change among the paddy farmers and the implications on the effects of climate change among women farmers of Kahama District. The study adopted a cross sectional research design on which 312 randomly selected farm households were interviewed. The study employed a triangulation approach whereby primary data were collected through household surveys, field observation and key informants' interviews. The findings revealed that women and men farmers disproportionally affected by climate change. These effects include prevalence pests and diseases over a period of 30 years and the general decrease in crop yields to due to the changes in temperature and rainfall patterns. These effects pose negative implications in increasing women's workload and time burden, health and safety risks, and livelihood and food security respectively. The study concluded that women bear a disproportionate burden of the challenges of climate change due to existing social and economic inequalities. This negatively subject women farmers into health, livelihoods and overall additional household burden of the households' activities. The study recommends to the Government to enforce gender-sensitive policies and interventions. Furthermore, it is recommended to the Government to ensure that effective strategies prioritize gender equity and inclusivity so as to build a more adaptive farming community.

Keywords: *gendered, climate change, paddy farmers, Kahama District*

1 INTRODUCTION

Climate change is recognized as one of the most pressing challenges of the 21st century, with profound implications for agricultural systems worldwide. The impacts are particularly more serious in sub-Saharan where agriculture remains a cornerstone of many economies. For instance, assessment by Fischer *et al*. (2005) showed 10% decrease in food production in several sub Saharan African countries due to climate change. In the similar, Adesete*et al*. (2023) indicated that climate change negatively affected food security in Sub-Saharan Africa (SSA).The impacts of climate change are particularly pronounced, the areas which more pronounced being food security, livelihoods and socio-economic stability.

In Tanzania, climate change has negatively affected agricultural production and productivity. The impact of climate change in the agricultural sector in Tanzania are evident across different settings such as semi-arid areas, rural areas and peri-urban settings (Mlozi*et al*., 2013; Kihupi*et al*., 2016; Lunyelele*et al*., 2018; Zellah *et al*., 2023).

Kahama District, which is located in northwestern Tanzania, is predominantly rural, with agriculture serving as the primary source of livelihood for the majority of its population. Paddy farming, in particular, plays a significant role in the district's economy, providing income and sustain the livelihoods of the households. Nonetheless, the District is increasingly experiencing the adverse effects of climate change,

including erratic rainfall patterns, prolonged droughts, and extreme weather events (Zellah *et al*., 2023). These events pose significant challenges in agricultural production and subsequently food security.

There is a growing recognition that these effects are not uniform and often exacerbate existing inequalities. As confirmed by Zinyengere*et al*., (2014) the impacts of climate change on crop yields vary across locations and crops. The inequalities as well occur in terms of economic differences and gender as well. Women, who represent a significant proportion of agricultural producers in many developing countries including Tanzania, are disproportionately affected by climate change due to their roles and responsibilities within agricultural systems and the entire production cycle.

Several studies have highlighted the gendered nature of climate change impacts on agriculture, emphasizing that women farmers often face unique challenges and vulnerabilities compared to their male counterparts. For example, research by Doss *et al*. (2018) indicated that women farmers in sub-Saharan Africa are more likely to experience food insecurity and income losses as a result of climate variability, primarily due to limited access to resources, land tenure insecurity and socio-cultural barriers.

In the context of paddy farming in Kahama District, gender disparities in access to land, water, inputs, and extension services may exacerbate the impacts of climate change on female farmers. Moreover, women's responsibilities for household food security and caregiving trigger additional burden among women during times of environmental stress. This situation compromises their resilience to climate change.

Despite these challenges, gendered disaggregated impacts of climate change among the paddy farmers in the study area are not sufficiently investigated. Therefore, there is a paucity of gender-disaggregated data and research on the specific impacts of climate change on paddy farmers in Kahama District. Understanding the gendered dimensions of climate change impacts is essential for designing effective and equitable adaptation strategies that address the diverse needs and priorities of male and female farmers.

By conducting a gender-disaggregated assessment of climate change impacts on paddy farmers in Kahama District, this study aims to fill this gap in knowledge and contribute to the development of gender-responsive policies and interventions that enhance the resilience of agricultural communities and promote gender equality in the face of climate change.

