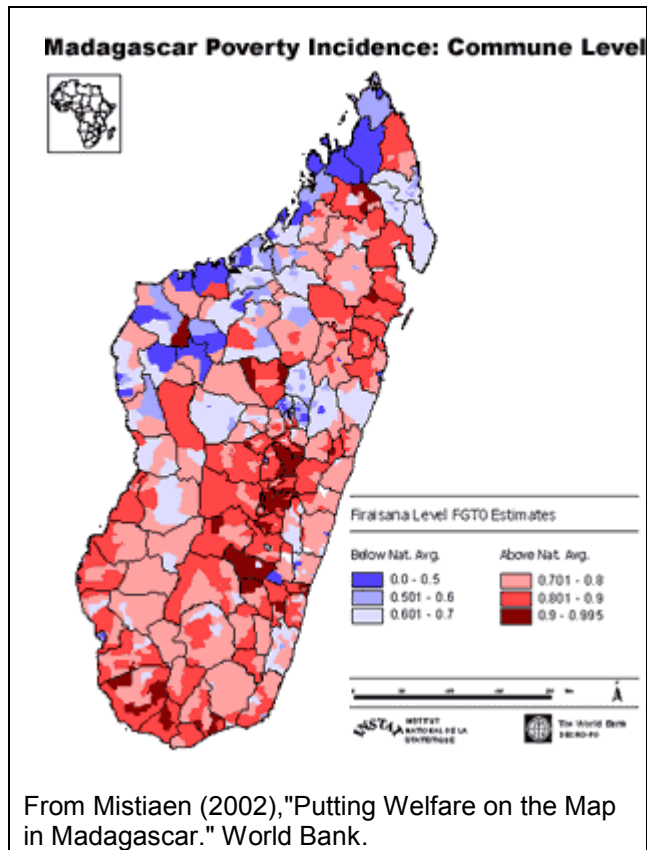# Mapping poverty

Aggregate, national level indicators often hide important differences between regions or areas (see map of poverty incidence in Madagascar). The analysis of poverty, its determinants and poverty-reducing interventions therefore requires a focus on poverty information that is further geographically disaggregated. In addition, poverty and inequality are multidimensional – consumption and income, education, health, opportunities, voice, etc. – and have multiple determinants – geographic and agro-climatic factors, services, infrastructure, etc. The plotting of such information on maps – poverty mapping – is useful to display information on the spatial distribution of welfare and its determinants. It is also useful to display simultaneously different dimensions of poverty and/or its determinants.

There are many types of poverty maps, a variety of use for these maps, and different ways to create them. This site provides information on the use of poverty maps, and on their construction. It also refers you to country applications and technical information.

In the left navigation menu, you will find information organized according to the following subtopics:

- **What can poverty maps be used for?** – gives an overview of applications and uses of poverty maps.
- **How are poverty maps built?** – describes information sources, tools, and types of maps, including small area estimation maps.
- **Documents and links –** presents a collection of references on technical aspects of poverty map elaboration and a series of country applications of poverty maps

From Mistiaen (2002),"Putting Welfare on the Map in Madagascar." World Bank.

WHAT CAN POVERTY MAPS BE USED FOR?

Poverty mapping, the spatial representation of indicators of poverty and its determinants for small geographic areas, is useful in a variety of ways.

Understanding poverty and its determinants

Highlighting geographic variations **–** Aggregate, national level indicators often hide important differences between different regions or areas. In almost all countries, these differences exist and can often be substantial. The map below provides an example of how disaggregated poverty indicators can reveal additional information to aggregate, national level, indicators. It shows how poverty in Ecuador is concentrated in the rural cantons of the Sierra, and in the north area of the Costa.

