Poverty and vulnerability: a static vs dynamic assessment of a population subjected to climate change shock in Sub-Saharan Africa.

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Abstract

Despite the effects of climate change being evident at a global scale, its negative impact will severely affect those communities highly dependent on natural resources. The emerging threat of climate change to household's welfare calls for more research to assess the household's probability to fall into poverty. This would need a combined analysis of the potential risk of experiencing a climate related extreme (such as droughts or floods) and the household's ability to cope with such events. This research aims to extend a methodology developed by 'micro-economists' and explicitly models the unexplained household components (i.e. idiosyncratic household component, error term) using Geographical Information System technique. Using data from the fifth round of the Ghana Living Standard Survey and detailed maps of rainfall variability and soil types, the research attempts to model the heterogeneous household shock, provides a profile of the most vulnerable and also highlights the gains obtained from this approach. [146]

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EXTENDED ABSTRACT

INTRODUCTION

There is now convincing scientific evidence that climate change is occurring and that it poses important global risks (IPCC, 2007a). It has been shown that increases in human activities such as burning fossil fuels and changes in land use and land cover have raised the atmospheric concentrations of greenhouse gases (particularly carbon dioxide, methane and nitrous oxide) (IPCC, 1997, 2007b). Since 1900, the global mean temperature has already increased by 0.7ºC (Stern, 2006), which has a knock-on effect on other climatic and geographical phenomena.

Despite the effects of climate change being evident at a global scale, its negative impact will be more severely felt in developing countries, particularly by those communities highly dependent on natural resources and with limited capacity to cope with climate variability and extremes. Climate change increases the vulnerability of poor people by adversely affecting their health and livelihood, thus undermining economic growth opportunities (Hulme, 2001; Davinson *et al.,* 2003; Fields, 2005). The warming in Africa is expected to exceed the global mean temperature increase. Drier subtropical regions, such as Ghana, are expected to warm more than moister tropics. Given the droughts experienced by the Sahara, Sahel and Guinean Coast in the 1970s and 1980s, further drying and decreases in rainfall are most likely (IPCC, 2007b). A climate change scenario used by van Boxel (2004) indicates that there will be a temperature increase of about 1.5 to 2.5 ºC in Sub-Saharan West Africa.

The contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) concentrated their efforts to define vulnerability to climate change, highlighting the need to improve the definition and empirical research on vulnerability to climate change in Africa (IPCC, 2007b). This was

considered to be key in order to developed strategies for adaptation and mitigation of its adverse impact on the lives of the poor.

CONCEPTUAL FRAMEWORK AND PROPOSED METHOD

Although related, vulnerability and poverty are different concepts. Moser (1998:3) found that 'although poor people are usually among the most vulnerable, not all vulnerable people are poor'. Vulnerability is a dynamic concept, as it allows for changing processes and circumstances (Lipton & Maxwell, 1992; Moser, 1998). Chaudhuri, Jlan and Suryahani (2002) pointed out that vulnerability is the *ex ante* risk that households will be poor, if not so currently, and if they are currently poor, the risk that they will remain poor. Poverty is therefore an *ex post* measure of wellbeing, and vulnerability an *ex-ante* measure (Hoddinot & Quisumbing, 2003a, 2003b; Chaudhuri, Jlan & Suryahani, 2002; Christiaensen & Subbarao, 2001; Kamanou & Murduch, 2002). In a vulnerability framework, the poor are considered to be active agents, and interventions can build on those strengths. Measurements of vulnerability usually include both the sensitivity, which is the extent of the response, and the resilience, which is the ability to recover, of economic units to a shock (Ligon & Schechter, 2003; Kamanou & Morduch, 2002; Hulme *et al*. 2001).

Undertaking a vulnerability assessment can be complicated due to both the multiple definitions of vulnerability and the scarcity of data useable for measuring vulnerability. The feasibility of applying a particular approach is often dictated by data availability, and most analyses have had to rely on cross-sectional data (Hoddinot & Quisumbing, 2003b). A number of approaches for empirically measuring vulnerability to climate change are possible.

One approach is the sustainable livelihood framework, which provides a social-conceptual approach to examining the ways in which agricultural research and technologies fit into the livelihood strategies of households or individuals with different types of assets and resources (Adato & Meinzen-Dick, 2002). It recognizes that households and individuals may pursue multiple strategies, either sequentially or

simultaneously. It suggests the consideration of an asset portfolio of five different types of assets, which are natural capital, physical capital, financial capital, human capital, and social capital. Moser (1998, 2007) explained that the channels of resistance are the assets and entitlements that can be managed in the face of hardship, noting that 'Vulnerability is closely linked to asset ownership. The more assets people have, the less vulnerable they are, and the greater the erosion of people's assets, the greater their insecurity' (Moser, 1998: 3).

An alternative approach is used by micro-economists. It developed from an understanding of the difference between the concepts of vulnerability and poverty. The method explicitly models the unexplained household components (i.e. idiosyncratic household component, error term) in order to include an heterogeneous household shock (Elbers *et al.* 2002; Hoddinot and Quisumbing, 2003a, 2003b; Chaudhuri, Jlan and Suryahani, 2002; Christiaensen and Subbarao, 2001; Kamanou and Murduch, 2002). Chaudhuri, Jalan and Suryahadi (2002) noted that modelling the heteroskedasticity of the disturbance term has implication for the economic analysis. In other words each household has a different probability ('risk') to incur in a climate related extreme which does not depend only from the individual and household level characteristics but also depend on the characteristics of the which each household share.

This research aims to extend a methodology developed by 'micro-economists' and explicitly models the unexplained household components (i.e. idiosyncratic household component, error term) using Geographical Information System technique. Using data from the fifth round of the Ghana Living Standard Survey and detailed maps of rainfall variability and soil types, the research attempts to model the heterogeneous household shock, provides a profile of the most vulnerable and also highlights the gains obtained from this approach.

DATA

This research will use household level data on living standards from the fifth round of the Ghana Living Standards Survey (GLSS 5) 2005 collected from the Ghana Statistical service in collaboration with the World Bank. The GLSS 5 contains information on the demographic characteristics of household members, their reported health status, education, employment, housing, and income from wages, business activities, and agricultural production, and detailed records of consumption and expenditure data. Furthermore, parallel to the GLSS survey a community questionnaire was also administered to community leaders on services and infrastructures available in the population point.

In addition to these data, this research will use data on rainfall variability obtained from the Ghana Meteorological service and soil type obtained from LandSat image of the country.

METHOD- draft

Assessing household vulnerability to poverty from cross-sectional data

Adapted from Chaudhuri, Jlan and Suryahani, 2002:

$\ln c_h = \chi_h \beta + e_h$ (1)

e_h idiosyncratic shock that the household will experience in the future

the variance of e_h depend upon household observable characteristics distributed in some parametric way

$\sigma^2_{e,h} = \chi_h \theta$

this can be estimated with a 3 step Feasible Generalized Least Square (FGLS)

$\hat{E}\left[\ln c_h / \chi_h\right] = \chi_h \hat{\beta}$

$\hat{V}\left[\ln c_h / \chi_h\right] = \hat{\sigma}^2_{e,h} = \chi_h \hat{\theta}$

$$\hat{v}_h = \hat{P}r\left(\ln c_h \langle \ln z / \chi_h\right) = \Phi\left(\frac{\ln z - \chi_h \hat{\beta}}{\sqrt{\chi_h \hat{\theta}}}\right)$$

$\hat{v}_h$ is the probability that an household will be poor= vulnerability

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