Research Application Summary

A support tool for enhancing policy decision making for climate change adaptation in agriculture: An information systems approach

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Abstract

Policy decision making often fails to achieve the desired outcomes due to complexity of both the environment and the policy making process itself. This article highlights the impacts of climate change on human livelihood, discusses the wait-and-see behaviour and its policy implications towards climate mitigation actions. It also demonstrates that existing techniques such as correlation heuristics (CH) have not been very useful in policy decision making compared to system dynamics approach that can handle complex problems involving a multitude of stakeholders holistically, model feedback based dynamic processes. It seeks to develop a support tool as an alternative approach for enhancing policy decision making for climate change adaptation in agriculture. The findings of this study will be utilised in the identification of vulnerabilities and coping measures as they relate to the various agricultural production strategies, improving climate forecasts along with procedures for use in agricultural management and integration of climate risks management in agricultural business strategies. The designed tool will lead to integration and standardisation of vulnerability indicators that relevant stakeholders can use to develop, review and harmonise national sector policies with regional/international polices related to climate change adaptation and mitigation.

Key words: Correlation heuristics, DST, policy decision making, system dynamics approach

Résumé

La prise de décision politique ne parvient pas souvent à atteindre les résultats escomptés en raison de la complexité de l'environnement et le processus d'élaboration de la politique elle-même. Cet article met en évidence les impacts du changement climatique sur des moyens de subsistance de l'homme, parle du comportement attendre- voir et de ses implications politiques vers des actions d'atténuation climatique. Il démontre également que les techniques existantes, telles que

l'heuristique de corrélation (CH) n'ont pas été très utiles à la prise de décision politique par rapport à l'approche dynamique du système qui peut traiter des problèmes complexes impliquant une multitude d'intervenants de manière holistique, il modèle les processus dynamique basé sur les réactions. Il cherche à développer un outil d'aide comme une approche alternative pour améliorer la prise de décision politique pour l'adaptation au changement climatique dans l'agriculture. Les conclusions de cette étude seront utilisées dans l'identification des vulnérabilités et des mesures d'adaptation en ce qui concerne les différentes stratégies de production agricole, l'amélioration des prévisions climatiques et de procédures à utiliser dans la gestion agricole et l'intégration de la gestion des risques climatiques dans les stratégies des entreprises agricoles. L'outil conçu permettra l'intégration et la normalisation des indicateurs de vulnérabilité que les acteurs concernés peuvent utiliser pour élaborer, réviser et harmoniser les politiques sectorielles nationales avec les politiques régionales/ internationales liées à l'adaptation et à l'atténuation du changement climatique.

Mots clés: heuristiques de corrélation, DST (heure d'été), prise de décision politique, approche de dynamique de système

Background

Uganda's economic and social development largely depends on exploitation of its environmental and natural resources, more especially agriculture. As the planet warms, shifts in rainfall patterns, tragic crop failures, increased hunger, malnutrition and diseases; extreme events such as droughts and floods are prospects poor people are facing (IPCC, 2007; UNFCCC, 2007g). For especially the poor, climate change threatens to deepen vulnerabilities, erode hard won gains and seriously undermine prospects for development (World Development Report, 2010). According to the Uganda National Development Plan (2010), vulnerability is associated with several factors including among others, lack of policy, legislation, regulation and guidelines for mainstreaming climate change into development plans at all levels. Good policies however have to be supported by credible evidence and logical decision support tools drawing on different scenarios to ensure a safe and sustainable future beyond 2015.

To-date, vulnerability assessment to climate change has fallen into the disciplinary silos (Cutter *et al*., 2000; Deressa *et al*., 2008; Gbetibouo *et al*., 2010) yielding islands of success. An integrated approach that consolidates the different viewpoints

is essential to guide policy decisions. A systems dynamics approach has the potential for more integrated and holistic view to aid relevant policy decisions to facilitate collective action towards mitigating the effects of climate change in agriculture. This study therefore aims to develop a policy decision support tool based on information systems dynamics for mitigating climate change in agriculture.

