

Research Application Summary

Assessing the impact of climate change and climate variability on agricultural productivity in selected climatological zones of Uganda: An overview

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Abstract

Climate change and climate variability are a major threat to livelihoods in sub-Saharan Africa (SSA). The IPCC report of 2007 indicates that SSA is the most vulnerable region to climate change and climate variability due to the weak economies and lack of adaptive capacity. If climate change and variability are not timely addressed, they are likely to worsen the poverty levels and further weaken the economies of the region. The poor agro-based communities in the dryland areas are particularly vulnerable to adverse effects of climate change and climate variability. There is therefore urgent need for concerted efforts to design appropriate mitigation and adaptation strategies to buffer communities in these ecologically sensitive areas against climate change and climate variability. Designing mitigation and adaptation strategies requires information and knowledge on the impact of climate change on the targeted sites. To-date, the impact of climate change and variability on the agricultural productivity is not well understood and the climate change threat remains largely unresolved. Most of the available information has been obtained from Global Circulation Models (GCM) but these models are inadequate to spatially differentiate the diverse ecosystems and adaptive capacities. The thrust of this study is to improve our understanding of climate change and climate variability impacts on agricultural productivity in selected climatologically contrasting districts of Uganda. The multidisciplinary project adopts diverse methods including modelling, experimentation, participatory rural appraisal (PRA) and household interviews. The study will provide a niche for improved strategies. Since the action area is a dryland, it is also envisaged that the results and recommendations from the study will potentially be replicable in other dryland areas and communities of SSA.

Key words: Adaptation strategies, climate change, climate variability

Résumé

Le changement climatique et la variabilité climatique sont une menace majeure pour les moyens de subsistance en Afrique sub-saharienne (ASS). Le rapport du GIEC de 2007 indique que l'Afrique au sud du Sahara est la région la plus vulnérable au changement climatique et la variabilité du climat en raison de la faiblesse des économies et le manque de capacité d'adaptation. Si le changement climatique et la variabilité ne sont pas opportunément adressés, ils sont susceptibles d'aggraver les niveaux de pauvreté et d'affaiblir encore davantage les économies de la région. Les communautés pauvres à base agricole dans les zones arides sont particulièrement vulnérables aux effets néfastes des changements climatiques et la variabilité du climat. Il est donc un besoin urgent de fournir des efforts concertés pour la conception d'atténuation appropriées et des stratégies d'adaptation pour que les communautés dans ces zones écologiquement sensibles résistent contre le changement climatique et la variabilité du climat. La conception des stratégies d'atténuation et d'adaptation requiert des informations et des connaissances sur l'impact du changement climatique sur les sites ciblés. À ce jour, l'impact du changement climatique et la variabilité de la productivité agricole n'est pas bien compris et la menace du changement climatique demeure en grande partie irrésolue. La plupart d'informations disponibles ont été obtenues à partir de modèles de circulation générale (GCM), mais ces modèles ne permettent pas de différencier spatialement les divers écosystèmes et les capacités d'adaptation. Le but de cette étude est d'améliorer notre compréhension du changement climatique et des impacts de variabilité du climat sur la productivité agricole dans certains contrastes districts climatologiques de l'Ouganda. Le projet multidisciplinaire adopte diverses méthodes, y compris la modélisation, l'expérimentation, l'évaluation rurale participative (PRA) et des interviews des ménages. L'étude fournira un créneau pour l'amélioration des stratégies. Depuis la zone d'action est une région aride, il est également envisagé que les résultats et recommandations de l'étude seront potentiellement reproduits dans d'autres zones arides et les communautés d'Afrique au sud du Sahara.

Mots clés: Stratégies d'adaptation, le changement climatique, la variabilité du climat

Background

Climate change and climate variability are among the biggest contemporary threats to agricultural productivity in the Sub Saharan Africa (SSA) region (IPCC, 2007). The agro-based

communities of SSA are expected to suffer most from climate change impacts due to their low adaptive capacities resulting from their weak economies and lack of adaptive technologies (Nkomo *et al.*, 2006). These regions are routinely stressed by climate variability, the principal source of fluctuations in food production. Studies show that mean rainfall amounts of the arid and semi-arid areas of SSA have steadily decreased (McGuigan, 2002). If this climatic trend continues, it is likely to exacerbate the already precarious ecologically stressed dryland regions and undermine the ongoing poverty reduction efforts, for example, the Poverty Eradication Action Plan (PEAP) for Uganda, as well as the realisation of the Millennium Development Goals (MDGs) targets for most SSA governments.

Although climate change and variability are generally recognized as major threats to agricultural productivity, there is a conspicuous lack of sufficient site-specific information and knowledge about its impact on agricultural productivity. Understandably this dearth of knowledge has constrained the development of appropriate strategies to cope, mitigate and adapt to climate change and variability. The design of mitigation and adaptation strategies to climate change and variability on agriculture requires reliable scientific information from empirical research on the nature of changes, impact on crop yields and animal productivity, *hot-spots* and *bright-spots* as well as the capacities of the communities to respond to the changes.

Literature Summary

The major dryland region in Uganda is classified as “agro-pastoral” (Basalirwa, 1995). The inhabitants of these areas depend primarily on the land resource and derive their livelihoods from cattle rearing and annual cropping (UNDP, 2007). The region is a predominantly small holder rural poor subsistence farming system with largely rain-fed agriculture. Because of this agro-based structure, coupled with the frequent climate variability which often leads to either drought or flood incidences, the agricultural productivity of the region is likely to suffer greatly from added burden of climate change (McGuigan, 2002).

