

Poverty maps are one place to begin. Technological advances of the past decade²² the increased capability to both collect and process improved data-make it possible to reveal the face of the poor in finer detail than ever before. By translating data into the visual accessibility of a map, we can locate poverty more precisely, understand its sources more comprehensively—and attack it more effectively. Such maps can even be used to monitor the results of anti-poverty efforts.

Poverty maps can be part of a strong, new foundation for building and tailoring policies and programs, to reach those people that will benefit the most.

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WHERE THE POOR ARE AN ATLAS OF POVERTY

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CIESIN (Center for International Earth Science Information Network) The Earth Institute at Columbia University New York

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FOREWORD

Mapping poverty is not a new idea. Well over a century ago, Charles Booth produced remarkably detailed maps showing wellbeing and social class differentials in London, using data gathered by visiting every single street in the city over a period spanning almost two decades. Receiving wide press coverage in the 1890s, these maps informed a policy debate that contributed to the eventual establishment of poverty-targeted safety net programs. Detailed spatial representations of various wellbeing indicators have long since become ubiquitous and are popularly known as "poverty maps." However, not until recently have detailed maps of some key current development policy indicators, such as income poverty and malnutrition measures, become widely available.

Many key development indicators, including income poverty and malnutrition incidence, can generally be measured only by administering detailed household surveys to carefully designed statistical samples of the population. As such, these critical indicators can only be measured with sufficient accuracy at the country level and large regions within countries. While critical for economy-wide and cross-country assessments, the aggregate spatial scale of these indicators becomes limiting in the context of decentralized policy making and within-country targeting of development efforts.

Recognizing this demand, economists in the World Bank's Development Economics Research Group recently explored adapting statistical techniques to generate geo-referenced databases containing small area estimates of income poverty and malnutrition. These techniques are implemented by combining detailed household sample survey data with the complete coverage provided by decennial population census data. In using existing data, this approach does not require purposively completing detailed questionnaires in every single rural community and city block. The approach is therefore feasible, relatively cheap, and quick to implement. And, unlike some approaches, the statistical precision of the estimated indicators generated by this method can be assessed. These statistical developments have coincided with a decade of rapid technological advances in GIS (Geographic Information Systems), and it has now become costeffective to scale up digitization of administrative, agro-climatic, and topographic boundaries in many countries. This has enabled the integration of geo-referenced databases of small area estimates with digitized maps. This atlas brings together a varied collection of maps from many continents and countries, depicting small area estimates of vital development indicators at unprecedented levels of spatial detail, and discussing their many potential uses. It is one output of an important collaboration between CIESIN and the World Bank to assemble and integrate a wide range of spatial data on poverty and related factors. It is my hope that by demonstrating that these critical development indicators can be estimated and mapped at highly disaggregated levels of geographic detail, the new information represented by this atlas can inform today's development policy debate and contribute to enriching our toolkit to measure and fight poverty.

This atlas marks a milestone in an ongoing process. World Bank researchers continue to refine small area estimation and gauge its validity and precision. Along with development practitioners, they are also part of a global team exploring innovative ways in which to use these maps in designing, monitoring, and evaluating development programs. I hope that, like me, you will find this atlas interesting and inspiring.

Shander Boochee

Shaida Badiee Director, Development Data Group The World Bank Spring 2006

PREFACE

This new compendium of poverty maps will be a major spur to improved understanding of global poverty and better solutions to end extreme poverty. CIESIN, working closely with The World Bank and other partners, has collected a vast amount of spatially referenced data on three key aspects of extreme poverty—hunger, child survival, and income poverty—and has done so at four critically important scales: global, continental, national, and local.

The results are not only visually stunning but also important in at least two distinct ways. First, the new poverty mapping allows us to test hypotheses about the underlying causes of poverty. The overlay of poverty and elevation in the Ecuador maps, for example, reveals a striking relationship between higher elevation and higher poverty rates, indicating that higher elevation may be impeding some aspects of economic development (e.g., transport and trade), and is perhaps also correlated with other social divisions in the country (e.g., along ethnic lines). The overlay is a first step towards a deeper structural analysis of that country's underlying poverty dynamics. Similarly, the comparison of the percentage of underweight children and the agroecological zones in Africa highlights the extreme vulnerability of the pastoralist and agrosilvopastoralist communities. The maps show, in general, the roles of distance, topography, disease ecology, climate zones, and other geographical features in the location and extent of poverty.

Second, the maps allow a better targeting of policy actions. The Earth Institute has used the underweight data and the agro-ecological maps to identify intervention sites for its Millennium Village Project, which is targeting poverty-reduction strategies for each major agro-ecological zone in continental sub-Saharan Africa that contains a "hunger hotspot." Poverty mapping is also serving to raise awareness among donors of financing needs to meet the Millennium Development Goals (MDGs). Similarly, poverty maps are already facilitating the creation of MDG-based national development strategies in several focus countries of the UN Millennium Project, including costing and needs assessments of key interventions by sub-national regions.