While the effects of climate change on agriculture in Tanzania are well-documented(eg. Lema and Majule, 2009; Arndt *et al*., 2012; Kangalawe*et al*., 2017; Mafie, 2022; Gwambene*et al*., 2023), there is a gap in understanding how these impacts differ based on gender. This study has been set to investigate the gender-disaggregated impacts of climate change on paddy farmers in Kahama District, focusing on vulnerabilities, adaptive capacities, and coping strategies. Specifically, the study assessed the differential impacts of climate change on male and female paddy farmers in Kahama District, identified the gender-specific vulnerabilities of paddy farming communities to climate change and explored the adaptive capacities and coping strategies employed by male and female farmers in response to climate change.

This study contributes to the growing body of knowledge on gender and climate change adaptation in agriculture, particularly focusing on paddy farming communities in Kahama District. By addressing the gender dimension of climate change impacts, it informs evidence-based policies and interventions aimed at building the resilience of farming communities and promoting gender equality in agricultural development.

The study also contributes to address Sustainable Development Goal Number which emphasizes ensuring gender equality. Addressing gender impacts translates into gender empowerment issues.

Conceptual Framework on the Gendered Impacts of Climate Change on Paddy Farmers in Kahama District

The conceptual framework portrays the existing interplay across the study variables. It seeks to elucidate the gendered dimensions of climate change impacts on paddy farmers in Kahama District. The study postulates that climate change stressors like rising temperature and the general rainfall decrease prevail in Kahama District. As of vulnerability to the stressors observable vulnerabilities exist between females and their counterparts' male farmers.Nonetheless, women farmers appear to be more vulnerable to climate change stressors essentially being powered by the existing societal patriarchal system. The system negatively subject women into limited access to the control and ownership of the resources like land and agricultural inputs. In addition, the system undermines women's position in decision making and socio-economic roles and responsibilities. Subsequently, this situation catalyzes women farmers' vulnerability to climate change and negatively subjects them into health related impacts and households' food insecurity.

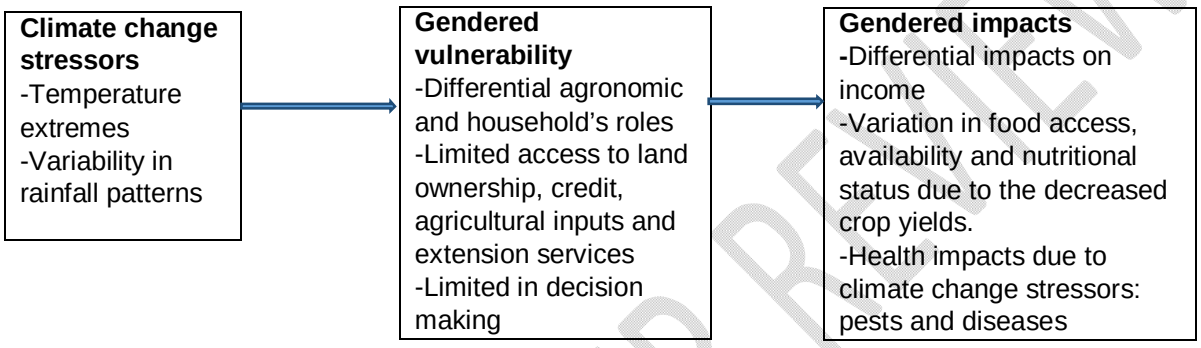

Figure 1. Conceptual Framework on Gendered Impacts of Climate Change among the Paddy Farmers in Kahama District, Shinyanga Region.

2. METHODOLOGY

2.1 The Study Area

The study was conducted in Kahama District, which is located in Shinyanga Region. The district is among three administrative districts in Shinyanga region namely Kahama, Kishapu and Shinyanga. Kahama has three councils among six councils of Shinyanga region, namely Kahama Town Council, Ushetu District Council and Msalala District Council. The district has total surface area of 9463 square kilometres which is distributed in five division consists of 58 wards, and 246 villages and 35 streets (Shinyanga Regional Commissioner's Office, 2019). Kahama District lies between Latitudes 30 15// and 4030// South of the Equator and between Longitudes 310 30// and 440 15// East of the Greenwich Meridian and South of Lake Victoria. The total population for the Municipality according to 2022 National Population and Housing Census was 453,654 (URT, 2022).