Literature Summary

System dynamics is increasing being used in agriculture and natural resources management. For example, Shin *et al*. (2009) applied simulation modeling to develop dynamic crop models as decision support tools to evaluate possible agricultural consequences from inter-annual climate variability and or climate change. Chu *et al*. (2009) also found system dynamics very useful in aiding lake system prediction and understanding temporally in sequential planning for water supply, environmental preservation and flood detention. As related to policy formulation and decision making, past research show a "wait-and-see" behaviour towards actions that mitigate climate change (Sterman and Sweeney, 2002). Further, people with scientific backgrounds support the wait and see behaviour towards climate mitigation actions (Dutt and Gonzalez, 2009). For example, Singer (2009) commented that human activities are not influencing the global climate in a perceptible way. Climate is expected to continue changing, as it has always been in the past, warming and cooling on different time scales and for different reasons, regardless of any human action. The recently undertaken climate initiatives like the Kyoto Protocol and Clear Skies, that have pledged to mitigate the global warming problem, have also expressed support for the wait-and-see behaviour: the Kyoto Protocol's proposed reductions in emissions fall short of the proposed targets and Clear Skies' initiative encourages even further greenhouse gas emissions growth (Sterman and Sweeney, 2007).

As argued by Sterman and Sweeney (2007) such wait-and-see behaviour will lead to wrong policy mitigation actions and delays in revision of such polices given a climate system that responds slowly to human emission actions. Previous approaches that have been used in past studies (Cronin and Gonzalez, 2007; Cronin *et al*., 2009) and directly suggested by Sterman (2008) and Sterman and Sweeny (2007), the wait-and-see behaviour on climate mitigation is related to a person's erroneous use of proportional thinking, or the "correlation heuristic" (CH, e.g. thinking that stabilizing carbon dioxide

emissions will stablise carbon dioxide concentration) (Cronin *et al.*, 2009), while reasoning in dynamic systems. In this case, despite the high applicability to climate change mitigation policies and public policy problems (Ford, 2008; Sterman, 2008; Thompson, 2008; Ghaffarzadegan, 2008), system dynamics is currently not utilised to its full potential in governmental policy making (Ghaffarzadegan *et al.*, 2009). As an indication, the 2008 system dynamics publications database lists only 94 entries containing the phrase "public policy" (out of more than 8800 entries). Moreover, many of the existing models are limited to academia and have had little impact on policy making, and other areas have not been fully explored (Forrester, 2007). This study will work towards developing a support tool for policy decision-making for climate change adaptation in agriculture taking information systems approach.

Study Description

This study aims at developing a support tool for enhancing policy decision making for climate change adaption in agriculture using an information systems approach. To achieve this, the study will identify key socio-economic and biophysical indicators of climate change vulnerability assessment, develop the support tools for determining location specific climate change adaptation strategies, implement the tool, test and validate the usability and accuracy of the tool using the standardised indicators for climate change adaptation. Undertaking these stated objectives will involve an integration of geographical information system (GIS) and system dynamics (SD). System dynamics is the main methodology that will be applied as it provides an inside view of endogenous feedback structures relating to climate change processes. The four stages of model building are outlined in (Fig. 1), showing the essential step of each stage or phase. This approach is grounded in control theory for distributed parameter systems, and the analysis and interpretation of results will be based on systems thinking theory to see the connectedness and complexity of the different factors at play in their context as well as interpretivism to understand and explain how people see, interprete, perceive, meanings and understanding of climate change and how these views influence adaptation to climate change and also use these people as the primary data sources.