Source: Ecuador Poverty Assessment (2004)
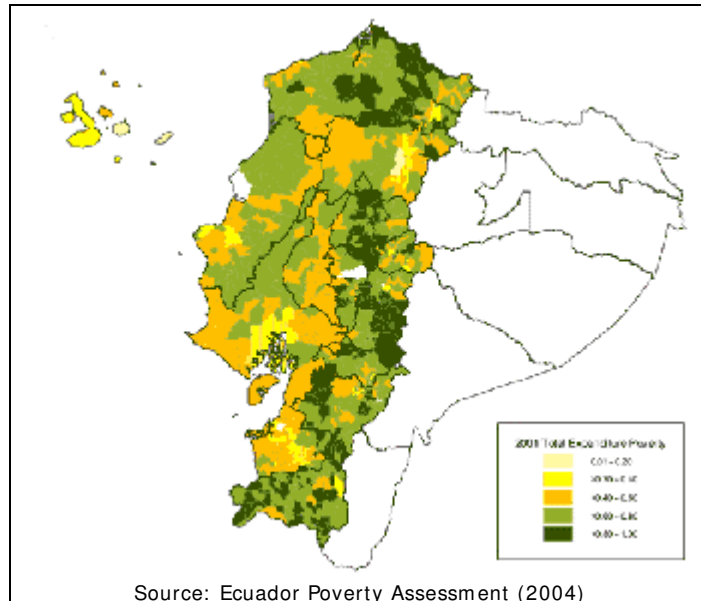
Simultaneously displaying different dimensions of poverty and/or its determinants **–** In addition to revealing disaggregated information, another advantage of poverty maps is there legibility – maps are powerful tools for presenting complex information in a visual format that is easy to understand. They can summarize multiple dimensions in a simple display, something difficult to do otherwise. The disaggregation by geographic area may for example be used to simultaneously display two or more indicators – for instance by presenting poverty headcounts and location of schools or medical centers. Maps encourage visual comparison and make it easy to look for spatial trends, clusters, or other patterns.

Understanding poverty determinants **–** A poverty map can be used to display simultaneously the outcome of interest (income poverty, incidence of disease, school enrolment, etc.) and its determinants (school location, infrastructure, health center location, natural resources endowment, access to input and output markets, etc.). This allows to deepen our understanding of the determinants of poverty. The spatial representation can therefore complement regression analysis to help us understand the influence of these determinants and their interaction. For example, Demombynes and Özler 2002 use data on crime and welfare in police jurisdictions in South Africa to analyze the effect of local inequality on crime.

Selecting and designing interventions

Poverty maps can be used to inform policy makers on what intervention to select (when choosing from a number of policy options) and on the details of its possible design.

Selecting interventions **–** Poverty maps can be used to identify areas in which development has been lagging behind, and which may therefore benefit most from additional resources – e.g. from additional infrastructure, or from transfer programs such as subsidized credit and funds for public works.

In addition, maps with information on poverty and many of its determinants can be used to identify which intervention to implement in a specific area. When deciding on a public investment program for example,

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The examples provided on this page, and the documents which support them, are only illustrative
and do not indicate World Bank endorsement of any data, methodologies, or geographic boundaries.

information on the specific needs of various areas can help increase the effectiveness of investments – since some areas would benefit more from certain types of investments than others. It might be the case, for instance that investments in roads and transportation would be more effective in some areas, while investments in public service infrastructure would improve economic opportunities in others.

Poverty mapping is also used for emergency response and food aid programs. An example is given by the early warning and mitigation of natural disasters system of USAID's "Famine and early warning systems network". This system helps select interventions in time for effective implementation during droughts or other natural disasters.

Designing interventions – Once an intervention has been decided, poverty mapping can further be useful for its actual design. Here, we list a few examples of use of poverty maps in the design of interventions.

Geographic targeting of resources – Targeted interventions aim at specific groups of the population, and the identification of the target population can be based on a variety of criteria. One possibility is to decide to target specific geographic areas. Sometimes, interventions decide to target specific individuals within specific areas (combining geographical targeting with some kind of test of individual compliance with the criteria selected – for instance, linked to income levels, enrolment in schools, participation in a specific health care program, etc.). Geographic targeting has limitations (e.g. when used in isolation, it targets both poor and non-poor in poor regions, and ignores the poor who live in non-poor regions), but its low design and administration costs make it often more effective than other options (see Bigman and Fofack 2000).

The smaller the geographic regions for which indicators are available, the greater the effectiveness of interventions – indeed, this allows to reduce leakage (i.e. transfers to the non-poor) and increasing coverage (i.e. minimizes the risk that a poor person will be missed by the program). Studies in India and Indonesia, for instance, show that states or provinces are too heterogeneous for targeting to be effective (Datt and Ravallion 1993, Ravallion 1994). This underlines the need for the collection of indicators for small areas, which are relatively homogenous (see Level of Disaggregation — Small Area Estimation Maps).

