Analysing Socio-Economic Characteristics Influencing Disaster Risk Management Approaches for Food Crop Production in Siaya County, Kenya

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Abstract

Socio-economic characteristics are a complex interplay of factors that have shown a changing trend and diversities worldwide. In Siaya County, food crop production has negatively been affected by climate change, making households to engage in different disaster risk management approaches to mitigate the negative impacts of climate change for increased food crop production. Socio-economic attributes have potential influence on the choice and adoption of the disaster risk management approaches used to increase food crop production. This study analyzed the socio-economic characteristics influencing disaster risk management approaches for food crop production in Siaya County. The study used descriptive survey and correlation research designs. A sample size of 385 households was determined through sampling techniques comprising multistage and proportionate. Secondary data were obtained from the publications, Journals, internet sources and newspapers. Descriptive and inferential statistics were used to correlate socio-economic characteristics and the disaster risk management approaches using Statistical Package for Social Scientist (SPSS) Version 20.0 for percentages, frequencies and level of significance while narrative analysis was used to analyze qualitative data. Findings revealed varying strengths of relationship between socio-demographic characteristics and disaster risk management approaches. Age ($r = 0.594$, $P<0.05$), Gender ($r = 0.610$, $p < 0.05$), Marital status ($r = 0.899$, $p<0.05$), Education level ($r = 0.072$, $p > 0.05$), Occupation ($r = 0.537$, $p < 0.05$), Year of residence ($r = 0.880$, $p < 0.05$), Monthly income ($r = 0.523$, $p < 0.05$), Family size ($r = 0.456$, $p > 0.05$) and land tenure ($r = 0.878$, $p=0.05$). The study concludes that all the socio-economic characteristics influenced disaster risk management except education level with a correlation coefficient of 0.072 which was not statistically significant at 0.697, $p > 0.05$. There is therefore need for concerted efforts by various stakeholders in food crop production and disaster risk reduction to consider socio-economic factors when planning for interventions and advocate for application of the disaster risk management approaches to mitigate agricultural risks from the changing climate for sustainable food crop production.

Keywords: Socio-Economic Characteristics, Disaster Risk Management Approaches, Food Crop Production

Introduction

Globally, socio-economic factors have shown a changing trend and diversities. However, According to Braveman *et al*., (2021), measuring the global socio-economic status has proved to be challenging due to the widened variations and diversities in socio-economic characteristic from the many countries of the world. According to Psaki *et al*., (2014), these varying characteristics have and are expected to influence human population development by differently impacting on their livelihoods hence making it an important determinant of development. In this study, socio-economic status as a determinant of development context is with regard to how they may influence adoption of approaches by communities towards mitigating the risks of food crop loss associated with climate change negative impacts. This has the capability to foster a risk sensitive development towards attainment of increased food crop production hence food security which is sustainable development goal number 2, "end hunger", improve nutrition and promote sustainable agriculture.

Notably, some studies have focused on the socio-economic characteristics of households and their influence on approaches used to mitigate climate change negative impacts on agricultural systems in the world. Stojanov *et al*., (2016) that found out that demographic characteristics of communities in the North Eastern part of Czech Republic significantly influence choice for different approaches and mainly corrective related to restoration of the damages caused by climate change rather than prospective approaches involving investing costly measures in mitigating the negative impact of climate change affecting different environmental systems such as agriculture.

In Africa, Kreibich *et al*, (2005) study revealed that demographic characteristics of households have contributed to the choices and the adoption of different disaster risk management approaches in relation to mitigation of climate change negative impacts. The study posits that level of income of household heads and of the entire household determines the community's level of managing the risks associated with climate change negative impacts. According to Kreibich *et al*., (2011), the low income households were highly involved in low cost measures such gathering precautionary information that constitutes community based disaster risk management approach and relocation to safer places from floods as an activity in corrective disaster management approach, medium income households mainly associated with insurance of crops against floods and droughts as a compensatory disaster risk management approach, while the high income households were involved in high cost measures such as building dykes and land use planning that are activities in prospective disaster risk management approach in mitigating climate change (Okonuola and Bako, 2021).