The district has been designated as a hub by Africa Rice centre for the promotion of paddy production in the Western part of the country. It's among the three districts chosen and operates as a hub in the country, others were Kilombero and Kyela, with the sole aim of promoting best and efficient practices in paddy production and marketing. Kahama District is known for production of paddy varieties like Kalamata, Mpyakambili, Mabeyenge, Bisholi and Kahogo but in the market all of these rice varieties have been grouped as Shinyanga rice. The area was chosen mainly because it lies in one of the key ecologies for paddy production and semiarid which the impacts of climate change in terms of droughts are well evidenced.

2.2 Sample and Sampling Procedures

Selection of the study area was guided by the available information which indicates Kahama District as a hub in paddy farming in the Lake Zone. Besides the aforementioned importance, the incidence of climate

change has been observed in Kahama District. The next sampling stage involved selection of the five wards. These purposely selected from three councils (Kahama, Msalala, and Ushetu) forming Kahama District. The selected wards were Mondo, Kagongwa, Ntobo, Chela, and Nyamilingano. Two villages were purposely selected from each ward for a detailed study, namely, Mondo, Bumbiti, Kagongwa, Gembe, Ntobo A, Kalagwa, Chela, Chambaga, Nyamilingano, and Ididi respectively. The sampling frame of the study was the list of households in the study villages of which the sampling unit was the farming household. Household is defined as a group of people living together and choose the authority of one person as a household head. The sampling frame was useful in determination of sample size and selection of a representative sample. It was found that the selected villages had a total of 8,832 households. Judgmental sampling technique used to select 20 key informants procedure. Table 1 present distribution of sampling frame in study villages.

Table 1: Distribution of households in study villages

Council	Wards	Villages	Number of households
Kahama	Mondo	Mondo	770
		Bumbiti	608
	Kagongwa	Kagongwa	3,585
		Gembe	698
Msalala	Ntobo	Ntobo A	802
		Kalagwa	665
	Chela	Chela	638
		Chambaga	597
Ushetu	Nyamilingano	Nyamilingano	216
		Ididi	253
Total			**8,832**

Sample size was determined using the equation for determination of sample size for known population and proportion by (Kothari, 2004) which is postulated as:

$$n = \frac{z^2 \cdot p \cdot q \cdot N}{e^2 (N-1) + z^2 \cdot p \cdot q}$$

Where: n = Sample size

z = Standard variate at a given confidence level (which is 1.96 at 95% confidence level: basing on table of area under normal curve)

p = Sample Proportion

$q = 1 - p$

N = Size of population (Number of farmer households)

e = Precision (acceptable error)

Data for the calculation were:

$z = 1.96$

$p = 0.7$ (Population varies in terms of practicing paddy farming or otherwise)

$q = 0.3$

$N = 8,832$

$e = 5\%$ (0.05)

Inserting data into the equation:

$$n = \frac{(1.96)^2 (0.7) (0.3) (8832)}{(0.05)^2 (8832) + (1.96)^2 (0.7) (0.3)} = 311.32 \approx 312$$

Thus, 312 respondents were interviewed during structured interviews. Number of respondents from each village was determined through proportionate stratified sampling which allowed for sampling of the

proportional number of respondents from each village according to its population size. The following equation for proportionate sampling by Salland (2010) was used:

$$P_i = \frac{N_i}{N} n$$

Where, P_i = Proportional sample of each village

N_i = Number of household in each village

N = Total household forming the sampling frame

n = Sample size.

The computations and sample size for each study village depicted in Table 2.

Table 2: Proportional sample in study villages

Villages	Number of households	Sample size
Mondo	770	770/8832 x 312 = 27
Bumbiti	608	608/8832 x 312 = 21
Kagongwa	3,585	3585/8832 x 312 = 127
Gembe	698	698/8832 x 312 = 25
Ntobo A	802	802/8832 x 312 = 28
Kalagwa	665	665/8832 x 312 = 23
Chela	638	638/8832 x 312 = 23
Chambaga	597	597/8832 x 312 = 21
Nyamilingano	216	216/8832 x 312 = 8
Ididi	253	253/8832 x 312 = 9
Total	**8,832**	**312**

These sampled units in each villages were randomly selected using lottery system from the village households list.