Designing interventions with regional variants – Detailed information and analysis can help define where interventions are needed and which interventions are needed within the areas selected. It can also help chose the type of program that is most relevant. For instance, a poverty map could reveal lack of coverage of health care services in a few regions, but reveal that some of these regions have low levels of poverty while others experience much lower welfare. Low coverage might be mostly explained by the absence of health care services in the first group, and by the cost of health care services in the second group. Hence, a health care program could use some form of cost-recovery in the first group of regions, and be subsidized in the poorer ones.

Informing decentralization – Poverty maps can also help inform decentralization. For instance, they can help inform the level at which a certain type of intervention or service is best managed and controlled by showing the area which benefits from them. They can also be used to inform formula for fiscal transfers that accompany decentralization of responsibilities. (see Henninger and Snel 2000).

Fostering participation at the local level – At the local level, poverty maps can also play an important role in communicating information. Because all stakeholders, including non-specialists, can easily understand them, poverty maps are an important tool for the participatory definition of priorities and interventions.

For more information on applications of poverty maps see Documents and Links.

HOW ARE POVERTY MAPS BUILT?

This section briefly presents building blocks of poverty maps:

- **Information sources:** Poverty maps can be built using censuses, surveys, administrative data and other sources of information.
- **Geographic Information Systems (GISs):** GISs are software programs which allow to display information on the basis of their geographic coordinates. They allow to combine information from heterogeneous sources.
- **Small area estimation maps:** A technique developed by the World Bank to combine information from surveys (which contain comprehensive information) and censuses (which allow fine disaggregation). This allows to present detailed information on poverty that is sufficiently disaggregated to capture heterogeneity.

Information sources

Surveys and censuses
The main sources of information on socioeconomic indicators are typically censuses and surveys. Surveys typically provide very comprehensive information on a broad range of dimensions of living standards and their determinants or correlates. For instance, multi-topic household surveys typically report information on income and/or consumption, while Demographic and Health Surveys present information on anthropometric measures and other indicators of health status. On the down side, surveys only cover a relatively small subset of households or individuals. Typically, estimates are only representative at relatively aggregated levels – such as regions.

Censuses provide information on all individuals and households in a country, thereby allowing for the finest geographic disaggregation. Census data can be compiled for small administrative areas, for communities, villages, and towns. On the downside, censuses are typically not carried out very frequently (usually once a decade) and they only collect information on a limited set of indicators (in particular, income or consumption are typically not available).

These two sources can also sometimes be combined to build on their respective strengths and obtain detailed information that is representative at a very low level of disaggregation (see Small area estimation maps below).

Administrative data
Another critical source of information to analyze the link between welfare indicators, their determinants and interventions is administrative data (e.g. information on schools, health facilities, markets, roads, etc.). For instance, information on the transport network and its quality can be used to estimate the distance or travel time that communities face to reach essential services or to access inputs or outputs markets. The map below for example shows the number of women in reproductive age
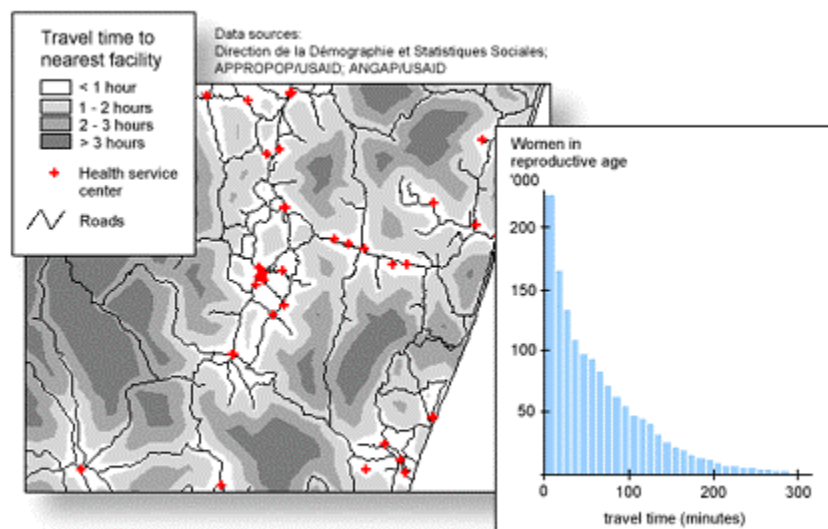
groups by travel time from health centers that offer reproductive services in a region of Madagascar. Although other factors determine actual use of facilities (e.g. quality and cost), the resulting indicators of equity in access to services are useful for efforts to improve public infrastructure.