I wish to take this opportunity to congratulate the CIESIN mapping team and to thank all of the partners of the Earth Institute, most notably The World Bank and the Government of Japan, for their generous assistance and cooperation in this pathbreaking effort. I am confident that the publication of this atlas and the other work undertaken through this collaboration will spark further activities along these lines, and improved analysis and policies in the future.

Jeffrey D. Sachs The Earth Institute Spring 2006

ACRONYMS AND ABBREVIATIONS

CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
DECRG-PO	The World Bank Development Economics Research Group, Poverty Cluster
DFID	UK Department for International Development
FISE	Fondo de Inversión Social de Emergencia (Emergency Social Investment Fund—Nicaragua)
GDP	Gross domestic product
GIS	Geographic Information Systems
IFAD	International Fund for Agricultural Development
ILRI	International Livestock Research Institute
INE	Instituto Nacional de Estadística (National Statistical Institute-Spain)
IRRI	International Rice Research Institute
МОР	Council for Social Development of Ministry of Planning—Cambodia
OMS	Organización Mundial de la Salud (World Health Organization)
OPS/PAHO	Organización Panamericana de la Salud (Pan American Health Organization)
SIDA	Swedish International Development Cooperation Agency
UDAPE	Unidad de Análisis de Politicas Sociales y Económicas (Department of Economic and Political Science Analysis—Bolivia)
UNDP	United Nations Development Programme
WFP	World Food Programme

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The atlas was generated by a core team at CIESIN, including Bridget Anderson, Deborah Balk, Melanie Brickman, Marc Levy, Maria Muñiz, Randolph Pullen, and Adam Storeygard; with assistance from James Connolly, Janina Franco, Brian Kauffman, Jennifer Korth, Valentina Mara, Laura Pisoni, Allison Smith, and Shane Taylor. For production assistance, thanks to Maureen Anders, Penny Mitchell, and Mary Pasquince of The Earth Institute.

We are grateful to Makiko Harrison, The World Bank, for her editorial guidance and for her help developing the text on poverty maps implementation. Warm thanks to our colleagues in the international community who responded with examples of implementing poverty maps: Dave Hodson, CIMMYT; Glenn Hyman, CIAT; Wilson Jimenez, UDAPE; Ratha Khim, WFP Cambodia; Patti Kristjanson, ILRI; Livia Montana, ORC-Macro; Pedro Sanchez, The Earth Institute; Boreak Sik; Sao Sovaratnak, M.D., Ministry of Health, Cambodia; and Saravy Tep, WFP Cambodia. Special appreciation to Johan Mistiaen, The World Bank, for his gracious help reporting on Kenya's recent use of poverty maps, as well as for his other input.

We acknowledge the pathbreaking work of Henninger and Snel, whose 2002 publication, Where Are the Poor? Experiences with the Development and Use of Poverty Maps, drew widespread attention to the practical benefits of poverty mapping.

Finally, all of us at CIESIN wish to express our condolences to the family, friends, and colleagues of the late Jean O. Lanjouw, who contributed substantially to the poverty mapping methods underlying this atlas, in collaboration with her husband Peter Lanjouw and others.

Robert S. Chen and Elisabeth Sydor, Editors

INTRODUCTION

In recent years we have witnessed a revolution in mapping the distribution of poverty. This revolution has been made possible by a number of important breakthroughs. Increasingly, major household survey efforts are being undertaken with an explicit spatial framework, making it easier to merge survey results into geographic databases. The computer technology that drives Geographic Information Systems (GIS) has become simpler to use as well as more powerful, making it easier for people to create maps and spatial databases out of information that otherwise would remain as tables of numbers. Data mining techniques have enabled researchers to discover statistical relationships linking poverty with information found in censuses and other sources. And the number of household surveys has grown considerably. Finally, econometric techniques have been developed and refined, notably by economists working at The World Bank, that permit the estimation of poverty rates at much higher spatial resolution than generally available before.

These advancements have led to a rapidly expanding array of poverty maps. Several dozen countries now benefit from precise geographic information about the distribution of poverty, measured in a variety of different ways, within their territories. Continental-scale measures are available as well—malnutrition has been mapped in Africa, for example, and unmet basic human needs have been mapped across Latin America. It has even become possible to visualize the spatial distribution of poverty worldwide by integrating large collections of subnational maps of infant mortality.

These maps, and the spatial databases underlying them, open up lines of investigation into the relationship between poverty and geography that could only be weakly approximated before, because poverty information was not organized along geographic lines. Now we can begin to better understand the interaction between poverty and such geographic factors as coastal proximity, climatic conditions, elevation, access to transportation networks, exposure to natural disasters, and other important drivers. Poverty maps are vital to the success of this critical area of scientific research.

