A Living from Livestock
Pro-Poor Livestock Policy Initiative

Poverty Mapping in Uganda: An Analysis Using Remotely Sensed and Other Environmental Data

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EXECUTIVE SUMMARY

In order to target poverty reduction we need to understand, describe and explain its spatial distribution and be able to predict the degree and distribution of poverty in other regions and/or at other times. Poverty maps should therefore incorporate potential driving factors that in some way or other are associated with, and possibly even responsible for the different levels of poverty being mapped. In this analysis we start from two assumptions: a) poverty is a function of several interlinked factors, including agricultural activities, human and animal diseases, natural resources and other environmentally-determined factors; and b) many important characteristic of the environment can be described by earth-observation satellite imagery, through their ability to capture seasonal variations of a range of environmental factors.

In this analysis we explore a novel approach in which we combine household survey data with a suite of environmental variables that are either direct measures of key climatic variables (such as temperature), descriptor variables of key ingredients of poverty-generating processes (such as agricultural production systems) or proxies for constraints on the health and well-being of the human populations (such as disease-causing pathogens).

Predictions were made using a Discriminant Analysis model, in which a poverty index was estimated by the likelihood of each pixel falling within a specified "poverty" class, based on the combination of values of the predictor variables. The poverty data were derived from breakdowns of food expenditure from the 2002-2003 Ugandan National Household Survey, which covered 9,711 households in 973 communities. The predictor variables included available raster datasets: elevation, cultivated land, length of growing period, population distribution, livestock density, market accessibility (calculated as time to travel to a population centre of a certain size), and tsetse distribution; and a set of Fourier-transformed time series satellite data, derived from the Advanced Very High Resolution Radiometer, including the mean, minimum, maximum, variance, phases and amplitudes of parameters like Normalised Difference Vegetation Index, Land Surface Temperature, Air Temperature, Vapour Pressure Deficit and Cold Cloud Duration.

The analysis was performed at different spatial resolutions, ranging from 0.01 to 1 degree (approximately 1.1 km and 110 km at the equator). The overall model accuracy tended to increase with decreasing spatial resolution. Satellite-derived variables tended to dominate the list of selected variables that determine the predictions, but different predictor variables tended to be selected by the model at different spatial resolutions.

This method is appealing because it can produce estimates of the same poverty measures as those produced by the more traditional small area mapping methods, as well as an indication of the degree of statistical precision of the estimates. Work in progress will make direct comparisons between these two approaches. These preliminary results show that external, independent data appear to have at least as much descriptive power for poverty mapping as the internally correlated

socio-economic data sets exploited by the small area estimates, though the precise interpretation of the correlations obtained here will require more research effort.