Other sources
Other data sources can also be central to the measurement of poverty, its understanding and policy design. These include information on rainfall and agro-climatic conditions which can be used to indicate communities' susceptibility to food shortages. Several major initiatives have developed monitoring systems to assess food security and coordinate drought relief operations. Two examples are USAIDS's Famine Early Warning System (FEWS) and the Food Insecurity and Vulnerability Information and Mapping System (FIVIMS) coordinated by FAO.

Geographic information systems

In order to present the disaggregated information on maps, one needs to have some kind of geographic location coordinate for each observation. Geographic information systems (GISs) are computer software programs designed to handle geographically referenced data. They are essentially database management systems that use geographic location as a reference for each database record. These systems are used to integrate information from very different sources (e.g. surveys, census, administrative data, satellite images, etc.) into a single platform, where each observation is matched with the identifier of the area it covers. They also permit the analysis of spatial association between different dimensions. In particular, they permit the simultaneous analysis of variables which are observed at different levels. For instance, poverty status might be observed at the district level while climate is recorded at the level of agro-climatic zones. Or some infrastructure might serve broad areas (hospitals, major roads) while others serve smaller zones (primary school or health post). The GISs allow the simultaneous analysis of information from heterogeneous sources, as long as they have geographic location coordinates. For instance, for each village, a GIS can generate the distance to the nearest market town, the average rainfall within a 20 kilometer radius, demographic indicators, and village-level estimates of income poverty. (See Documents and Links for selected readings on GIS).
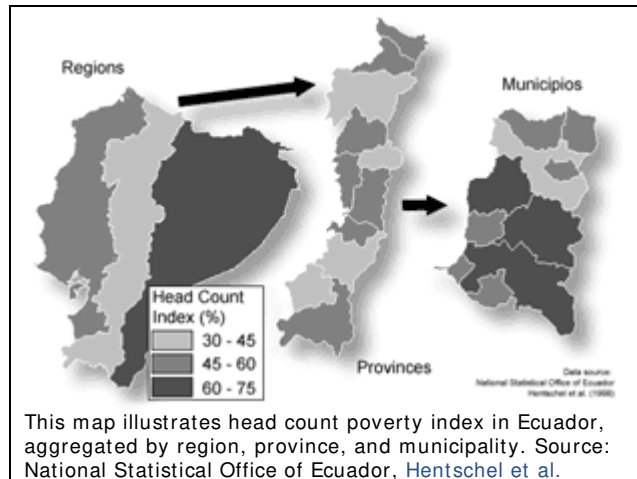
Small area estimation maps

The key to the use of poverty mapping is to present information that is sufficiently disaggregated to capture heterogeneity (Lanjouw and Özler 2002). Small area estimation is a statistical inference technique that allows estimation for very small areas, by combining information from censuses and household surveys.

A team of researchers in the Development Economics Research Group, Poverty Cluster (DECRG-PO) at the World Bank, provides technical assistance, capacity building, and various free software tools to statistical institutes in developing countries upon demand. The team is also developing a "how-to manual" for poverty mapping, platform-independent software tools, and training courses.

Small area estimation maps combine the depth of information in a survey (information on consumption and/or income) with the complete spatial coverage available from a census (without detailed information on welfare). Many countries have used small area estimation to create local welfare estimates and poverty maps (see Documents and Links for readings on the methodology and on policy applications in various regions).

The methodology of small area estimation involves imputing into population census data—which does not have consumption data—a measure of per capita consumption from household survey data—which has a sample to small for small area disaggregation. The first step consists in the estimation of regressions that model expenditure or consumption using a set of explanatory variables that are common to both the household survey and the census (e.g. household size, education, housing and infrastructure characteristics and demographic variables). These regressions are estimated at the lowest geographical level for which the survey data is representative. The second step consists in using the estimated coefficients from these regressions

This map illustrates head count poverty index in Ecuador, aggregated by region, province, and municipality. Source: National Statistical Office of Ecuador, Hentschel et al.

(including the estimated error terms associated with those coefficients) to predict expenditure or consumption for every household in the census. Basically, the coefficients are used to "predict" the expenditure or consumption level of each household on the basis of the explanatory variables that are common to the census and the survey. These household level data are then used to compute poverty estimates for small areas. (See Demombynes' A Manual for the Poverty and Inequality Mapper Module and Zhao's User Manual for PovMap).

