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MAPPING WHERE THE POOR LIVE

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A key consideration in planning action to assist poor and hungry households is simply to have a good understanding of where they live and the characteristics of those locations. For the past 10 years, poverty researchers at the World Bank, IFPRI, and other organizations have worked with local analysts to produce detailed poverty maps for more than 30 countries. Such maps provide estimates of the incidence and severity of poverty for relatively small areas—such as at the subdistrict and even community levels—and enable the user to better understand the spatial distribution of the poor and to investigate the relationship between poverty and other geographic factors. Knowledge of where the poor and hungry live and of the manner in which those locations are connected (or not) to other locations can provide key insights for action to address poverty and hunger. In this brief, the poverty maps developed for Vietnam, Malawi, and Mozambique are used to demonstrate how a better understanding of the spatial distribution of the poor and hungry deepens awareness of how they live and provides a fuller appreciation of the challenges they face in seeking to live healthy and active lives and to realize their full human potential.

Policymakers and researchers are interested in the spatial distribution of poverty for several reasons. First, poverty maps synthesize a large amount of information on the spatial distribution of poverty in a format that is easy for the nontechnical reader to understand. Broad national or regional poverty measures may hide stark differences in welfare levels within a country or region. Detailed poverty maps provide a clearer picture of how poverty levels vary across a country. In time, as more countries develop a series of comparable small-area poverty maps for different years, an examination of trends in poverty at the local level will provide a better understanding of where poverty reduction strategies have and have not proven successful, prompting modifications so that the strategies can be made more effective.

Second, knowledge of these patterns facilitates the targeting of programs designed, at least in part, to reduce poverty. Many countries use some form of geographic targeting for government programs that provide the poor with services such as credit, food aid, input distribution, health care, and education. The efficiency and cost-effectiveness of many of these programs is enhanced by targeting them to areas where more of the poor reside.

Third, the patterns of a country's distribution of poverty (as seen in the maps) provide a starting point for investigating the geographic factors associated with poverty, such as access to markets or other public services, climate, or topography. When examining a detailed poverty map, most map readers immediately ask why poverty levels are high in some areas and low in others. A range of analytical techniques have been used with poverty maps to investigate the spatial determinants of poverty. A better understanding of the geographic factors associated with poverty will allow for the development of poverty reduction strategies that focus on modifying those factors, thereby enabling households living in poor areas to improve their standard of living.

How Are Poverty Maps Generated?

Until recently, maps of the incidence of poverty were generated from household survey data, but this approach usually generates poverty rate estimates for a limited number of provinces or states. About 10 years ago, researchers developed a method to produce much more detailed poverty maps by combining census and household survey data (see Box 1). This new approach generates estimates of poverty and inequality for hundreds or even thousands of administrative units within a country, allowing for the creation of high-resolution maps of poverty and inequality. It is important to note that poverty mapping analysis generally does not involve the collection of new data. Rather, it makes use of existing survey and census data, the latter being an often underexploited source of information on spatial patterns in a country.

As an example of the results of such an analysis, Figure 1 shows a map of the incidence of poverty from the poverty mapping exercise for Malawi. This map was based on analyses of the 1997–98 Integrated Household Survey (IHS) and the 1998 Population and Housing Census. The initial poverty analysis of the IHS alone permitted poverty measures to be calculated for only the 28 districts and four urban centers of the country. In contrast, this map provides poverty information for approximately 360 subdistrict administrative units. Considerable heterogeneity in poverty levels within districts can be seen.

Box 1—Methods for Constructing a Poverty Map

The most common way that poverty is measured for policy and monitoring purposes is by comparing the value of per capita expenditure (including cash expenditure for consumption, the value of food produced for own consumption, and the value of owner-occupied housing) against a poverty line. Various poverty measures for a population can be computed based on the distribution of consumption in that population relative to the poverty line, the most common of which is the incidence of poverty, also called the headcount ratio. Traditionally, information to determine the distribution of consumption has come from household income and expenditure surveys. These national surveys generally have sample sizes of 2,000 to 6,000 households, which typically allow estimates of poverty for just 5 to 15 regions within a country.

The only household information that is regularly collected in most countries that would allow for much finer estimates of local conditions comes from the population and housing census, usually conducted every decade. However, census questionnaires are generally limited to household characteristics and rarely include the questions on income or expenditure that would be necessary to examine poverty directly.