Poverty maps are also being used in creative new ways to support practical efforts to reduce poverty. The maps permit more effective targeting of poverty reduction efforts by enabling decision makers and the public to visualize the problem they are attempting to solve. They permit more precise delivery of disaster relief services to vulnerable populations. They enable planners to identify priority areas for intervention. They make it possible to better tailor poverty reduction activities in ways that take into account important geographic differences, for example, with respect to ecosystem services. As more countries begin to generate poverty maps at multiple points in time, it has become possible to track the progress of implementing poverty reduction goals. Because maps can communicate complex patterns in powerful, visually compelling ways, their monitoring dimension can be especially useful.

In spite of these great advances in the production and use of poverty maps, their full potential has not yet been realized. Some countries lack adequate combinations of survey and census data. Others lack the ability to utilize available data to the full extent necessary. As a result, most countries still do not have poverty maps. Moreover, many of the maps produced thus far are not readily available to researchers and planners, limiting the capacity of maps to shed new light on the science and practice of poverty reduction. With funding from the Japan Policy and Human Resource Development Fund, CIESIN (The Center for International Earth Science Information Network), a center within The Earth Institute at Columbia University, has welcomed the opportunity to collaborate with The World Bank to simplify access to poverty mapping data, to demonstrate the power of geographic analysis of poverty, and to help fill critical data gaps.

This report is one output of that collaboration. It demonstrates the breadth of poverty mapping that has taken place in recent years, shows some of the geographic patterns that have emerged, and identifies some of the ways these maps have been put to use in efforts to mitigate poverty. Our purpose: to shed a spotlight on the pioneering work that has been done in this area, and to inspire continued innovation and progress.

2 POVERTY ON A CLOBAL SCALE

dvances in data collection and processing have made it possible to portray the global distribution of poverty with greater spatial precision than ever before. By identifying geographic patterns of poverty, and expressing these patterns in the visual language of maps, we can

explore the relationship between poverty and forces of nature such as climate and landscape. Such maps provide a better idea of where to target interventions, letting us use knowledge to translate political ideals and commitment into action.

FIGURE 2.1. Global Distribution of Infant Mortality

FIGURE 2.2. Global Distribution of Hunger

Unlike the global infant mortality map, this map suggests that children in parts of South Asia are faring as poorly or worse than their counterparts in Africa. In South Asia, areas of highest hunger correspond to some of the areas of highest population density. However, nowhere in the Americas comes close to the highest levels of hunger in the Eastern hemisphere, at least at the levels mapped.

3 POVERTY WITHIN CONTINENTS

"The poverty maps we used to identify 'hunger hotspots' throughout Africa were the main source of data for identifying the Millennium Villages. The maps acted as an organizing principle for the selection process: to cover the main farming systems and agro-ecological zones of Africa, with over 93 percent of the farming population of sub-Saharan Africa."

Pedro Sanchez, Co-chair, UN Millennium
Project Task Force on Hunger

Fighting Hunger with Maps

he Africa Hunger maps (pages 8–9) and later, the Global Distribution of Hunger map (page 5), were commissioned by the United Nations (UN) Millennium Project Hunger Task Force to identify hunger "hotspots" throughout Africa—areas where more than 20 percent of preschool children are underweight. Toward achieving the UN Millennium Development Goals to "halve hunger" globally by 2015, these maps answer the question, where is hunger most persistent and severe? Earlier mapping technology could identify which countries have high poverty, but not the location of the saturation of poverty or how the incidence of poverty might be related to national boundaries. Analyzing subnational units throughout the continent—states, provinces, and districts—the Africa Hunger maps arrive at a higher resolution of analysis than has been available before.

On the community level, the poverty maps gave local politicians a clear idea of the location and concentration of underweight children.

The maps also provided a conceptual framework for the work of the UN Hunger Task Force. The hotspots guided the selection of locations for the Millennium Villages—twelve sites in ten different African countries and agro-ecological zones—for implementing the Task Force recommendations. (Phase II of the Project plans clusters of ten villages around the existing villages.)

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CIESIN 2005

This map shows how regions close to the coast are generally better off than their inland counterparts. This pattern can be seen at both national and subnational scales, most clearly in West Africa. The Sahel (the region on the southern fringes of the Sahara, extending from Senegal to Ethiopia) is strikingly worse off than its neighbors. In Mozambique, broadly speaking, the closer to South Africa, the better off.

FIGURE 3.2. Africa, Hunger Density

CIESIN 2005

Population density of children age 0–5 underweight, circa 2000 (per square kilometer)

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FIGURE 3.3. Millennium Research Villages and Agro-Ecological Zones

The Dixon Farming Systems and Poverty map provided an additional framework for assessing the areas under consideration for inclusion in the Millennium Village Project. Incorporated into the Millennium Research Villages and Agro-Ecological Zones map (above), it summarizes information on underweight, farming systems, location, and priority areas.

Together with the Hunger maps, the Dixon map has not only provided critical spatial analysis, but also helped raise awareness of where interventions and mobilization of resources are most critically needed.