Given that indirect estimation of poverty indicators implies some degree of uncertainty, small area estimation data should be compared with information that describes more general characteristics of the communities. Such information is available from the censuses themselves and from other data sources. Besides cross-checking the sensibleness of the estimated data, such comparisons bring to light correlations between welfare and characteristics such as climate, the number of livestock per capita, the distance to the nearest health facility, and the number of water pumps per community—characteristics not necessarily included in censuses and surveys.

DOCUMENTS AND LINKS

Overview

1. Deichmann, Uwe. "Geographic aspects of inequality and poverty." World Bank. January 1999.
2. Henninger, Norbert (1998). "Mapping and Geographic Analysis of Poverty and Human Welfare – Review and Assessment." Report prepared for the UNEP/CGIAR Initiative on GIS, World Resources Institute, Washington, D.C.
3. Henninger, Norbert and Mathilde Snel (2002) Where are the Poor?: Experiences with the Development and Use of Poverty Maps. World Resources Institute.
4. Hetschel, Jesko and Peter Lanjouw (1998). "Using Disaggregated Poverty Maps to Plan Sectoral Investments." PREM Notes. The World Bank.
5. Lanjouw, Peter, Berk Özler (2002). "Poverty on the Map."

Tools (general)

1. GIS Frequently Asked Questions. Maintained by the U.S. Bureau of the Census.
2. GIS and geography WWW resource list at the University of Edinburgh's Department of Geography. Links to university departments, public and commercial sites dealing with GIS and geography
3. GIS and geography WWW resource list at the University of Utrecht (Netherlands). Links to university departments, public and commercial sites dealing with GIS and geography
4. Anselin, Luc (1992) Spacestat Tutorial: A Workbook for using Spacestat in the Analysis of Spacial Data.University of Illinois: Urbana-Champaign. [1..49Mb]
5. United Nations Statistics Division (UNSD). Compilation of statistics; Standards development and technical advisory services for census taking.

Methodology (general)

1. Bigman, D. and U. Deichmann (2000). "Geographical Targeting: A Review of Methods and Approaches," in D. Bigman and H. Fofack, editors, Geographical Targeting for Poverty Alleviation: Methodology and Applications. World Bank.
2. Croft, T., S. Rutstein, J. Brunner and N. Abderrahim, 1997, West Africa Spatial Analysis Prototype: Development of a Geo-Referenced Regional Database, Technical paper, DHS/Macro International.
3. Davis, Benjamin (2003). Choosing a method for poverty mapping. Food and Agriculture Organization of the United Nations.
4. Ghosh, M. and J.N.K. Rao. (1994). Small Area Estimation: An Appraisal, Statistical Science, 9(1):55-93.
5. Hoogeveen, Johannes G., Youdi Schipper. "Correcting Survey Non-Response using Census Data." World Bank, Vrije University Amsterdam. DRAFT: December 16, 2003. (How to make panel poverty maps in the presence of only 1 panel.) [41Kb]
6. Minot, Nicholas and Bob Baulch. (2002) Poverty Mapping with Aggregate Census Data: What is the Loss in Precision? Markets and Structural Studies Division. Discussion Paper 49. Washington, D.C., International Food Policy Research Institute.