2.3 Methods of Data Collection

The study utilised both primary and secondary quantitative and qualitative data. Primary data were collected using survey and participatory rural appraisal (PRA) methods on which household questionnaire survey, in-depth interviews, focus group discussion and direct field observation techniques were employed. Semi-structured questionnaire, checklist of questions, checklist of themes and checklist of things to observe were used as tools for data collection. Household questionnaire surveys and interviews were conducted among male and female paddy farmers in Kahama District to gather information on their experiences, perceptions, and practices related to climate change. In addition to those mentioned, documentary review was extensively done to establish the existing debate on the subject matter.

2.4 Data Analysis

Qualitative data were analysed contently and quantitative data were analysed statistically using Statistical Package for Social Sciences (SPSS) software. Selected socio-economic and demographic characteristics were analysed through descriptive statistics on which frequencies and scores were produced.Responses from the households' surveys on gendered disaggregated impacts of climate change were also subjected to descriptive statistics on which multiple responses were produced Qualitative data collected from the key informants were analysed qualitatively to enrich quantitative findings elicited through the households' surveys.

3.0 RESULTS AND DISCUSSION

3.1 Gendered Effects of Climate Change among Paddy Farmers of Kahama District

The study analysed gender-disaggregated data on the impacts of climate change among paddy farmers in Kahama District in order to establish the existing gender disparities in the episode. This is a way of promoting gender equity in climate adaptation and mitigation efforts so as to create more inclusive and effective strategies for building a resilient future. The findings as presented in Table 3 showed that in Kahama District, both male and female respondents identified drying leaves, pests, insects, and stunted growth as the prevalent crop pests over the past 30 years. These pests have significantly impacted paddy crops in the district. The causes of crop pest prevalence, as reported by both male and female respondents, are primarily attributed to drought, low rainfall, and high temperatures.

These climatic factors create favorable conditions for the proliferation and spread of pests, making the crops more vulnerable to infestation and damage. Insufficient water availability due to drought and low rainfall weakens the plants, making them more susceptible to pest attacks. The elevated temperature promotes pest reproduction and quickens their life cycles, which increases the prevalence of pests. It is remarkable that respondents from both sexes reported an increase in crop pest occurrence. This finding is consistent with how climate change is affecting agricultural systems, where altered weather patterns and higher temperatures make it easier for insect populations to proliferate. The Kahama District's paddy farmers face a serious problem as a result of the reported rise in pest frequency, endangering crop output and food security. The results of this study highlight the pressing need for adaptable strategies to deal with the growing issue of crop pests in Kahama District. It emphasizes the significance of including pest control techniques and climate-smart agricultural practices in order to increase resilience in the face of changing climatic circumstances.

Both male and female respondents reported a considerable decline in paddy yields per acre (kg) during pest occurrences compared to before pests' incidence in the Kahama District survey results. Prior to the occurrence of pests, paddy yields, according to the majority of respondents (59.9%), ranged from 1000 to 2000 kg per acre. However, the majority of responders (92%) stated that paddy yields were less than 1000 kg per acre during pest outbreaks. These results show how pests negatively affect paddy output in Kahama District. Pest infestations cause crops to grow more slowly, have worse health, and produce less. Pests can harm the paddy plants' leaves, stems, and fruits, resulting in decreased yield and financial losses for farmers. The considerable drop in paddy yields during insect incidents highlights the district's urgent need for efficient pest management techniques. Implementing integrated pest management (IPM) strategies that mix cultural, biological, and chemical treatments is essential since pests continue to pose a danger to agricultural productivity. IPM strategies can aid farmers in reducing pests' effects on crop output while using less toxic pesticides. Farmers in Kahama District can lessen pests' effects on paddy yields, increase productivity, and safeguard their livelihoods by employing sustainable pest control strategies and prompt treatments. In order to overcome the difficulties caused by pests in paddy production, it will be essential to invest in farmer education, extension services, and research on local context-specific pest management measures with gender inclusion.

Additionally, the majority of male and female respondents to the Kahama District study (85.6%) recognized drying leaves as the most common paddy illness over the past 30 years. The region's crop health and productivity are greatly impacted by this paddy disease. In view of the findings, both male and female respondents blamed the drought, little rainfall, and high temperatures for the incidence of paddy diseases. The paddy plants are more vulnerable to infections due to these climatic variables, which foster the growth and spread of diseases. The plants' immune system is weakened by the lack of water due to drought and poor rainfall, which makes them more susceptible to disease. The incidence of paddy illnesses is further exacerbated by high temperatures, which promote the growth and reproduction of pathogens. According to the majority of male and female respondents to the poll (87.2%), paddy infections are becoming more common. This tendency is consistent with the effects of climate change,

which can increase the frequency and severity of plant diseases by altering weather patterns and temperatures. Farmers in the Kahama District have a serious issue as a result of the rising frequency of paddy diseases, which diminish yields, cause financial losses, and jeopardize food security.

