Spatial Analysis of ‘Food Poverty’ in Ecuador

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Abstract

Almost one fifth of Ecuador’s inhabitants are undernourished[2] and over a quarter of children under 5 years of age are affected by chronic under nutrition[2]. This situation is deteriorating. Ecuador has been ‘dollarised’, privatised and decentralised, and due to El Niño related floods and the economic crises of the past five years poverty has increased by 50% and now afflicts three-quarters of Ecuador’s population[3,4].

In this study we identify the lack of access to food within Ecuador and search for linkages between ‘food poverty’ and the spatial dimensions of the wider socio-economic and biophysical environment. We add value to existing studies by analysing explicitly the role of environment, access, distance and spatial structure in poverty and food security.

We aim to assist a variety of institutions in targeting both their resources and their research, particularly the capacity of the Ecuadorian government to design policy or development interventions necessary to improve food security.

‘Food Poverty’ hotspots

Food consumption in Ecuador is non-random and displays spatial patterns or ‘hot spots’ of worse than average values of the ‘food poverty’ headcount ratio. In an analog with disease mapping we use the Geographical Analysis Machine (GAM) [6] to find clusters of parroquias where the food poverty headcount ratio is significantly different from the expected (global) incidence at multiple scales (Figure 2).

Determinants of ‘Food Poverty’

We produced a national level linear stepwise regression model which produced poor results with low adjusted R² values. To improve the predictive power of the model we split the data to represent three biophysical and cultural regions: costa, sierra and oriente. Our dependent variables are estimations rather than observations. We have therefore run simulations of the regression models randomly adding or subtracting a percentage of the standard error to the dependent variable (Table 2).

Spatial Analysis of ‘Food Poverty’

Spatial structure of food consumption in Ecuador is not random. We use the area centroids of each parroquia in continental Ecuador to create semi-variograms to explore the spatial variation of food consumption.

Changes in ‘Food Poverty’: 1990-2001

Comparison between 1990 and 2001 data shows that the number and location of food poverty ‘hot spots’ have both changed (Figure 2). The spatial pattern of change shows clearly that the proportion of food poor has deteriorated mainly in the coastal provinces, and most dramatically in the north-western province of Esmeraldas (Figure 3). These areas were seriously affected by heavy rains during the 1997-98 El Niño event (Figure 4). The results of a y² test of association between parroquias that have deteriorated and those that suffered losses due to El Niño show the association is highly significant and support our hypothesis that deterioration in food poverty is associated with the effects of El Niño.

We have observed that national values of correlation mask the spatial structure of food poverty. Figures 5-7 show the spatial variation of correlation [9] between access to markets and the 2001 Food Poverty headcount ratio.

Geographically Weighted Regression [12]

Instead of 8 independent variables (as in Table 2) we have included all 12 that entered the models for the costa and sierra regions. The adjusted R² for the global model is 0.44, this improves to 0.61 when we use geographical weights. Figures 8 - 9 show the spatial variation in the regression coefficients. The maps show in green those areas where the variable has greater power of determination than in the global regression. Areas in blue are where the variable has less power of determination and areas in red show where the variable has an inverse power of determination.

Dissemination

A web-site http://www.ecuadormapalimentaria.info has been created in collaboration with the Ecuadorian network of food security projects (REDPESA). The web site allows users to view the data produced during this study using ESRI ArcIMS software (Figure 10). These data and complete metadata can also be downloaded from the website.

http://povertymap.net