MAPPING AND GEOGRAPHIC ANALYSIS OF HUMAN WELFARE AND POVERTY — REVIEW AND ASSESSMENT

NORBERT HENNINGER

World Resources Institute
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1. INTRODUCTION

1.1 BACKGROUND

Preparation of this review to map rural poverty in developing countries was motivated by a study, carried out by Nelson *et al*. (1997) on behalf of the Technical Advisory Committee (TAC) of the Consultative Group on International Agricultural Research (CGIAR), on CGIAR research priorities for marginal lands. The study differentiated between marginal agricultural land (MAL) and favored agricultural land (FAL) and estimated their extent and the number of people living in these areas. According to this analysis, about 634 million rural poor are living in marginal lands, of which 375 million (59%) are in Asia. The report also shows that only 25% of the 374 CGIAR projects endorsed in 1997 are fully targeted at poverty alleviation in MAL, suggesting a need "to sharpen its [CGIAR's] strategic focus on poverty alleviation particularly in setting priorities for research related to marginal rural areas."

The relevance of such research targeting the poor was highlighted by a study by the International Food Policy Research Institute (IFPRI) which found that public investments in low-potential rainfed areas, for example with high-yielding varieties, irrigation, and education, would increase agricultural productivity and reduce rural poverty in India, providing a greater gain per unit of additional investment than similar investments in irrigated or high-potential rainfed areas (Fan and Hazell, 1997). Similarly, a study based on the 1992-93 Living Standard Measurement (LSMS) Study survey of Vietnam found that the highest increase in net crop income would occur in Vietnam's two poorest regions: the Northern Uplands and the North Coast (van de Walle, 1996).

These two studies took advantage of disaggregated data on population, incidence of poverty, land use, and infrastructure. But in many developing countries the empirical basis for characterizing and mapping marginal lands is so weak and at times unavailable as to make policy recommendations meaningful. Similar limitations are apparent in the Nelson *et al*. study: the soil and length of growing period maps used to define MAL and FAL included no information on land cover or use, population data were only available at the first subnational level, and a constant poverty rate was applied for all areas within a country.

In its review of Nelson *et al.*, the TAC (1996) identified the following key limitation in our understanding of the nature and distribution of marginal lands: "the lack of readily available data in a geo-referenced framework, in particular with respect to the incidence and nature of poverty and probability of land degradation by land type." The TAC recommended a "review of available data on poverty and land degradation in relation to these marginal lands."

In response to this observation, United Nations Environment Programme (UNEP)/GRID-Arendal contracted with World Resources Institute (WRI) to carry out a review of poverty mapping (see Appendix 1 Terms of Reference - Poverty Mapping Assessment, page 75). This review is part of an ongoing collaborative project between UNEP and CGIAR to strengthen the use of Geographic Information Systems (GIS) in agricultural research, assist in the production of reliable statistical and cartographic products, for example on poverty and land use quality, and contribute to further development of global databases relevant to agricultural research. WRI had

previously mapped human development indicators in West Africa to support regional priority setting by the Abidjan-based Regional Office of the U.S. Agency for International Development (USAID).

1.2 POVERTY MAPS - APPLICATIONS AND USERS

Most national poverty assessments using household and community surveys have compiled data that allow disaggregation by broad categories such as urban and rural areas, socio-economic characteristics such as household types and educational backgrounds, and major geographical regions such as a coastal, forest, and savanna zone. These poverty assessments have helped in

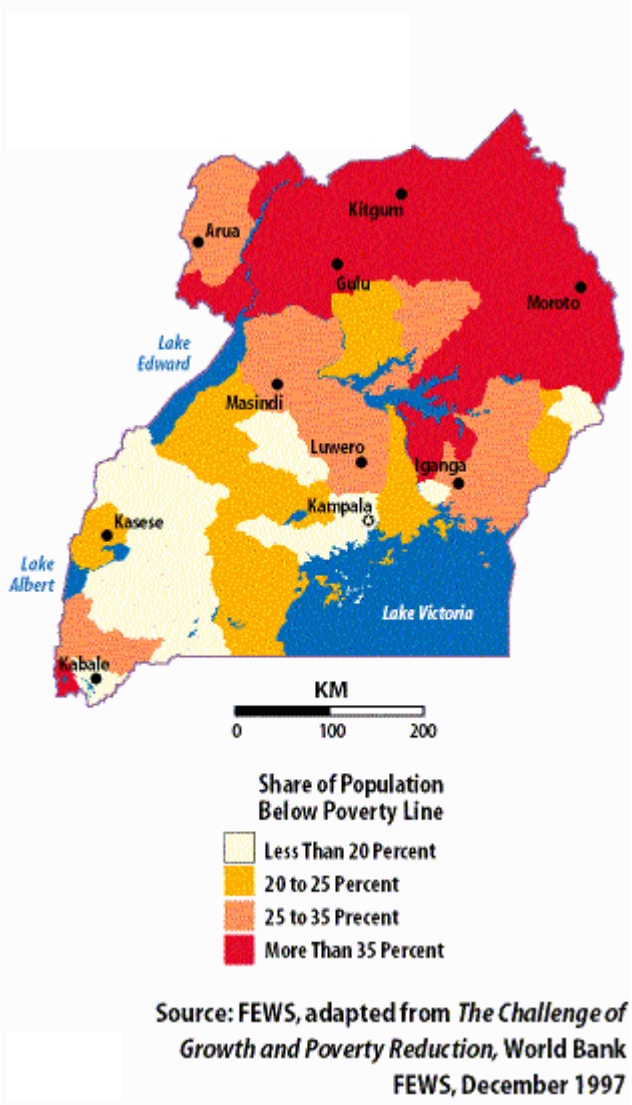
- defining poverty,
- describing the situation and problem,
- identifying and understanding causes of poverty,
- developing programs and formulating policies, and
- selecting interventions and guiding allocation of resources.

Geographically disaggregated data from these assessments can be displayed in a map. Figure 1, page 3, shows such a thematic poverty map for Uganda.

Poverty maps can provide quickly information on the spatial distribution of poverty. However, the coarse resolution of Figure 1 is too limiting for many applications. Analysts are beginning to produce poverty maps at finer resolution, by geo-referencing surveys and integrating these data with other information. Linking poverty assessments to maps provides new benefits in addition to the applications of poverty assessments outlined above:

- Poverty maps make it easier to integrate data from various sources such as surveys, censuses, and satellites and from different disciplines such as social, economic, environmental data. This can help in defining and describing poverty. For example, by comparing spatial patterns of income with educational level, access to services, and market integration, different dimensions of human well-being can be examined or even be integrated.
- A spatial framework allows to switch to new units of analysis, for example from administrative boundaries to ecological boundaries, and access new variables like community characteristics, not collected in the original survey.
- Identifying spatial patterns with poverty maps can provide new insights into the causes of poverty, for example how much are physical isolation and poor agro-ecological endowments impediments to escape poverty. This in turn affects what type of interventions to consider.
- The allocation of resources can be improved. Poverty maps can assist in where and how to target antipoverty programs. Geographic targeting, as opposed to across the board subsidies, has been shown to be effective at maximizing the coverage of the poor while minimizing leakage to the non-poor (Baker and Grosh, 1995). Research examining narrow geographic targeting at the community level is currently being conducted in Burkina Faso (see 5.3.2, page 60). With appropriate scale and robust poverty indicators, poverty maps can assist in the implementation of antipoverty

Figure 1 Poverty Map of Uganda



Source: FEWS, adapted from *The Challenge of Growth and Poverty Reduction*, World Bank
FEWS, December 1997

programs, for example by promoting subsidies in poor communities and cost recovery in less poor areas.

- Poverty maps with a high resolution can support efforts to decentralize and localize decision making.
- Maps are a powerful tool to visualize spatial relationships and can be very effective in reaching policy makers, providing an additional return on investments in survey data, which often remain unused and unanalyzed after the initial report or study is completed.
- Internationally comparable poverty maps applying a consistent set of indicators at subnational level can improve decision making and strategic planning of international development organizations that had to rely mostly on national level indicators.

The CGIAR-System as a whole and specific Centers are potentially important users of poverty maps, especially since they are working within an agro-ecological framework and require assessments at both administrative and biophysical levels. Specific applications include broad strategic planning and priority setting exercises and analyses, for example examining the impacts of specific agro-technological interventions on poverty.

Other users of poverty maps include organizations that have poverty alleviation or reduction as their mandate, for example, at the international level, UNDP, the World Bank, and bilateral development agencies. Here, poverty maps of various scales could be used for planning, analyses, and monitoring.

1.3 SPATIALLY DISAGGREGATED DATA - AT WHAT SCALE OR RESOLUTION?

The final applications of these poverty maps ultimately determine the appropriate scale or resolution. For example, data can be analyzed at the individual, household, village, community, administrative, national, or regional level. Whether comparing countries, setting research priorities, studying causes and effects, developing a baseline for monitoring, or targeting specific project interventions, each application requires a specific resolution for reference units. Data can generally be aggregated from the individual to the macro level, and analysts need to balance detail and coverage required for analysis with the cost of data collection. A coarse resolution or a scale too small neglects the heterogeneity within each unit and provides insufficient detail for decision making, a fine resolution or a scale too large increases the cost of compiling, managing, and analyzing the data. In addition, data at coarse resolution, for example national poverty indicators, usually are more readily available and cover a wider geographic area.

It is difficult to pre-determine an ideal resolution or scale that would be a perfect framework to guide all research priorities for marginal lands. The TAC and CGIAR Centers need to define the purpose and specific applications of their poverty mapping more precisely and determine how accurately they want to reflect the spatial distribution of poverty. Ultimately, multiple assessments and scales will be necessary, and the optimal scale will be determined by the loss attached to errors of identification in locating the poor.

2. HUMAN WELFARE AND POVERTY

2.1 CONCEPTS, DEFINITIONS, AND MEASUREMENT

2.1.1 Human Well-Being is Multidimensional

Mapping rural poverty is more than a cartographic exercise. The measurement of human well-being itself is difficult and raises many methodological issues. No universally agreed upon definition of poverty has been established. People are considered poor when they cannot secure a minimum standard of well-being and/or when their choices and opportunities for a tolerable life

are denied or severely restricted (United Nations Development Programme, 1997; Blackwood and Lynch, 1994). Most authors acknowledge that well-being is multidimensional and define poverty as a lack of well-being (See Box 1, page 5, and Box 2, page 6). In his review of concepts and methods for poverty comparisons, Ravallion points to the difference between materialist ideas such as "standard of living" and concepts such as "opportunities" or "rights" to participate in society (Ravallion, 1992).

Box 1 Multidimensionality of Human Well-Being

In their global assessment of rural poverty, the International Fund for Agricultural Development (IFAD) identified eight broad components of poverty (Jazairy *et al*., 1992):

- Material deprivation - Includes inadequate food supplies, poor nutritional status, poor health, poor education, lack of clothing and housing, fuel insecurity, and absence of provisions for emergencies.
- Lack of assets - It covers both material assets (land, agricultural inputs, etc.) and human capital (education, training, etc.).
- Isolation - This component tries to capture social, political, and geographic marginalization. The latter can be found in remote areas, far from development and service institutions with very limited access to transport, roads, markets, and communication links.
- Alienation - Alienation results from isolation and exploitative social relations and includes people that lack identity and control, are unemployed or underemployed, lack marketable skills, and have limited access to training and education.
- Dependence - Poor people are often exposed to skewed dependency relationships that can be found for example between landlord and tenant, employer and employee, creditor and debtor, buyer and seller, or patron and bonded laborer.
- Lack of decision making power - This is a result of limited participation and freedom of choice.
- Vulnerability to external shocks - External shocks can be caused by factors found in nature (droughts, floods, cyclones, locusts, etc.), markets (collapse in commodity prices, labor supply and demand, etc.), demography (loss of a household's earning member, death, divorce, etc.), health (illness of earning member), and war.
- Insecurity - This is defined as the risk of being exposed to physical violence.

Similarly, participatory studies where local people and not experts from the outside define well-being reveal this multidimensionality (Chambers, 1997). A review of such participatory assessments identifies the following elements of human well-being:

- Access to food, land, livestock, farm equipment, water, and income.
- Adequate housing.
- Resources to send children to school.
- Free of obligations to make children work for others.
- Ability to decline demeaning or low-status jobs.
- Not being dependent on common property resources.
- Not being disabled, widowed, or a single parent.
- Social support and social networks.
- Ability to fulfill social obligations.
- Decent burial for the dead.

2.1.2 What Do We Measure?

According to Ravallion, the most important reason for measuring poverty is to make comparisons, for example: Has poverty increased or is it lower in a certain region (ordinal comparison)? By how much has poverty changed over a specific time period (cardinal comparison)? It is important that poverty measurements are robust, especially when used for targeting and decision making, and the underlying value judgment for measurement are clearly understood by the decision maker (Ravallion, 1992).

To measure poverty, four essential questions need to be answered:

1. How do we define human well-being?
2. What do we measure - the means or inputs of human well-being or well-being itself?
3. At what level of well-being is a person poor, or how do we determine a poverty line?
4. How do we combine measurements of well-being at the individual or household level to aggregated poverty measurements, both along one dimension and along different dimensions of well-being?

Box 2 Poverty, Development, and Equity

Poverty intersects and overlaps with other concepts, notably development and equity. For a more detailed discussion, see Lok Dessallien (1995), Streeten (1994), and Boltvinik (1994).

Poverty and development are both multidimensional. Development looks at a community as a whole and measures change and advancement along different dimensions of well-being (United Nations Development Programme, 1997). Poverty focuses on a segment of a community. It compares different dimensions of human well-being to a standard, for example a poverty line, and then classifies a person or household as poor or non-poor. This standard can be defined in absolute or relative terms. For example, an absolute standard could be all households that do not have the means for human survival. A relative standard simply compares different households according to their degree of deprivation.

Like development, poverty is a dynamic phenomena. Households can move in and out of poverty or shift in their relative status of well-being, depending on changes in household characteristics, such as sudden unemployment of a household member, and external circumstances, such as failure of crops or increase in food prices.

Although poverty and development indicators are correlated, they are not necessarily interchangeable measurements to identify poor households. Comparing a targeting approach based on indicators measuring basic needs (access to water and sanitation, waste removal, education, and household crowding) with one based on household consumption expenditures produced significant differences in the ranking of households (Hentschel *et al*., 1997).

Poverty and equity are closely connected. While poverty captures deprivation, equity looks at the distribution of an indicator. Poverty itself is generally the result of larger inequity, although a theoretical case could be imagined where everybody is absolutely poor with no significant variation in the status of well-being among the poor. More sophisticated poverty measures usually incorporate the distributional aspects of poverty. For example, the squared poverty gap of the Foster-Greer-Thorbecke (FGT) class of poverty measures applies an increasing weight to distances below the poverty line, thus capturing the severity of poverty.

The literature refers to questions 1 - 3 as identification problem and question 4 as aggregation problem (Ravallion, 1992). Box 1 (page 5) and Box 2 (page 6) provide more detail to question 1. Question 3 and 4 are discussed in Box 3 (page 8) and Box 4 (page 9), respectively. Different ways to measure poverty are outlined below.

There are basically two methods to develop indicators of human well-being and poverty. We can measure the means or inputs of human well-being or well-being itself. Food consumption, income, and use of health services are indicators of means or inputs to human well-being. Nutritional status, life expectancy, and literacy rate are examples measuring the ends or outcome, that is well-being itself. Indicators of human well-being at the ends or outcome level are sometimes referred to as measures of human capabilities. Poverty is then defined as a lack of basic capabilities. For example, basic capabilities include a life free of avoidable morbidity, adequate nourishment, healthy reproduction, personal security, and participation in society (McKinley, 1997).

Some authors suggest that poverty indicators should focus as much as possible on people's capabilities, since means or inputs do not always lead to the desired outputs or capabilities (McKinley, 1997). On the other hand, selected outcome variables have the problem of not being able to determine the exact causes that are responsible for the observed results. For example, stunting of children is a good indicator for chronic undernutrition, but its exact causes may not be readily identifiable and include factors such as inadequate food supply, recurrent and chronic illnesses, or length of breastfeeding.

2.2 HUMAN WELFARE AND POVERTY INDICATORS - MAJOR DIMENSIONS

Most human welfare and poverty indicators can be grouped into three major dimensions of well-being: economic, social, and enabling environment. They are summarized in Table 1 (page 11). Indicators for these dimensions will be discussed in turn.

Table 1 lists three major approaches to produce poverty indicators under the economic dimension of well-being: current consumption expenditures, income, and wealth. Indicators of wealth are sporadically used and can be both an outcome or an input variable. For economists, the preferred measure to calculate poverty indicators is current household consumption expenditures, that is the aggregate expenditures on all goods and services consumed (including consumption from own production), valued at appropriate prices. If consumption of services can be expressed appropriately in monetary terms, then current consumption can capture elements of the economic and social dimension of well-being. Since household income of the poor can vary significantly over time (more than consumption) and such data are more difficult to collect in developing countries, it is usually a second choice for economists producing poverty indicators (Ravallion, 1992).

Household consumption expenditures as a measure of standard of living has its foundation in welfare theory. The total amount of money spent on the consumption of goods and services reflects the magnitude of utility derived from consumption. Each household's mix of goods and services is based on individual preferences. Prices provide the appropriate weighting for the chosen goods and services. It is assumed that a household maximizes its individual utilities and that a higher consumption of goods and services raises utility (Ravallion, 1992).

Box 3 At What Level of Well-Being is a Person Poor?

Whether analysts choose an economic or a social measure to assess poverty, they need to select a specific threshold to distinguish the poor from non-poor. For social indicators it is usually a specific threshold of deprivation that defines inadequate housing, poor nutrition, poor health, inadequate education, etc. For economic indicators it is typically drawing a poverty line. A poverty line often serves various other purposes, in addition to the initial identification of the poor: It is the starting point to monitor poverty, develop a poverty profile, and identify determinants of poverty. It can become a threshold for entitlements and the focus for public debate (Olson Lanjouw, 1997).

The most common method to establish poverty lines based on household per capita expenditures uses an absolute line that is linked to a specific standard of living. Thresholds can be set differently reflecting a range of living standards, including lines sometimes referred to as 'extreme poverty line,' 'full poverty line,' and 'vulnerability line' (The World Bank, 1996).

The 'extreme poverty line' or 'food poverty line' is usually set at a household's total expenditures that equal a basket of food items that meets a household's minimum necessary calorie requirements. For example, 2,250 calories per person per day is considered the minimum requirement for India (McKinley, 1997).

The 'full poverty line' includes both a household's total expenditures on the same basket of food items plus non-food items. The share of total expenditures spent on non-food can be calculated by examining those households whose total expenditures equal the 'extreme poverty line' and determine what share they devote to food items. The inverse of this share is then multiplied with the 'food poverty line' to come up with the total expenditures defining the 'full poverty line'. Scaling up of non-food items in such a way, assumes that reference households made the trade-off between necessary food and non-food items, and their final basket represents the most essential items.

In practice, the most common approach to draw a poverty line uses a different reference group than the previous method. Sometimes termed the 'vulnerability line,' it looks at households whose total food expenditures equal the minimum basket of items used to define the 'extreme poverty line.' The inverse of these household's share of non-food expenditures in total expenditures is then used to scale up to the vulnerability line. The non-food expenditures for the reference households represent an essential part of household consumption, however without the trade-off between the most essential food and non-food items assumed to define the 'full poverty line'. Households between the 'vulnerability line' and the 'full poverty line' represent the share vulnerable to poverty.

Since countries use any of the approaches above to draw a poverty line and different methods to determine non-food share in household expenditures, international comparisons of national poverty rates require a careful look at the definition of these poverty lines. The definitions for a minimum living standard and the compositions of the minimum basket need to be compatible and corrections need to be made for spatial and temporal variations in prices. For a more detailed discussion of setting absolute poverty lines and comparing poverty lines, see Olson Lanjouw (1997).

The limitations of using monetary measures to capture household well-being have been discussed extensively in the literature (McKinley, 1997). It includes difficulties of capturing non-marketed and non-priced goods, such as subsistence consumption and free social services, or other aspects important to human well-being, such as community resources, social relations, and the natural environment. Economists usually supplement their economic measures with other indicators such as literacy, infant mortality, and access to public services, to cover these non-monetary

Box 4 How Do We Combine Measurements of Well-Being?

Once a threshold for human well-being has been established, there are two aggregation problems, the first dealing with aggregating household data along a single dimension and the other with combining various indicators measuring different dimensions of well-being. Aggregation along a single dimension will be discussed for measurements based on household consumption expenditures using a poverty line. They include the following major aggregate poverty measurements: 'headcount,' 'poverty gap,' and 'squared poverty gap.' Aggregating different dimensions into a single index will be described with various examples of international composite indexes using national level data.

After a poverty line has been drawn, and the data were provided by a household consumption survey, poor households can be identified and their absolute number can be established. The first and most widely known economic poverty indicator is the 'headcount' measure. It is simply the percentage of households below the poverty line. The 'headcount' is easily understood, but has the drawback of being insensitive to the degree of poverty, that is the index does not change with a household's distance to the poverty line. The second indicator, the 'poverty gap,' tries to address this issue by incorporating into its formula the degree to which the mean consumption of poor households differs from the poverty line. It is thus a better measure of the depth of poverty. The third indicator, the 'squared poverty gap,' is sensitive to the distribution of poverty below the poverty line and applies an increasing weight to distances below the poverty line, thus capturing the severity of poverty. All three measures are part of the Foster-Greer-Thorbecke (FGT) class of poverty measures. For more detail, see Ravallion (1994).