Schoolboys receive lunch of locally-produced food, as part of Millennium Village Homegrown Feeding Program.

FIGURE 3.4. Asia, Infant Mortality

CIESIN 2005

Number of infant deaths per 1,000 live births, 2000

The pattern of poverty across Asia reveals a combination of geopolitical and geophysical processes at work. There is a clear indication that coastal regions have lower poverty than inland areas. Large expanses of China have infant mortality rates among the lowest in the world, reflecting the great economic growth that has taken place in that country—but significant pockets of very high poverty in China show that this growth is actually uneven. This map also shows how highly diverse mortality rates can be revealed when high resolution data are available, allowing for greater targeting of interventions. FIGURE 3.5. Latin America, Infant Mortality

CIESIN 2005

This map reveals the great diversity in poverty levels in Latin America, measured here through infant mortality rates. While some regions have infant mortality rates as low as the wealthiest countries in the world, others have rates as high as the world's poorest regions. The extreme variation within Brazil—the country with the highest level of income inequality in the world—is readily apparent here. In Bolivia, a relationship can be seen between very high infant mortality rates and the fact that the country is land-locked and at high elevation.

4 POVERTY WITHIN COUNTRIES

nterest in using poverty maps to inform decision making and the design of interventions from local to national level is growing in many different areas of the world:

• In Mexico, poverty maps were the framework for selecting 22 locations in three states for

on-farm work using innovative breeding techniques for maize. Coordinated by CIMMYT (International Maize and Wheat Improvement Center), the mostly farmer-managed process aims to help poor, small-scale farmers. Poverty maps have also been effective in targeting post-harvest technologies in southern México, with plans for expanding similar work into the state of México. Maps were also used for strategic planning of programs and activities for CIMMYT's TES (Tropical Ecosystems).

• In Kajiado District, Kenya, livelihood asset maps were distributed widely to policy makers and groups in the form of a district atlas. This action was part of a study database coordinated by ILRI (International Livestock Research Institute) that used poverty maps developed with CBS (Central Bureau of Statistics) and The World Bank, with support from the Rockefeller Foundation, to analyze the role of livelihood assets in explaining variations in poverty levels. The database was made available at the local level in the form of a CD, along with free software. Local communities helped select which division-level thematic maps (natural resources, livestock, etc.) would be most helpful to produce, and computer-literate individuals within the district were given GIS (Geographic Information Systems) training to do their own mapping and analysis.

The database will form the basis of a community information system, which will be maintained and updated regularly by a local NGO. District water officials have already used the water access maps to target new interventions, and technical government officers from other districts have requested training in the participatory land-use mapping approach used in the study.

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FIGURE 4.1. South Africa, Mozambique, Malawi, and Madagascar, Inequality

Alderman H. et al. 2002; Simler, K., and V. Nhate 2005; Benson T. et al. 2000; Mistiaen, J.A. et al. 2002. Census data circa 1996/Household Survey Data circa 1996.

Inequality is the degree to which resources are concentrated. Where every individual has the same amount of resources, the inequality rate is zero. Where resources are shared unequally, so that a greater share of the resources is concentrated within a small share of the population, higher levels of inequality are denoted. The highest incidence of inequality occurs where one individual holds all of the area's resources.

Note: On this map, consumption aggregation differences among the countries may make the distributions and inequality estimates not strictly comparable.

Inequality rate (mean log deviation) within a given administrative unit

• In Uganda, ILRI and The World Bank, supported by the Rockefeller Foundation and DFID (UK Department for International Development), are leading poverty mapping efforts that include training poverty analysts and GIS specialists within the Uganda Bureau of Statistics. Plans are to more widely disseminate the information in the form of a poverty map CD-ROM to local authorities, district officials, schools, NGOs, and the private sector; and to implement browsing the data CD at training sessions. Further research will examine poverty-livestock-environment relationships.

• For several years, Cambodia has used poverty maps in different ways to target aid. For its launch of a national and regional dissemination of poverty and vulnerability analysis and mapping in 2003, WFP (World Food Programme) in close collaboration with MOP (the General-Secretariat of the Council for Social Development of Ministry of Planning), as well as relevant ministries and the National Committee for Disaster Management, used poverty maps overlaid with maps of nutrition, basic and adult education, and vulnerability to natural disasters. Representatives from provinces, districts, and communes actively participated in an integrated approach to exploring the influence of poverty on education and health status, and to devise coping strategies for the people living in these areas. Some outcomes of this initiative included:

—A partnership between WFP and IFAD (International Fund for Agricultural Development) on several projects in three southeastern provinces;

—Targeting the poorest areas of Cambodia where primary education needs are the highest, WFP provided food for schoolchildren while the Ministry of Education helped distribute resources and support curriculum improvement; and

—Using the poverty maps to help identify different project targets, WFP and Provincial Rural Development Committees coordinated activities throughout different provinces to maximize project impact in the poorest areas.