The IPCC 2007 report generally projects increases in temperatures and shifts in rainfall patterns in SSA. In East Africa, analyses from General Circulation Models (GCM's) indicate that there will be increased drop in rainfall. If the projected scenarios by the GCM's for the Eastern Africa region are realised, the major agricultural implications may be two-fold: crop yield reduction due to extremely dry conditions and

diminished suitability; and increased crop moisture availability, hence improvement of optimum crop growth conditions. GCM's scenarios are however insufficiently precise in terms of spatial resolution or scale of assessment and fail to reasonably differentiate spatiality (Burton *et al.*, 2002). Information from these coarse GCM's that lump all ecosystems can not be reasonably used to inform decision making, particularly for drylands which are relatively more sensitive. This conspicuous uncertainty needs to be addressed from a research perspective (Downing *et al.*, 1997; McGuigan *et al.*, 2002; Bradshaw *et al.*, 2004).

Studies on climate change impacts on crop productivity elsewhere particularly on annual crops which are dominant in the region give a pessimistic picture. For example, model based maize yield changes due to climate change in related ecosystems in Tanzania predict average country yield decrease of 33%, but can be as high as 84% in some region (Agrawala, 2003). Cognizant of the local and regional ecological and economic importance of Uganda's drylands, there is a compelling need to understand the agricultural sensitivity of this region to climate change and variability to facilitate the formulation of interventions and policy options to mitigate and improve the adaptation capacities of the communities. This study seeks to ascertain crops that will be constrained by the changes and those that are likely to thrive under the projected climatic changes in this ecosystem. The study will focus on annual crops. Information will be generated through community diagnostic study on perceptions of the impact of climate change and variability on various crops. This study aims at contributing to improved adaptation to climate change and variability of the dryland communities in East Africa.

The specific research objectives are to identify the existing and feasible coping and adaptation strategies to climate change and climate variability and to determine the impact of climate change on the productivity of major annual crops in selected climatological zones of Uganda.

Study Description

The study is being conducted in Soroti and Manafwa districts, representing two contrasting climatological zones of Uganda. Soroti district lies in the so called cattle corridor vulnerable to droughts due to the light textured soils while Manafwa district lies in the so called highland areas of Uganda. The study sites in Soroti were selected based on the areas where past Regional

Universities Forum for Capacity Building in Agriculture (RUFORUM) funded studies on water balance were conducted (Wesige *et al.*, 2002). In Manafwa district the study sites were based on on-going erosion study funded by the Nile Basin initiative.

This study will utilize innovative and mixed method approach to analyze the climate change and variability impacts in the selected climatological zones. In general, the research team will observe, measure and assess climate change dynamics, livelihoods coping and adaptation capacities. Communities will be engaged for detailed studies. Effort will be made to capture the diverse socio-cultural dimensions and how they influence/affect adaptation. Computer simulations, back and forward analyses of historical climatic data impacts on various crops will be done and validated through participatory on-farm trials. Subsequent crop specific on-farm studies will be based on results from both the participatory survey and modelling approaches.

Study 1: Identification of the existing coping and adaptation strategies to climate change and climate variability. The gist of this study is to establish the communities knowledgeable about climate change and variability, existing and evolving coping mechanisms, socio-structures and acceptability of alternative livelihood and adaptation strategies to climate change and variability. It is planned to use participatory rural appraisals (PRA), structured household interviews to strengthen the data obtained from PRA, while livelihoods analysis will be employed in selected focus areas to understand the resilience of rural communities using the CARE sustainable livelihood impact assessment method. Subsequent application of the UNDP Adaptation Policy Framework (APF) will provide guidance on designing and implementing projects that reduce vulnerability to climate change, by both reducing potential negative impacts and enhancing any beneficial consequences of a changing climate.

Study 2: Determining the impact of climate change on the productivity of major annual crops. The achievement of this study objective will be premised on leveraging data from past and ongoing studies, characterising the patterns and trends of climatic change and climatic variability, as well as mapping and characterising hotspots and bright spots. From results of the first study we shall identify crops that are more or less

vulnerable to climate change and variability. Backward and forward simulations, using historical climate data and water balance studies, will be used to evaluate the farmers' perceptions. The conditions under which specific crops are vulnerable or less vulnerable to climate change and variability will then be used to design on-farm trials to validate the results.

Research Application

A database of historical and projected climate scenarios will be developed. Results of the study will contribute to the improved understanding of climate change and variability impacts in dryland areas and provide a niche for improved adaptation and livelihoods. Since the action area is a dryland, it is also envisaged that the results and recommendations from the study will potentially be replicated in other dryland areas and communities of SSA. Specific study outputs and outcomes include: trajectories of climate change and climate variability, the existing coping and adaptation strategies to climate change and climate variability established, resilience of agro-based communities characterised and crops that can thrive under the changes, identified and policy options for climate change mitigation and adaptation prepared and shared.

The project dissemination and communication strategy targets various stakeholders and actors in climate change and agriculture. We envisage working with the local communities in the study areas, and other leaders and technical staff throughout the duration of the project to create greater impact. Dissemination workshops will target the local leaders, district technical staff, local NGOs and CBOs, and policy makers.

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