Many social indicators typically represent headcount-type measures such as the percentage of households without safe water. If data are disaggregated, for example at village level, and a metric can be established to measure the distance from the poverty threshold, then similar weighted indexes can be produced for social indicators. For example, Deichmann (1997a) has discussed different indexes measuring physical access to service providers that mirror the latter two economic measures of poverty above.

Accepting a multi-dimensional concept of well-being requires assessing different indicators and dimensions simultaneously. To overcome the complexities of such a profile of well-being, which is difficult to comprehend, composite indexes combining the various indicators have been developed.

For example, the United Nations Development Programme (UNDP)'s Human Development Report series has produced various composite development indexes. The most recent Human Development Report presents a Human Poverty Index, compiled at a national level, for 78 countries (United Nations Development Programme, 1997). It is a composite of three variables: percentage of people expected to die before age 40, percentage of adults who are illiterate, and a non-income based measure for standard of living defined by the proportion of people with access to health services, proportion of people with access to safe drinking water, and the proportion of malnourished children under five years of age. In a previous edition, UNDP introduced a Capability Poverty Measure, again with national level data (United Nations Development Programme, 1996). It included three equally weighted variables: percentage of children under five who are underweight, percentage of adult women who are illiterate, and the percentage of births unattended by trained health personnel.

IFAD has produced similar indexes at national level. It includes an Integrated Poverty Index which combines the following variables: GNP per capita, income-gap ratio, annual growth in GNP per capita, percentage of rural population below the poverty line, and life expectancy at birth. Other indexes include a food security index, an educational status index, and a health status index (Jazairy *et al*., 1992).

Most of these indexes have been used for broad international comparisons and advocacy. Although they provide a consistent summary of the chosen variables, their internal weighting schemes are arbitrary. See Ravallion (1997), for a discussion on the implicit weighting scheme of UNDP's Human Development Index. These indexes have been less widely applied for policy making, since the national level input data may hide important aspects of poverty. For example, they are not very good predictors for the subnational distribution of poverty (Ravallion, 1996a).

aspects of household well-being. For example, see list of priority indicators in the World Bank' s (1992) Poverty Reduction Handbook and Operational Directive.

Monetary measures have the advantage of being easily comparable. They solve the problem of assigning weights to a mix of goods and services and allow to produce integrated poverty indexes that measure the depth and severity of poverty (see Box 4, page 9, for more detail).

Indicators under the social dimension of well-being in Table 1 include measures on nutrition, energy, sanitation and water, health and family planning, and education, covering both various means and outcome indicators. The strength of social indicators is that they provide a number of useful capability measures. For example, indicators of child nutritional status based on anthropometric measurements have been used as a proxy for the constraints to human welfare of the poorest, capturing dietary inadequacies, infectious diseases, and other environmental and economic constraints. Difficulties in aggregating different social indicators into a composite index is their greatest limitation (Lok Dessallien, 1995).

Development practitioners are beginning to broaden their field of potential poverty indictors and are looking at causes of poverty that are structural and systemic. Potential indicators seek to capture empowerment, governance, participation, and transparency of legal system and look at structural inequities and skewed processes that become an impediment to human well-being. Potential indicators are listed in Table 1 under the category enabling environment. Work in this area is still very preliminary because some of the concepts are not very well defined, are difficult to quantify, or cannot easily be isolated from poverty indicators in the other two dimensions (McKinley, 1997). Geographic factors may be one of those structural impediments and are summarized under the concept peripheral areas which are isolated areas where poverty is largely determined by geographic factors. Table 1 lists also some indicators that measure food security related vulnerability such as poor agricultural endowment and high environmental hazard under the enabling environment dimension.

Both vulnerability and peripheral areas will be discussed in more detail (2.3, page 12, and 2.4, page 17, respectively). Vulnerability and peripheral areas are not mutually exclusive and overlap to some degree with economic and social well-being. Vulnerability often combines information on hazards (drought, floods, etc.) with economic and non-economic measures of well-being, and may include indicators for peripheral areas as well. Peripheral areas combines information on economic and non-economic well-being with spatial factors.

A number of general limitations apply to many of the indicators listed in Table 1: They have problems capturing the dynamics of poverty. For many developing countries, data are not always available or accurate enough for detailed poverty analyses. International comparisons of national data are difficult since countries use different methods to calculate the same indicator. If measurements are at the household level, adjustments have to be made to address the imbalances within households, for example by disaggregating indicators by gender or using adult equivalent units to reflect different household sizes (Lok Dessallien, 1995).

Table 1 Indicators of Human Well-Being and Poverty

Dimension	Component	Means Examples of Indicators	Ends/Outcome/Capability Examples of Indicators
Economic (monetary measurement)	current consumption expenditures	• number of people below poverty line • head count index (proportion of people below poverty line) • poverty gap • squared poverty gap • other composite poverty indexes • percentage of household budget spent on food (food ratio)	• lack of wealth [- productive assets - land, livestock, and equipment - housing - consumer goods - savings]*
	income	same as above	
Social (Non-Economic or non-monetary measurement)	nutrition	• calorie intake to requirement	• low height-for-age • low weight-for-age • low weight-for-height • body mass index • low birth weight
	sanitation and water	• access to adequate sanitation • access to potable water	• morbidity - water-borne diseases
	energy	• access to adequate energy supply • access to electricity	
	health and family planning	• access to primary healthcare • immunization rates • access to family planning • births attended by trained healthcare personnel	• mortality - infant • mortality - children under 5 years of age • mortality - maternal • morbidity of certain diseases • contraceptive prevalence rate • percentage of pregnant women who are anemic • life expectancy
	education	• net primary enrollment rate	• literacy rate - female/male/adult • primary school completion rate
Enabling Environment (tries to capture structural inequities, processes, and systemic disadvantages)	access to means of production	• limited or no participation in decision making • limited or no social capital • limited or no access to productive assets • limited or no access to employment • limited or no access to land • limited or no access to credit • limited or no access to technology • limited or no access to information	
	vulnerability **	• poor agricultural endowment • high environmental hazard (droughts, floods, etc.) • great insecurity (crime, intimidation, etc.)	
	peripheral areas***	• poor access to markets • poor access to infrastructure • poor access to public transportation	

* Wealth or household assets are an outcome of economic activities. But they are also means or inputs for human well-being.
** These are just some of the components of food security related vulnerability - see 2.3, page 12
*** Can be defined as isolated areas where poverty is largely determined by geographic factors - see 2.4, page 17.

2.3 VULNERABILITY

Reviewing the concept of vulnerability will highlight useful frameworks and definitions that may be adapted to poverty mapping. It will also show what has been and can be mapped within the limits of existing data sets. Food security and famine early warning organizations have made significant investments in geo-referenced data sets and are producing maps regularly.

2.3.1 Definitions

Vulnerability can be defined as the susceptibility of an individual, household, or community to external shocks and fluctuations. The concept of vulnerability has been applied extensively in famine early warning programs, food security assessments, and drought relief coordination, primarily in Africa. In this context, vulnerability is perceived as a concept that combines food security with risk factors that increase or decrease food security (FSTAU and FEWS, 1997).

Food security measures access to or control of resources required to meet basic needs for food, clothing, and shelter that are necessary to lead a healthy and active live. It includes two important components: food availability and food access.

Risk factors include an external and an internal element. The external element covers events or conditions that affect a household's food security, for example drought and economic change. They are referred to as shocks or hazards. The internal element deals with the coping resources of a household. These are factors that determine a household's ability to re-establish its food security once a shock has come to pass. For example, a subsistence farming family with few assets and limited skills which is experiencing frequent and severe droughts would be classified as a household with high risk factors, because it is exposed to frequent shocks and has low coping ability.

2.3.2 Types of Vulnerability

Vulnerability can be grouped into five categories by major risk factors, some of which could be mapped (Ministry in the Office of the President, 1995):

- Environmental risk (droughts, floods, and pests).
- Market risk (price fluctuations, wage variability, and unemployment).
- Political risk (changes in subsidies or prices, income transfers, and civil strife).
- Social risk (reduction in community support and entitlements).
- Health risk (exposure to diseases that prevent work).

Vulnerability and poverty are concepts that overlap, but are not always identical. A rural household that produces almost all of its food and is isolated from national and international market forces could be categorized as poor based on its household income but may not be very vulnerable to changes in subsidies or prices. At the same time a household in an urban area could be classified as not poor because of a slightly higher household income, but may be very vulnerable to price and labor market changes (Glewwe and Hall, 1995).

2.3.3 Approaches for Measurement

A recent review meeting of food security and famine early warning experts distinguished between three major approaches to carry out vulnerability assessments: The top-down approach used by the USAID-financed Famine Early Warning System (FEWS) and two bottom-up approaches, used by Save the Children Fund (SCF) and by Agence Européene pour le Développement et la Santé (AEDES), respectively (Global Information and Early Warning System, 1997).

FEWS uses food security indicators linked to or reported by geographic area from which the food security situation at the household level is inferred. Data inputs include remotely sensed data, primarily measures of vegetative vigor and land use, and agricultural and socio-economic data at administrative level.

Conceptual frameworks for vulnerability assessments vary between countries, but generally include measures for chronic (baseline) vulnerability and acute vulnerability (reflecting the success or failure of the most recent agricultural season). Most indicators measuring baseline vulnerability could become an appropriate input for poverty assessments.

SCF conducts their vulnerability assessments in a two-step approach (Seaman *et al*., 1993). First, they delineate different food economy zones which are areas that are more or less homogeneous in their livelihood systems. Then, key informants from district to village level are interviewed to obtain information on the current food economy of poorer, middle, and richer households, thus producing an assessment for a larger geographic region. The methods used to delineate food economy zones could be adapted to develop a typology of economic activities. Figure 13, page 50, shows an example of such food economy zones in Sudan.

Similar to SCF, AEDES relies on interviews of key informants. The collected information is aggregated upwards and reported by administrative units.

2.3.4 Conceptual Frameworks and Indicators for Vulnerability Assessments

Analysts conducting vulnerability assessments have adapted their approaches to reflect the differences in local risk factors that are caused for example by the physical geography, agroclimatic conditions, colonial history, agricultural production systems, infrastructure, economic and policy environment, and data availability. Tables 2 - 6 summarize the conceptual frameworks and indicators of five different vulnerability assessments in Africa (Ramachandran and Eastman, 1997). For some of these vulnerability assessments, all variables were combined to calculate a composite index, for example with the help of z-scores, in others the different variables were mapped for visual interpretation and overlay analyses. Selected components or variables of these assessments could be appropriated for poverty mapping.

The first example, a vulnerability assessment for four countries in the Sahel, differentiates between baseline and current vulnerability and is summarized in Table 2, page 14 (Wright *et al*., 1995). Two components, one reflecting the resource base and the other income structure, include variables that could be adapted for poverty analysis.

Table 2 FEWS - Vulnerability Assessment for the Sahel 1995

Dimension	Component	Variable
Baseline vulnerability	Resource base	Length of growing season
		Variability of growing season
		Access to infrastructure
	Income Structure	Average per capita cereal production value
		Average per capita livestock value
		Average per capita cash crop income
Current vulnerability		Quality of growing season, current year
		Quality of growing season, previous year
		Quality of growing season, two years ago
		Pasture conditions, September to December
		April millet prices compared to average
		Millet price change - August previous year to January this year
		Insecurity

Source: Wright *et al*. (1995)

Table 3, page 14, a summary of a vulnerability assessment for Kenya in 1995, lists various variables under 'depth of household entitlement base,' which could be of interest for poverty mapping (USAID FEWS, 1995). Most of them are similar to those shown in Table 2 (access, livestock income, and cash crop income). The variable 'hectares of high potential land equivalent per capita' could be a good indicator of agricultural resource endowment in a poverty assessment for the CGIAR System.

Table 3 USAID - Vulnerability Assessment for Kenya 1995

Dimension/Component	Variable
Drought risk	Coefficient of variation of NDVI, current season
	Coefficient of variation of NDVI, previous season
	Coefficient of variation of NDVI, two seasons ago
	Average NDVI, current season
	Average NDVI, previous season
	Average NDVI, two seasons ago
	Average NDVI weighted by the coefficient of variation
Depth of household entitlement base	Number of livestock units per capita
	Share of income from non-agricultural activities
	Share of income from cash crops
	Hectares of high potential land equivalents per capita
	Access to urban infrastructure
Physical insecurity	Pastoralists insecurity
	Tribal clashes
	Elephant conflicts

Source: USAID FEWS (1995).

The third example, a framework for famine early warning in Kenya, is less complex and shown in Table 4, page 15 (Hutchinson *et al*., 1992). The authors used an unusual variable, 'number of locally funded schools per capita per district,' as a measure for local wealth.

Table 4 FAO/University of Arizona - Famine Early Warning Framework for Kenya 1992

Dimension	Component	Variable
Risk indicators	Drought probability	Coefficient of variation, NDVI
	Food production	Maize production per capita
	Mortality	Mortality of children under age 2
Coping ability indicators	Cash crops	Area under cash crops (coffee, tea, sugarcane, cotton, pineapple)
	Wealth	Locally funded schools per capita per district
	Infrastructure	Distance to all-weather roads

Source: Hutchinson *et al*. (1992)

The vulnerability assessment for Zambia in Table 5, page 15, covers three dimensions: crop risk, market access, and coping strategies (USAID FEWS, 1994a). The variable 'share of drought resistant crops' suggests a link to agricultural research priorities. One could develop similar crop related variables, for example share of high yielding varieties or share of salt tolerant varieties in a poverty mapping activity for the CGIAR System.

Table 5 FEWS - Vulnerability Assessment for Zambia 1994

Dimension/Component	Variable
Crop risk	Average length of growing season
	Share of drought resistant crops
Market access	Average cost of travel to nearest district market
	Average cost of travel nearest major urban market
Coping strategies	Per capita livestock unit
	Per capita fisheries production
	Staple food production per capita
	Percentage of female headed households
	Average percentage of households with less than one month's stock

Source: USAID FEWS (1994a)

A more recent vulnerability assessment for Zambia expands on the approach used in 1994 (WFP, 1996). It also differentiates between risk and coping variables and conducts analysis at the district level. Risk variables include comparable measures related to drought risk based on different NDVI indicators. Coping ability is grouped into a short-term and a long-term component. The short-term component includes variables similar to the ones used above: average per capita cereals production, average per capita cassava production, average per capita cash crop production, average per capita fisheries production, average per capita livestock offtake, other transfers, wild food gathering, and wages and salaries. Unlike the 1994 assessment, the income and assets data are more detailed (sometimes missing data were estimated) and were converted to per capita cereal equivalents. They were then aggregated to district level and compared to the minimum per capita cereal equivalent requirements to reach the poverty line in Zambia (based on the 1991 Priority Survey). The long-term indicators included 19 variables covering demographics, health and nutrition, access to infrastructure, and education.

In their vulnerability assessment for Zimbabwe (Table 6, page 16), the authors calculated a composite development indicator, comparable to UNDP's Human Development Index and Composite Poverty Index at national level (USAID FEWS, 1994b). They sought to capture the level of development at the district level and combined six variables: child mortality, female literacy, housing type, electrification, sanitation, and type of energy use.

Table 6 FEWS - Vulnerability Assessment for Zimbabwe 1994

Dimension	Component	Variable
Amount and variability of income from agriculture		Sum of average annual per capita value of communal cash crop production
		Livestock off-take income
		Food for work distribution
Level of development and asset ownership	Level of development index	District infant mortality rate
		District female literacy rate
		District housing type
		District electrification rate
		District toilet type
		District cooking fuel
	Asset ownership	Average per capita value of communal area livestock holdings
	Crop risk	Average annual maximum NDVI per communal area
		Rainfall index of equally weighted mean
		Rainfall, coefficient of variation
		Frequency of drought by watershed
	Observed stress	Average percent district population eligible for drought relief

Source: USAID FEWS (1994b)

Most of the vulnerability maps described above collect and analyze data at the administrative level and infer local (household level) conditions from these aggregated data. Such an approach produces rapid results at relative low cost, but often is too coarse for program design and targeting, especially when the subnational units are large in size or have a very heterogeneous population. FEWS is currently testing the integration of additional and more detailed data sets in their assessments. For example, a new research project for the Sahel tries to combine survey data with traditional food security variables (McGuire, 1997; Josserand, 1997). A recent vulnerability assessment for Malawi combined poverty data with the more traditional food security variables.

In the Malawi vulnerability mapping exercise, FEWS collaborated with the Malawi Ministry of Economic Planning and Development and their Poverty Monitoring Systems (WFP *et al*., 1996). They used statistical methods to combine biophysical and socioeconomic indicators. The study proceeded in the following four steps:

1. The first step defined a conceptual framework that captures the causes (risks of producing and acquiring food), responses (resilience to withstand these risks), and outcomes (results of food insecurity and vulnerability processes) of food security.
2. With the help of an expert panel, 154 subnational units (Extension Planning Areas) were grouped into five major, discontiguous geographic clusters. These clusters were differentiated by key variables related to food production and acquisition and included a cluster dominated by maize production, a cluster with mixed-agricultural production systems, a cluster dominated by large-scale farms, a cluster where households were largely dependent on non-agricultural income, and a cluster dominated by major urban centers.
3. With the help of principal components analysis, indicators measuring vulnerability outcomes (variables related to poverty, access to food, malnutrition, and coping strategies) were combined into three composite measures of vulnerability outcomes for all 154 subnational units.
4. The final step involved a detailed analysis to identify the most important factors determining these vulnerability outcomes with the help of multivariate regression.

2.4 PERIPHERAL AREAS

Poverty comparisons often show a spatial clustering in a few geographic areas. El Sherbini talks of the "forgotten regions" such as northeastern Somalia, northwestern Mozambique, eastern Senegal, and the Okavango Delta in Botswana, all of which can be characterized by physical isolation and high rates of poverty, often persisting over a long time (El Sherbini, 1986). IFAD identifies similar spatial poverty concentrations in other countries (see Appendix 4 Types of Poverty and Location of Poor, page 84). These spatial concentrations raise various questions:

- Why do poor areas exist?
- How much does geography determine the spatial concentration of poverty?
- If geography determines the concentration of poverty, can we identify areas where poverty is largely determined by geographic factors? These locations could then be defined as peripheral areas.

2.4.1 The Geography of Poverty - Why Do Poor Areas Exist?

Analysts examining the causes and spatial clustering of poverty, generally point to individual or structural explanations. Individual explanations concentrate on human capital (education, skills, etc.) and endowments of productive resources. Structural explanations focus on structural factors that constrain opportunities. They include constraints imposed by the economy, social system and geography, for example limited job supply, discrimination, and poor natural resource endowments (Crump, 1997).

Ravallion (forthcoming) summarizes explanations for poor areas under two theoretical models, one named "individualistic" and the other "geographic." Both will be discussed in turn.

The individualistic model assumes that people are highly mobile and migrate to or remain in poor areas because of specific wage and price incentives. Poor areas are thus a consequence of personal decisions and, if they persist over time, reflect local resource endowments, rents for housing and land, etc. In some cases, poor areas could also result from a time lag in the adjustment process of labor markets because individuals are unable to migrate or are delaying their relocation.

Poverty researchers using an individualistic model try to identify causes of poverty at the individual level. They do not attribute any causal significance to spatial inequalities in resource endowments (geographic capital), although they see differences in geographic endowment as the sorting mechanism that leads to spatial poverty concentrations. Consequently, they would target their anti-poverty measures towards improving the endowment of individuals, for example by providing training opportunities (Ravallion, 1996b).

In Ravallion's geographic model, the mobility of individuals is restricted and poverty has a causal link to geography. Local factors such as climate, soil type, infrastructure, and access to social services change the marginal returns of investments, for example to a given level of education. Barriers to migration ensure that these differences persist.

The degree to which individual or geographic factors are causing poverty has implications for developing a strategy of agricultural research aimed at improving the situation of the poor in

marginal areas. If geographic factors play an important role, then geographic targeting of agricultural research to the poor in marginal lands can become a useful tool to address poverty issues. If individual characteristics explain most of the local poverty, and individuals are free to migrate, then the mobility of people and capital will limit the success of targeting marginal lands.

Each of the two theoretical models has shortcomings in explaining the spatial clustering of the poor. The two models have not been compared sufficiently yet. Typically, either one or a combination of individual and structural factors are identified as causes for poverty and its spatial concentration (Miller, 1996).

Ravallion (forthcoming) cites a number of studies that support a geographic model of poverty. Empirical research on poor areas in China and Bangladesh shows significant geographic effects on living standards after controlling for non-geographic characteristics (Jalan and Ravallion, 1997; Ravallion and Wodon, 1997).