In 2002, the outputs of a small area estimate poverty map produced by WFP, in close collaboration with MOP, were used cooperatively by many stakeholders to allocate scarce resources to communes (the lowest level of geographic aggregation, where there is high incidence of poverty). The outputs were later used in the National Poverty Reduction Strategy 2003–2005, and in the Cambodia Millennium Development Goals Report 2003.

Here we see patterns of income inequality within administrative units in four southern African countries. In the darkly shaded regions, income is shared very unequally across households, while in the lightly shaded regions income is shared more evenly. It is much more common to find administrative regions with high inequality in South Africa than in the other countries. Urban areas in South Africa show less inequality, but this is not the case with the other three countries.

In the health and nutrition sector, poverty maps made information easy to see and understand during a workshop series led by Ministry of Health, Department of Planning and Health Information and MEASURE DHS (Demographic and Health Surveys) Project, 2002–2004. The group also advanced GIS training for

Cambodian personnel, but the reality of their still relatively limited expertise in spatial analysis has limited the use of maps in practice. Maps were used for decision making in the malaria, dengue, and tuberculosis centers.

• In Nicaragua, the poverty gap measure is used as a tool for planning and targeting resources by FISE (Fondo de Inversión Social de Emergencia), the national organization that developed a poverty map in collaboration with The World Bank. Municipalities with the greatest poverty gap receive a larger proportion of the fund's resources.

FIGURE 4.2. Nicaragua, Poverty Gap

Gobierno de Nicaragua 2001. Census data 1995/Household Survey data 1998.

This map shows the average gap between household expenditures and the poverty line. The gap tends to be higher in the more remote, sparsely populated parts of the country. There is also important variation within the more densely settled areas of the country. In the Managua area, for example, the areas of low, medium, and high poverty gaps are clearly visible in the map.

Simler, K., and V. Nhate 2005. Census data 1997/Household Survey data 1996–1997.

Thirteen separate poverty lines are defined, reflecting regional differences in purchasing power. Values range from 5,473 to 19,515 Meticals (daily expenditure per capita), or 0.22 to 0.78 US Dollars.

Average shortfall between actual household welfare levels and

Mistiaen, J.A. et al. 2002. Census data and Household Survey data, 1993.

In Madagascar, poverty rates are lowest in the lowlands in the north and east. They are high in the central highlands, where much of the country's population is concentrated.

Poverty line (2003) is 354,000 Malagasy Francs (expenditure per person per year). Value in US Dollars: (2003) 184.95.

FIGURE 4.5. Bolivia, Poverty Rate

UDAPE, INE, y Banco Mundial 2003. Census data 2001/Household Survey data 1999–2001.

The majority of Bolivia's population lives at very high elevations, concentrated along the mountain range that runs approximately down the middle of the country from north to south. The poverty rates vary enormously in this region. Within the cities, poverty rates are consistently low; in the mountainous rural areas, however, poverty rates are extremely high, approaching 100 percent in many areas.

Sixteen separate poverty lines are defined, reflecting regional differences in purchasing power. Values range from 185.1 to 250.3 Boliviano (monthly expenditure per capita), or 28.37 to 38.37 US Dollars.

In the past few years, Bolivia has used poverty maps in several arenas. The Bolivian government think tank UDAPE (Unidad de Análisis de Politicas Sociales y Económicas), together with The World Bank and INE (Instituto Nacional de Estadística), developed poverty maps to report on poverty and inequality in municipalities. In 2004, the UNDP (United Nations Development Programme)

drew on data from the maps for the municipal human development index; and in 2005, poverty maps were the basis for defining arguments for funding for OMS-OPS (Organización Mundial de la Salud and Organización Panamericana de la Salud) by the Ministry of Agriculture. Also that year, FPS (Social and Productive Fund) used data from the poverty maps to choose certain municipalities for assessing social investments.

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FIGURE 4.6. Viet Nam, Poverty Rate

Minot N., B. Baulch, and M. Epprecht, in collaboration with the Inter-Ministerial Poverty Mapping Task Force 2003. Census data 1994 and 1999/Household Survey data 1998.

Proportion of the population living below the poverty line.

Poverty line (1998): 1,789,871 Dong (expenditure per person per year). Value in US dollars: (1998) 143.19.

FIGURE 4.7. Viet Nam, Poverty Density

Minot N., B. Baulch, and M. Epprecht, in collaboration with the Inter-Ministerial Poverty Mapping Task Force 2003. Census data 1994 and 1999/Household Survey data 1998.

Number of poor people per square kilometer of total land area.

Each dot corresponds to 1,000 persons below the poverty line. •

Greater Urban Extent

Poverty line (1998) is 1,789,871 Dong (expenditure per person per year). Value in US dollars: (1998) 143.19. ▲ In Viet Nam, poverty rates are highest in the remote rural highlands—yet this map shows that most of the poor people live along the coast and in cities. In many countries, there is a stark contrast between where poverty rates are highest and where the most poor people are concentrated. Different kinds of policy interventions are required to bring about improvements in these two factors; most countries pay attention to both. Having detailed maps of both rates and concentrations of poverty enables policy makers and the public to set policy goals in a transparent manner, and to track results over time.