Tools and Methodology for Small area estimation mapping

1. Demombynes, Gabriel.   "A Manual for the Poverty and Inequality Mapper Module."   University of California-Berkeley and the World Bank. REVISED VERSION: April 2002.
2. Demombynes, Gabriel, Chris Elbers, Jenny Lanjouw, Peter Lanjouw, Johan Mistiaen, Berk Özler. "Producing an Improved Geographic Profile of Poverty: Methodology and Evidence from Three Developing Countries." World Institute for Development Economics Research, United Nations University discussion paper no. 2002/39. March 2002.
3. Elbers, Chris, Jean O. Lanjouw and Peter Lanjouw (2002).   "Micro-Level Estimation of Poverty and Inequality." *Econometric* 71:1, pages 355-364.
4. Elbers, Chris, Jean O. Lanjouw, Peter Lanjouw (2004).   "Imputed Welfare Estimates in Regression Analysis." Amsterdam Institute for International Development, Vrije University Amsterdam, U.C. Berkeley, Brookings Institution, Center for Global Development, World Bank. April 26, 2004.
5. Elbers, Chris, Tomoki Fujii, Peter Lanjouw, Berk Ozler and Wesley Yin. (2004). "How much does disaggregation help?".
6. Hentschel, Jesko, Jean Olson Lanjouw, Peter Lanjouw, Javier Poggi. (1998). "Combining Census and Survey Data to Study Spatial Dimensions of Poverty and Inequality." *The World Bank Economic Review* .
7. Hoogeveen, Johannes, Peter Lanjouw, Johan Mistiaen, Qinghua Zhao and Berk Özler. Poverty Research: Small Area Estimation Poverty Maps.
8. Özler, Berk (2003). "Small Area Estimation Methods for Producing Poverty Maps." PowerPoint presentation April 28, 2003. World Bank.
9. Zhao, Qinghua. User Manual for PovMap Version 1.1a . World Bank. [116Kb]

Policy Applications

1. Bigman, David, Hippolyte Fofack. 2000. "Geographical targeting for poverty alleviation: An introduction to the special issue." *The World Bank Economic Review* 14 (1): 129-145.
2. Deichmann, Uwe, Somik V. Lall, Pragya Rajoria, and Ajay Suri. "Information-Based Instruments for Improved Urban Management." World Bank. March 19, 2003.
3. Elbers, Chris, Peter Lanjouw, Johan Mistiaen, Ken Simler, and Berk Özler (2003). "Are Neighbours Equal? Estimating Local Inequality in Three Developing Countries."
4. Elbers, Chris, Peter Lanjouw, Johan Mistiaen, Berk Özler, Ken Simler. "On the Unequal Inequality of Poor Communities." Vrije University Amsterdam, World Bank, International Food Policy Research Institute. February 5, 2004.
5. Henninger, Norbert and Mathilde Snel. Where are the Poor?: Experiences with the Development and Use of Poverty Maps. World Resources Institute. 2002.
6. Snel, Mathilde, Anna Ballance (2003). "Workshop on the Impacts of Poverty Maps: Past Experiences and New Applications." Joint FAO/CGIAR/UNEP Poverty and Food Security Mapping Project background document.[374Kb]

Policy Applications: East Asia & the Pacific

1. Agrawal, Nisha and James Beard (2002). "Localizing MDGs for Poverty Reduction in Vietnam: Eradicating poverty and hunger." Vietnam Poverty Task Force.
2. Centre for International Economics, Canberra and Sydney (2002). Vietnam Poverty Analysis. Prepared for AusAID. [1.3Mb]
3. Fujii, Tomoki, Peter Lanjouw, Silvia Alayon, Livia Montana."Micro-level Estimation of Prevalence of Child Malnutrition in Cambodia." U.C. Berkeley, World Bank, ORC Macro. February 1, 2004. [456Kb]
4. Fujii, Tomoki.   "Commune-level Estimation of Poverty Measures and its Application in Cambodia." U.C. Berkeley. June 7, 2003. [1.49Mb]
5. Fujii, Tomoki. (2004). "Micro-level estimation of child malnutrition indicators in Cambodia".

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–
The examples provided on this page, and the documents which support them, are only illustrative
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6. Healy, Andrew J., Somchai Hitsuchon, Yos Vajaragupta. "Spatially Disaggregated Estimates of Poverty and Inequality in Thailand." Massachusetts Institute of Technology, Thailand Development Research Institute. September 3, 2003. [1.80Mb]
7. Minot, N. and B. Baulch. 2002. The Spatial Distribution of Poverty in Vietnam and the Potential for Targeting. Markets and Structural Studies Division. Discussion Paper 42. Washington, D.C., International Food Policy Research Institute.
8. Minot, Nicholas, Bob Baulch, Michael Epprecht. "Poverty and inequality in Vietnam: Spatial patterns and geographic determinants." International Food Policy Research Institute, Institute of Development Studies. 2003. [8.23Mb]
9. Minot, Nicholas. "Generating Disaggregated Poverty Maps: An Application to Viet Nam." International Food Policy Research Division, October 1998.
10. Pitt, M.M., M.R. Rosenzweig and D.M. Gibbons (1993). "The Determinants and Consequences of the Placement of Government Programs in Indonesia."- *World Bank Economic Review*, 7(3): 319-348.
11. Vietnam Development Information Center (2003). "Poverty Mapping Display." VDIC Newsletter, December 2003.