A study on migration and poverty in the USA confirmed that the spatial concentration of poverty is a reflection of differences in economic opportunities. In this study, poor people migrated to poor areas, because they faced an overall lack of opportunities throughout most areas. High poverty areas provided them with small but real economic opportunities, for example a greater availability of low skill jobs and inexpensive housing. The authors concluded that the causes of poverty differ from the factors leading to its spatial concentration. A spatial association between poverty rates and the social and economic characteristics of high poverty areas does not always point to the root causes of poverty. Thus anti-poverty interventions need to be targeted within and outside these areas. They cannot be successful by concentrating efforts solely on high poverty areas (Nord *et al.*, 1995).

A detailed study of high poverty areas, however, could identify the opportunity structure that attracts and keeps poor people (Nord *et al.*, 1995). This structure is often seen as an impediment for people trying to escape from poverty or for the effectiveness of anti-poverty interventions (spatial poverty trap). Spatial poverty concentrations may be intensified by further discrimination or exclusion. For example, a bank decides not to extend its credit programs to high poverty areas. The subsequent lack of access to financial services will impact local economic development, increasing the differences between poor and non-poor areas (Leyshon, 1995).

There is some empirical evidence to defend the concept of a spatial poverty trap. A study for rural China supported the idea of a spatial poverty trap (Jalan and Ravallion, 1997). Studies examining urban poverty concentrations in the USA have used the neighborhood effects hypothesis which assumes that the prospects for leaving poverty are partly influenced by the neighborhood, e.g. access to education and other services, and its social environment, e.g. values of local communities affect individual aspirations and expectations (O'Regan and Wiseman, 1990).

2.4.2 Characteristics of Peripheral Areas

While empirical research has shown geographic effects on the level of poverty and the rates of poverty reduction, more research is needed to examine cause and effects in more detail. The studies cited above could isolate a geographic effect and identify peripheral areas, but could not

identify the specific characteristics of these areas that were responsible for the level of poverty. There are many possible interacting geographic factors such as access to markets, availability of goods and services, limited agro-climatic conditions, low quality of labor force, and poor entrepreneurial environment (Rasmussen, 1986). Whether it is one of these factors or a combination of them that contributes to the spatial clustering of poverty depends very much on the local situation.

Without additional research, it is difficult to identify universal characteristics that could explain the geographic effects on poverty or define peripheral areas. It can be assumed, however, that isolation is one important element of the factors explaining geographic poverty effects. Isolation may not always cause poverty or be among the major geographic determinants of poverty. Isolation will certainly accentuate poverty and increase the risk of natural disasters. Isolation may even reduce the motivation to produce, because markets are not close by to sell additional outputs or consumer goods are not available to purchase with the proceeds of marketable surplus (El Sherbini, 1986).

Isolation can be measured with different access indicators. This could include access to resources, land, infrastructure, irrigation, technology, transport, communication, social services, or labor and capital markets.

2.5 IMPLICATIONS FOR POVERTY MAPPING

2.5.1 The Selection of a Specific Conceptual Approach Matters

Choosing a specific conceptual approach to define poverty determines what type of data to compile and map. For example, using an economic definition of poverty requires comparable household income or expenditure data that are usually collected through household surveys such as the World Bank's Living Standards Measurement Study (LSMS) surveys. However, such survey data are not available for all developing countries. Ultimately, the TAC and the different CGIAR centers need to agree upon a poverty definition that meets the following criteria:

- It is generally useful for CGIAR's envisioned exercise of setting priorities and analysis,
- provides a sufficient pool of data,
- is relevant to agricultural research, and
- allows to compile poverty statistics at the subnational level.

2.5.2 The Choice of Indicator Matters

Since many of the discussed poverty indicators measure different dimensions of human well-being it is expected that they are not perfectly correlated. Households identified as poor by a single poverty indicator based on household consumption may not be classified as poor if variables based on health and educational status are used. The choice of specific poverty

indicators thus influences which households are classified as poor or which regions rank lower in a poverty assessment.

A case study using household survey data for Côte d'Ivoire compared seven indicators of human well-being: household or per capita consumption, per capita income, per capita food consumption, food ratio (proportion of household budget spent on food), food consumption expressed in calories, anthropometric data (weight-for-height and height-for-age measurements) of children, and basic needs (households are defined as poor if their basic needs for food, shelter, clothing, health care, and education are not met). The study simulated targeting households by each of the seven indicators. The results showed that each indicator identified different population groups as poor with very little overlap between the indicators, except for the economic measures which had higher correlation coefficients (Glewwe and Gaag, 1988).

Similarly, a study examining the benefits of geographic targeting compared income-based poverty measures from household surveys with a poverty map for Venezuela. The poverty map was based on a composite index developed with the help of a principal components analysis of 32 indicators such as unemployment, literacy, and access to safe water. The composite poverty map and the economic indicators differed significantly in their ranking of states (Baker and Grosh, 1994).

The findings of the studies above were confirmed by differences in targeting results between a consumption-based poverty measure and a composite basic needs index (access to water, access to sanitation, access to waste disposal, education, and household crowding) in Ecuador. At the regional level, both methods came up with similar rankings of broad geographic regions, but rural areas appeared poorer under the basic needs indicator. A comparison of household rankings, however, showed less correspondence between the two alternatives. For example, households in the poorest quintile under the basic needs methods did not completely match those grouped into the poorest quintile under the consumption measure. Only 40.8 percent in the bottom quintile of the households identified with the basic needs method would be also included in the bottom quintile using the consumption based indicator (Hentschel *et al*., 1997).

3. DATA COLLECTION AND SOURCES

Poverty maps are not only influenced by the selection of a conceptual approach to define poverty and by the choice of a specific poverty indicator. The data collection method itself can determine the resolution of the poverty map and the type of analysis to conduct.

A brief review of different data collection methods will highlight the pros and cons of various subjective and objective methods and the trade-off between survey and census data. A short section summarizing major sources for international poverty maps will show that the pool of existing data for a global poverty map is limited. Additional investments in data collection and modeling need to be made to produce maps with higher resolution, more comprehensive poverty measures, and a wider international country coverage.

3.1 DATA COLLECTION METHODS

Methods to collect data for poverty assessments can be grouped into two approaches, bottom-up and top-down approaches. Bottom-up approaches solicit active participation of the poor, incorporate their perspectives into the assessment, and generally are more qualitative in nature. Top-down approaches rely more on questionnaires, collect information via a survey or census, and tend to be more quantitative in nature. The following summary is based on reviews by Lok Dessallien and Oyana, respectively. For more detail refer to Lok Dessallien (1996), Oyana, (1997), Kingsbury *et al*. (1995), United Nations (1984), and United Nations (1991).

Figure 2, page 22, summarizes some of the major data collection methods and presents them within a two-dimensional space. The horizontal axis depicts a continuum of methods ranging from case studies to census. A movement along this axis toward the right reflects an increase in sample size to complete coverage of the population, lower frequency of data collection, and an increase in cost and effort to collect and process data. The vertical axis, a continuum from subjective assessment to direct measurement, represents a movement from more subjective to more objective methods. Most bottom-up approaches can be found in the two left quadrants. The top-down methods are in the upper right quadrant.

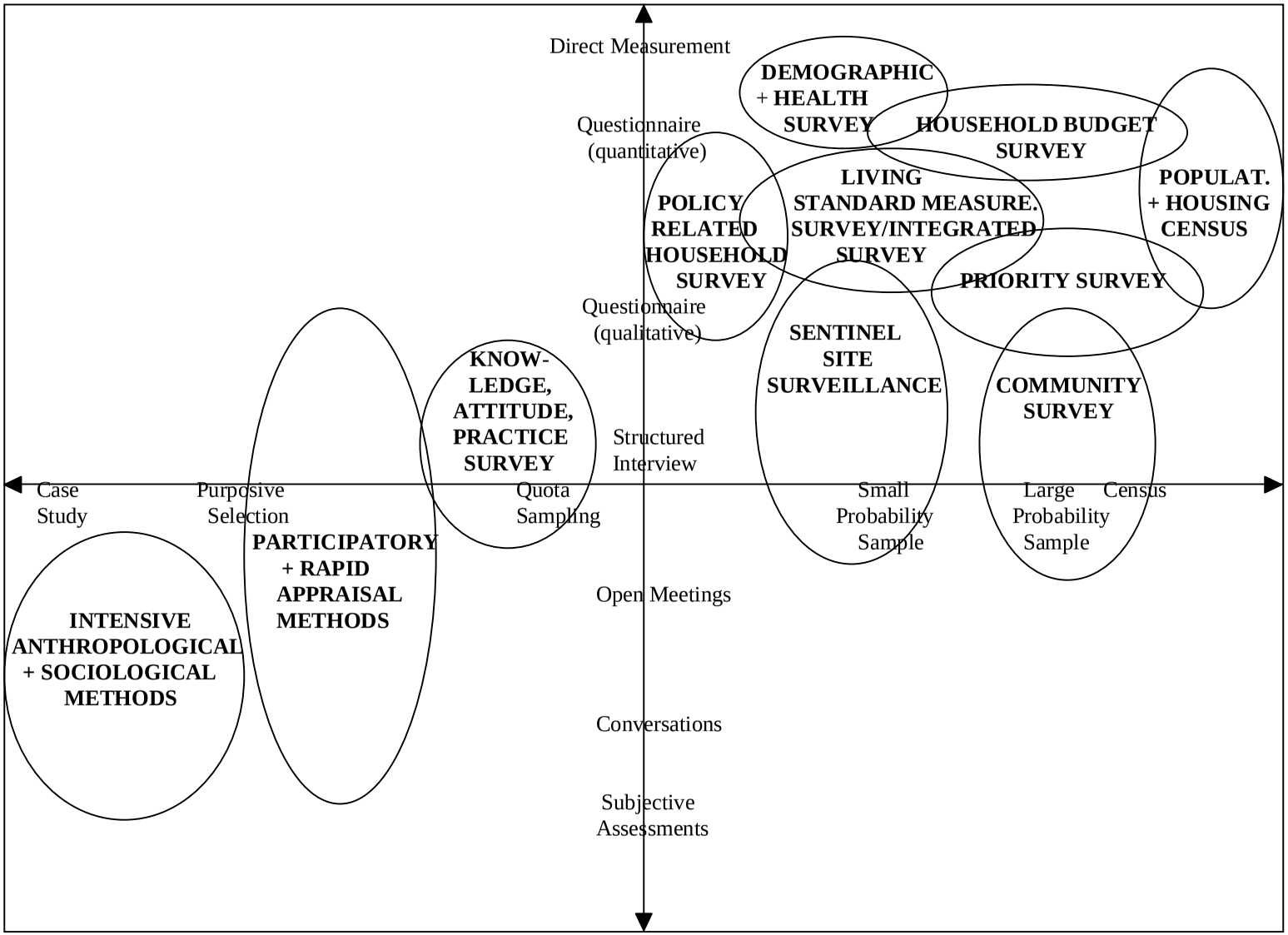
The upper right quadrant illustrates some of the methodological challenges for poverty mapping. While census data permit easy aggregation to appropriate subnational units and a fine resolution map, they provide only selected and sometimes outdated indicators of well-being. Surveys yield more up-to-date and relevant indicators, but require additional processing and modeling efforts to overcome the limitations of small sample sizes and produce poverty maps of adequate resolution.

Major bottom-up approaches in Figure 2 include intensive anthropological and sociological methods (ethnographic and participant observation), participatory and rapid appraisal methods, and beneficiary assessments (systematic consultations with project beneficiaries and stakeholders). Knowledge, attitudes, and practices (KAP) studies have been used primarily in health and family planning to identify decision making patterns, perceptions, and awareness. They combine formal questionnaires with sampling methods and use qualitative approaches relying on key informants and focus groups. Oyana mentions the ‘E Delbecq-Delphi’ method which has been applied for vulnerability mapping in Bangladesh. It relied on experts who were familiar with the study area and included technical and development specialists, government officials, and village elders. KAP and ‘E Delbecq-Delphi’ are hybrid methods, employing bottom-up and top-down components (Oyana, 1997).

Bottom-up approaches bring with them the advantage of allowing participants to apply their own criteria to define poverty, thus making them the main stakeholder of poverty assessments. This in turn provides a better foundation for identifying solutions and implementing interventions. A participatory survey is usually less costly than a household survey and produces outputs faster. It provides micro-level information and identifies nuances of poverty that become very important when analyzing causes of poverty.

The disadvantage of bottom-up approaches is that they use relatively small samples that make it difficult to extrapolate results and compare different surveys. A second major limitation is that the quality of participatory approaches varies greatly with the skills of the facilitators and the established level of trust between facilitators and participants.

Figure 2 Data Collection Methods for Poverty Assessments



Source: Lok Dessallien (1996)

Two studies, one in Honduras and the other in Tanzania, provide instructive examples of participatory methods. The Honduras study proposes a method to quantify and extrapolate local perceptions on poverty (see 5.3.3, page 62). The Tanzania study, carried out by the World Bank, was able to bridge some of the methodological gaps usually found between these two approaches (Narayan, 1997).

The participatory poverty assessment for Tanzania sampled 100 villages which are part of Tanzania's National Master Sample framework. National-level studies are conducted in these framework villages to permit generalizations to the nation's rural area as a whole and to make findings from different surveys comparable. The study employed three methods to collect data: participatory tools (community mapping, group discussions involving wealth ranking, trend and price analysis, gender analysis, and Venn diagrams of village-level groups and institutions), key informant interviews (tried to answer similar questions as elicited at group sessions), and household surveys. The household surveys consisted of two questionnaires: The first asked questions related to social capital and the second tried to capture household consumption and expenditures.

The study's work on social capital is a good example how to measure structural conditions that determine poverty, discussed in 2.2 under the enabling environment dimension of well-being. Based on the household survey, the study developed a Social Capital Index, which represented the average of both the number and characteristics of groups to which a household belongs.

Both the conventional household survey and the participatory approach yielded similar aggregated results measuring poverty. The participatory assessment provided more subtle and detailed observations related to social capital, gender, seasonality, and access to water that were not picked up by the household consumption survey. The study's conclusion sees participatory poverty assessments as a useful tool for interim poverty monitoring between major surveys.

Examples of the top-down approaches that can provide information for poverty assessments are presented in the upper right quadrant of Figure 2. They include population and housing censuses and different types of household surveys based on a probability sample.

Because population censuses are, by definition, comprehensive in their coverage, they are usually only designed to provide information on the structure and distribution of the population, not on poverty. However, they may collect information on educational attainment and sometimes under-five mortality statistics can be calculated from the demographic parameters. Only a few censuses in developing countries have included questions on income. If a country conducts a regular housing census, poverty can be inferred from questions related to type and size of dwelling, water supply, sanitation, and cooking facilities.

Many household surveys, on the other hand, which are based on a sample of the population (typically less than 1%), contain detailed questions on economic indicators of well-being (e.g., consumption, income) or non-economic measures related to health, education, and services. A number of surveys provide internationally comparable data relevant to characterizing marginal populations. They include the Demographic and Health Survey (DHS), Living Standards Measurement Study (LSMS) Survey, and other surveys under the World Bank's Social Dimension of Adjustment Program.

The DHS was established by USAID to provide information on fertility, health, and morbidity. As of 1997, surveys in 59 developing countries have been carried out, often repeatedly, by Macro

International, a Maryland-based consultancy. The DHS is a specialized survey. Other specialized (single topic) surveys that provide information relevant for poverty assessments include household budget surveys, labor force surveys, agricultural surveys, and other social surveys such as food consumption and nutrition surveys.

The LSMS was established by the World Bank in 1980 to improve the type and quality of household data collected by statistical offices in developing countries. The first surveys were conducted in 1985. As of 1997, LSMS surveys have been carried out in 31 developing countries. The LSMS is a multi-topic household and community survey. It consists usually of three major modules, a household survey, a community level survey, and a price survey that tries to measure purchasing power.

Other survey instruments used by the World Bank to assess and monitor poverty include Integrated Surveys (IS) and Priority Surveys (PS) under the Social Dimension of Adjustment Program. The IS is an in depth survey, similar to the LSMS, and provides information to assess impacts of structural adjustments on households. A PS is conducted more frequently (ideally annually) and uses a large sample to insure that all population groups are represented. Another, rapid survey, the Core Welfare Indicators Questionnaire, is being developed and field tested by the World Bank (Lok Dessallien, 1996).

The Sentinel Site Surveillance in Figure 1 combines bottom-up and top-down elements and tries to monitor policy impacts. It is based on small samples, uses a minimum of numerical data and interviews, focuses on key informants, and communities participate in questionnaire design, data analysis, and communication of results.

3.2 DATA SOURCES AND COUNTRY COVERAGE

To produce internationally comparable maps that show poverty measures at subnational level requires consistency in the definition of the indicators used and a wide geographic coverage. National population and housing censuses and international surveys such as the LSMS and DHS can provide the principal variables for such mapping or become the input for subsequent modeling efforts. A potential list of variables from these three sources (Table 7, page 25) makes clear that most of these indicators are captured by the social dimension of human well-being. This restricts international poverty mapping to these available variables or will require additional investments in new data collection or modeling to estimate missing indicators.

The geographic coverage and the timeliness of these data further restricts the universe of countries. Of 141 developing countries, only 59 have conducted a DHS, 31 a LSMS, and 72 have a population and housing census with data collected after 1991 (Table 8, page 25). See Appendix 2 Availability of Survey and Census Data, page 77, for a detailed country list).

There are other international sources providing for example economic measures such as the Integrated Surveys, Community Surveys, and surveys conducted under the Social Dimension of Adjustment Program of the World Bank. Appendix 3, page 80, summarizes all housing surveys from these sources completed in Africa since 1985. Over the past 12 years, most countries in Africa conducted at least one household survey that provides variables of relevance to poverty assessments. However, only two countries, Tanzania and South Africa, provide access to their

survey data. All other countries require special Government permission or have not established a data access policy yet.

Table 7 Variables Related to Poverty and Human Welfare - Census, LSMS, and DHS

Indicator	Census	LSMS	DHS
Health			
Anthropometric measurements		•	•
Child Mortality			•
Disability	(selected countries)		
Education			
Literacy	•		•
Educational attainment	•	•	•
School attendance	•	•	•
Economics			
Economic characteristics of households	•		
Occupation	•		
Status in employment	•		
Total consumption		•	
Household income	(selected countries)	•	
Total household expenses		•	
Total food expenses		•	
Access to services			(selected countries)
Housing			
Type of building	•	•	•
Number of rooms, floor space	•	•	•
Water supply	•	•	•
Sanitation	•	•	•
Cooking facilities	•		
Number of occupants (crowding)	•	•	•

Source: Appendix 2

Table 8 Availability of Census, LSMS, and DHS Data - Summary

	Census			Surveys		
	before 1985	**1986-90**	**after 1991**	**LSMS**	**DHS**	**TOTAL**
Africa	7	19	27	13	33	**53**
Asia + Oceania	6	21	25	8	14	**52**
Central America + Caribbean	3	8	12	3	6	**23**
South America	2	3	8	7	6	**13**
TOTAL	**18**	**51**	**72**	**31**	**59**	**141**

Source: Appendix 2

4. EXAMPLES OF MAPPING HUMAN WELFARE AND POVERTY

Examples of mapping human welfare and poverty can be found at international and national level. No concerted multi-institutional effort to produce a global poverty map has been initiated yet. Different activities by international organizations such as IFAD, UNDP, and the World Bank, selected CGIAR Centers, and individual countries, however, can become the starting point for international poverty mapping exercises. The following review shows what progress has been made by selected institutions and the differences in approaches, resolution, and country coverage.

4.1 INTERNATIONAL EFFORTS

Three international sources, IFAD, UNDP, and the World Bank, can provide information on poverty and human well-being at country level. In some of their reports, human well-being and poverty indicators have been mapped or are at least listed at coarse subnational level.

IFAD has produced national level poverty indicators and prepared a descriptive table on the location of the rural poor in 56 countries. This information is summarized in Appendix 4, page 84.

UNDP has published country level Human Development Reports and has calculated composite indicators (Human Development Index, Human Poverty Index, and Capability Poverty Measure) at subnational level for selected countries. Appendix 5, page 90, is a bibliography of publications and gray literature used for this effort. It includes country studies describing the conditions and trends in human development and background papers summarizing the methods for disaggregating UNDP's composite indexes.

The World Bank has completed poverty assessments for 35 countries. Although the majority of these assessments do not map poverty indicators at a very detailed level, the listed publications usually provide data disaggregated by urban and rural characteristics and by broad geographic regions. They are a useful entry point to understand poverty and human welfare issues for a country. This bibliography of poverty assessments can be found in Appendix 6, page 95.

4.2 ACTIVITIES BY CGIAR CENTERS

No coordinated poverty mapping effort involving all CGIAR centers is currently underway. All CGIAR Centers were contacted to inquire about their activities to map human welfare indicators or study the relationships between poverty, environment, and land use. Five of the 16 Centers provided information about ongoing or planned projects.

4.2.1 Centro Internacional de Agricultura Tropical (CIAT)

Of the five respondents, CIAT has made the most significant investments in mapping human welfare indicators. The CIAT Hillsides Project started in 1995 with poverty assessments in Colombia and Honduras. In 1996, poverty mapping exercises for Honduras and Nicaragua were initiated and additional GIS staff was hired in 1997 to expand upon these efforts (Leclerc, 1997).

