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Response to climate risks among smallholder farmers in Malawi: A multivariate probit assessment of the role of information, household demographics, and farm characteristics

Chalmers Mulwa [a,*], Paswel Marenya [b], Dil Bahadur Rahut [c], Menale Kassie [d]

[a] Environmental Policy Research Unit (EPRU), University of Cape Town, South Africa
[b] International Maize and Wheat Improvement Centre (CIMMYT), Addis Ababa, Ethiopia
[c] International Maize and Wheat Improvement Centre (CIMMYT), Texcoco, Mexico
[d] International Centre of Insect Physiology and Ecology (ICIPE), Nairobi, Kenya

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ABSTRACT

Why do many smallholder farmers fail to adopt what appear to be relatively simple agronomic or management practices which can help them cope with climate-induced stressors? Using household and plot level data collected in 2011, we implement a multivariate probit model to assess the determinants of farmer adaptation behavior to climatic risks and the relative contribution of information, credit and education on the probability of adopting specific practices in response to adverse changes in weather patterns. We find that plot characteristics, credit constraints and availability of climate-related information explain the adoption of several of these practices. In relative terms, we also find that even when financial limitations are binding, making climate-related information available can still motivate farmers to adapt. Policy implications are that the deepening of extension access with information on the appropriate adaptation strategies is crucial to help farmers make adaptation choices. The need to foster credit markets for easy accessibility and affordability by farmers or otherwise strengthening access to assets is also important.

1. Introduction

1.1. Overview

In the face of climatic change, the ability of agrarian economies to adapt to these new challenges is crucial if such economies are to avoid long-term negative impacts and a diminished ability to develop (World Bank, 2013). For the most part, countries in SSA and some parts of Asia have the least capacity to cope with climate shocks and their negative environmental and human consequences. For example, India and Africa are projected to see reductions in agricultural output by 30% or more (Cline, 2007). The situation is worse in Africa where for a long time, agricultural production has performed unsatisfactorily especially when compared to Asia from 1961 to 2007 (Pretty et al., 2011).

* Corresponding author at: Environmental Policy Research Unit (EPRU), School of Economics, University of Cape Town, Private Bag X3, South Africa.
E-mail address: chalmers.mulwa@gmail.com (C. Mulwa).

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Agriculture, as a natural resource-based industry will be affected by climate change more than any other sector. Yet, much of the discourse on climate change has been on the mitigation of the causes of climate change like industrial CO_2 emissions (IPCC, 2007). With the current agreements on limiting carbon emissions not likely to stabilize concentrations of greenhouse gases in the atmosphere over the next few decades, it is projected that agricultural productivity may diminish further in some places (Di Falco and Veronesi, 2013; Mendelsohn et al., 1994). Taking adaptation measures at the farm level should thus be an integral part of the responses needed to deal with climate change and its consequences (Burton et al., 2002). Farmers need to change their practices to cope or adapt in the face of rapidly changing climatic conditions. Adapting to climate change entails taking appropriate measures to reduce its negative effects (UNFCCC, 2007). In the agricultural sector context, these measures include: changing crop or livestock enterprises, use of more or less of certain inputs, implementing new resource management practices, diversifying farming systems and sometimes diversifying into non-farm activities (Howden et al., 2007).

Assuming economic rationality, farmers will seek to balance the benefits and costs of these new actions demanded by changing climatic conditions (Antle, 2009). Before these economic benefits can be realized, farmers need to have the requisite information about these new methods. In addition, they must have access to resources with which to successfully implement them. Whether resource scarcity or information deficiencies are the more constraining factors remains an empirical issue. Finding the answer to that question has important policy implications. If resources, rather than information, is the issue, then the policy focus should be on credit availability and asset building programs. If information is the issue, then strengthening extension systems and information delivery to farmers should be prioritized.

In this study, we analyze the major factors that act as co-determinants of why farmers opted to use various practices in response to difficulties related to climate risks. This study specifically asked farmers to state which practices they had adopted in recent years to cope with recently-observed changes in weather patterns. Results showed that nearly 40% of the farmers had changed to planting drought-tolerant varieties and 27% had made it a practice to plant early. Further, 35% reported that they had now switched to pest- and disease-tolerant varieties due to increased disease and pest pressures, while 36% now planted more than one crop type. The simulated impacts from a multivariate probit model showed that while issues such as credit remain crucial, in relative terms, the availability of climate information had a large impact; as much as 45% on the probability of farmers implementing crop diversification as an adaptive measure. An extra year of primary schooling (raising the average years of schooling as observed in the sample by one year), increased the probability of using drought-tolerant varieties by about 30%. Without minimizing the role of resources in enabling adoption and adaptation, these results show that adaptation and coping with weather and climate changes among farmers is likely to be an information-intensive phenomenon. Extension and information delivery systems will be a crucial element to enable smallholder communities to adapt successfully.

1.2. Country background and agro-climatic situation

Rain-fed smallholder agriculture continues to dominate most economies of SSA. In Malawi, where over 74% of the population lives on less than 1.24 dollars per day (OECD, 2009), agriculture contributes over 39% to the GDP and employs about 85% of the country's entire labor force (Chirwa et al., 2008). The significant role of agriculture in the economy belies the fact that this sector faces a number of challenges. Decades of continuous cultivation like the predominant ridging practice coupled with inadequate use of capital (fertilizers, soil conservation, and mechanization) has led to a fragile production environment and stagnation in productivity (Denning et al., 2009). Low investments in soil fertility improvement and increasing climate variabilities over the last five decades have further compounded the problem, leaving the sector increasingly vulnerable (Binswanger-Mkhize et al., 2011).

There is evidence in the literature which strongly suggests that in recent decades adverse and extreme weather events such as droughts, floods, and dry spells have increased in frequency, intensity and magnitude, exacerbating rural poverty and threatening the sustainability of rural livelihoods (Ibrahim and Alex, 2009; Nangoma, 2007). Against the backdrop of rapidly changing weather conditions and the severity of the impact on poor subsistence farmers, it is urgent that the different options available to farmers to cope are documented. A good understanding of how these can be widely adopted is critical. This understanding includes the adaptation options that farmers may have access to, their perception towards these and the determinants to adopting them. Therefore, this study contributes to the emerging literature on agricultural technology adoption and its connections to adaptation to climate variability.

1.3. Climate change adaptation

Broadly, several climate change adaptation strategies are identified in the literature and include: 1) use of drought-tolerant crop varieties (hereinafter DT); 2) use of pest and disease tolerant (PDT) varieties; 3) a change in the timing of agricultural activities (early planting or EP); 4) diversification of crop enterprises (CD); and 4) investment in soil and water conservation technologies (SWC). Despite the documented benefits of these practices in reducing exposure to climate risks, their uptake has been slow in Malawi (Jain, 2007; Nhemachena and Hassan, 2007). It is still not clear why, faced with climatic risks, farmers are not implementing practices that appear to demand modest amounts of external capital. Other than SWC, which may require increased amounts of labor, the other practices (DT, PDT, EP and CD) do not require large adjustments. Taking into consideration the expected benefits, the costs of such adjustments may well be justified.