Policy Applications: Europe & Central Asia

1. Ivaschenko, Oleksiy (2004). "Poverty and Inequality Mapping in Bulgaria." World Bank. [1.35Mb]

Policy Applications: Latin America & the Caribbean

1. Chomitz, K.M. and D.A. Gray (1995). "Roads, Lands, Markets and Deforestation. A Spatial Model of Land Use in Belize." World Bank.
2. Ecuador Poverty Assessment (2004). World Bank. Chapter 2 of the report is almost entirely devoted to poverty comparisons using a map of panels.
3. Elbers, Chris, Jean O. Lanjouw, and Peter Lanjouw (2002). "Micro-Level Estimation of Welfare." Data from Ecuador.
4. Hentschel, J., J. Lanjouw, P. Lanjouw, and J. Poggi. 2000. "Combining Census and Survey Data to Trace the Spatial Dimensions of Poverty: A Case Study of Ecuador." *The World Bank Economic Review* 14(1): 147-65.
5. Larrea, Carlos, Malki Sáenz, Javier Cervantes, Carolina Chiriboga. "Métodos utilizados para la creacion de la información geografica y de base de datos." Ecuador. [1.99Mb]
6. Larrea, Carlos. "Mapa socioambiental nacional." Ecuador. [144Kb]
7. Mapa de pobreza: metodología para su elaboracíon. (1999) República de Panamá Ministerio de Economía y Finanzas. [4.69Mb]
8. Mapas de pobreza de Guatemala. (2001). [7.96Mb]
9. Nicaragua PRSP (2001). Government of Nicaragua. Annex IV includes the poverty map, poverty tables and discussion of policy applications.

Policy Applications: Middle East & North Africa

1. Lanjouw, Peter. "The Geography of Poverty in Morocco: Micro-Level Estimates of Poverty and Inequality from Combined Census and Household Survey Data." World Bank. February 24, 2004. [246Kb]

PovertyNet website – www.worldbank.org/poverty - under topic "Poverty Analysis", section "Mapping Poverty"
–
The examples provided on this page, and the documents which support them, are only illustrative
and do not indicate World Bank endorsement of any data, methodologies, or geographic boundaries.

Policy Applications: South Asia

1. Bangladesh Bureau of Statistics and the United Nations World Food Program (2004). Local Estimation of Poverty and Malnutrition in Bangladesh. [2.85Mb]
2. Bigman, David, P. V. Srinivasan. "Geographical targeting of poverty alleviation programs: methodology and applications in rural India." Journal of Policy Modeling Volume 24, Issue 3, June 2002, Pages 237-255.
3. Datt, G. and M. Ravallion (1993). "Regional Disparities, Targeting, and Poverty in India," in M. Lipton and J. van der Gaag, *Including the Poor*, The World Bank.
4. Deichmann, Uwe, Somik V. Lall, Pragya Rajoria, and Ajay Suri. "Information-Based Instruments for Improved Urban Management." (India) World Bank. March 19, 2003.
5. Juan-Albacea, Zita Villa. (2004) "Small Area Estimation of Sub-National Poverty Incidence" (Philippines) [1.14Mb]. Presented at the ADB-GTZ-CEPA Regional Conference on Poverty Monitoring, March 24-26, 2004. See accompanying presentation [74Kb].
6. Ravallion, Martin (1994)."How Robust is a Poverty Profile." A case study on Indonesia. *The World Bank Economic Review.* 8(1): 75-102. [1.52Mb]
7. Van der Weide, Roy (2004)."How poverty came on the map in Lao PDR." [923Kb]