CIAT has produced a working paper reviewing different poverty assessment methods (Oyana, 1997). The paper outlines poverty mapping activities for Honduras and proposes a composite human needs index, which combines an educational attainment index (enrollment ratio and adult literacy rate) with a shelter quality index and a health status index. Research for Honduras is currently or will be conducted at different scales including departments (18 units), municipalities ('municipios' - 291 units), villages (3,792 units), and selected watersheds. CIAT staff have proposed to produce various other working papers that are summarized under the following titles: 'Tools and Methodologies to Handle Poverty Data and Studies,' 'Lessons Learned: Poverty Mapping in Latin America,' and 'Census Data: A Means to Understand Spatial Complexities.'

Both the work in Honduras and in Nicaragua is following a four-step approach:

1. Develop a spatially integrated poverty database.
2. Produce maps at various scales.
3. Examine relationships between poverty, land use, and policy variables.
4. Communicate results and return data to data providers at national, municipal, and village level in appropriate formats.

So far, poverty mapping activities for Honduras have made the most progress. CIAT envisions using multiple measures of well-being based on household expenditures (and a designated poverty line) and composite indexes measuring unsatisfied basic services and human needs with the best available data. The composite indexes will include variables related to shelter (quality of housing and type of dwelling), biophysics (land cover, slope, agro-climate, soil, and protected areas), infrastructure (roads, electricity, and telephones), education (enrollment, number of schools, student-teacher ratio, etc.), health (infant mortality, safe water, sanitation, number of physicians, and primary care facilities), and nutrition (per capita food consumption).

By the end of September 1997, the following data sets were assembled for Honduras: Population census for 1974 and 1988, agricultural census for 1974 and 1993, health status variables for subnational administrative units, and data used for the 'Fondo Hondureno de Inversion Social' (FHIS), the latter data at municipal level of four variables: population density, infant malnutrition, access to water, and access to sanitation.

Most of the outputs are still preliminary, use census data, and include selected education variables and disaggregated demographic data by age groups at village level. Based on these data an educational achievement index was calculated for each village and 'municipio.' This index was then compared with the demographic characteristics of villages, population density, and poverty levels at 'municipio' and village level.

Preliminary maps classify villages along an urban-rural continuum and group municipalities according to different education variables (number of schools, enrollment, number of teachers, number of students repeating selected grades, educational achievement, literacy rate) and population density. Other exploratory research has looked at the relationship between a basic service index and a water balance risk index for different seasons and conducted sensitivity analysis of educational variables at multiple scales ('municipio' and 'aldea' [community] level).

Honduras will be one of the case studies for CIAT's work on participatory poverty assessment. Based on methods developed in Africa and Colombia, CIAT expects to develop and test a method to extrapolate results from a participatory assessment (well-being ranking). See 5.3.3, page 62, for a detailed discussion.

Most of the poverty mapping work in Nicaragua is still in the initial phase of assembling core data sets. Various thematic maps have been produced. They include poverty measures from the latest LSMS survey and maps showing population without access to basic needs (education, water, and health services) for 214 'cordobas.'

As in Honduras, CIAT expects to use the same participatory approach in Nicaragua. This has been planned for the Rio Callico watershed in Matagalpa.

In addition to the work in the two Central American countries, CIAT is testing other proxy indicators for poverty. One example, combined farm size, based on digitized cadastral maps, with a digital elevation model for selected watersheds in Colombia and Peru.

CIAT is currently exploring the potential for a poverty map at continental scale. Researchers have started to review existing country efforts to map poverty and human welfare indicators. Staff have obtained digital data sets from poverty assessments in Venezuela, Ecuador, and Peru, and expect to obtain such data for Bolivia. Based on preliminary findings, the continental work will attempt to map poverty at first subnational level. The greatest challenge seems to be integrating different national data sets that are based on different methods and poverty definitions (Hyman, 1997).

4.2.2 Centro Internacional de la Papa (CIP)

The Center has prepared a proposal to analyze the relationships between rural poverty and environmental degradation in the Altiplano (Winters, 1997). It envisions a set of case studies that will be carried out with selected partners in Bolivia and Peru. Methodologically, CIP intends to use maps for presentation and identification of field sites, but not specifically for analysis. The Center and its partners intend to carry out the following workplan:

1. Use remote sensing images to identify environmental degradation for two time periods capturing three major environmental problems: salinization, soil erosion, and removal of woodlands.
2. Examine the depth and severity of poverty in these areas. Data will be collected with household surveys and combined with national poverty data (quality of life index) at the province level for Bolivia and the district level for Peru.
3. Examine the links between the quantity and quality of household assets, environmental degradation, and existing policies (macro-economic, sectoral, institutional, etc.).
4. Try to extrapolate from these case studies to the whole Altiplano watershed and make recommendations on appropriate changes of selected policy variables.

4.2.3 International Center for Agricultural Research in the Dry Areas (ICARDA)

ICARDA has prepared a background paper on rural poverty and natural resources in the "Dry Areas" falling under ICARDA's mandate (Rodríguez, 1997). The paper's objective was to review the severity and distribution of rural poverty, identify natural resource constraints, and relate these indicators to the production value of ICARDA's mandate commodities. The paper used national rural poverty figures from IFAD's global poverty assessment. For countries without poverty data, a linear regression between total poverty and infant mortality was used to estimate missing poverty rates. ICARDA developed a Rural Poverty Indicator (RPI), which combined per capita GDP (as an estimate for income) with a Gini coefficient of income or expenditure inequality. Countries were then ranked by multiplying the RPI with the number of poor, to help set priorities for ICARDA.

At present, no high resolution poverty maps have been produced. The GIS staff has integrated relevant national data sets related to poverty, human well-being, natural resources, agricultural

production, and labor force, and will provide thematic maps based on these data to ICARDA's staff. ICARDA, upon request and in cooperation with national programs, will create or use data at higher resolution (provincial, regional, or watershed). Possible research questions include analyzing the correspondence between natural resource endowment and incidence of poverty and examining the impact of agricultural research on human well-being (Thomas, 1997).

4.2.4 International Food Policy Research Institute (IFPRI)

IFPRI has published two studies that estimate poverty and malnutrition, respectively, by agro-ecological zones. Their estimates were generalizations of survey data (Broca and Oram, 1991; Sharma *et al*., 1996).

The first study by Broca and Oram on the location of the poor was initiated by the TAC in 1990 which was looking for the most up-to-date and consistent poverty estimates by agro-ecological zones. The authors of the study employed two definitions of poverty:

1. A household is absolutely poor if it cannot meet 80 percent of its required daily allowance of calories (data came from nutrition surveys).
2. A household is absolutely poor when its food expenditures is less than 80 percent of the amount required to purchase the required daily allowance of calories (data came from expenditure surveys).

The first definition was the preferred one, but when no other data were available, the second definition was used. Agro-ecological zones are based on FAO definitions.

Since household surveys in developing countries (in this case nutrition and expenditure surveys) have not been consistently stratified by agro-ecological zones, the study had to generalize from one or a few sites to a whole agro-ecological zone, sometimes covering more than one country of a geographical sub-region. For example, poverty estimates for 33 sub-Saharan countries are based on surveys from 22 sites in nine countries (Burkina Faso, Ethiopia, The Gambia, Kenya, Niger, Nigeria, Rwanda, Sudan, and Zambia). Most estimates for Asia used poverty measures at the first subnational level (states, provinces, and regions) which were provided by different national assessments. The poverty estimates for Latin America are based on national figures.

The second study by Sharma *et al*. used anthropometric surveys that were then generalized to the same FAO-based agro-ecological zones. Anthropometric data of children was interpreted as a proxy for poverty. The relationship between poverty and anthropometric data is especially strong for countries at the lower end of the income range.

While the Sharma *et al*. study had the same problem of generalizing from a limited number of surveys, it had the advantage of using an internationally accepted and comparable indicator of well-being (the Broca and Oram study is an amalgam of different poverty definitions). Neither study had access to geo-referenced survey data and sampling weights, making it impossible to calculate meaningful averages and standard errors for agro-ecological zones. Section 5.2, page 51, will demonstrate how geo-referenced survey data can be used to calculate such statistics. It will also highlight the great spatial variability within agro-ecological zones, thus making generalizations from a few sample sites questionable.

4.2.5 International Livestock Research Institute (ILRI)

ILRI and IFPRI are conducting a joint project examining policies for sustainable land management in Mixed Crop Livestock Systems for the Highlands of East Africa (Ehui, 1997). The research will be initially implemented in Ethiopia with possible extensions into Uganda and Kenya. The goal is to understand the extent and main causes of land degradation and suggest policies to improve soil and water management, increase agricultural productivity, and reduce poverty. The project description did not explicitly mention maps and mapping activities related to poverty and human well-being.

4.3 COUNTRY ASSESSMENTS

Policy makers in different countries are using maps or data disaggregated by subnational administrative units of human well-being and poverty indicators to guide the allocation of public resources, plan infrastructure development, design poverty alleviation programs, etc. Methods and applied scales vary from country to country. This makes it difficult to integrate and compare such national poverty maps to generate an international view.

Four examples, three in Latin America, one in Africa, will be summarized. The El Salvador study uses a simple aggregation of various variables. The Nicaragua and Peru study show how multivariate statistical methods (small area estimation) can be used to produce disaggregated poverty maps. The South Africa study combines income-based poverty measures and a Human Development Index at subnational level.

4.3.1 El Salvador

The study for El Salvador classified those households as poor that cannot satisfy their basic needs such as housing and education and created a 'unsatisfied basic needs index' (Ministerio de Coordinación del Desarrollo Económico y Social, 1995). Fourteen indicators from the 1992 Population and Housing Census were combined to construct the index:

- Infant mortality
- Illiteracy rate of population older than 10 years
- Overcrowding (percentages of dwellings with more than 3 people per room)
- Percentage of dwellings with earth flooring
- Percentage of substandard dwellings/improvised housing
- Percentage of dwellings without drinking water service
- Percentage of dwellings without sanitation services
- Gross school enrollment rate (grade 1 - 6)
- Gross school enrollment rate (grade 7 - 9)
- Proportion of students enrolled in grade 1 - 6 who are older than the required age for this level
- Proportion of students enrolled in grade 7 - 9 who are older than the required age for this level
- Population in 'municipio' as a percentage of country population

- Rural population as a percentage of 'municipio' population
- Percentage of population under 15 of 'municipio'

The composite index for each 'municipio' was derived as follows:

- Identify the maximum and minimum values of each indicator.
- Define ten equal intervals between the maximum and minimum value.
- Assign a value of 10 to the highest interval and a value of 1 to the lowest interval.
- For each 'municipio' and for each indicator assign a value between 1 and 10 depending into which interval category the respective indicator falls. For example, the maximum value for 14 indicators would be 14 x 10 = 140, representing areas with the highest priorities. The lowest value would be 14 x 1 = 14, representing 'municipio' with the lowest priorities.

This index was then tabulated by 'municipio' (262 units) and 'departmento' level (14 units).

4.3.2 Nicaragua

Poverty assessments in Nicaragua have used an 'unsatisfied basic needs index' and household consumption expenditure in relation to a poverty line. Examples for the 'unsatisfied basic needs index' include composites of variables on basic education, health service, and access to safe water and an index used for public sector spending ('Fondo de Inversión Social de Emergencia') that combines three principal variables: child malnutrition, access to safe drinking water, and proportion of displaced people in the community. FGT-type poverty measures based on household consumption expenditures have been produced for seven large geographic sub-regions from the most recent LSMS (McKinnon, 1994).

The objective of a more recent study was to produce income-based poverty indicators at the 'municipio' (143 units) level and improve on the methods used for the targeting of public social funds, the 'Fondo de Inversión Social de Emergencia' (Arcia *et al*., 1996). The study used multivariate regression (small area estimation) to calculate monthly household expenditures for municipalities that did not have a sufficient sample size to calculate robust statistics from the LSMS data. Socio-economic variables on education, infrastructure, health, and nutrition available for all municipios were the independent variables in the regression model.

4.3.3 Peru

In Peru, various poverty assessments based on an 'unsatisfied basic need index' and on an income-based poverty line have been produced over the past years. A recent example integrated socio-economic information from the 1993 national population and housing census (Censo de Poblacion y Vivienda - CPV) with 1995 national household survey data (Encuesta Nacional de Hogares - ENAHO) to overcome some of the shortcomings of the previous approaches (INEI, 1996).

Basic needs indexes have the shortcoming of not clearly differentiating between correlation and causality of poverty and implying for example that low access to services means a household is poor. They do not differentiate between the quality of services and do not measure the degree or

severity of poverty. Survey data have the problem of a small sample size that make it difficult to extrapolate the data to subnational units.

The study used the following approach to estimate household income and the proportion of poor households:

- Find the statistical relationship between the survey and the census data. This requires a common set of variables and compatible definitions between the two datasets.
- Based on these common variables, develop a prediction model that expresses household income as a function of household characteristics, education, locality, etc.
- Apply this model to the census data and use the census data to predict the proportion of households below the poverty line at departmental and provincial level.

Tables and maps were produced at the provincial ('provincia') and district level ('distritos').

4.3.4 South Africa

The South Africa example used data from the 1993 Living Standards and Development Survey (LSDS), conducted by the South African Labor and Development Research Unit and funded by the World Bank, and the 1991 Population census (Whiteford *et al*., 1995). Poverty indicators include income-based measures (headcount index and poverty gap based on household income, and Gini coefficient of income inequality) and a Human Development Index (HDI). The HDI was a composite of life expectancy, literacy, and income. Since life expectancy data were not available by magistral districts, province level data were used. Literacy was defined as the percentage of adults who had completed Standard 5.

The maps and tables show poverty measures for 9 provinces and 371 magistrates. Data were also disaggregated by race, gender, and educational level.

5. APPROACHES TO PRODUCE POVERTY MAPS

There are basically three approaches to produce subnational poverty maps:

1. Mapping auxiliary data,
2. mapping survey data, and
3. mapping modeled results, that is a combination of auxiliary and survey data.

The first approach typically employs area estimates (e.g., data are at subnational administrative level), the second can be displayed with geo-referenced point data (representing enumeration area, communities, or villages), and the third combines area and point estimates in a model. Examples for each approach will be discussed.

5.1 MAPPING AUXILIARY DATA

Auxiliary data usually provide complete coverage of a country at various resolutions. They can be used to produce maps with relatively fine resolution, for example data from a population and housing census can be mapped at district (area) or village level (point). Possible indicators capture the social and economic dimension of human well-being and include education, housing, and 'basic needs' variables, and for selected countries income measures. Or, they can be at coarser resolution and include for example subnational statistics by administrative area (agricultural production, health and education statistics, etc.), maps (roads, water sources, location of clinics, etc.), and satellite imagery (land use, vegetative vigor, etc.). Possible indicators come from all three dimensions of human well-being.

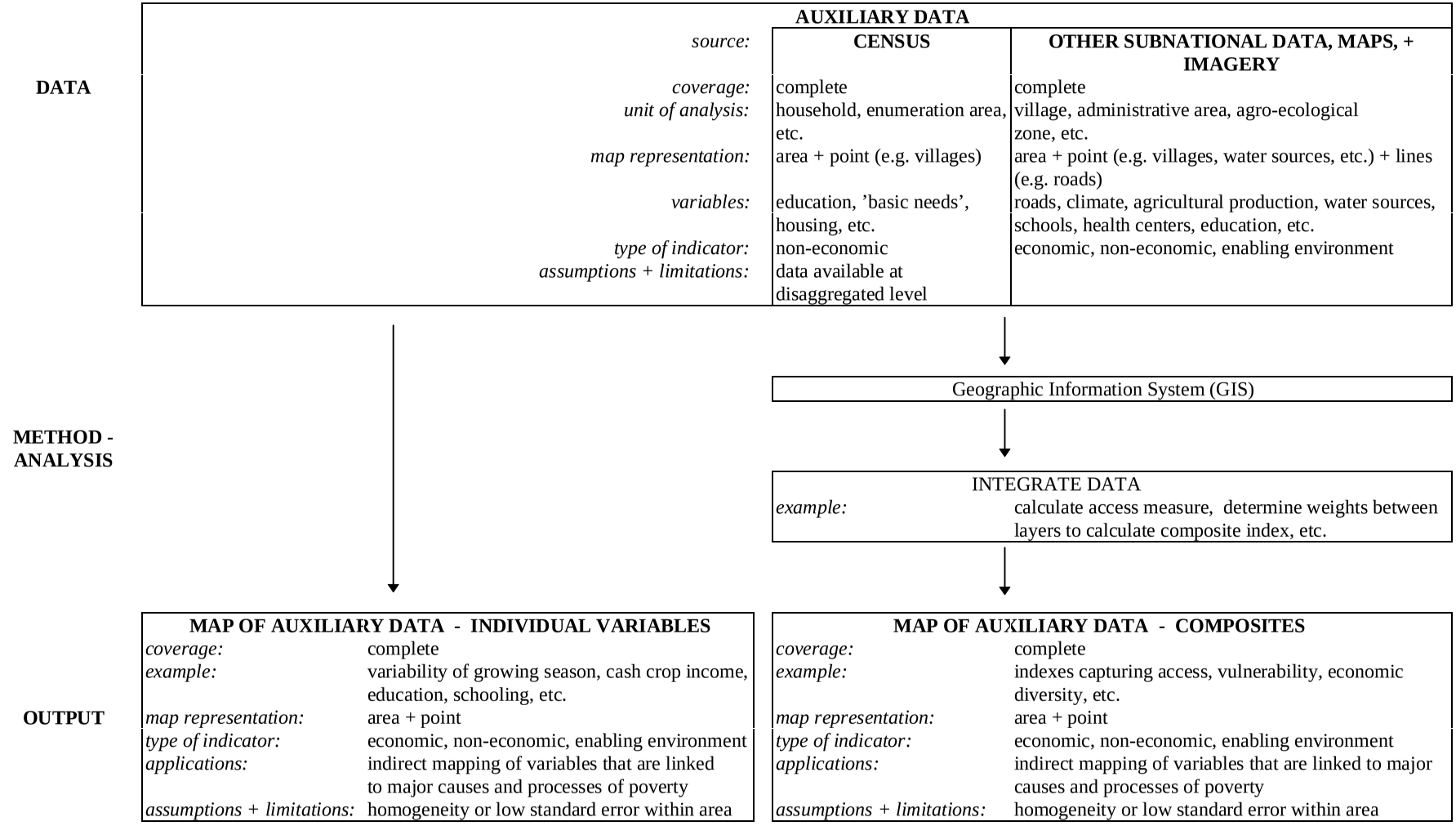
Figure 3, page 34, presents two different approaches to map these data: (1) The auxiliary variables can be mapped individually, for example average household income at district level or variability of the growing season from a satellite image. (2) The auxiliary variables can be integrated, with the help of a GIS, to produce composite measurements, for example maps representing access, vulnerability, and economic diversity. Because of data availability, mapping auxiliary data is more often a presentation of variables that are linked to major causes and processes of poverty, and to a much lesser degree a presentation of direct poverty indicators such as the number of people below the poverty line or average household income.

The advantages of mapping auxiliary data are a good supply of international medium resolution datasets and expertise gained in food security and vulnerability mapping. Its disadvantages are the coarse resolution and our limited understanding of the causes and effects related to poverty, especially under local conditions. Another limitation arises when data are provided at and presented by administrative units. Since an area presentation disregards spatial heterogeneity within units, the produced maps are often too coarse to determine priorities within countries, develop and target specific poverty alleviation projects, or study causal relationships between poverty and marginal lands. Mapping auxiliary data is appropriate for international comparisons and broad priority setting exercises, and can become a useful input for high resolution poverty maps that model poverty estimates (see 5.3, page 56).

Three examples showing composite maps of auxiliary data - access, vulnerability, and economic diversity - will be discussed in more detail (5.1.1 - 5.1.3). Limited access to markets, high vulnerability to natural hazards, and a narrow economic base may be important dimensions of peripheral areas where the incidence and changes in poverty are greatly dependent on geographic factors.

Other examples of auxiliary data that could be mapped include population pressure and environmental degradation. Examples and data sources will be discussed in 5.1.4.

Figure 3 Approaches for Poverty Mapping - Auxiliary Data



Source: World Resources Institute, 1998

5.1.1 Access

Accessibility has been defined as the ability to interact with sites of economic or social opportunity, for examples markets, schools, and health facilities (Deichmann, 1997b). It is usually influenced by physical, economic, and social factors. The assumption is that areas with poor access or low market integration provide fewer economic opportunities for poor people to escape poverty, accentuate the severity of poverty, and may even contain a larger proportion of poor people. Deichmann has produced a detailed review of physical accessibility indicators which will be a useful background document for any poverty mapping exercise (Deichmann, 1997b).

Figure 4, page 37, and Figure 5, page 38, show accessibility maps for West Africa. Cities with a population greater than 200,000 were defined as major urban centers, representing major markets. Average travel time is then used as an indicator for market access and integration. Box 5, page 35, describes in more detail how to produce such maps.