Moreover, based on survey results in the Kahama District (Table 3), both male and female respondents claimed that the yield of paddy per acre (kg) was much lower when diseases were prevalent than when there were no disease incidences. Paddy yields without disease occurrences, according to the majority of responders (61.2%), ranged from 1000 to 2000 kg per acre. However, the majority of responders (92.3%) stated that paddy yields were less than 1000 kg per acre when disease incidences occurred. These results demonstrate the disease's significant impact on paddy productivity in Kahama District. Crop growth and output are hampered when diseases attack them. Diseases can result in stunted growth, diminished tillering, and poor grain development, lowering yields and costing farmers' money.

The considerable drop in paddy yields during disease outbreaks highlights the district's need for efficient disease management techniques. To reduce the impact of illnesses on agricultural output, it is essential to implement effective disease prevention and control strategies. This includes applying appropriate cultural practices, such as crop rotation and sanitation, adopting disease-resistant paddy varieties, and using integrated disease management systems, which incorporate diverse control strategies. Farmers in Kahama District can lessen the effects of illnesses, increase paddy yields, and assure agricultural sustainability by prioritizing disease management and enacting proactive measures. Access to training programs and extension services that inform farmers on disease recognition, prevention, and control strategies is crucial. Farmers can efficiently manage illnesses and secure their livelihoods in paddy cultivation by equipping them with information and resources.

Table 3: Gendered impact of climate change among paddy farmers

	Sex of the respondent		
Information	**Male**	**Female**	**Total**
Crop pest prevalence for past 30 years*:	58(18.6)	23(7.4)	81(26)

	Insects			
	Pests	68(21.8)	8(2.6)	76(24.4)
	Fungi	1(0.3)	1(0.3)	2(0.6)
	Stunted growth	46(14.7)	1(0.3)	47(15.1)
	Drying leaves	80(25.6)	26(8.3)	106(34)
Causes of crop pest prevalence*:				
	High rainfall	8(2.6)	0(0)	8(2.6)
	Low rainfall	253 (81.1)	58(18.6)	311(99.7)
	High temperature	249(79.8)	55(17.6)	304(97.4)
	Low temperature	0(0)	3(1)	3(1)
	Drought	253(81.1)	59(18.9)	312(100)
Trend of crop pests' prevalence:				
	Increasing	244(78.2)	57(18.3)	301(96.5)
	No change	9(2.9)	2(0.6)	11(3.5)
Paddy yields per acre(kg) before pests' incidence:				
	< 1000 kg	115(36.9)	5(1.6)	120(38.5)
	1000 – 2000 kg	133(42.6)	54(17.3)	187(59.9)
	>2000 kg	5(1.6)	0(0)	5(1.6)
Paddy yields per acre(kg) during pests' incidence:				
	< 1000 kg	229(73.4)	58(18.6)	287(92)
	1000 – 2000 kg	24(7.7)	1(0.3)	25(8)
Paddy diseases prevalence for past 30 years:				
	White dots	0(0)	1(0.3)	1(0.3)
	Drying leaves	212(67.9)	55(17.6)	267(85.6)
	Stunted growth	41(13.1)	2(0.6)	43(13.8)
	Yellow leaves	0(0)	1(0.3)	1(0.3)
Causes of paddy diseases prevalence*:				
	High rainfall	0(0)	1(0.3)	1(0.3)
	Low rainfall	246(78.8)	55(17.6)	301(96.5)
	High temperature	249(79.8)	54(17.3)	303(97.1)
	Low temperature	7(2.2)	3(1)	10(3.2)
	Drought	252(80.8)	56(17.9)	308(98.7)
Trend of paddy diseases prevalence:				
	Increasing	216(69.2)	56(17.9)	272(87.2)
	No change	33(10.6)	2(0.6)	35(11.2)
	Don't know	4(1.3)	1(0.3)	5(1.6)
Paddy yields per acre(kg) without diseases incidence:				
	< 1000 kg	111(35.6)	5(1.6)	116(37.2)
	1000 – 2000 kg	137(43.9)	54(17.3)	191(61.2)
	>2000 kg	5(1.6)	0(0)	5(1.6)
Paddy yields per acre(kg) with diseases incidence:				
	< 1000 kg	229(73.4)	59(18.9)	288(92.3)
	1000 – 2000 kg	24(7.7)	0(0)	24(7.7)