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FIGURE 4.8. Ecuador, Poverty Rate

The World Bank. 2004. Census data 2001/Household Survey data 1999.

Percentage of the population living below the poverty line.

Poverty line: (2001) 15,807 Sucre (expenditure per person per day). Value in US Dollars: (2001) 1.3.

The World Bank 2004. Census data 2001/Household Survey data 1999.

NOTE: Each category is represented by one color class, although it may appear in multiple hues due to shading for elevation. ▲ These maps highlight not only that urban areas are the loci of population concentrations, but also of the more affluent areas. They further show that high-poverty *parroquias* (parishes) are numerous, more spatially distributed, and of much lower population densities, on average. Although not all of Ecuador's poorest parroquias are found at high elevations, there is nevertheless a strong association: Of the lowest-poverty parroquias (those in brown shading), no non-urban ones are found at elevations above 2000 meters. In contrast, of the high-poverty parroquias (those in blue shading) almost half (47 percent) are found at elevations above 2000 meters.

FIGURE 4.10. Kenya, Poverty Rate

CBS and the Ministry of Planning and National Development, Kenya 2003. Census data 1999/Household Survey data 1997.

In Kenya, poverty rates are lowest in the region surrounding Nairobi, as well as where the main Northern road corridor that links Mombasa, Nairobi, and Kisumu passes through, although the regions surrounding Mombasa and Kisumu experience high poverty. Poverty rates are very high in the remote areas of the country. They also appear high in both sparsely populated regions and densely populated regions (such as Mombasa and Kisumu).

Separate rural and urban poverty lines are defined, reflecting differences in purchasing power. Values are 1,239 and 2,648 Kenyan Shillings, respectively (monthly expenditure per adult equivalent), or 21.30 to 45.52 US Dollars.

Mapping Poverty Nationwide

THE CASE OF KENYA

Kenya's interest in evidence-based policy making helped spur the development of a georeferenced database of poverty and inequality estimates, released in 2005 in conjunction with The World Bank, SIDA (Swedish International Development Cooperation Agency), and others. New statistical techniques developed by DECRG-PO (The World Bank Development Research Group, Poverty Cluster) combined detailed household surveys with population census data to pre-

dict spatially detailed consumption-based poverty indicators for small geographic areas (divisions and locations as well as provinces and districts).

The Kenyan government began by using the poverty estimates to inform budgeting decisions. Based on the constituency poverty map, for example, annual geographic disbursements of about US\$25 million are made (amounting to a fund equivalent to 2.5 percent of GDP). "Poverty maps provide new and multiple opportunities. Integrated with other geo-referenced data, they are the foundation for building a more powerful system of assessment and more effective interventions on behalf of the poor."

-Colin Bruce, Kenya Country Director, The World Bank, commenting on the inaugural release of Kenyan poverty maps and inequality estimates

COLLABORATION IS KEY

Government and aid agency officials see the poverty maps as part of the "backbone" of a new system—used with additionally referenced data such as the location of schools, health dispensaries and roads, and climatic data such as soil quality, rainfall, and cropping patterns—to inform, monitor, evaluate, and ensure accountability of government expenditures.

With the launch of the poverty maps, new questions were raised by the Kenyan media about the sources and results of inequality throughout constituencies. Greater implications for allocation and use of development funds were also considered, further elaborating the possibilities for intervention and development that poverty maps introduce.

Commenting on the implementation process, World Bank economist-statistician, Johan Mistiaen, said: "High buy-in from policy makers resulted, we believe, from taking a collaborative approach to developing the poverty maps, as well as emphasizing capacity building. In the works is support for wide dissemination as we also develop clear guidelines on how to use poverty maps correctly."

Springboard to New Projects

In Kenya, The World Bank Western Kenya Community Driven Development (WKCDD) project is exploring how to use poverty maps with other statistics to reach the greatest number of needy areas, keep allocations independent from political influence, and build a randomized-design impact evaluation directly into the project.

"People relate better to maps than tables with figures, and understand tradeoffs better," says Nyambura Githagui, Senior Social Development Specialist and Task Team Leader for the project.

Poverty maps are also being used in conjunction with survey analysis to design project components such as

Government officials (left) and World Bank staff use a GPS to geo-reference a primary school in Bungoma, Kenya.

targeting of development grants to communities, community infrastructure upgrading, and school bursaries to needy children.

GREATER ACCESSIBILITY ENABLED

As part of its Joint Poverty Assessment, The World Bank will disseminate best guidelines for using the poverty maps to policy makers and country operatives. Social accountability information and support to communities will also be offered, through The World Bank's Anti-corruption Action Plan. A "howto" manual, platform-independent software tools, and a training course for staff are also planned for use at the local level. "Intensive hands-on training in using the poverty maps lets us back up the numbers, explain exactly how they were computed, and feel confident about applying the methodology again when new data become available."