The quality of the accessibility maps depends on the spatial accuracy of the road layer, correct road quality information, and realistic estimates of relative travel costs. The presented example used relatively coarse data and a simplistic model to define access. More sophisticated algorithms have been developed to calculate accessibility. For example, Deichmann has developed a program to generate a suite of accessibility indicators for each node in a network, and a lattice that estimates the "market integration" at each point (Deichmann, 1997). The West African Long-Term Perspective Study (WALTPS) demonstrated a strong correlation between population density, per capita agricultural production, and potential market integration, defined as the virtual price offered by the market for a standard basket of products (Ninnin, 1994). WALTPS assumed that the higher the virtual price, the greater the incentive to produce, on a sustained basis, an agricultural surplus and the greater the earning opportunities. The applicability of WALTPS throughout Africa needs further examination since there appear to be other factors than access that limit market integration such as farmers' capacity to sustain high outputs over the long-term.

Box 5 Calculating Measures of Accessibility

The presented example tries to characterize market accessibility in West Africa by producing a map of travel time to major urban centers. It is based on digital maps of settlements and roads from a database produced for the West Africa Long-Term Perspective Study (Brunner *et al*., 1995).

In a first step, markets are defined by major urban centers that are cities with a population greater than 200,000. Information on the extent and quality of the road network becomes the second input. Different types of roads are assigned specific friction values corresponding to relative travel costs. For example, if a gravel road has a friction value of 4 and a paved road a value of 1, it will be four times as difficult or time consuming to cross the same distance on a gravel road than a paved road. GIS programs use for example "grid cell equivalents" (GCE) as the unit of measurement to calculate total travel costs.[1] Moving through a grid cell with a friction value of 1 produces a GCE of 1. A total cost of 5 GCE could result from a movement through five cells with a friction of 1, or one cell with a friction of 5.

Based on these friction values, cost-distance to the nearest market (metropolitan center) can be calculated. The GIS program generates a distance and proximity surface (also known as a cost surface) where distance

(continued)

Box 5 (continued)

is measured as the least effort required to move over a friction surface. Costs are determined radially from a set of source targets to the edges of the image.

A specific average speed for different road types and non-road areas was assumed. To obtain a final cost surface with a more intuitive indicator than GCE, friction values were converted to travel time in minutes across each grid cell (average grid cell size was 6 km). The following table lists the different road friction and speed values for the dry and rainy (values in brackets [ ]) season. It also provides the equivalent relative friction values.

Friction Values and Assumed Speed for Calculating a Cost Surface for West Africa

Road Type	Road Friction (minutes/ 6 km cell)		Assumed Speed (km / hr)		Relative Friction Value	
Paved road, two lanes	7.0	[7.7]	51.4	[46.8]	1.0	[1.1]
Paved road, one lane	9.1	[10.5]	39.6	[34.3]	1.3	[1.5]
Improved road	13.3	[16.1]	27.1	[22.4]	1.9	[2.3]
Partially improved	15.4	[54.6]	23.4	[6.6]	2.2	[7.8]
Earth roads	27.3	[54.6]	13.2	[6.6]	3.9	[7.8]
Dirt track, marked	51.1	[60.2]	7.0	[6.0]	7.3	[8.6]
Non-road areas	91.0	[98.0]	4.0	[3.7]	13.0	[14.0]

Two cost surfaces, representing the cost-distance in minutes to the nearest market for the dry and rainy season, were calculated. These cost surfaces were then reclassified into six accessibility zones, identified as 0-1 hours, 1-3 hours, 3-6 hours, 6-10 hours, 10-20 hours, and more than 20 hours of travel time. The classified surfaces are shown in Figure 4, page 37, and Figure 5, page 38.

[1] The cost surfaces were computed with the Idrisi software using the COST module. COST incorporates two algorithms for the determination of cost distances -- a pushbroom algorithm and a growth algorithm. The COSTPUSH algorithm was used to generate the resulting cost image. It operates in the following way: 1. Distances are measured according to the minimum number of cells that must be traversed to move from that cell to the nearest source target. 2. Movements are in 8 directions from any cell, and diagonal movements produce a cost of 1.41 times the friction value. This concept of distance should be clearly distinguished from Euclidean distance. A more complex analysis could have employed the COSTGROW algorithm which allows to incorporate barriers, for example caused by customs delays at national borders, and maximum distance for travel. It also allows to calculate cost distances along the road network alone.

5.1.2 Vulnerability

The second example of mapping auxiliary data uses subnational administrative areas as the unit of analysis. It is based on a regional vulnerability assessment for the Sahel (Wright *et al*., 1995) which was discussed in more detail in 2.3.4 (see Table 2, page 14). The assumption is that highly vulnerable areas may contain a high proportion of poor people, expose the poor to frequent shocks, and trap them in chronic poverty.

The FEWS database includes data for 1,130 administrative units. Figure 6 to Figure 8, pages 40 to 42 show composite maps representing income structure, resource base, and current vulnerability, respectively. Income structure is based on district-level data. Resource base combines satellite imagery with an access measure to urban centers. Current vulnerability is a combination of satellite imagery, market data, and expert opinion. FEWS combined all three elements in an overall vulnerability index.

Figure 4 Access to Major Urban Centers in West Africa - Dry Season

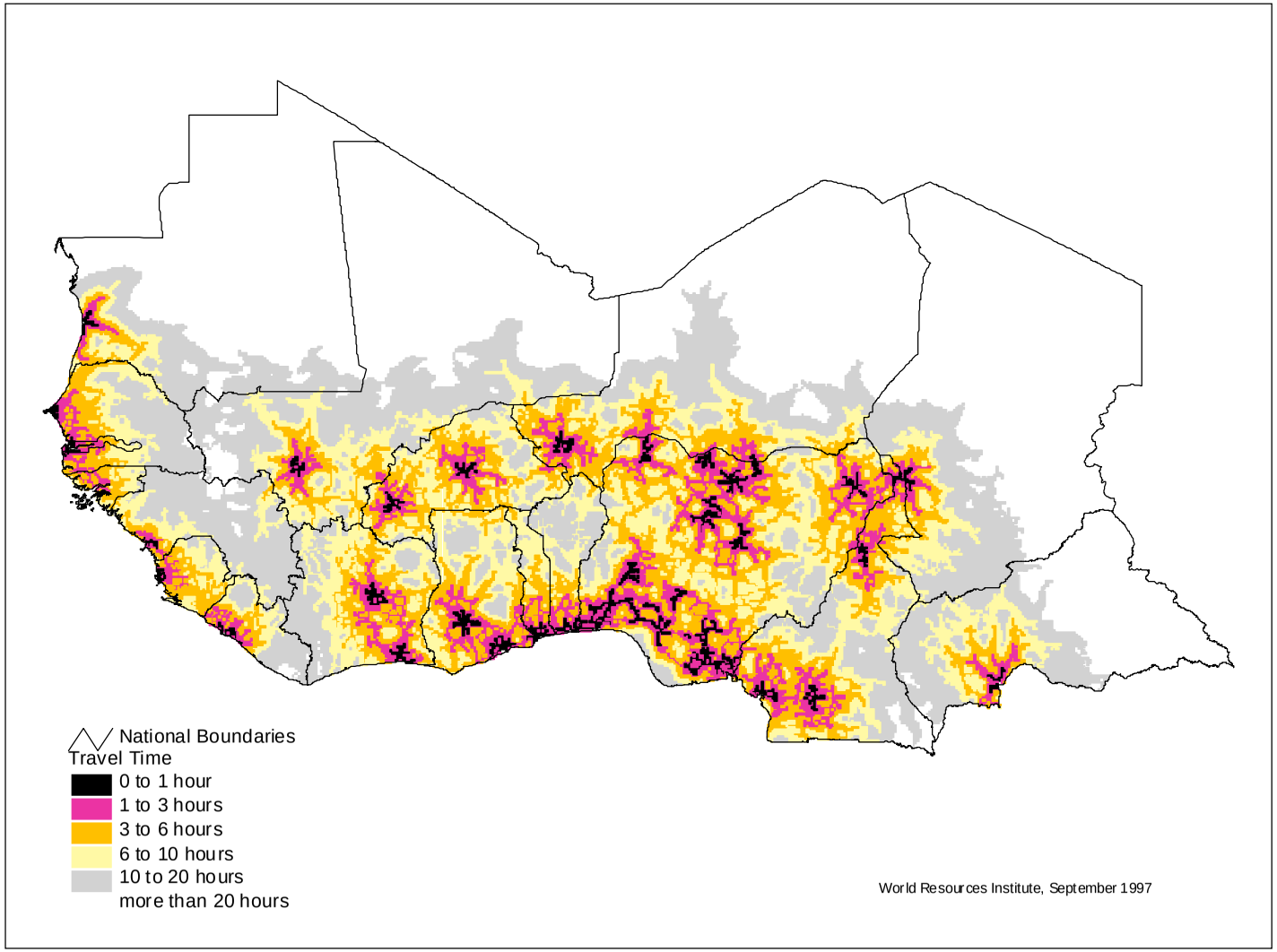
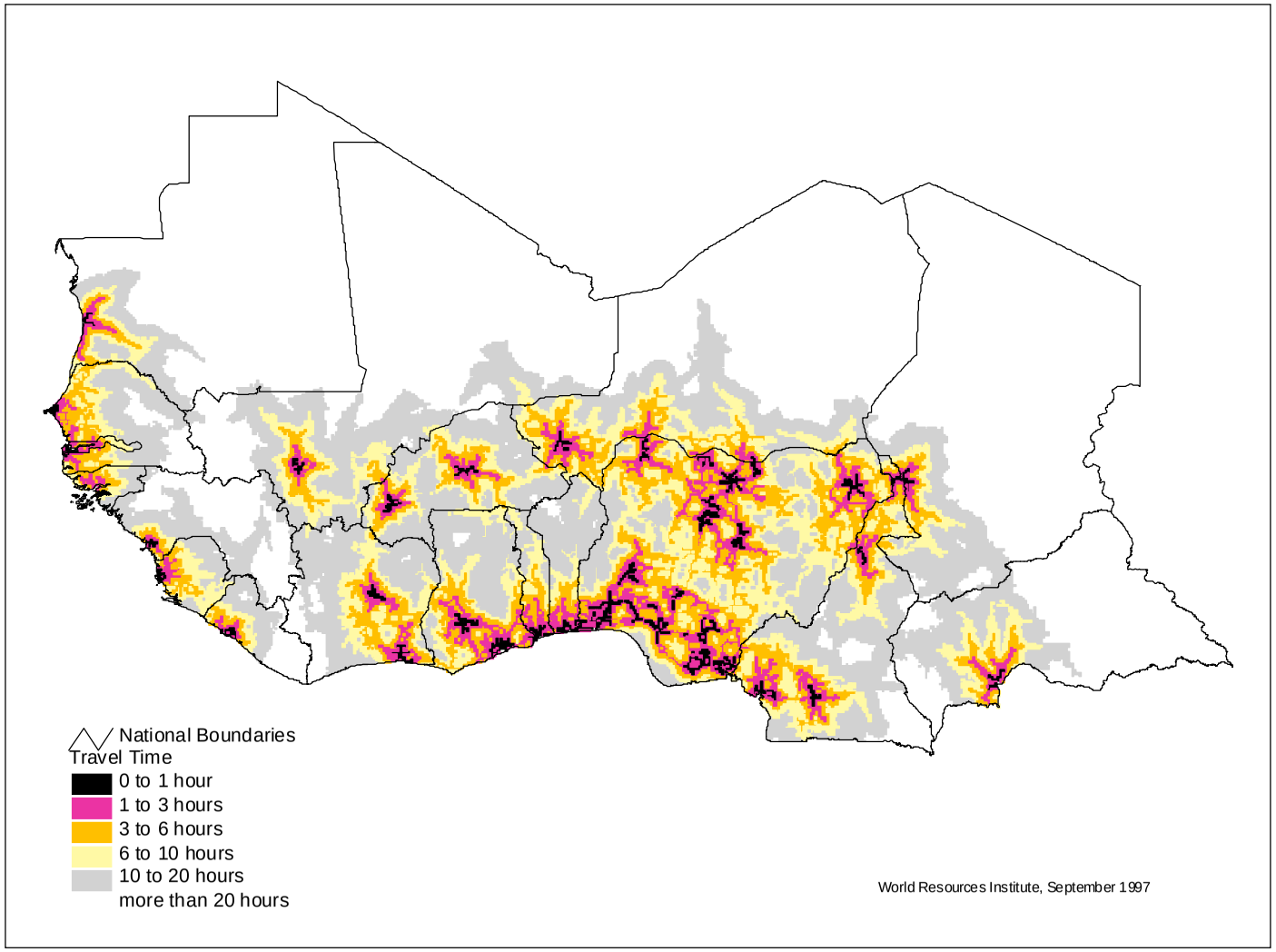


Figure 5 Access to Major Urban Centers in West Africa - Rainy Season



The extent and the location of map units that are much below and much above average differ significantly between the three maps. This demonstrates that if any of the composite measures are used as a proxy for poverty, different areas will be characterized as poor. The three maps also show the limitation of a coarse area presentation. Large administrative units in the northern part of these Sahelian countries can dominate the map which is out of proportion to the small number of people living within them.

5.1.3 Typology of Economic Activities

The goal of developing a typology of administrative areas is to build an analytical framework by identifying areas with social, economic, or environmental characteristics that are of importance to poverty, human welfare, and agricultural research. These may include areas that are highly vulnerable to drought, have experienced rapid population growth, or suffer from a depleted natural resource base.

For example, the U.S. Department of Agriculture's Economic Research Service (ERS) has developed a typology of rural areas that has become the framework for statistical analyses, mapping, and graphical presentation of data. For more information on rural typology codes in the U.S., see Cooke and Mizer (1994) and Sommer and Hines (1991).

The availability of clearly defined typology codes which reduce the economic and social diversity of U.S. counties to few important policy relevant themes, has allowed analysts to examine the effects of national policy making on rural areas in more detail. For example, areas classified as "persistent poverty counties" have been compared to the rest of the country as for variables such as farm investment, potential ground water contamination, educational attainment, and local government capacity.

The detailed economic data that were used in the USA are not readily available at international level for most developing countries. However, a rough prototype typology of economic activities, based on existing data for West Africa, can be developed to show how a typology for a group of developing countries would look like (see Box 6, page 43). A plausible hypothesis, which will need further research, assumes that areas with a less diversified economy provide fewer economic opportunities for poor people to escape poverty and may even have a larger proportion of poor people than more diversified areas.

Figure 9 to Figure 12 (pages 46 to 49) are the resulting maps of this prototype typology. The map of metro and non-metro areas (Figure 9, page 46) used a previous accessibility map (Figure 4, page 37) as an input. This may be a useful approach to define rural areas for an international mapping activity, since no commonly agreed upon definition of rural areas exists yet. With additional data a more sophisticated typology could be developed. For example, non-metro areas could be further characterized by crop specialization, market access, and infrastructure variables.

Other examples of typologies capturing the economic resource base that could become a useful input for poverty mapping include a map of agricultural production systems for the Greater Horn of Africa produced by FAO (van Velthuizen *et al*., 1995) and maps of food economy zones developed by Save the Children Fund (Seaman *et al*., 1993; Save the Children Fund, 1996). Figure 13, page 50, presents such food economy zones for Sudan.