The new approach involves two steps. First, household survey data are used to econometrically estimate the relationship between per capita expenditure and household characteristics such as age and sex composition, educational attainment, occupation, housing characteristics, and asset ownership. Second, census data on those same household characteristics are inserted into the regression equation to generate estimates of per capita expenditure for each household in the census. The estimates for each household are unreliable, but when aggregated over several thousand households, they yield relatively precise estimates of various measures of poverty and inequality. These estimates are then mapped using geographic information systems software. An important feature of this method is that standard errors for the poverty and inequality measures are also computed, enabling users to have some idea of how accurate the estimates are.

The World Bank has developed a software program called PovMap to automate much of the analysis, reducing the time and technical skills needed to carry out this type of study. PovMap requires that the user identify the household characteristics to be used to predict expenditure, specify the names of key files and variables, and choose among a number of analysis options. The output consists of estimates of poverty and inequality for each geographic unit, as well as the standard errors for each (see <http://iresearch.worldbank.org/PovMap>).

Another example can be seen in Figure 2, which shows poverty maps for Vietnam. This analysis, based on the 1997–98 Vietnam Living Standards Survey and the 1999 Population and Housing Census, shows that the incidence of poverty is highest in the remote areas of the northeast and northwest regions, the upland areas of the north central coast, and the northern part of the central highlands. Poverty rates are intermediate in the Red River and Mekong River deltas. The lowest poverty rates are found in the principal cities of Hanoi and Ho Chi Minh City, in other urban areas, and in the southeast region. However, an analysis of the density of poverty, as seen in the map at right in

Figure 2, shows that most of the rural poor live in the lowland deltas. In the deltas, the incidence of poverty is relatively low but the absolute number of poor people is high due to the high population density.

Using Poverty Maps for Policy and Program Design

This section presents several examples from Vietnam, Malawi, and Mozambique of how poverty maps have provided new insights to guide poverty reduction strategies. Such maps provide a better understanding of the relative significance of spatial factors in accounting for the distribution of poverty in a country and how those factors might modify approaches taken to reduce poverty.

Many antipoverty programs are geographically targeted in Vietnam. However, by showing the difference between areas where the prevalence of poverty is high and areas where the density of poverty is high, the two maps in Figure 2 highlight a key element to be considered in the targeting of such programs. Programs that concentrate exclusively on areas with high poverty rates will not reach the majority of the poor, since the majority live in areas in which there are also many nonpoor households.

These findings are not unique to Vietnam. In almost every case where it has been examined, the incidence of poverty is highest in areas with low population density, implying that, in many countries, the majority of the poor do not live in the poorest areas.

The poverty mapping analysis for Mozambique highlights the limitations of geographic targeting of poverty reduction programs in that country. The authors of the study, Simler and Nhate, note that while there is much to recommend geographic targeting—it is less costly to administer than household- or individual-level targeting and it allows programs to be tailored to the specific conditions of an area—it is not sufficient in itself for targeting for poverty reduction purposes in Mozambique. The “poor areas” of the country contain significant numbers of nonpoor. An analysis of the consumption inequality measures from the Mozambique poverty map showed that of the total inequality in the country, about 85 percent occurs within districts; differences between districts account for only about one-sixth of the total variance in per capita consumption. Because the most local administrative unit in the country—the administrative post—is so heterogeneous in terms of household welfare, with poor and nonpoor living in close proximity, it is unlikely that there will be significant efficiency gains realized from targeting poverty reduction programs exclusively by administrative post. This finding that much of the income inequality in developing countries exists within small administrative units such as villages and towns is common across poverty mapping studies. This suggests that in many countries, programs that treat all households or individuals within an area equally in terms of their

welfare level will likely result in large targeting errors by providing benefits to many nonpoor or by failing to provide benefits to the poor who live in less poor administrative posts.

Poverty maps have also been used to investigate the geographic factors associated with poverty in several countries. In rural Malawi, spatial regression models were used to estimate the incidence of poverty for about 3,000 small, spatially defined populations as a function of about two dozen independent variables. The results indicated that the poverty rate is positively related to the dependency ratio and is an indicator for matrilineal inheritance patterns, and is negatively related to the average maximum educational attainment in households, crop diversity, and nonfarm employment.

Similarly, the district-level poverty map for Vietnam was used to explore the importance of topography, soil type, land cover, climate, and access to urban areas in explaining rural poverty (Figure 3). Average slope (or variation in elevation) was more important than elevation per se. Poor soils (rocky, salty, sandy, or acid sulfate soils) were positively associated with poverty. And distance to small towns of 10,000 inhabitants was more closely related to poverty than was distance to medium-sized towns (100,000 inhabitants) and distance to cities (1 million inhabitants). This highlights the important role of local infrastructure—such as local markets, health care facilities, and schools—in poverty reduction.