> —Godfrey Ndeng'e, Head of Poverty Research, CBS, Kenya

Astrup C., and S. Dessus 2001. Census data 1997/Household Survey data 1996–1998.

In West Bank and Gaza, poverty rates are shown to be lowest in the region near Jerusalem. With few exceptions, poverty rates increase as one moves farther from this hub of economic activity. Rates are very high in remote Gaza, as well as along the eastern and southern borders of the territory.

Poverty line (1998) is 7.94 New Israeli Shekels (expenditure per person per day). Value in US Dollars: (1998) 2.1.

FIGURE 4.12. Bangladesh, Poverty Rate

Bangladesh Bureau of Statistics in collaboration with WFP 2004. Census data 2001/Household Survey data 2000.

In Bangladesh, the pattern of poverty rates is primarily shaped by proximity to the capital Dhaka. In this map we can see that in general, poverty rates rise as one moves increasingly far from Dhaka. We can also see how the coastal remote areas are less disadvantaged than the inland remote areas. For the country as a whole, the urban areas tend to be less poor than their rural counterparts.

Fourteen separate poverty lines are defined, reflecting regional differences in purchasing power. Values range from 582 to 971 Taka (monthly expenditure per capita), or 11.21 to 18.70 US Dollars.

Small area estimate mapping in Bangladesh by IRRI has shown distinct regionalization of spatial relationships between poverty and various socio-economic, physical, and natural resources. As poverty incidence in Bangladesh has grown more localized over the past decade (even as overall poverty has been reduced), mapping has targeted small pockets of poverty to reveal more livelihood-influencing

correlates than just ecological factors—for example, education, accessibility, and services. The possibility of geographical targeting of relatively well-off areas has also been raised based on maps identifying high income inequality there.

Poverty maps were used successfully in Bangladesh to improve disaster-averting measures, as in the July 2004 floods when European Space Agency, sarmap s.a. (Switzerland), and IRRI jointly used radar imagery to quickly map flood-affected areas. Overlays of the Bangladesh poverty map on the flood map revealed which communities were most vulnerable to flooding—in the low depressions and along river banks—and maps were distributed to government officials for action.

he world is undergoing a fundamental transformation. In the near future, the population of the world will consist more of urban dwellers than rural. Africa and Asia are the two regions of the world expected to undergo the most rapid urban change. Change is likely to occur in the world's poorest countries, those least equipped with the means to invest

in urban infrastructure—water, sanitation, tenured housing—and least able to provide vital economic opportunities for urban residents to live in conditions above the poverty line.

Poverty maps may provide a singular view of urban areas. Some countries, such as Kenya and Morocco, apply a unique urban poverty line measure for urban areas so that differences in the standards of poverty may be taken into account. Others, like South Africa and Malawi (see figures 5.1. and 5.5) use national-level poverty lines which indicate that poverty is lower within cities due to the overall level of amenities (such as access to electricity) that comprise consumption-based measures of poverty. When we compare poverty estimates (at the third administrative level) by the choice of poverty line, as shown in the box-plots for Viet Nam and Kenya (figures 5.2 and 5.3), the differences in urban versus rural poverty estimates are evident. Poverty rates appear much lower in Viet Nam's urban areas than in its rural areas, whereas in Kenya, the median poverty rate (shown as a horizontal line in the boxes in figures 5.2 and 5.3) appears to be slightly higher in urban areas, and has a much wider distribution.

Both approaches provide insight, and each country has constructed measures suited to its needs (some countries produce both). The policy debate around urban versus rural poverty should account for both the strengths and weaknesses of each approach.

FIGURE 5.1. South Africa, Poverty Rate

Alderman H. et al. 2002. Census data 1996/Household Survey data 1995.

These high-resolution poverty maps show that the urban areas of South Africa have much less poverty than the rural areas. The maps are also able to reveal differences within urban areas. Cape Town, for example, has low poverty almost everywhere within its boundaries, although it is bounded by a periurban zone of somewhat higher poverty. By contrast, the urban area of Johannesburg and Pretoria/Tshwane has clear divisions between high and low poverty within its boundaries; likewise, Durban has clearly elevated poverty rates around its interior edges. But Durban also has more elevated poverty rates just outside its city limits, unlike the other cities, where the gradients are somewhat more gradual.

Poverty line (1995) is 800 Rand (expenditure per household per month). Value in US Dollars: (1995) 220.60. FIGURE 5.2. Comparison of Poverty Rates based on a National Poverty Line. Viet Nam, Third Subnational Administrative Level.

FIGURE 5.3. Comparison of Poverty Rates based on Urban and Rural Poverty Lines. Kenya, Third Subnational Administrative Level.

FIGURE 5.4. South Africa, Inequality

Alderman H. et al. 2002. Census data 1996/Household Survey data 1995.