Ekreng *et al*., (2021) found out that socio-economic characteristics of the household and heads significantly influence their participation on plans, implementation and monitoring of the risks associated with climate risks and help take precautionary measures as a community-based risk reduction approach towards building resilience of different systems such as of agriculture for improved food crop production. This was also in tandem with Ihemezie *et al*., (2018) that demographic characteristics such as literacy levels and income of household heads determined the kind of approach taken towards mitigating risks from the changing climate in most sub-Saharan countries.

Additionally, Access to information founded on one's education level (Yameogo *et al.,* 2018), and income levels and family size (Chete, 2019) of households in communities are major factors influencing choice for

the adaptive disaster risk management approaches in mitigating climate change on agricultural systems in the rural sub-Saharan Africa. Compensatory disaster risk management approach has been significantly influenced by demographic characteristics such as level of income of households through provision of contingency funds by mainly governments to help them prevent adverse impacts of the extreme weather evens such as floods and droughts on agricultural production (Weru *et al*., 2017).

Related studies in Kenya such as Mogaka *et al*., (2021) on socio-economic factors influencing the choice for climate smart agricultural practices in Western Kenya where Siaya County in located, found out that household age, education level, gender, duration of practice, form of land ownership influenced the adoption of the CSA practices. Climate smart agricultural practices are under the corrective disaster risk management approach in relation to their ability to lessen or reduce the existing negative impact of climate change on food crops. According to Paustian *et al*., (2016) CSA practices are part of rehabilitation and protection of the climate and specifically on the media for agriculture such as land for sustainable food crop production.

Additionally, founded on the prospective disaster risk management, Ng'ang'a *et al*., (2017) and Abubeker *et al*., (2017), findings revealed that socio-economic factors had a positive influence on the agro-forestry practices among Kenyan farmers towards greenhouse gas sequestration and improvement of soil quality for quality and quantity food crop production. Relatively, Beyene *et al*., (2019), findings also found out that age of the household heads, land tenure systems and educational level, income and farming experience had a significant influence on the adoption of climate change mitigation approaches. However, the study reiterated that most studies have investigated the influence of socio-economic factors on adoption of approaches used on mitigation of climate change in isolation. The interplay of these socio-economic attributes in Siaya county dictated by the challenges from each attribute such as low-income levels, unemployment, high population density and insufficient access to means of production due to gender disparities are assumed to have a significant influence on the choice and adoption of the kind of disaster risk management approach in mitigating climate change.

Research Objective

To establish the socio-economic characteristics influencing disaster risk management approaches for food crop production in Siaya County.

Research Methodology

Study Area

This research was conducted in Siaya County, which is one of the six counties in the Nyanza region. Siaya County has a land surface area of 2,530 km² with a water surface area of 1,005 km^2. The water surface area forms part of Lake Victoria. It approximately lies between latitude 0º 26´South to 0º 18´ North and longitude 33º 58´ and 34º 33´ East (GoK, 2015).

Research Design

Descriptive and correlation research design was used to establish the socio-economic characteristics of the household heads influencing disaster risk management approaches on food crop production. Additionally, the study utilized both qualitative and quantitative approaches.

Methods of Data Analysis

Collected qualitative data were categorized into specific themes and sub themes and were analyzed through narrative. All the quantitative data from the questionnaires were analyzed using the Statistical Package for Social Scientists (SPSS) version 20.0 for inferential statistics and results are presented in figures, pie charts, and tables.

Results and Discussions

This section focused on the demographic characteristics of the respondents mainly on age, gender, marital status, education level, income levels, occupation, years of residence, family size and the type of land tenure system and influence on adoption of various disaster risk management approaches as prospective with activities (greenhouse gas reduction, land use planning, agro-forestry, and early warning information), corrective approach with activities (soil and water management, drought tolerant crops, crop diversification, improved storage facilities, and flood management), compensatory approach with activities (contingency funds, crop insurance, safety nets, and agricultural subsidies), and community based approach with activities (prediction of hazards, planning of risks reduction, implementation of risk reduction, monitoring of implementation of risk reduction strategies and risk analysis) adoption in Siaya County.