An additional analysis using commune-level poverty rates for Vietnam highlighted the importance of sociocultural differences, such as language barriers or other cultural distinctions. The results provide strong evidence that remoteness is a considerably weaker determinant of poverty than is the ethnicity of a household. Language barriers, for instance, might prevent an ethnic minority family from completing the paperwork required to obtain credit or from purchasing appropriate drugs at a pharmacy, even if the travel time to a bank branch or a pharmacy is minimal. The broad spatial patterns of poverty are largely due to the spatial distribution of the ethnic minority populations, and to a much lesser extent to spatial patterns in terms of physical accessibility or other overtly spatial factors. These results suggest that development policies aimed at balancing welfare levels across subpopulations require an increased emphasis on the targeting of specific population segments within an area.

Finally, poverty maps have also been shown to be valuable for prioritizing the allocation of resources across local government units. The maps provide governments and their development partners with necessary information to ensure that those areas that most need resources receive the highest priority. One way in which this was done for Mozambique was to calculate the aggregate poverty gap between current conditions and a hypothetical state in which poverty is eliminated. The size of the aggregate increase in income perfectly targeted to the poor that would be necessary so that each

person currently below the poverty line exactly reaches the poverty line was calculated. This increase could come from economic growth, a transfer program, or some other means. In 1996–97, the national poverty gap for Mozambique totaled US\$2.3 million per day. The share of the total poverty gap that can be attributed to each of the 424 administrative posts of the country is presented in the map in Figure 4.

Future Directions in Poverty Mapping

Poverty mapping methods are being extended in several ways. First, studies in Cambodia and Tanzania have estimated the probability of child stunting or child wasting (instead of per capita expenditure), leading to the creation of high-resolution maps of the incidence of child malnutrition. Preliminary results suggest that these maps are less accurate than poverty maps because it is more difficult to “predict” malnutrition using household characteristics, but they merit further attention.

Second, studies in Malawi, Vietnam, and elsewhere have used “geographically weighted regression” with poverty estimates for small areas to examine whether the relationship between measures of poverty and the demographic, social, economic, or agroecological characteristics of those locales may vary across a country. Preliminary results indicate that such relationships do vary significantly from one area to another. One implication of this finding is that programs that address the causes of poverty need to be tailored to local conditions rather than being uniform across the country.

Third, a study of Tanzania applied a variation of the poverty mapping method to examine trends in poverty over time by applying the prediction equation to household characteristics in four comparable surveys carried out from 1999 to 2003. Although this approach avoids some problems in measuring changes in poverty by comparing household budget surveys (mainly, the problem of adjusting values for inflation), it does assume that the relationship does not change over time, an assumption that requires further testing.

Conclusion

An important objective of poverty mapping analyses is to promote well-informed debate on poverty and welfare inequalities in a country and what should be done about them, based on reliable data and objective and transparent analyses. Poverty maps provide a considerably more detailed understanding of the distribution of poverty in a country than was previously available for many countries. In spite of their many strengths, however, it is also important to be aware of their limitations. Several are listed here.

- As with the results of all quantitative analyses, poverty maps are subject to errors, such as arise from poor quality in the underlying data, from poor choices in the selection of model components, or in computations. Moreover, the

analyses required to create poverty maps require more than a basic understanding of econometric techniques. While this is a capacity problem, it also poses a problem for using the maps in policy processes and program design, since decisionmakers are unable to confidently use the poverty map estimates of poverty because they often are not clear on how they were derived.

- Since poverty maps typically are dependent upon national censuses, which generally are conducted only once a decade, poverty maps provide a static understanding of the spatial distribution of poverty. Poverty maps are not very useful for understanding short-term poverty dynamics within a country.
- Particularly when using consumption- and expenditure-based household welfare measures, it is difficult to create international poverty maps. The surveys of each country or the manner in which poverty rates are computed from household income and expenditure surveys renders it very difficult to develop fully compatible data sets that encompass several countries from which to develop poverty maps.

Poverty maps can provide important new insights on the spatial distribution of welfare,

poverty, and inequality within a country at quite a high level of detail. Moreover, these measures are presented in an objective manner that includes information on the potential range of error in the estimates. However, a broader perspective on their use should be adopted. Given their limitations, it is best to use poverty mapping results for policy formulation and program design alongside a range of other information on poverty and welfare. Doing so both provides a fuller understanding of poverty in its multiple dimensions—going beyond the consumption- and expenditure-based definition used in the maps—and serves to triangulate the accuracy of the poverty mapping results.