Figure 6 FEWS Vulnerability Mapping - Resource Base

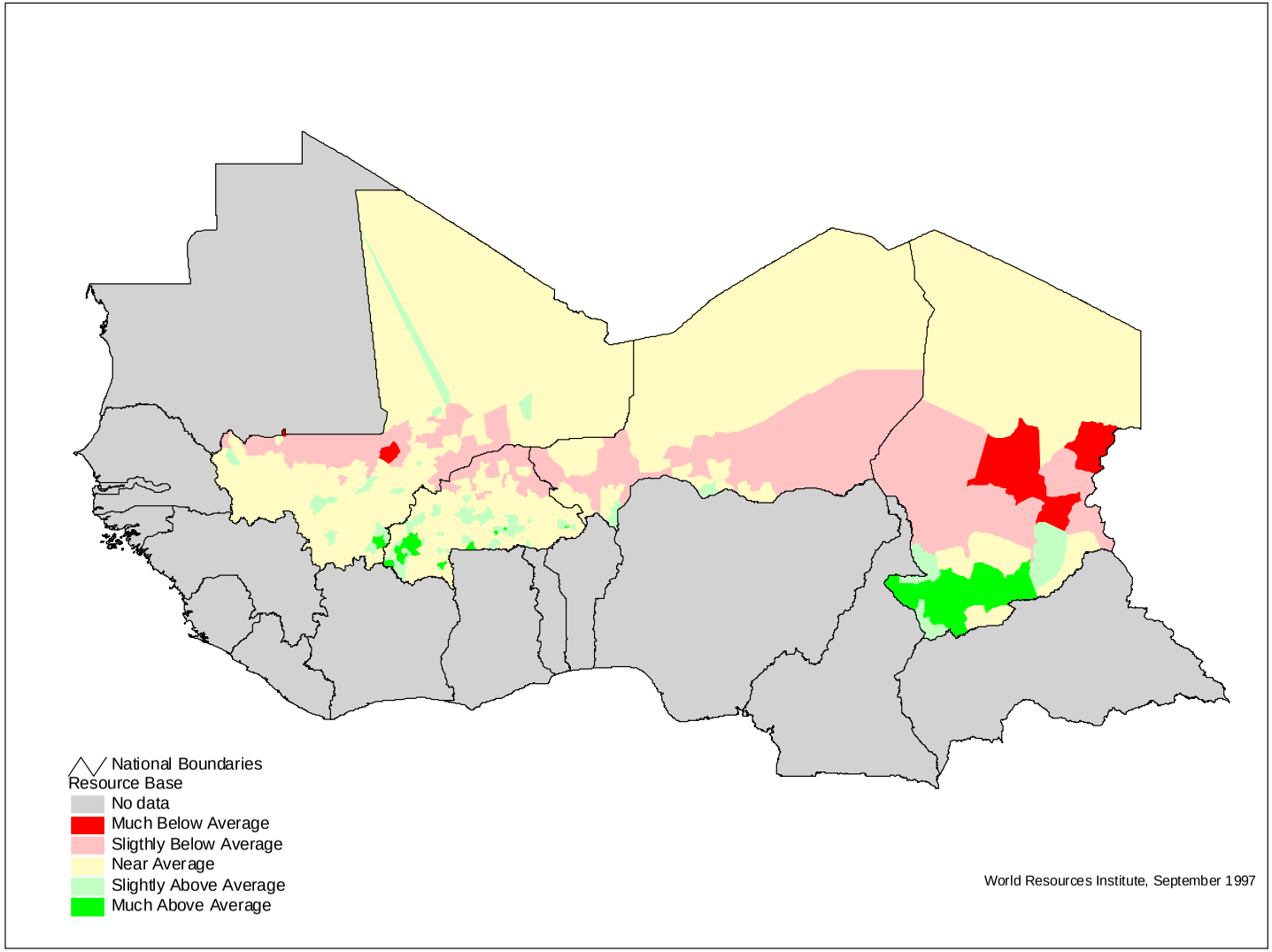


Figure 7 FEWS Vulnerability Mapping - Income Structure

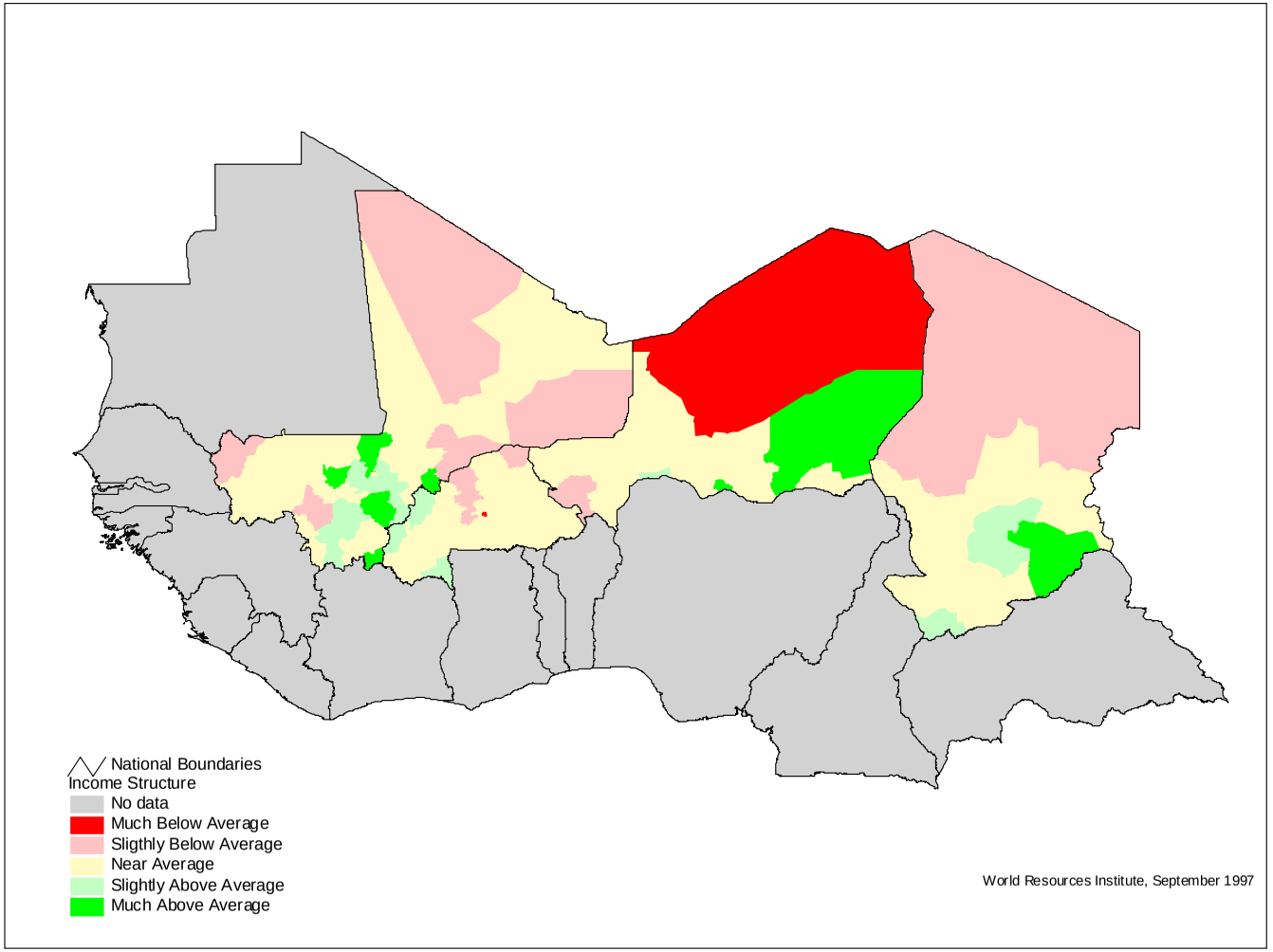
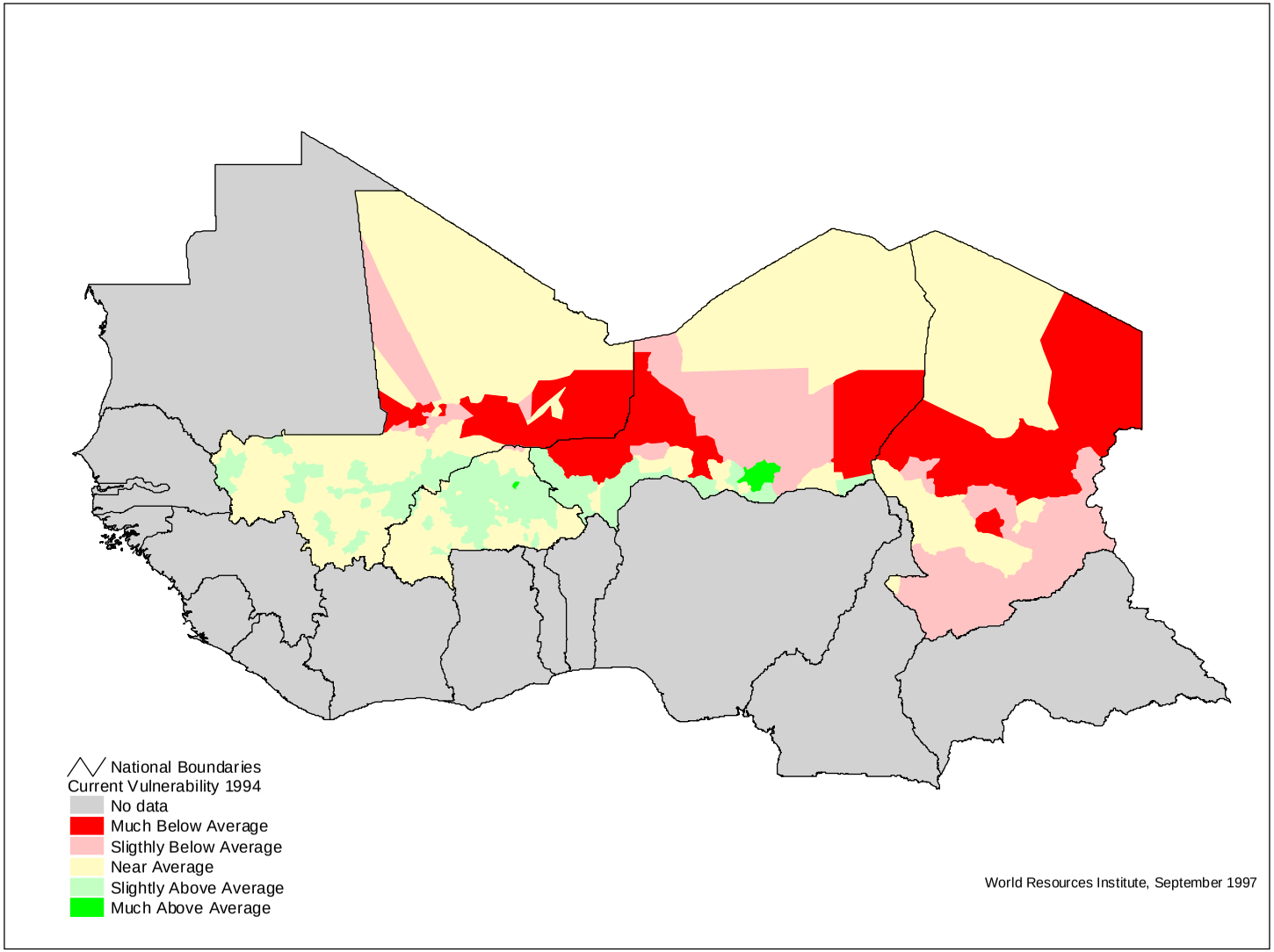


Figure 8 FEWS Vulnerability Mapping - Current Vulnerability 1994



5.1.4 Other Indicators

Other potential indicators that could be mapped include population pressure (land availability per capita), environmental degradation, and if known, causes of poverty (see Box 7, page 50). Various high quality large-area GIS databases have been published recently and could become a useful input for this approach:

- 5 km resolution climate surfaces for Africa and Latin America (Corbett, 1996).
- 5 km resolution population for Asia and Africa (Deichmann, 1996; Deichmann, 1997c)
- 1 km resolution global land cover characterization (USGS, 1997a).
- 1:250,000 scale cropland use intensity (CUI) for the Sahel and Southern Africa (USGS, 1997b).

For example, the CUI coverages for Mali, Burkina Faso, and Niger were intersected with village population databases for each country to estimate the amount of cultivated land per person per village (Brunner and Nielsen, 1997). Under conditions of extensive, low input agriculture, a shortage of cropland can cause forest clearing and expansion into environmentally marginal lands. But other empirical evidence links increased population density to increased agricultural productivity and environmental protection. A study of Machakos District, Kenya shows that despite a six-fold increase in population between 1930 and 1990, the rural population succeeded in raising productivity on both a per hectare and per capita basis, while controlling and even reversing the degradation of their natural resources (Tiffen, *et. al.*, 1994)

Box 6 Developing a Typology of Economic Activities

The typology was developed as follows. First, administrative units were classified as metro and non-metro. Next, economic activity codes were assigned to each unit. Finally, economic diversity per unit was determined by the number of activity codes assigned to each unit. Economic diversity was classified as single sector, dual sector, and three or more sectors dominant per administrative unit. These three categories, the codes, and a brief definition are summarized in the figure at the end of this box.

Rural - Urban Continuum

All administrative unit areas for West Africa were categorized as metro and non-metro areas. Of the 1,996 administrative unit areas, 447 were classified as metro and defined as areas that intersected with the 1 hour travel zone to cities with a population over 200,000. Of these metro units, 120 metro-core units were selected, based on all units whose center is located within the 1 hour travel zone. The remaining 327 metro units were classified as metro-periphery. All other 1,549 units are non-metro areas. Figure 9, page 46, shows a map of these areas.

Economic Diversity and Activity Codes

Nine economic activity codes were developed: Agriculture (very high, high, medium, and low), Protected Areas, Forest, Mining, Other, and Service. Economic activity was defined by the spatial extent or location of these activities within the administrative unit. This provides a starting point how an economic typology can be developed and allows to examine potential use for spatial and statistical analyses. It is recognized that with more detailed economic production data at subnational level - although it may not currently be

(continued)

Box 6 (continued)

collected consistently at regional scale - a more accurate and robust economic typology could be developed.

The category "other" is defined by areas that have no or minimal cropping (less than 2% of the land area of the administrative unit area is cropped), no major mining activity, no protected areas with significant areal extent, and no significant forest area. "Other" includes primarily desert and areas where herding plays an important economic role.

All administrative divisions that had a mine, pipelines, and/or gas fields within their unit area were classified as having ongoing economic activities in the mining sector.

Those administrative units that had more than 50% of the area covered by tropical moist forest were classified as having significant economic activities in the forest sector. This can include areas with degraded forest, for example resulting from intercropping with coffee and oil palms.

All administrative units with more than 20% of the area under some sort of protection were identified as having some economic activities related to biodiversity and tourism.

To estimate agricultural activities, a very simplistic approach was used. All areas that had more than 2% of the administrative land area under crops were classified as having ongoing agricultural activities. Agricultural activities were classified into four categories, expressing the percent of land area allocated to the agricultural sector. The exact thresholds for these four categories varied across six different vegetation zones. Such an approach makes adjustment for the latitudinal differences in resource endowment. The four categories (low, medium, high, and very high agriculture) were defined as outlined in the table below. A more sophisticated approach could have combined crop land use intensity (CUI) data with length of growing period maps.

Classification of Agricultural Activities for Economic Typology

	AGRICULTURE LOW (percentage of land area under) crops)	AGRICULTURE MEDIUM (percentage of land area under crops)	AGRICULTURE HIGH (percentage of land area under crops)	AGRICULTURE VERY HIGH (percentage of land area under crops)
Desert + Pasture Zone	2 to 8	8 to 25	25 to 55	55 to 100
Dry Savanna Zone	2 to 10	10 to 30	30 to 45	45 to 88
Transition Zone	2 to 8	8 to 20	20 to 45	45 to 79
Wet Savanna Zone	2 to 8	8 to 20	20 to 45	45 to 100
Coastal Forest Zone	2 to 15	15 to 35	35 to 80	80 to 100
Forest Zone	2 to 8	8 to 18	18 to 30	30 to 45

It was assumed that all metro areas include a significant service sector consisting for example of local and national government agencies, private and personal services, wholesale and retail trade, transportation, and public utilities.

In a final step, the degree of economic diversification for the 1,996 administrative divisions was expressed. All units that were assigned only a single economic activity were classified as units with a single dominant sector (Figure 10, page 47). Those with two overlapping activity codes were categorized as having a mixed economy with two dominant sectors (Figure 11, page 48). All areas with three or more economic activity codes were classified as having a diversified economy (Figure 12, page 49).

(continued)

Box 6 (continued)

CLASSIFICATION OF ADMINISTRATIVE AREAS BY ECONOMIC ACTIVITY

RURAL-URBAN CONTINUUM	ECONOMIC DIVERSITY AND ACTIVITY CODES	
Non-Metro [all other areas]	**Single Dominant Sector**	[one dominant sector - 1,323 units]
	- *Other*	[no or minimal cropping, no mine, no protected area, no significant forest]
	- *Mining*	[location of mine(s) in unit, no or minimal cropping, no significant forest]
	- *Forest*	[> 50% of unit closed forest (includes degraded forest), no mine, no or minimal cropping]
	- *Protected Areas*	[> 20% of unit under some protection]
	- *Crop Dependency Low*	[area under crops: desert 2-8%, dry sav. 2-10%, trans. sav. 2-8%, wet sav. 2-8%, coastal forest 2-15%, forest 2-8%]
	- *Crop Dependency Medium*	[area under crops: desert 8-25%, dry sav. 10-30%, trans. sav. 8-20%, wet sav. 8-20%, coastal forest 15-35%, forest 8-18%]
	- *Crop Dependency High*	[area under crops: desert 25-55%, dry sav. 30-45%, trans. sav. 20-45%, wet sav. 20-45%, coastal forest 35-80%, forest 18-30%]
	- *Crop Dependency Very High*	[area under crops: desert 55-100%, dry sav. 45-88%, trans. sav. 45-79%, wet sav. 45-100%, coastal forest 80-100%, forest 30-45%]
	Mixed Economy	[two dominant sectors - 200 units]
	- *Agriculture + Protected Areas*	[combination of sectors defined under single dominant sector]
	- *Forest + Agriculture*	[combination of sectors defined under single dominant sector]
	- *Mining + Agriculture*	[combination of sectors defined under single dominant sector]
	- *Mining + Protected Areas*	[combination of sectors defined under single dominant sector]
	Diversified Economy	[three or more sectors - 26 units]
	- *Forest /Agriculture/Protected Areas*	[combination of sectors defined under single dominant sector]
	- *Mining/Forest/Agriculture*	[combination of sectors defined under single dominant sector]
	- *Mining/Agriculture/Protected Areas*	[combination of sectors defined under single dominant sector]
	- *Four Sectors*	[combination of sectors defined under single dominant sector]
Metro - Periphery [administrative unit intersects with 1 hour travel zone to city over 200,000]	**Mixed Economy**	[two dominant sectors - 281 units]
	- *Service + Agriculture*	[metro-periphery and more than 2% of area under crops]
	- *Service + Other*	[metro-core and sector definition from single dominant sector]
	Diversified Economy	[three or more sectors - 46 units]
	- *Service/Mining/Agriculture*	[metro-periphery, more than 2% of area under crops, and sector definition from single dominant sector]
	- *Service/Agriculture/Protected Areas*	[metro-periphery, more than 2% of area under crops, and sector definition from single dominant sector]
	- *Service/Forest /Agriculture*	[metro-periphery, more than 2% of area under crops, and sector definition from single dominant sector]
	- *Four Sectors*	[combination of sectors defined under single dominant sector]
Metro - Core [center of the administrative unit is located within area of 1 hour travel zone to city over 200,000]	**Mixed Economy**	[two dominant sectors - 110 units]
	- *Service + Agriculture*	[metro-core and sector definition from single dominant sector]
	- *Service + Mining*	[metro-core and sector definition from single dominant sector]
	Diversified Economy	[three or more sectors - 10 units]
	- *Service/Mining/Agriculture*	[metro-core and sector definition from single dominant sector]
	- *Service/Agriculture/Protected Areas*	[metro-core and sector definition from single dominant sector]
	- *Service/Forest /Agriculture*	[metro-core and sector definition from single dominant sector]

Text in **bold** represent different classification categories; Text in *italics* are the respective economic typology codes; Text in brackets[ ] provide a brief definition of the category or variable.