Table 1: Relationship Socioeconomic Characteristics and Disaster Risk Management Approaches for Food Crop Production in Siaya County

		Prospective Drma	Corrective Drma	Compensatory Drma	Community Based Drma	Cumulative Correlation
Age	Pearson Correlation	.695	-.103*	.509	.592	.594
	Sig. (2-tailed)	.026	.043	.250	.070	.045
Gender	Pearson Correlation	-.024	.029	.140**	-.018	. 610
	Sig. (2-tailed)	.634	.566	.006	.724	.023
Marital Status	Pearson Correlation	.734	.910	-.854	-.011	.899
	Sig. (2-tailed)	.503	. 047	.029	.834	.008
Education Level	Pearson Correlation	.544	.712	-.037	-.071	.072
	Sig. (2-tailed)	.393	.819	.468	.166	.697
Occupation	Pearson Correlation	-.061	. 650	-.057	-.046	.537
	Sig. (2-tailed)	.233	. 024	.267	.366	.046
Years Of Residence	Pearson Correlation	.911	-.104*	-.007	.663	.880
	Sig. (2	.033	.842	.893	.217	.048

	tailed)					
Monthly Income	Pearson Correlation	.809	.649	.076	-.079	.523
	Sig. (2-tailed)	.017	.033	.539	.123	.035
Family Size	Pearson Correlation	-.830	.529	-.014	-.016	.654
	Sig. (2-tailed)	.222	.313	.791	.748	.423
Land Tenure	Pearson Correlation	.931	-.070	-.072	-.073	.878
	Sig. (2-tailed)	.001	.573	.161	.650	.050

Source: Field data (2023)

Age of the Household Respondents and the Disaster Risk Management Approaches for Food Crop Production in the Study Area

In an effort to establish the relationship between age and disaster risk management approaches for food crop production in the study area, correlation analysis was conducted and the results are as presented in Table 1. The results show a correlation coeficient of 0.695 indicating a strong positive relationship between age and prospective disaster risk management approach, -0.103 showing a weak negative relationship between age and corrective approach, 0.509 as positive moderate relationship between age and compensatory approach, and 0.592 positive moderate relationship between age and community-based disaster risk management approach. Generally, a correlation coeficient of 0.594 indicating a moderately positive relationship between age and cummulative disaster risk management approaches such as prospective, corrective, compensatory and community based as applied by the respondents with statistical significance of 0.045 ($P<0.05$).

Findings show that as the ages of the respondent's increase, there is an increased involvement in the practice various disaster risk management approaches to mitigate the climate change negative impact for improved food crop production. This was found to vary from one disaster risk management approach to the other hence age being a factor that influences use of various approaches however, this showed a low statistical significance in their application in the study area. The study established that the most involved in food crop production in Siaya County were the members of the community that still had enough physical and economic energy such as the middle age. According to Wairimu *et al*., (2020) and Mogaka *et al*., (2021) social differentiation such as age of individuals is a factor in adoption of approaches used in mitigating climate change in the ASAL regions of Kenya. However, Simeon *et al*., (2018) revealed that low food crop production was highest among the young population between 20 – 35. This therefore attests that the young could be the majority in food crop production but are not highly involved in the practice of disaster risk management approaches to mitigate the negative impacts of climate change hence low low food crop production in Siaya County.

Gender of the Household Respondents and the Disaster Risk Management Approaches for Food Crop Production in Siaya County

To establish any relationship between gender and the disaster risk management approaches applied for food crop production in Siaya County, the study conducted a correlation analysis, and the results are as shown in Table 1. The results show a correlation coefficient of -0.24 indicating a weak negative relationship between gender and prospective approach, 0.29 indicating a weak positive relationship between gender and corrective approach, 0.140 showing a very weak relationship between gender and compensatory approach and -0.018 showing a negatively very weak relationship between gender and community-based approach. Cumulatively, a correlation coefficient value of 0.610 indicated a strong positive relationship which was statistically significant 0.023, $p < 0.05$.

The results therefore show that there was a significant variation in the usage of the various disaster risk management approaches based on variation in the gender of the household heads for food crop production in the study area. Studies have shown that women play a greater role majorly in subsistence agriculture than men. According to Rojas (2008), women make an essential contribution in rural agriculture and specifically in food crop production in most developing countries. Previous studies have also shown that women produce between 60 – 80% of the food crop production in most developing countries like Kenya. It therefore means that by default, the female gender is highly involved in the various disaster risk management approaches than the male counterparts in prevention, reduction and in risk transfer in the event of climate change negative impact on the food crops. In most situations the question of women involvement in the food crop production is coupled by their level of participation in the disaster risk management approaches in enhancing food crop resilience and adaptation strategies to climate changes (Mamkwe, 2016). However, Kimani and Murage (2011) asserts that women do not produce food separately from men but with contribution from both men and women in a collaborative process hence possible equal participation of both gender in all the disaster risk management approaches in mitigating the negative impacts of climate change for food crops production.