For Further Reading: Center for International Earth Science Information Network (CIESIN), *Where the Poor Are: An Atlas of Poverty* (New York: Columbia University, 2006) <<http://sedac.ciesin.org/povmap>>; C. Elbers, J. O. Lanjouw, and P. Lanjouw, *Micro-Level Estimation of Welfare*, Policy Research Working Paper WPS 2911 (Washington, DC: World Bank, 2002); N. Minot., B. Baulch, and M. Epprecht, *Poverty and Inequality in Vietnam: Spatial Patterns and Geographic Determinants*, IFPRI Research Report No. 148 (Washington, DC: IFPRI, 2006); T. Benson, J. Chamberlin, and I. Rhinehart, "An Investigation of the Spatial Determinants of the Local Prevalence of Poverty in Rural Malawi," *Food Policy* (Vol. 30, 2005); and K. R. Simler and V. Nhate, *Poverty, Inequality, and Geographic Targeting: Evidence from Small-Area Estimates in Mozambique*, Food Consumption and Nutrition Discussion Paper No. 192 (Washington, DC: IFPRI, 2005).

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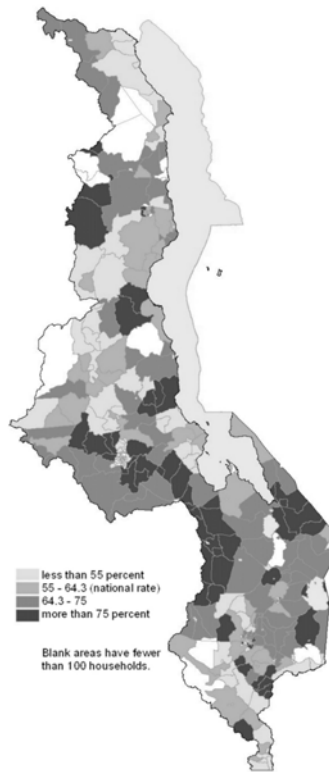
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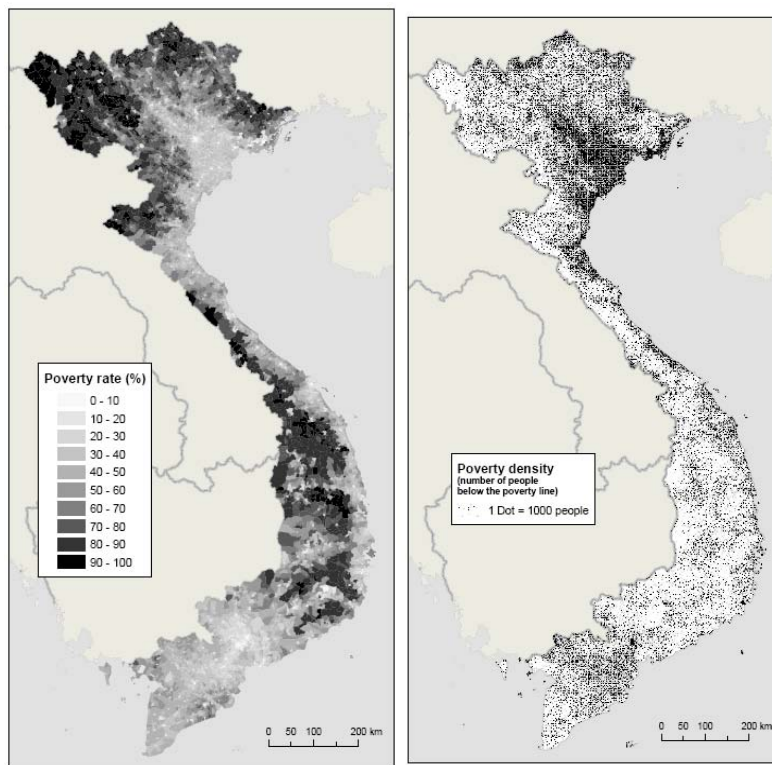
Figure 1—Malawi: Poverty Headcount at Traditional Authority Level, 1997–98



Source: T. Benson with J. Kaphuka, S. Kanyanda, and R. Chinula. 2002. *Malawi: An Atlas of Social Statistics*. Washington, DC, and Zomba, Malawi: IFPRI and National Statistical Office.

Note: Color versions of the figures in this brief can be accessed at <http://www.ifpri.org/2020chinaconference/pdf/beijingbrief_bensonmaps.pdf>.