Figure 9 Metro and Non-Metro Areas in West Africa

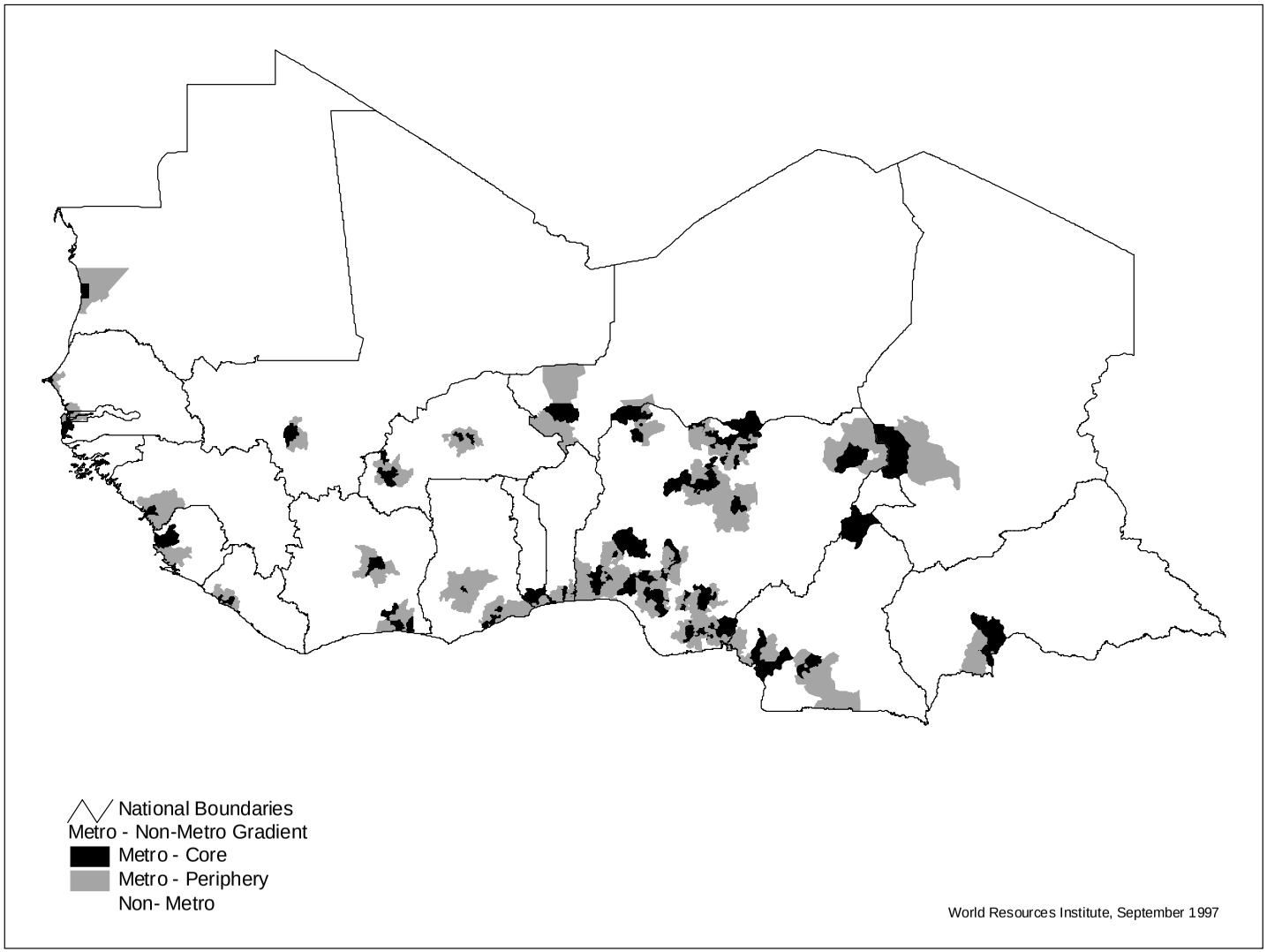


Figure 10 Economic Diversity - Single Dominant Sector

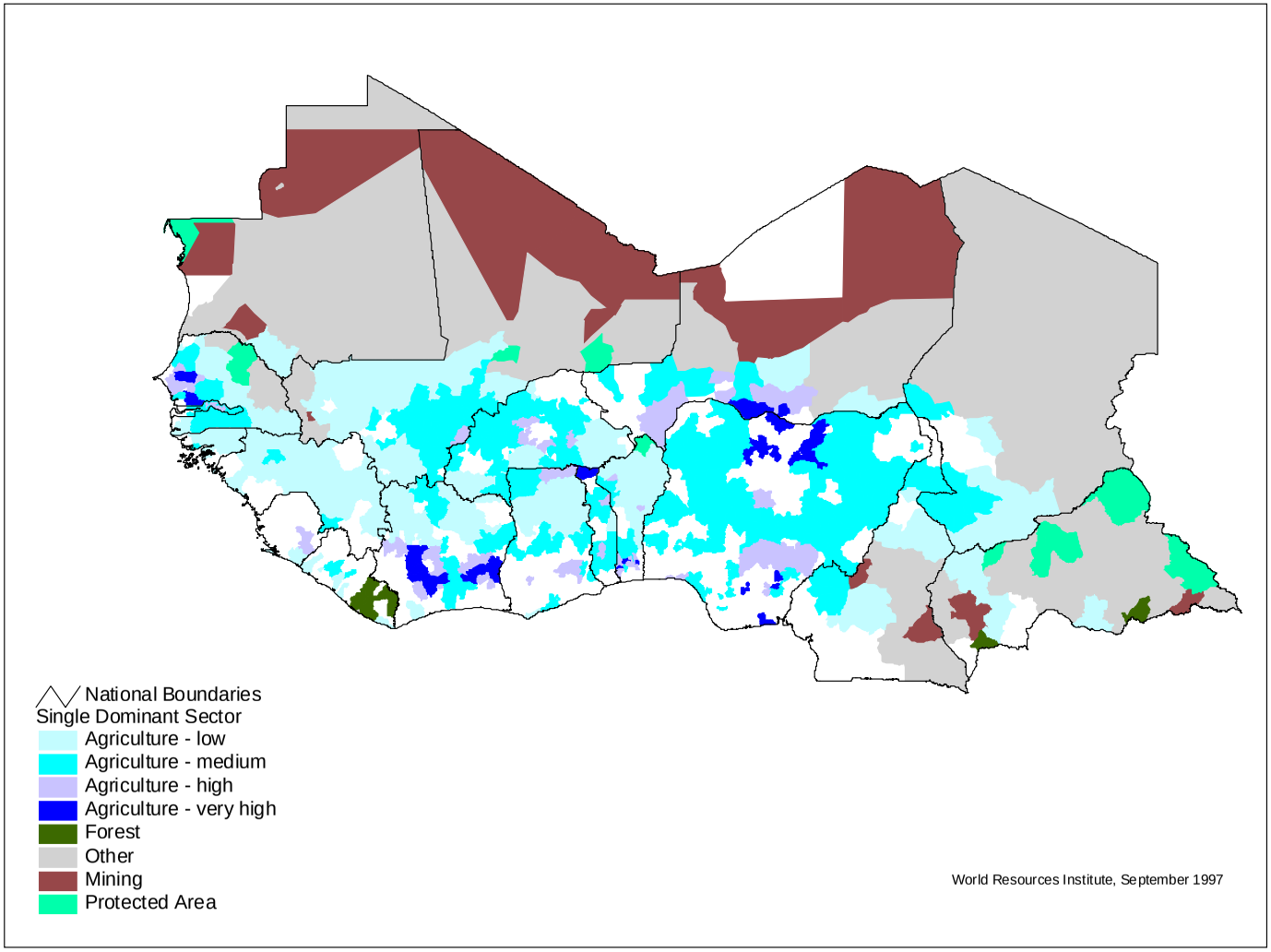


Figure 11 Economic Diversity - Two Dominant Sectors

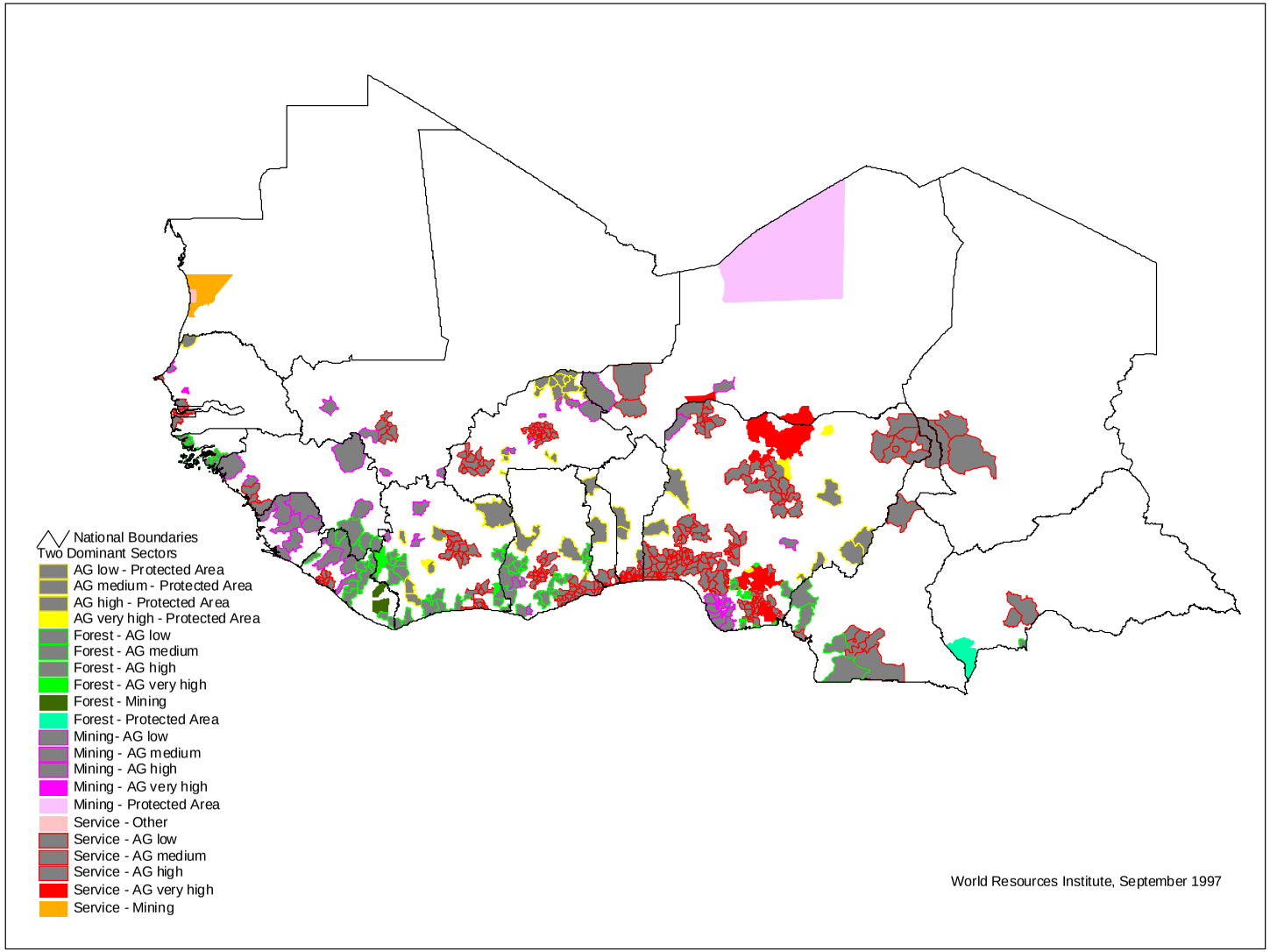


Figure 12 Economic Diversity - Three or More Sectors

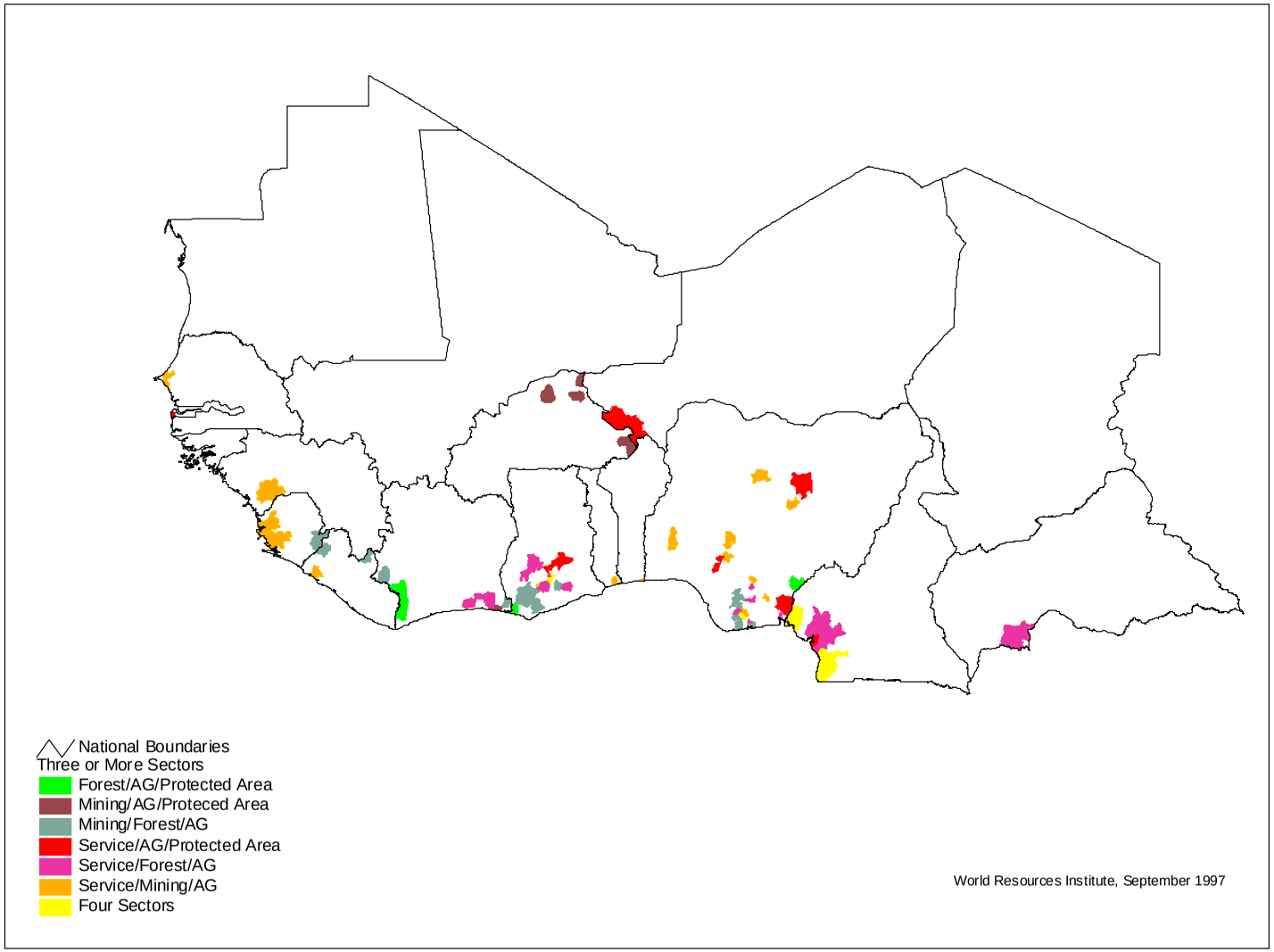
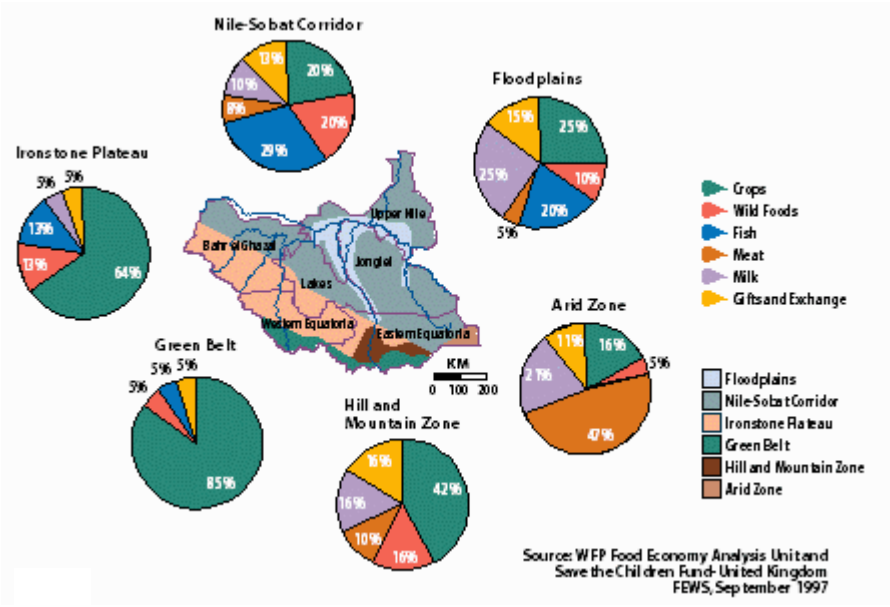


Figure 13 Food Economy Zones for Sudan



Box 7 Mapping Causes of Poverty

A closer look at the causes and types of poverty may help to identify other indicators that could be mapped subnationally. For example, if a poverty assessment finds that the majority of the poor are landless laborers, pastoralists, and indigenous populations and information is available on the proportion of these population groups within each district, then mapping the location of these groups can become a useful proxy for the spatial distribution of poverty. The limitation of using such proxy indicators for poverty mapping is obvious: Causes of poverty must be known, and causes may vary from country to country. For example, size of land holdings may be a good poverty marker in Bangladesh, but not necessarily in the Sahel (Ravallion and Sen, 1994). Two reviews classifying causes and types of poverty, one by the Swedish International Development Cooperation Agency (Sida) the other by IFAD, are summarized below (Sida, 1996; Jazairy *et al*., 1992).

Sida identifies four major interacting conditions that determine well-being or poverty status:

- Lack of material assets and productive resources.
- Low level of human resource development (education, skills, and health).
- Lack of power (economical and political).
- Vulnerability (fragile economic base and frequent exposure to shocks and fluctuations).

Sida proposes a typology of poverty with the following broad categories:

- Occupational based poverty - Typically, this can be found among landless farm laborers, marginal farmers, traditional fishing populations, and pastoralists.
- Poverty associated with disadvantaged populations - All marginalized social groups such as indigenous populations, tribal populations, and groups relegated to a low status are included here.

(continued)

Box 7 (continued)

- Poverty resulting from discrimination based on biological attributes - Material deprivation can be the result of age or gender discrimination.
- Geographically determined poverty - People living in a specific region may be materially deprived because the area is deficient in resources, isolated, and/or avoided, intentionally or unintentionally, by government policies and programs.

IFAD on the other side, distinguishes between ten major causes or processes of poverty: international processes, domestic policy biases, dualism (parallel expansion of large-scale production and impoverishment of small-scale activities, often a continuation of historical factors such as the latifundia and minifundia relationships in selected Latin American countries), population pressure, environmental degradation, natural cycles, gender biases, cultural and ethnic biases, exploitative intermediation (exposure to unequal exchanges from traders, moneylenders, and exploitative tenure arrangements), and internal civil strive (Jazairy *et al*., 1992).

According to IFAD, generally the most poor and vulnerable segments of society can be found among smallholders, landless, nomadic pastoralists, ethnic indigenous groups, artisinal fishing populations, displaced and refugee populations, and households headed by women.

IFAD classifies rural poverty into five categories: interstitial poverty, peripheral poverty, overcrowding poverty, traumatic or sporadic poverty, and endemic poverty. Areas with interstitial poverty are pockets of material deprivation and alienation within close proximity of affluence and power. Material deprivation combined with isolation creates peripheral poverty that can be found in marginal areas. Overcrowding poverty is a result of material deprivation caused by population pressure and limited resources. Traumatic or sporadic poverty is often transitory and caused by external shocks (drought, floods, and labor displacement). Endemic poverty is long-term and can be characterized by high dependency, isolation, alienation, lack of assets, and technological deprivation (see Appendix 4, page 84, for IFAD summary on location of poor and types of poverty).

5.2 MAPPING SURVEY DATA

Most national surveys based on a probability sample are designed to provide valid estimates at the national level. They do not provide data for maps at the sampling level, for example health statistics by households, since there are too few observations to derive statistically valid estimates. However, geo-referencing surveys, that is assigning a latitude and longitude to a sampling point, can provide the following benefits:

1. Internationally standardized surveys such as the DHS can be integrated across countries for regional assessments.
2. The sampling points in such regional assessments can be aggregated to new units of analysis, as long as corrections can be made for differences in the probability of selection and a sufficient number of sample points are selected for each new unit of analysis.
3. The raw data, i.e. statistics by sample clusters, can be plotted on a map to reveal spatial patterns of the variable under investigation. This is similar to a visual examination of the relationship between two variables in a scatterplot. Mapping data by sample clusters is best used for explorative analysis, especially when the survey is not based on a spatially representative sample.

4. Survey data can be integrated with other mapped data to produce new modeled estimates (see 5.3, page 56).

Figure 14, page 53, summarizes how geo-referenced survey data can be used to produce two types of subnational maps: (1) map of sample clusters and (2) map of new units of analysis. Considering the limitations of mapping sample clusters discussed above, it is most appropriate for broad international comparisons and formulating hypotheses. Similarly, mapping new units of analysis are most suited for international comparisons and regional analyses. The resolution of these new units cannot go beyond the original sampling design, which typically is comparable to the first subnational administrative unit for international surveys such as the DHS and LSMS.

A brief example will demonstrate how geo-referenced DHS can be used to plot a map of enumeration areas and calculate indicators for new units of analysis (aridity zones). The data came from the USAID supported West Africa Spatial Analysis Prototype (see Box 8, page 54, for more detail).

5.2.1 Example - Child Nutritional Status and Aridity

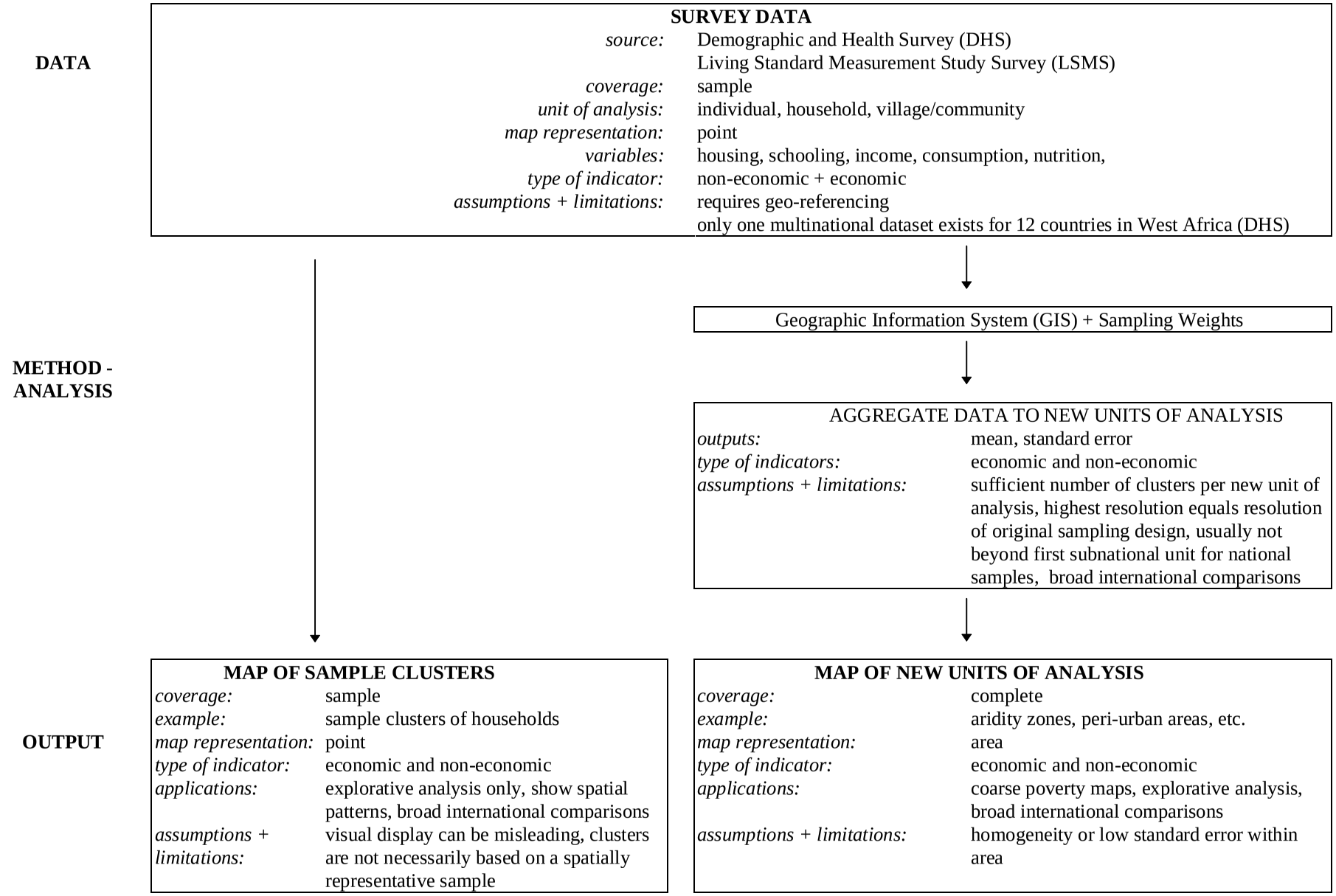
The presented example uses geo-referenced measures of child nutritional status from the DHS, aggregates them to new units of analysis (aridity zones), and examines the relationship between child nutritional status and aridity. Indicators of child nutritional status based on anthropometric measurements were selected because they represent a good indicator for the degree of development in a region and can be interpreted as a proxy for poverty. Experts from the Second Report on the World Nutrition Situation 1992 identified anthropometric measurements as the best general proxy for constraints to human welfare of the poorest, including dietary inadequacies, infectious diseases, and other environmental health risks. They proposed anthropometric measures as a strong predictor, at individual and population levels, of subsequent ill health, functional impairment and/or mortality (United Nations, 1992). Anthropometric indicators by themselves do not allow to identify the specific causes of growth retardation and wasting. Data were available from the following ten surveys: Burkina Faso (1993), Cameroon (1991), CAR (1995), Côte d'Ivoire (1995), Ghana (1988), Mali (1995), Niger (1992), Nigeria (1990), Senegal (1992), and Togo (1988).

Four indicators of child nutritional status were used:

- stunting (low height-for-age),
- wasting (low weight-for-age),
- underweight (low weight-for-age), and
- wasting and stunting.

Stunting measures chronic undernutrition and is an indicator for the long-term effects of undernutrition in a population. Low height-for-age is primarily caused by inadequate nutrition over a long time period, but is also affected by recurrent and chronic illness. Wasting is a measure for acute undernutrition and represents nutritional deficits immediately preceding the survey. It may also be caused by recent episodes of illness or an acute food shortage. Low weight-for-age (underweight) takes into account both acute and chronic undernutrition, but cannot distinguish between children who are underweight because of stunting or wasting. The

Figure 14 Approaches for Poverty Mapping - Survey Data



Source: World Resources Institute, 1998

proportion of children underweight and stunted indicates the share of children who are experiencing at the same time chronic and acute nutritional deficits

Aridity was defined using the aridity index (AI) ranges given in the World Atlas of Desertification (United Nations Environment Programme, 1992). The index is defined as the ratio of precipitation to potential evapotranspiration and then classified into six aridity zones: hyper-arid, arid, semi-arid, dry-subhumid, moist subhumid, and humid. Data came from the International Center for Research in Agroforestry (ICRAF) in Nairobi.

Box 8 Geo-Referencing Survey Data

The USAID supported West Africa Spatial Analysis Prototype (WASAP) was motivated by a desire to add value to the DHS so that clusters could be grouped to new units of analysis and used in broad international analyses. Data have been geo-referenced for 12 countries in West Africa.