Research Application

This work will be useful to a number of stakeholders such as agriculturalist, academics, environmentalists, meteorologists, climatologists and government Ministries. The meteorologists and climatologists will use the findings of this study to improve climate forecasts along with procedures for use in agricultural

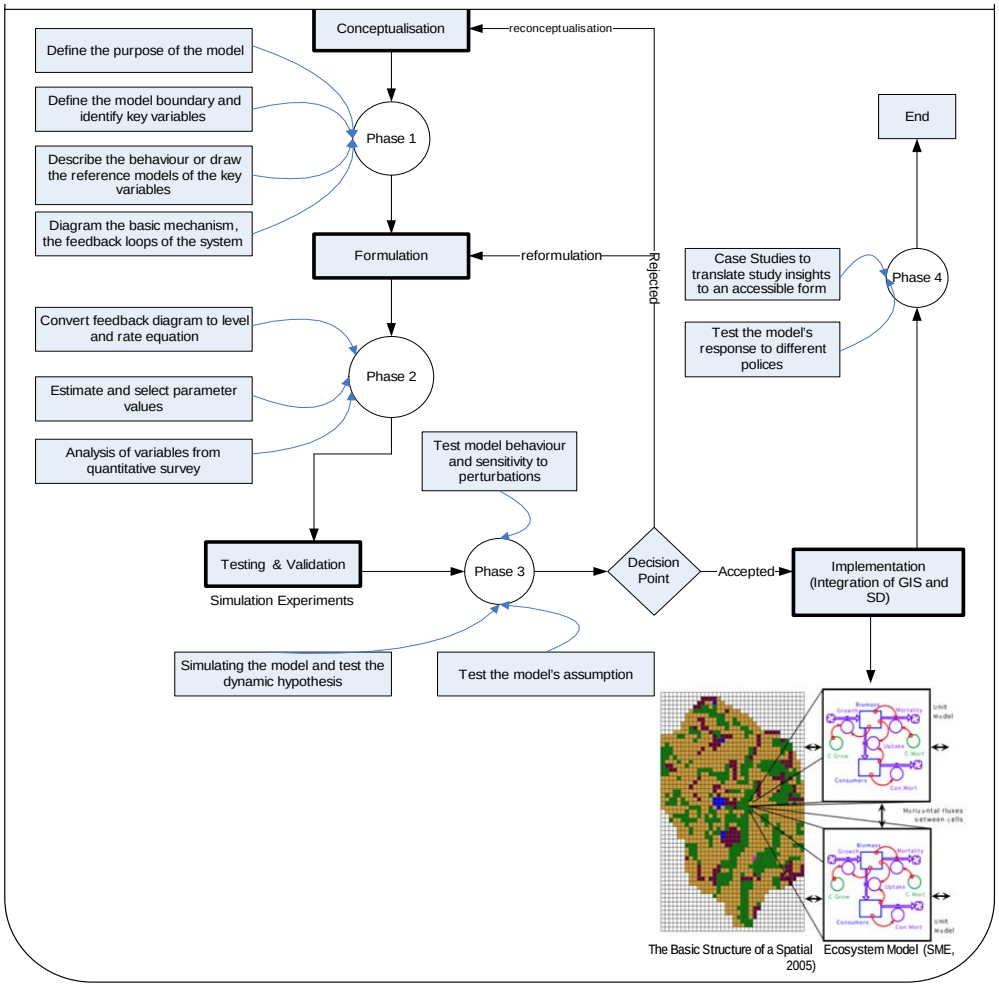

Figure 1. Research design framework (adapted from Forrester, 1997; Williams, 2000; Rwashana, 2010).

management and to integrate climate risks management in agricultural business strategies. The designed tool will lead to integration and standardisation of vulnerability indicators that relevant government Ministries, such as Ministry of Agriculture Animal Industry and Fisheries and Ministry of Lands, Water and Environment can use to develop, review and harmonise national sector policies/strategies with regional/international polices related to climate change adaptation and mitigation and strengthen central and local government capacities to integrate climate change into planning. To academia, an alternative approach to measuring vulnerability assessment through modelling feedback based dynamic processes in time and space will become available while giving insights into the interactions among different components of the system.

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