Marital Status of the Household Respondents and the Disaster Risk Management Approaches for Food Crop Production in Siaya County

The study therefore sought to establish the relationship between marital status of the household respondents and the disaster risk management approaches practices in Siaya County. A correlation analysis was done and a coefficient of 0.734 showing a strong positive relationship between marital status and prospective approach, 0.91 showing a strong positive relationship between marital status and corrective approach, -0.854 showing a strong negative relationship between marital status of a household head and compensatory approach and -0.11 showing a weak negative relationship between household heads marital status and community based disaster risk management approach while cumulatively, a correlation coefficient of 0.899 was generated indicating a very strong positive relationship which was significant at 0.008, $p<0.05$. This shows that there is significant association between household heads marital status and the practice of the various disaster risk management approaches.

The results show that variation in marital status influenced the variation in the levels and type disaster risk management approach practiced in mitigating negative impacts of climate change in Siaya County in improving food crop production in Siaya County. According to Karla *et al*., (2007), low food crop

production may be as a result of limited access to resources such as means of production like land and access to financial resources. In African setting and specifically in rural areas like Siaya County, resources are mainly owned by men as opposed to women ownership. It means that in the likely event that the man ceases to exist then women also lose ownership through cultural vices. While women contribute to over 60% of small scale food crop production, there are high chances that those not married may not actively participate in farming due to lack of or may experience reduced investment on disaster risk management approaches that are expected to build food crop production systems resilience due to their lack of accessibility to land or financial credits for crop farming.

The study therefore concludes that married couples have a higher potential of increasing food crop production unlike the unmarried, the single, the divorced and widowed who may either have little or no resources or have little or no access to other financial resources to help them invest in long-term disaster risk management approaches for increase food crop production. From the Focus Group Discussion, it was established that Siaya County just like majority of other parts of Africa is a patriarchal society. The participants explained that the means of production such as land belonged to the men and many times when the men die then the land ownership is taken from the widows. In addition, the failure by women to own land deprives them the opportunity to benefit from loans as land is the main asset for majority of the households in Siaya County.

Education Levels of Household Respondents and The Disaster Risk Management Approaches for Food Crop Production in Siaya County

In an attempt to establish the association between education level and the practice of the various disaster risk management approaches for food crop production in the study area. A correlation analysis was done and results in Table 1 show a correlation coefficient of 0.544 showing positive moderate relationship between literacy level of household heads and prospective approach practice, 0.712 showing a strong positive relationship between literacy level of household heads and corrective approach practices, -0.037 showing a weak negative relationship between literacy level of household heads and compensatory approach practices, and -0.072 showing a very weak negative relationship between literacy level of household heads and the practice of community based disaster risk management approach. A cumulative correlation analysis between education level and the disaster risk management approaches displayed a correlation 0.072 which was not statistically significance of 0.697, $p > 0.05$.

The study therefore established that practice of the various disaster risk management approaches has no association and are not influenced by education levels among the households in Siaya County. Contrary to the study of Mogaka *et al*., (2021), in Western Kenya where Siaya County was sampled for the study, education level had an influence on climate smart agriculture practices adoption which is a corrective approach towards climate change mitigation. It is believed that individuals with higher education are in a position to make informed and better decisions relating to food crop loss risks reduction as opposed to ones with lower education levels. This is in agreement with Ihemezie *et al*., (2018) with general considerations that with their high level of education, they have better access to information and understanding of the available knowledge and technologies in disaster risk management and their application in mitigating and adapting to climate change for food crop production than those who never had the opportunity for higher education.

According to Bashir and Schilizzi (2013), education influences food crop production through utilization of the acquired agricultural risk management practices Additionally, education is also associated with better income through better employment opportunities that is expected to have an effect on affordability of the critical technologies for mitigating the negative impacts of climate change among populations (Gebre 2012).