Inequality is the degree to which resources are concentrated. Where every individual has the same amount of resources, the inequality rate is zero. Where resources are shared unequally, so that a greater share of the resources is concentrated within a small share of the population, higher levels of inequality are denoted. The highest incidence of inequality occurs where one individual holds all of the area's resources.

In contrast, a map of inequality shows that urban areas are highly varied. Although rural areas appear for the most part highly unequal, urban areas contain parts that are both equal and unequal. Even in Durban, where the surrounding areas appear to be more or less equal in their poverty distribution, the urban area is not. Measures of inequality tend to be more pronounced in countries, such as South Africa, where the rates of poverty are not as severe as in neighboring Mozambique or Malawi.

FIGURE 5.5. Malawi, Poverty Gap

Benson T. et al. 2002. Census data 1998/Household Survey data 1997 and 1998.

This map compares poverty gaps in the capital, Lilongwe, and in Blantyre. Both cities are comparable in population (approximately one-half million). Lilongwe has far less poverty within its limits, but is surrounded by regions of very high poverty. Blantyre, by contrast, has very high poverty within its limits, but is surrounded by regions of only moderate poverty.

Poverty line (1998) is 10.47 Kwacha (expenditure per person per day). Value in US Dollars: (1998) 0.41.

AFTERWORD

In 1992, geographers Robert W. Kates and Viola Haarman published "Where the Poor Live: Are the Assumptions Correct?" in the journal *Environment*. They attempted to analyze the location of poor countries and poor people in relationship to "marginal" environments, proposing a set of dynamic interrelationships between poverty and environmental degradation. Unfortunately, at the time not only were geographic information systems and spatial analysis techniques in their infancy, but the necessary data on poverty and environmental conditions at the subnational level were also lacking.

Now, more than a decade later, we are beginning to acquire both the data and the tools to seriously assess the links between poverty, environment, and other factors such as demographic trends, urbanization, and health. The subnational poverty data portrayed in this atlas represent a major step forward in documenting the distribution of poverty in a way that opens up the potential for more detailed and rigorous analysis of the causes and effects of poverty. Tools and techniques for analyzing spatial relationships have also advanced substantially.

But this is not just an academic research exercise: as illustrated in this atlas, these data and tools can also help with very practical and applied decisions and actions. They can help guide efforts at international, national, and local levels to address constraints on development, to target those most in need, and, in the end, to alleviate poverty for all.

In this sense, it is important to recognize that the maps and data represented in this atlas have both negative and positive implications: *negative* in that they depict the continued suffering and extreme distress of hundreds of millions of people, but *positive* in that they—in some cases for the first time—reveal where the poor are and what conditions and constraints they face. With less than a decade left to meet the Millennium Development Goals, such information is vital.

Robert S. Chen and Elisabeth Sydor

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CLOSSARY

Inequality

The degree to which resources are concentrated. By resources, we mean "consumption" or goods and services that are purchased and produced in-kind by households. Where every individual has the same amount of resources, the inequality rate is zero. Where resources are shared unequally, so that a greater share of the resources is concentrated within a small share of the population, higher levels of inequality are denoted. The highest incidence of inequality occurs where one individual holds all of the area's resources.

Infant Mortality Rate

The number of infant deaths per one thousand live births.

Poverty Density

The number of poor people per square kilometer of total land area.

Poverty Gap

The average shortfall between actual household welfare levels and the poverty line, expressed as a fraction of the poverty line.

Poverty Line

A threshold income, wealth, or consumption level, typically defined by a national government, below which households are defined as poor. Sometimes, the threshold represents the amount needed to purchase enough food to survive, or some multiple of that quantity.

Poverty Rate

The proportion of the population living below the poverty line.

Underweight

A child is defined as underweight if his or her weight is more than two standard deviations below the median of the WHO/CDC (World Health Organization/U.S. Centers for Disease Control and Prevention) International Reference Population for his or her age.

APPENDIX

Poverty Mapping Web Sites

- CIESIN: Global Distribution of Poverty, Poverty Mapping Project http://www.ciesin.columbia.edu/povmap/ Downloadable maps, spatial data, and tabular data; also metadata. Global coverage for infant mortality and malnutrition, and higher-resolution national coverage for consumption and basic needs in 28 countries.
- FAO, UNEP, and the CGIAR: Poverty and Food Insecurity Mapping Project http://www.povertymap.net/
- The World Bank: Japan Policy and Human Resource Development Fund Project http://devdata.worldbank.org/phrd/country.html
- The World Bank Development Economics Research Group: Small Area Estimation Poverty Maps <u>www.econ.worldbank.org/research</u> > Projects & Programs > Poverty Research > Subtopics > Small Area Estimation Poverty Maps -----">" indicates "go to" or "click"
- The World Bank Poverty Reduction Group: Mapping Poverty <u>www.worldbank.org/poverty</u> > Poverty Analysis > Mapping Poverty
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