***Multiple responses**

3.2 Implications on Gendered Effects of Climate Change among the Paddy Farmers of Kahama District

3.2.1 Implication on increased women farmers' workload and time burden

More frequent and severe weather events like droughts and decreased amount of rainfall directly or indirectly disrupt farming activities and increase the workload for farmers. Women farmers, who constitute the key players inagronomic tasks such as planting, weeding, and harvesting are generally subjected to the additional burden in responding the challenges of climate change. This increase workload can lead to time constraints and fatigue, limiting women's ability to engage in income-generating activities outside of farming and pursue education or other opportunities.Other studies have established the link between challenges of climate change versus increased workload among women. For example, a study by Quisumbing *et al*. (2015) which was done in Bangladesh, Ghana and Nepal found that climate change consequences negatively subject women into additional responsibilities. In the similar vein, FAO (2014) highlighted that climate change effects intensified women's workload in different areas to include water and natural resource management, food production and caregiving activities. This can be more serious in Kahama District where the study was done given the dominance of the patriarchy system among the Lake Zone communities of Tanzania exacerbate women's burden and subject them into impoverishment.

3.2.2 Implication on health and safety risks

Climate change-related impacts which have been triggered by increased temperature like exposure to pesticides and paddy diseases prevalence, pose health and safety risks to paddy farmers. Women, who are often involved in activities such as farm preparations, transplanting seedling and applying agrochemicals, are exposed to health related risks due to their roles in farm labor. Moreover, women's reproductive health are likely being adversely affected by climate-related stressors, such as food insecurity and displacement, which can have intergenerational impacts on household well-being. This is supported with the other studies (eg.Ebi and Neira 2009; von Schirnding*et al*., 2011; Paudya*et al.,* 2019) which showed that the effects of climate change negatively affects women' health. These findings reinforces the importance of recognizing and addressing the gender-specific challenges of climate change in order to build the well-being and resilience of women and the rest of communities.

3.3.3 Implication on livelihoods and food insecurity

The negative effects on paddy production system is associated with crop failures and the prolonged reduced paddy yields. All these trigger loss of livelihoods among the farmers particularly women. Women who are disproportionately represented among the majority small-scale and subsistence paddy farmers, are particularly vulnerable to these impacts due to their limited access to alternative income sources and social protection mechanisms. The loss of paddy farming livelihoods can exacerbate food insecurity and malnutrition. Often women and children bearing the brunt of these consequences of households food insecurity. This can further trigger men displacement into other areas seeking for alternative livelihood options leaving behind women to manage households and farms. This is in conformity with a study by Deressa *et al*. (2009) who asserted that climate change exacerbates gendered vulnerabilities among the farming communities by affecting agricultural productivity and increasing food insecurity. In the similar vein, Paavola and Adger (2006) indicated that reduced crop yields due to climate change exacerbates gender inequalities with women adversely affected due to the inequalities. Although these studies were carried out in different context from the present study they all underscores that gender disegrageted findings are very key in addressing climate change.

4 CONCLUSIONS AND RECOMMENDATIONS

The findings highlight that women, as crucial actors in paddy farming, bear a disproportionate burden of climate-related challenges due to existing social and economic inequalities. These challenges include gendered effects in terms of increased crop pest and diseases and are caused by women's limited access to resources, land tenure insecurity and reduced decision-making power. This exacerbate women's susceptibility to climate-induced risks such as erratic rainfall patterns and water scarcity. Failure to recognize and address these gender disparities undermines the resilience and adaptive capacity of women farmers and hampers their overall sustainability of agricultural systems in Kahama District.

The conclusion on the gendered impacts of climate change among the paddy farmers of Kahama District underscores the urgent need among the Ministries responsible for agriculture and the Ministry responsible for Health for gender-sensitive policies and interventions. These are very key in the bid to address disparities and vulnerabilities faced by women in agricultural communities.

It is recommended to the Government to ensure that effective strategies which prioritizes gender equity and inclusivity. This will foster resilience and prosperity forthe farming communities.

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