Policy Applications: Sub-Saharan Africa

1. Alderman, Harold, Miriam Babita, Gabriel Demombynes, Ntabiseng Makhatha, and Berk Özler (2001). 'How Low Can You Go? Combining Census and Survey Data for Mapping Poverty in South Africa'. Journal of African Economies, Volume 11, Issue 3.
2. Balk, Deborah. (2004) "Spatial Analysis of Childhood Mortality in West Africa." Presentation to National Population Association of America, April 2, 2004. Columbia University.
3. Benson, Todd (2002). Malawi: An Atlas of Social Statistics . National Statistical Office, Government of Malawi and the International Food Policy Research Institute.
4. Bigman, D., S. Dercon, D. Guillaume, and M. Lambotte. (2000) "Community Targeting for Poverty Reduction in Burkina Faso." *The World Bank Economic Review* 14 (1): 167-93.
5. Central Bureau of Statistics, Ministry of Planning and National Development, Kenya (2003). Geographic Dimensions of Well-Being Kenya: Where are the Poor? From Districts to Locations, Volume 1.
6. Croft, T., S. Rutstein, J. Brunner and N. Abderrahim (1997) West Africa Spatial Analysis Prototype: Development of a Geo-Referenced Regional Database, Technical paper, DHS/Macro International.
7. Demombynes, Gabriel, Berk Özler (2002). "Crime and Local Inequality in South Africa." World Bank.
8. Fofack, Hippolyte. (2000) "Combining light monitoring surveys with integrated surveys to improve targeting for poverty reduction: the case of Ghana." *The World Bank Economic Review* 14 (1): 195-219.
9. Galasso, Emanuela. "The geographical dimension of public expenditures and its link to poverty: the case of Madagascar." PowerPoint presentation World Bank.
10. Hoogeveen, Johannes G. "Measuring Welfare for Small Vulnerable Groups: Poverty and Disability in Uganda." World Bank. DRAFT: December, 2003. (How one can use poverty mapping techniques to get poverty estimates for small populations that are otherwise 'statistically' invisible.) [84.6Kb]
11. Hoogeveen, Johannes G., Thomas Emwanu, Paul Okiira Okwi. "Updating Small Area Welfare Indicators in the Absence of a New Census." World Bank, Uganda Bureau of Statistics, Economics Department, Makerere University, Kampala. DRAFT: November 13, 2003. (Reweighting household surveys, something that often has to be done in the course of poverty mapping.) [265Kb]
12. Mistiaen, Johan, Berk Ozler (2002). "Putting Welfare on the Map in Madagascar." World Bank.

13. Moçambique Ministério de Plano e Finanças, Direcção Nacional do Plano e Orçamento (2002)."Mapeamento da Pobreza em Moçambique: Desagregação das Estimativas da Pobreza e Desigualdade aos Níveis de Distrito e Posto Administrativo."
14. Nucifora, Antonio (2003). "Reforming the Malawi Agricultural Development and Marketing Corporation (ADMARC): Synthesis Report of the Poverty and Social Impact Analysis" World Bank.
15. Simler, Ken, Virgulino Nhate (2003)."Poverty, inequality, and geographic targeting: Evidence from small-area estimates in Mozambique." International Food Policy Research Institute, Ministry of Planning and Finance, Maputo, Mozambique. [1.52Mb]
16. The Monitoring and Evaluation of Starter Pack and the Targeted Inputs Programme in Malawi: 1999-2003. Statistical Services Center. The University of Reading: United Kingdom. Last updated March 2004.

External Websites

- Center for International Earth Science Information Network - Columbia University
- Department of Geography, University of Leicester, International Inequality: Spatial Aspects. Interrelationships between the different dimensions of inequality and their spatial patterns.
- FAO, UNEP and the CGIAR
- FAO Food Insecurity and Vulnerability Information and Mapping System (FIVIMS) Development of country level food security and vulnerability monitoring systems—extensive use of GIS.
- GIS and geography WWW resource list at the University of Edinburgh's Department of Geography. Links to university departments, public and commercial sites dealing with GIS and geography.
- GIS and geography WWW resource list at the University of Utrecht (Netherlands). Links to university departments, public and commercial sites dealing with GIS and geography.
- GIS Frequently Asked Questions. Maintained by the U.S. Bureau of the Census.
- International Food Policy Research Institute
- International Center for Tropical Agriculture (CIAT), Cali, Colombia. Compilation of GIS data sets; projects investigating the relationship between poverty and agricultural development; focal center for GIS in the CGIAR.
- Stone Environmental. A US firm that manages Geographic Information Systems (GIS) projects on a variety of topics, including Information for Sustainable Development initiatives in Africa.
- USAID Famine Early Warning System. Large-scale monitoring systems, compilation of bio-physical and socioeconomic data—many in GIS format.
- United Nations Environment Programme/ Global Resource Information Database (UNEP/GRID). Poverty mapping initiative; UNEP/CGIAR cooperation in GIS use for agricultural research.
- World Food Programme Vulnerability Analysis and Mapping