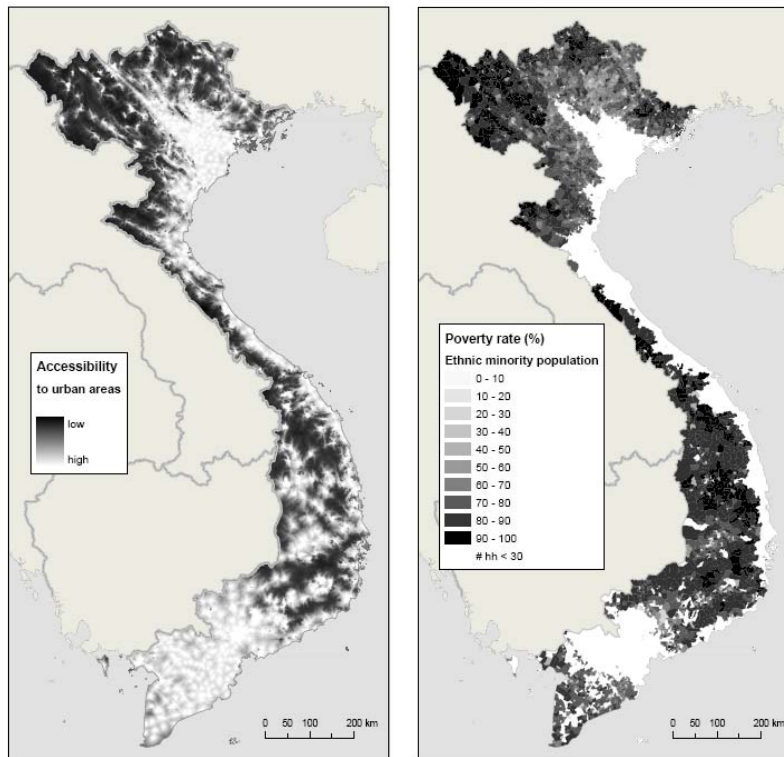
Figure 2—Vietnam: Poverty Headcount at Commune Level and Density of Poverty, 1999



Source: M. Epprecht and A. Heinimann, eds. 2004. *Socioeconomic Atlas of Vietnam: A Depiction of the 1999 Population and Housing Census*. Berne: Swiss National Centre of Competence in Research (NCCR) North-South, University of Berne.

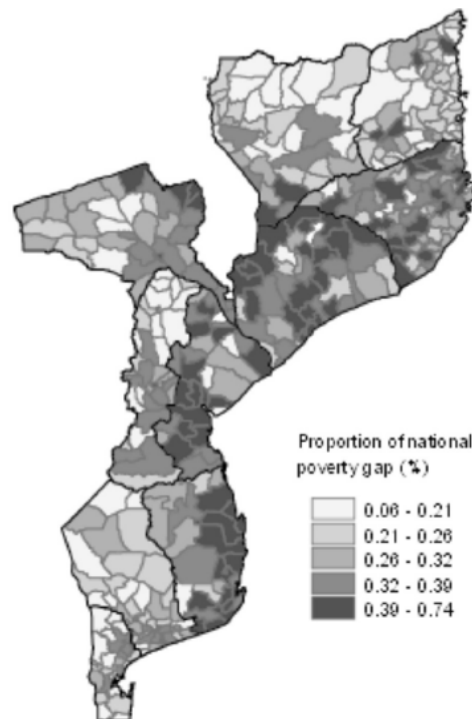
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Figure 3—Vietnam: Accessibility to Urban Areas and Poverty Headcount of Ethnic Minorities at Commune Level, 1999



Source: M. Epprecht and A. Heinemann, eds. 2004. *Socioeconomic Atlas of Vietnam: A Depiction of the 1999 Population and Housing Census*. Berne: Swiss National Centre of Competence in Research (NCCR) North-South, University of Berne. Note: Color versions of the figures in this brief can be accessed at <http://www.ifpri.org/2020chinaconference/pdf/beijingbrief_bensonmaps.pdf>.

Figure 4—Mozambique: Percentage of Total Poverty Gap by Administrative Post, 1996–97 (\$2.3 million/day)



Source: K. R. Simler and V. Nhate. 2005. *Poverty, Inequality, and Geographic Targeting: Evidence from Small-Area Estimates in Mozambique*. Food Consumption and Nutrition Discussion Paper No. 192, Washington, DC: IFPRI. Note: Color versions of the figures in this brief can be accessed at <http://www.ifpri.org/2020chinaconference/pdf/beijingbrief_bensonmaps.pdf>.