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## **Welfare impacts of livelihood diversification strategies in response to rainfall variability - A case study of Northern Ghana**

**Sarah Redicker**, Roshan Adhikari, Thomas Higginbottom, Ralitza Dimova, and Timothy Foster  
(sarah.redicker@manchester.ac.uk)

More than 70 percent of West Africa's (WA) poor live in rural areas and depend largely on rain fed agriculture for food production and income generation. The livelihoods of farmers are threatened not only by long-run climate variability but also by seasonal extreme weather events that can reduce yields and increase agricultural income uncertainties. Low adoption levels of improved agricultural technologies and poor soil qualities further increase farmer vulnerability to rainfall variability. Therefore, the impacts of changes in rainfall patterns and rainfall intensity are severe and can result in the loss of income sources poverty and even food insecurity.

To mitigate against losses from these events, farmers in the region engage in several risk diversification strategies. For rural areas where adoption options are limited, diversification of agricultural production or engagement in off-farm work are the most viable options. However, governments and donor agencies pursue other strategies such as agricultural intensification through irrigation development to prepare for increased impacts of climate change. Engagement in year around irrigated agriculture can however, potentially limit farmer's ability to participate in further risk diversification strategies, especially if these involve off-farm strategies.

A considerable amount of literature has looked at how access to irrigation benefits farmer livelihoods. However, research on this subject has been mostly restricted to benefits of dry season irrigation and impacts of irrigation in overcoming dry spells. What is not yet clear is the benefit of irrigation to overcome effects of irregular rainfall, such as late onset of rainfall in the rainy season and implications for the agricultural income and further risk diversification strategies. This paper seeks to remedy these problems by analysing whether irrigation provides enough security and agricultural income to justify that farmers focus on agriculture as main economic activity and engage in year round farming.

We address this research question in three steps. First we ask how farmers in the region are impacted by rainfall variability. We combine household survey data (n=646) with information collected in focus group discussions and climate data from a case study from North Ghana. Second, we use a two-stage regression analysis to estimate what factors affect smallholder's decisions to adopt different risk diversification strategies across different strata of irrigation access. In the second stage, we estimate the causal relationship between diversification strategies and household welfare as measured in crop income. This study offers some important insights into applied risk diversification strategies across heterogeneous farmer groups, potentially helping

to understand why so many irrigation initiatives have not been successful in involving local farmers in extensive and all year round irrigated agriculture. The comparison of drivers and constraints of diversification strategies across irrigation typologies enables us to value the worth of irrigation for smallholder households in the context of on-farm and off-farm incomes. Additionally, the combination of climate data and targeted questions in the household survey enables us to understand what seasonal rainfall events pose a risk to livelihoods and how frequently they are encountered.