Research Application Summary

The implications of climate change on economic and food security in Kenya

Musebe, I., Edriss, A.[1], Mangisoni, J. [1] & Mbogo, J.[2]
[1]University of Malawi, Bunda College of Agriculture, P. O. Box 219, Lilongwe, Malawi
[2]University of Nairobi, P. O. Box 29153, Nairobi, Kenya
Corresponding author: nambuya2005@yahoo.com

Abstract

This study, covering six provinces in Kenya, aims at establishing impact of climate change on food security and Kenya's economy as a whole. Both primary and secondary data will be collected and analyzed using approaches such as the translog model, Ricardian model, etc. Changes in crop and livestock yields as affected by climate change will be quantified and economic implications identified.

Key words: Climate change, crop yields, Kenya, livestock productivity

Résumé

Cette étude, couvrant six provinces au Kenya, vise à établir l'impact du changement climatique sur la sécurité alimentaire et l'économie du Kenya dans l'ensemble. Des données primaires et secondaires seront rassemblées et analysées en utilisant des approches telles que le modèle translog, le modèle de Ricardian, etc. Des changements des rendements de culture et de bétail affectés par le changement climatique seront quantifiés et les implications économiques seront identifiées.

Mots clés: Changement climatique, rendements de culture, Kenya, productivité du bétail

Background

Climate change is a worldwide problem whose effects need to be addressed urgently in the wake of food insecurity episodes and environment hazards in many countries. According to the Intergovernmental Panel on Climate Change (2001) there are very few detailed climate change impact assessment carried out in developing countries.

In Kenya, the adverse effects of climate change manifests itself as increased temperature range, declining amounts of precipitation in some parts and unpredictable onset of rainfall seasons in semi-arid and agriculturally high potential areas causing tribulations to farmers. Subsequently, it is no longer feasible for farmers as well as the entire agriculture sector to depend on the conventional methods of rain-fed regime for agricultural production. Consequently, the country has plunged into a situation of frequent food crises. The purpose of this study is to assess the economic and food security implication of climate change in Kenya.

Literature Summary

Adams *et al.* (1998), Mendelson *et al.* (1994), Rosenzweig and Hillel (1998) and U.S Global Research Programme (2001), analysed the impact of climate change on agriculture and food security and concluded that there exist marked regional differences. For instance, the threat in the developed economies and to global food security is not as dreadful as in Sub-Saharan Africa and elsewhere which depend on rain-fed agriculture. Adams *et al.* (1999), Lewandrowski and Schimmelpfennig (1999) and Reilly *et al*. (2002, 2003) review indicated that U.S agriculture was resilient to climate change with even higher yields for some crops in the Northern regions and lower yields in Southern regions. Downing (1992) in a study of Zimbambwe agriculture found that over the entire surface of the country, a 1% increase in temperature caused 15% increase in water evaporation and 2% increase in temperature which would reduce the country's core agricultural zone by 67%. On the other hand, Keiser *et al.* (1993), Schimmelfennig *et al.* (1996), Adam *et al.* (1998, 1999) and Rosenzweig and Hillel (1998) showed that while climate change may adversely affect agriculture, human adaptations, categorised into three major groups as biophysical, policy and trade may help cushion economies against the negative effects of climate change.

Study Description

A multi-stage random sampling method will be used to collect primary data from six provinces in Kenya namely: Western, Nyanza, Rift valley, Eastern, Central and Coast selected as the high potential and transitory high potential areas of Kenya. Two districts from each province will be selected, one from transitory high potential and the other from high potential areas from which one division will be randomly selected. Thirty farmers will be randomly selected from one village for the study. This will yield a sample size of 360 farm households to whom semi-structured questionnaire will be administered. Another two districts, from semi-arid area will be randomly selected from which 30 farmers each will be selected. This will make a total of 60 farm households.