Occupation of the Household Heads Respondents and Disaster Risk Management Approaches for Food Crop Production in Siaya County

It was established that the majority in farming are self-employed in their farms and totally depend on the farm produces for food. Those involved in fishing also use the fish both for subsistence while the rest are engaged in small businesses such retailing, motorbike operations and vendor businesses. Lastly, the other populations of the household heads were of formal employment majority being civil servants such as teachers. To test if there existed any association between occupation of the household heads and disaster risk management approach practices for food crop production, a correlation analysis was conducted, and the results are as shown in Table 1.

The results show a correlation coefficient of -0.061 showing a weak negative relationship between the occupations of the household heads and prospective approach, 0.650 showing a strong positive relationship between household heads occupation and corrective approach, -0.057 showing a weak negative relationship between household heads occupation and compensatory approach, and -0.046 showing a weak negative relationship between household heads occupation and community based disaster risk management approach. Cumulatively, a correlation coefficient of 0.537 showed a moderate positive relationship between household head's occupation and the various disaster risk management approaches which was significant at 0.046, $p < 0.05$.

It therefore means that the variations in occupations of the respondent influenced positively the different types of disaster risk management approaches by the respondents for food crop production in the study area. Majority (58%) were involved in farming, explaining the number of household occupations that were more vulnerable to climatic risks, hence reducing food crop production. While it is expected that other sources of income from other occupations such as formal employment may be used to afford best agricultural technologies that may reduce the risks from climate change negative impacts just a minority 42% who were not in farming hence confirming the low food crop production in Siaya County. Mukami (2020) argues that household heads who are formally employed are able to alleviate their food crisis by supplementing production of food crops by investing in various disaster risk management approaches from their earnings from formal employment which is contrary to the situation in Siaya with minority having formal employment, hence low food crop production.

Years of Residence of the Household Head Respondents and Disaster Risk Management Approaches for Food Crop Production in Siaya County

To test the association between period of residence and practice of the disaster risk management approaches for food crop production by the household heads, a correlation analysis was done, and the results are as shown in Table 1. Correlation coefficient of 0.911 showed a very strong positive relationship between years of residence of a household head and prospective approach, -0.104 showed a very weak negative

relationship between years of household head and corrective approach, -0.007 showed a very weak negative relationship between household head years of residence and compensatory approach, and 0.663 showing a strong positive relationship between household head's years of residence and community based disaster risk management approach. Cumulatively, a correlation coefficient of 0.880 showing a very strong positive relationship which was significant at 0.048, $p < 0.05$ was shown from the analysis.

Results therefore show that there is a strong positive association where the increased number of years one resided with the increased and intense application of the disaster risk management approaches by the households towards mitigation of the negative impacts of climate change to improve food crop production in the study area. From the results, majority of the respondents are natives who are mainly engaged in farming that frequently get impacted on by floods and droughts, hence adversely been affected by low food crop production in Siaya. The study established that among the farming households, those who had stayed for more than 12 years practiced long term disaster risk management approaches such as in prospective together with other approaches while those who had lived for less than 12 years mainly practiced corrective, compensatory and community-based disaster risk management approaches.

Monthly Income from the Sale of Agricultural Produces and the Disaster Risk Management for Food Crop Production in Siaya County

To establish the possible influence of the monthly income of the household heads on disaster risk management approach practiced triggered a correlation analysis as shown in Tables 1. The results show a correlation coefficient of 0.809 showing a very strong positive relationship between a respondents monthly income and prospective approach, 0.649 showing a strong positive relationship between respondents monthly income and corrective approach, 0.076 showing a very weak positive relationship between respondent's monthly income and compensatory approach, and -0.079 showing a very weak negative relationship between respondent's monthly income and the practice of community based disaster risk management approach. Cumulatively the correlation analysis summed up the results with a correlation coefficient of 0.523 showing a moderate positive relationship that was statistically significant at 0.035, $p < 0.05$.

The results therefore show that there was an association where difference in monthly income positively influenced practices in different disaster risk management approaches in mitigating the negative impacts of climate change mainly to food crop production in the study area. This means that those who had higher monthly income had the potential to actively practice the disaster risk management approaches in mitigating the negative impacts of climate change as opposed to those with low monthly income. This finding resonates with Okunola and Bako (2021) that categorized the climate change mitigation into low cost, medium cost and high cost as influenced by the affordability from varied household incomes It was established that the majority of household earnings were insufficient hence majority were not in a position to invest the high-cost disaster risk management approaches such as in food crop insurance, pest and disease management and in soil and water management in Siaya County.

