Introduction

Rogers *et al.* (2006) showed how the spatial pattern of household expenditure in Uganda could be described in terms of environmental data derived largely from remote sensing. This approach differs considerably from the Small Area Estimate (SAE) technique (Hentschel *et al.* 2000; Elbers and Lanjouw 2000; World Bank 2000), which exploits correlations between socio-economic data collected from detailed household surveys and those collected from housing and population censuses. In the environmental approach the same household survey data are linked, not to census data but instead to environmental data, which are more likely to be representative of factors that cause poverty (agricultural potential, for example) than those that merely reflect it (type of housing, for example). If the sole objective were to map poverty in greater detail than that offered by the household surveys, then the only important criterion by which to compare approaches would be the spatial resolution and accuracy of the predictions. If, however, our objectives go beyond describing the distribution of poverty, and look towards explaining that distribution, then we must turn to more fundamental explanatory variables in our statistical analyses. The underlying assumption in the environmental approach is that people are poor because their environments fail, in some way, to provide the goods and services that are available to those who are less poor.

Such an environmental approach can only be relevant where people are likely to be largely dependent for their livelihoods and welfare on the environment close to where they live, such as in subsistence agricultural systems, where external inputs are minimal or lacking. In Uganda, where 88 percent of the population live in rural areas, the agricultural sector is the main source of livelihoods, employment (73 percent of all employment in 2005/06), and food security (Fan *et al.* 2004); most industries and services in the country are dependent on it (UBOS 2009). Throughout the country, smallholder production predominates, with bananas, cereals, root crops and oil seeds being the main food crops. Some 40 percent of the rural population lives below the poverty line, accounting for 95 percent of the poor in the country as a whole. It follows, therefore, that Uganda provides an appropriate context for environmental poverty mapping, an idea borne out by the results presented in Rogers *et al.* (2006) and Robinson *et al.* (2007).

In the present analysis the extent to which spatial data from remote sensing and other sources are correlated with household survey data is further examined, with the ultimate aim of exploring whether the correlates of poverty vary in different parts of the country. For each geo-referenced rural household with expenditure data in the 2002 household survey corresponding values were extracted from a suite of environmental variables, whose selection was based on the results of previous studies (Rogers *et al.* 2006; Robinson *et al.* 2007; Pozzi and Robinson 2008; Pozzi *et al.* 2009; Rogers *et al.* 2011), and on exploratory analyses described here.

As a bench mark a single Ordinary Least Squares (OLS) regression model was developed for the entire country. The effects of zoning were explored by developing different OLS models for different aggregations of livestock production sys-

tems. Finally, Geographically Weighted Regression (GWR) was used explicitly to model the spatial variation and scale dependency of the regression coefficients.

In the following section, below, some of the factors associated with rural poverty in Uganda are discussed. There follows a description of the datasets and statistical methods used. The results are used to explore issues of scale and methodological accuracy and are compared with the SAE results using the same household data. The final section draws conclusions and suggests how the environmental approach to poverty mapping may be taken forward.