Both secondary and primary data will be collected. Primary data to be collected will include farmer perceptions of climate change, attitudes and knowledge of its effects and data on production (yields of main food crops (maize, potatoes and beans) and cash enterprise (coffee, livestock), institutional and land tenure issues. Secondary data will be collected from key respondents in government, private and international organizations institutions and will include: climatic parameters, temperature and rainfall amounts, variability and trends, agronomic and biophysical factors of crop production, crop productivity and crops yield trends, as well as output, input and labour market forces variations in terms of prices, supply and demand.

Research Application

The normalised translog model as used by Sauer and Tchale (2009) will be used to determine agricultural production of the three crops (maize, potatoes and beans) as follows:

$$\mathrm{Ln}q = \alpha_0 + \Sigma\alpha_1 \ln x_i + 0.5\Sigma\Sigma\beta_{ij} \ln x_j \ln x_j + \Sigma\!-\!l_k Z_k + \alpha_3 h + \alpha_4 S + \alpha_5 f + \varepsilon$$

Where: q = Yield in kilograms per ha of crop; X_i = Variable inputs fertilizers; Xj = a vector of climate variables (amount of rainfall and average temperature) as variable input; Z_k = a vector of yield shifters (climate variability, i.e., rainfall and temperatures, years of extension services and timely crop operations like planting, weeding, etc.; h= Presence of climate change adaptation measure on the farm (as a dummy; 1= adaptation measure Present and 0 = Otherwise).

S = seed (as a dummy; 1= use of certified seed as a recommended technology and 0= otherwise); f= food self sufficiency (as a dummy; 1= self sufficiency and 0= otherwise).

The Ricardian model, following Mendelsohn *et al*. (1994, 1996) will also be used to establish a net revenue function as:

$$NR = \Sigma P_i Q_i \, (X,F,G,Z,\,) - \Sigma P_x X$$

Where; NR = net revenue per hectare, Pi = is the market price of crop i, Qi = output of crop i, X = a vector of purchased inputs, F = a vector of climate variables, G = a set of economic variables such as livestock ownership, Z = a set of soil variables, **c** = adaptation measure and P_X is a vector of input prices. This culminates into the regression:

$$NR = \beta_0 + \beta_1 F + \beta_2 F^2 + \beta_3 G + \beta_4 Z + \beta_5 + U$$

Where; U is the error term and the $\hat{a}_i$ the parameter value of the variables appended to it.

Research Application

The results will enable quantification of trends of major crops (maize, potatoes, coffee and beans) and livestock yield changes due to climate change. It will also quantify economic losses at national and producer-consumers levels. The information generated will allow for policy recommendations on land management strategies and appropriate adaptation options against climate change and variability.

Acknowledgement

We thank the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) for the financial support towards the study. The Ministry of Agriculture and Ministry of Environment & Mineral Resources in Kenya and thanked for allowing the first author to undertake this PhD study.

References

Butt, T. A., McCarl, B.A., Angerer, J., Dyke, P.T. and Stuth, J.W. The economic and food security implications of climate change in Mali. www.agronomy-journal .org

Howden, S.M., Soussana, J.F., Tubiello, F.N., Chhetri, N., Dunlop, M. and Meinke, H. Adapting agriculture to climate change; www.pnas.org/cgl/dol/10.1073

Tingem, M., Rivington, M. and Bellocchi, G. 2009. Adaptation assessment for crop production in response to climate change in Cameroon. *Agron. Sustain. Dev.* 29:247-256.

Tingem, M. and Rivington, M. 2009. Adaptation for crop agriculture to climate change in Cameroon: Turning on the heat. *Mitig Adapt Strateg Glob Change* 14:153-168.

Nkonya, E.M. and Parcell, J.L. 1999. Redistribution of social benefits from advances in extension and research in Tanzanian maize industry. *Agricultural Economics* 21(3): 231-239.

Mertz Ole, M., Cheikh, A., Reenberg, L. and Diorf, A. 2009. Farmers perceptions of climate change and agricultural adaptation strategies in Rural Sahel. *Environmental Management* 43:804-816.

Rosenzweig, C. and Hillel, D. 1998. Climate change and the global harvest: Potential impacts of the green house effects on agriculture. Oxford University Press, New York.