Family Size of the Household Respondents and Disaster Risk Management Approaches for Food Crop Production in Siaya County

To establish the relationship between the family size of the households and the disaster risk management applied in mitigating the negative impacts of climate change, a correlation analysis was done, and the results are as shown in Table 1. Correlation coefficient of -0.830 showed strong negative relationship between family size and prospective approach practice, 0.529 showed a moderate positive relationship between family size of the households and the corrective approach practice, -014 showed a very weak negative relationship between family size of the households and compensatory approach, and -0.016 indicating a very weak negative relationship between family size of the respondents and community based disaster risk management approach. Lastly, correlation analysis between family size and cumulative disaster risk management approaches showed a correlation coefficient of 0.456 that was not statistically significant at 0.423, $p > 0.05$.

Analysis therefore show that the varying family sizes had a positive association and influenced though of low significance to the kind of disaster risk approaches that were applied to mitigate climate change and improve food crop production in Siaya County. It is expected increased manpower in larger households translates to increased participation in various disaster management approaches hence increased food crop production. This study therefore resonates with Mukami (2020) on social predictors of household food production founded on the various agricultural risk reduction activities in Machakos, a county categorized under ASAL like Siaya County indicating a relationship between the two attributes though of no statistical significance.

Land Tenure Systems of the Households and Disaster Risk Management Approaches for Food Crop Production in Siaya County

To establish any association between land tenure and disaster risk management approaches applied in mitigating the negative impacts of climate change in Siaya County, a correlation analysis was done and the results are as presented in Table 1. Results show that there was a strong positive relationship between the kind of land tenure practiced by the respondents and prospective approach at 0.931 correlation coefficient, -0.070 very weak relationship between kind of land tenure and corrective approach, -0.072 very weak negative relationship between kind of land tenure and compensatory approach, and -0.073 very weak negative relationship between kind of land tenure by the respondents and community based disaster risk management approach. Cumulatively, a correlation coefficient of 0.878 with a significance level of 0.050, p=0.05 was generated from the analysis.

Results therefore show that there is an association where the variation in land tenure systems influenced the variety in disaster risk management approaches used to mitigate the negative impacts of climate change for food crop production. The results in Figure 4.9 show that majority (64.5%) of the respondents practice freehold land tenure systems. This was found out that it's due to the fact that the majority are natives hence land inheritance as a contributing factor to the kind of practice. Secondly, the study established that few of the households or individuals that are involved in leasehold had the financial capability and invested heavily in various disaster risk management approaches while the majority practicing freehold are the natives who most of them have limited or no resources to invest in intensive agriculture hence experience were not

highly involved in the various disaster risk management approaches hence low food crop production in Siaya County.

The study established that the two groups, as those who practiced freehold and leasehold held larger pieces of land that would be used for food crop production. Mamkwe (2016) on household socio-economic factors and climate change mitigation approaches, farm size in relation to land tenure systems has a significant influence on adoption of the mitigation strategies for climate change for production such as in food crops. According to Maxwell and Keith (1998) it is believed that increased security of land tenure in productive resources dictates the kind of investments individual get involved in and mainly those that are meant to reduce the agricultural risk and those meant to improve agricultural system resilience for increased food crop production in the wake of environmental factors such as climate change.

Conclusion and Recommendation

All the socio-economic factors in Siaya County had a positive influence to disaster risk management approaches application to mitigate climate change. However, marital status, gender and monthly income 0.008, 0.023 and 0.035 respectively p value < 0.05 significantly influenced the practices of disaster risk management approaches compared to age, occupation, year of residence and land tenure at 0.045, 0.046, 0.048 and 0.05 respectively p value < 0.05. Contrary, family size, and education of the respondents at 0.423, and 0.697 respectively, p value > 0.05 though positive, had no significant influence on the disaster risk management approaches applied in mitigating climate change for the improvement of food crop production in the study area.

The study showed varying trends of various socio-economic factors influencing disaster risk management approaches for food crop production in Siaya County. There is therefore need for concerted efforts by various stakeholders in food crop production and disaster risk reduction such as Ministry of Agriculture to consider socio-economic factors when planning for interventions and advocating for application of the disaster risk management approaches to mitigate agricultural risks from the changing climate for sustainable food crop production

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