The DHS is funded by USAID and implemented by Macro International Inc. in collaboration with country statistical services. The DHS is a national sample survey designed to provide information on fertility, family planning, and health. The survey involves interviewing a randomly selected group of women between 15-49 years of age.

Typically, the DHS is selected in two stages. First, a stratified random sample of Enumeration Areas (EAs) is chosen with equal probability of selection per region or urban/rural area. Second, a complete household listing is carried out in each EA from which a number of households is chosen at random. The number of households chosen is proportional to the population of the EA. The DHS reduces sampling costs by sampling a relatively large number of households from few EAs. The sampled EAs are known as clusters.

Most of the DHS clusters were mapped by the U.S. Bureau of the Census (BUCEN) at the request of USAID's Regional Office for West and Central Africa (REDSO/WCA) in Abidjan. With the exception of the Côte d'Ivoire and Mali DHS which used GPS to geo-reference the survey clusters, no survey explicitly mapped the clusters. BUCEN located each cluster by linking the name of the settlement with the settlement names, and associated latitude/longitude coordinates, given in the Defense Mapping Agency (DMA) Gazetteers. For settlements not found in the Gazetteers, the coordinates in degrees and minutes were read from a map. About 85% of the clusters were mapped using the Gazetteers (BUCEN, 1996). If the settlement name did not appear in either the Gazetteer or map, the cluster was located in the capital of the administrative unit within which the cluster lies. Administrative centers typically have the same names as their administrative units. In Nigeria, where some have different names, the cluster was located in the capital of the higher level administrative unit. As a result of this hybrid procedure, there may be differences of up to 10 km (50 km in Nigeria) between the estimated and actual location of each cluster.

5.2.2 Aggregating Cluster Data to New Units of Analysis

Anthropometric data for the ten countries include 2,250 clusters, of which 1,038 are urban and 1,212 rural. Each cluster includes about 30 households. Although the household data have been aggregated to the cluster level, there are too few observations to derive statistically valid estimates at the cluster level (MacroInternational, 1996). To be of any real value, the cluster level data need to be aggregated to higher levels, such as administrative units or agro-ecological zones. However, to aggregate the data to higher levels, it is not sufficient to sum the values for each cluster and then divide by the number of clusters per region. This would merely produce the average of cluster level values that are themselves averages, and not the average for the population per region of interest. A second problem arises from the fact that the DHS is collected using a nationally, not locally, representative sample, i.e., the probability of selection of

a household for interview is not constant across the whole country. To aggregate cluster level data to new units of analysis, corrections need to be made for differences in the probability of selection using appropriate sampling weights. These are the inverse of the probability of selection and need to be applied when new averages are calculated from the DHS data. These weights are included in the DHS cluster files. The indicators in this example were calculated using an ArcView script written by Trevor Croft (Macro International Inc.). The script produces means and standard error for the selected variables and warns users when too few clusters are aggregated that would yield an unrobust measurement. Proportions for children aged 3-35 months were calculated using weights that take into account the size of the sample relative to the background population.

5.2.3 Results

The results of aggregating the data to new units of analysis are presented in Table 9, page 55, that show the mean and standard error of the incidence of each indicator per aridity zone expressed as a percentage of children sampled, disaggregated by urban and rural clusters. Clusters of the hyper-arid zone were combined with those of the arid zone because it contained too few clusters (6) to produce statistically significant results.

Table 9 Nutrition Indicators by Aridity Zones in West Africa

	ARIDITY ZONE					
	Hyper-arid and Arid	**Semi-arid**	**Dry Subhumid**	**Moist Subhumid**	**Humid**	**TOTAL**
URBAN AND RURAL						
NUMBER OF CLUSTERS	178	806	189	476	601	2,250
NUMBER OF CHILDREN	1,971	8,967	2,193	5,072	6,155	24,358
Stunting (%)	34.9 [1.6]	41.6 [1.4]	36.3 [1.8]	32.7 [2.1]	28.0 [0.9]	
Wasting (%)	21.2 [1.1]	17.7 [0.8]	11.1 [1.1]	8.4 [0.8]	7.2 [0.6]	
Underweight (%)	45.6 [1.6]	45.1 [1.4]	36.1 [1.7]	30.1 [2.7]	25.4 [1.1]	
Stunting and Wasting (%)	8.1 [0.8]	8.2 [0.6]	4.5 [0.7]	2.6 [0.4]	2.8 [0.4]	
URBAN						
NUMBER OF CLUSTERS	36	371	92	203	336	1,038
NUMBER OF CHILDREN	358	3,098	677	1,643	2,730	8,506
Stunting (%)	21.7 [2.7]	25.8 [2.0]	31.4 [4.2]	25.8 [1.4]	22.6 [1.4]	
Wasting (%)	17.3 [2.8]	15.7 [1.3]	6.8 [1.6]	7.7 [0.8]	6.3 [0.9]	
Underweight (%)	29.6 [3.1]	30.0 [1.7]	25.2 [2.9]	22.7 [1.7]	19.4 [1.5]	
Stunting and Wasting (%)	4.2 [1.0]	4.4 [0.7]	2.0 [0.7]	2.8 [0.4]	1.9 [0.5]	
RURAL						
NUMBER OF CLUSTERS	142	435	97	273	265	1,212
NUMBER OF CHILDREN	1,613	5,869	1,516	3,429	3,425	15,852
Stunting (%)	36.8 [1.8]	45.4 [1.6]	38.7 [1.7]	35.5 [2.7]	30.3 [1.1]	
Wasting (%)	21.8 [1.2]	18.1 [0.9]	13.2 [1.6]	8.7 [1.1]	7.6 [0.8]	
Underweight (%)	47.7 [1.8]	48.7 [1.6]	41.5 [2.0]	33.6 [3.5]	27.9 [1.4]	
Stunting and Wasting (%)	8.6 [0.9]	9.1 [0.8]	5.8 [1.1]	2.4 [0.6]	3.2 [0.4]	

Note: The values in brackets [ ] show the Standard Error for each average.
Source: World Resources Institute, September 1997

As expected, stunting, wasting, and underweight are highly correlated. Both short and long-term indicators show a gradual decline toward the richer and more fertile coastal zone. The incidence of malnutrition is significantly higher in rural than in urban areas.

The proportion of stunted children is the highest in the semi-arid zone for rural clusters and in the dry subhumid zone for urban clusters. The results would suggest that the greatest constraints to human welfare caused by the interaction of factors such as dietary inadequacies, infectious diseases, and other environmental and economic constraints are within these two ecological zones.

To test this proposition, the relationship for one specific indicator, the proportion of children stunted in rural areas, was examined. Of the four indicators, stunting is probably the most robust measure. Stunting typically persists over years and is not reversible. Thus, it is relatively insensitive to the fact that the surveys were carried out over a seven year period (1988-95). The analysis was limited to rural clusters because of their higher dependence on agriculture and subsistence food production with the associated high risks of crop failure for rainfed agriculture.

Figure 15, page 57 (map of sample clusters) shows the spatial variation of stunting. Stunting varies greatly across the semi-arid zone, ranging from lower values in Senegal, comparable to the coastal areas in Ghana and Côte d'Ivoire, to the highest values in eastern Niger and northern Nigeria. The highest concentration of stunting is found around Kano, Nigeria, an area characterized by high levels of agricultural intensification and environmental protection (Adams and Mortimore, 1997), suggesting that a rising agricultural productivity, on a per capita or per area basis, does not preclude low levels of human development.

Aggregating malnutrition indicators by aridity zone is only one example how new units of analysis can be created with geo-referenced survey data. Although there appear to be clear spatial trends at aggregated and disaggregated level, further analysis is required to understand some of the underlying factors contributing to this spatial pattern. This could be done for example with the help of multivariate analyses at the cluster level that include in addition to aridity zones other explanatory variables from the DHS (family size, mother's education, etc.) and other sources (market access, cropping system, policy environment, etc.).

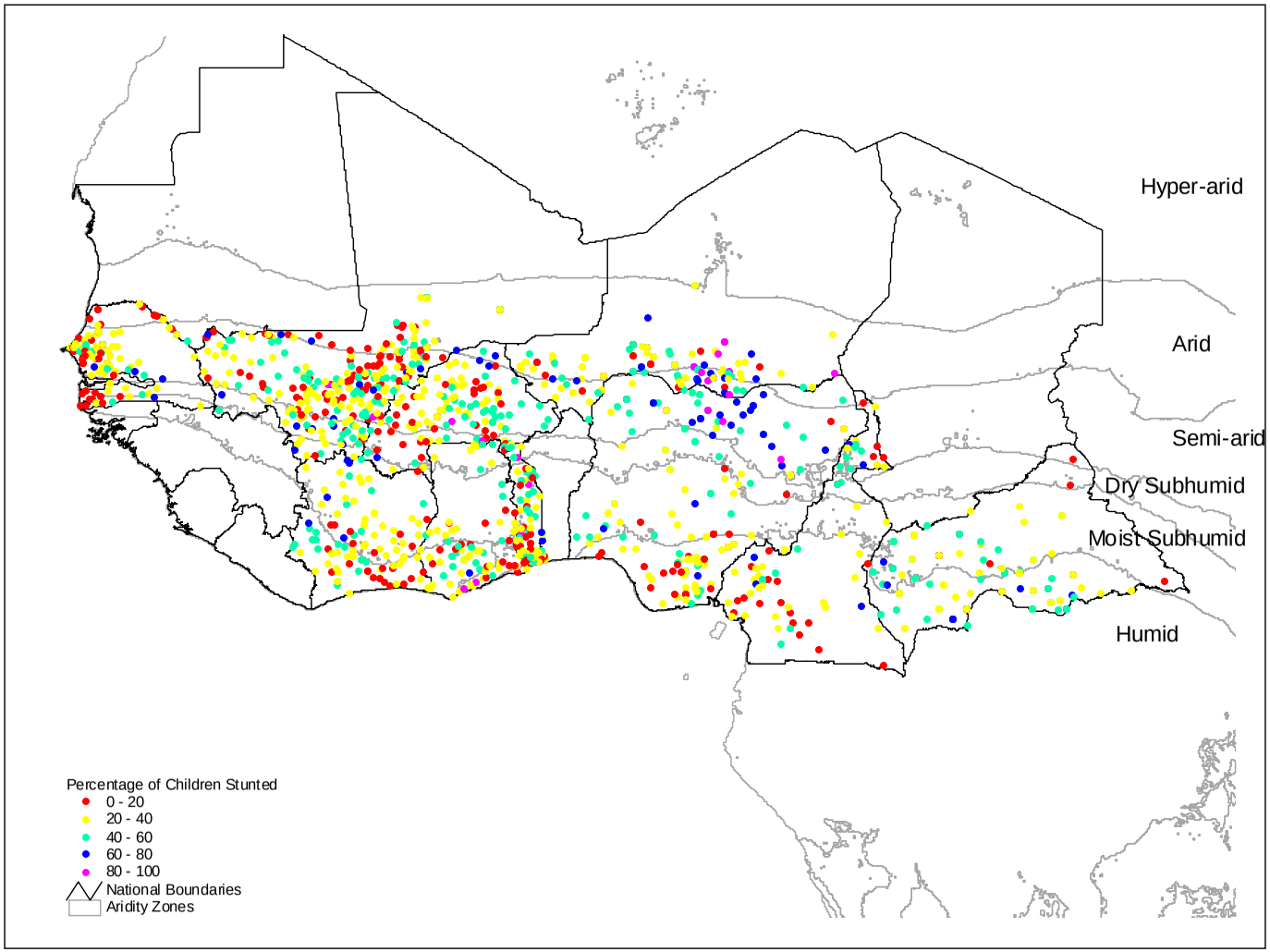
Other variables from the geo-referenced DHS data have been mapped by UNEP/GRID-Arendal and include selected variables related to human development (UNEP/GRID-Arendal, 1997). Geo-referenced survey data could also be aggregated to composite indexes, for example to a cluster-level Human Development Index (HDI), which combines child malnutrition, adult female literacy, and female school enrollment, and a Household Assets Index (HAI), which combines water source (piped, well, etc.), quality of housing, and means of transport.

5.3 MAPPING MODELED RESULTS

Mapping survey data helps identify broad patterns in human development. As a rule of thumb, however, this approach cannot be used to characterize areas below the first subnational administrative level which renders it of little use as a tool for targeting anti-poverty interventions or studying detailed causes and effects of poverty. Poverty maps with a high spatial resolution can be an effective tool to reach the poor and improving the targeting efficiency of programs. To produce such local poverty estimates requires:

1. data that are geo-referenced and can be disaggregated at large scale,
2. a system, usually a GIS or an enumeration area code, that allows to integrate

Figure 15 Mapping Survey Data - Stunting and Aridity Zones in West Africa



different data sets spatially, and
3. statistical methods to estimate missing values at local scale.

Different statistical techniques have been developed to extrapolate from survey data and produce poverty measures at larger scale, for example at the community or village level. These techniques typically demand data with a wide geographic coverage, such as census data and national digital maps, which are incorporated into a multivariate prediction model that estimates poverty measures for much smaller areas than the original sampling of the survey was designed for (small area estimation).

Figure 16, page 59, summarizes how auxiliary and survey data can be combined to produce poverty maps with the help of such statistically techniques. Two examples of modeling poverty estimates that could be used in sub-national poverty maps will be discussed in 5.3.1, page 58, and 5.3.2,
page 60. Example 1 combines survey and census data for Ecuador. Example 2 uses a GIS to integrate data from household surveys, community surveys, and national digital maps for Burkina Faso.

A third example of modeling local poverty estimates is methodologically different from the two examples above. Section 5.3.3, page 62, describes how CIAT is testing a method to extrapolate from local participatory assessments to a larger geographic area.

5.3.1 Ecuador

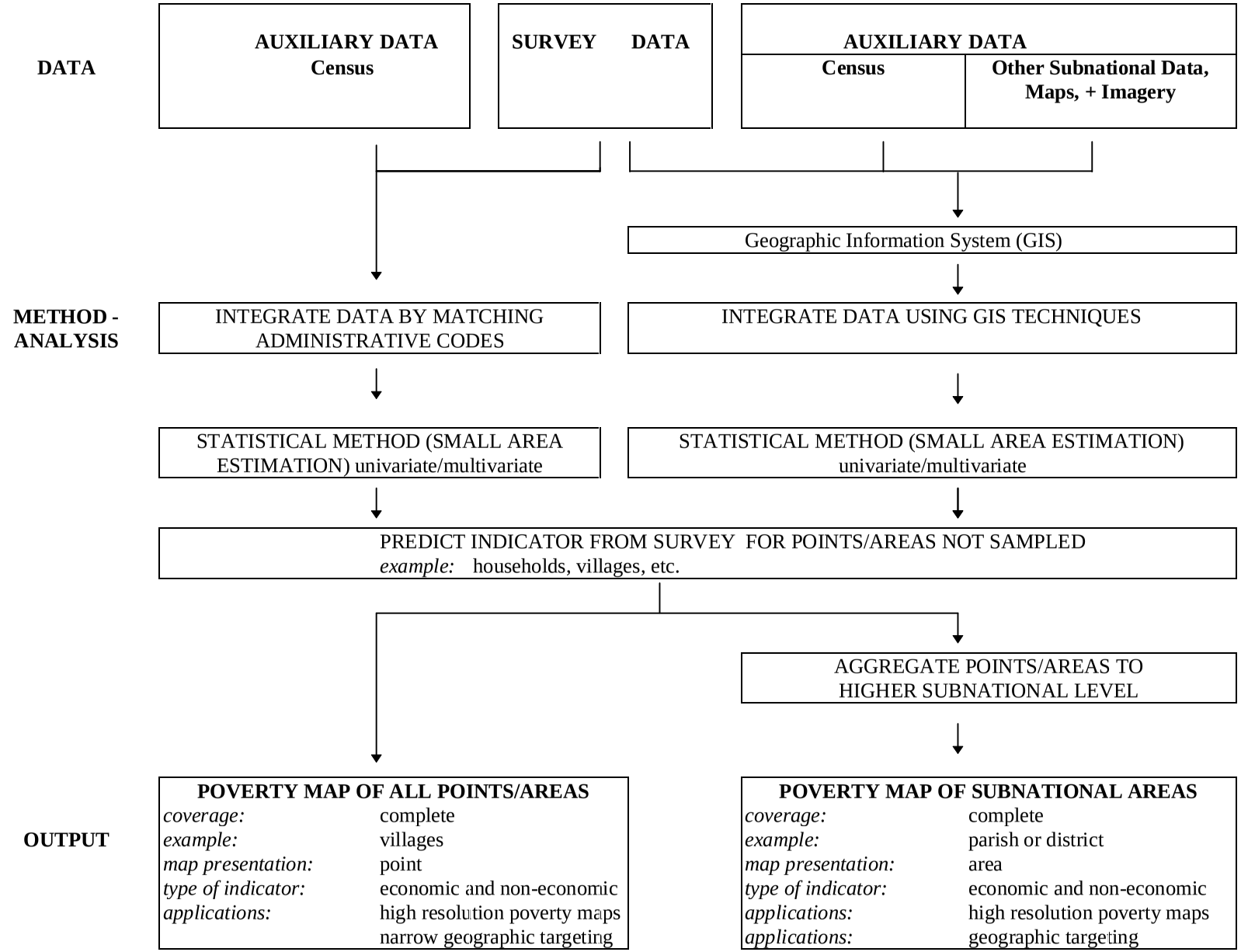
The case study for Ecuador demonstrates how household survey data can be combined with census data to predict per capita expenditure figures for all households in the census (Hentschel *et al*., 1997). It required two datasets:

1. A household survey that provides household consumption expenditure data. The study used the 'Ecuador Encuesta Sobre Las Condiciones de Vida' (ECV) for 1994, a nationally representative survey that follows closely the design of LSMS surveys.
2. Census data at the unit level. The study used data for 2.5 million households from the 1990 population and housing census for Ecuador.

To produce local poverty estimates, the authors of the study carried out the following steps:

1. Construct a prediction model with the ECV data to impute households expenditures for households outside the survey. Such a model requires variables which are common in both the survey and the census and included household size, household composition, type of housing, access to electricity and water, educational status, principal language spoken in the household, location of residence, etc. The study tested different prediction models using multivariate regression analysis and ultimately settled on 48 explanatory variables.
2. The parameters estimated for the regression model in Step 1 were applied to the census data and household consumption expenditures (and a standard error) imputed.
3. Incidence of poverty was then calculated based on a poverty line established for a recent poverty assessment.

Figure 16 Approaches for Poverty Mapping - Auxiliary and Survey Data



Source: World Resources Institute, 1998

The modeled poverty estimates matched closely the poverty rates calculated from the household survey data alone. A comparison of this consumption-based poverty measure and a composite basic needs index revealed significant discrepancies in identifying the same poor households.

Since the study is still work in progress, no high resolution poverty maps have been produced yet. The authors presented poverty rates for 8 different regions in Ecuador. They discussed producing more detailed poverty maps, for example for the 400 cantons or over 1,000 'parroquias' (parishes), a relative easy aggregation since estimates are available at the household level.

5.3.2 Burkina Faso

The Burkina Faso case study combines spatial data at the village level and modeling expertise and is being carried out by the Human Resources and Poverty Division of the Africa Technical Department at the World Bank in collaboration with a team from Oxford University and I-MAGE, a Belgian GIS consultancy. The project tries to develop criteria for better targeting of public investments and projects to poor rural communities in Burkina Faso (Bigman, 1996).

The purpose of this project is to identify criteria which allow narrow geographic targeting, that is identifying and reaching poor villages and communities. The study combines data from household surveys, community surveys, and national digital maps in a Geographic Information System (GIS) and then uses econometric modeling to develop criteria for narrow geographic targeting.

The research project is based on various observations of rural communities in Africa. Poor people tend to live with poor people. In selected countries, the majority of the rural poor often concentrate in a relatively small number of villages where the majority of residents are poor. For example, in Nigeria nearly 80 percent of the rural poor live in 25 percent of the villages. A comparison of income differences in rural areas of Ghana, Kenya, Nigeria, and Uganda showed that the overall income inequality between individuals can be mostly explained by income inequality between communities and to a much lower degree by income differences between individuals within communities (Bigman, 1997).

The analytical design of the study is as follows:

1. Assemble all information on villages from household surveys, community surveys, and national digital maps and combine them in a GIS. Table 10, page 61, and Table 11, page 62, summarize which data sets have been assembled and were spatially integrated.
2. Select an index of well-being. The study chose household consumption from the 1994 Household Income and Expenditure Survey. It became the dependent variable in the econometric analysis used in the prediction model described in Step 4. To calculate different poverty indicators, the authors established a poverty line that was defined as a proportion (2/3) of mean consumption
3. Based on the data integrated in the GIS, calculate new variables for example average distance to capital city, water points, etc. Selected spatial variables from

Table 10 Survey Data Assembled for Selected Villages in Burkina Faso

Source	Data	Coverage
Household Income and Expenditure Survey 1994	• Income and expenditure of households • School enrollment of children • Morbidity of household members	national sample of 8,628 households
Household Income and Expenditure Survey 1994	• Village population • Principal economic activities • Distance to main road and road quality • Type of water source and distance to water source • Distance to health clinics • Distance to primary school • Distance to nearest market	national sample of 351 villages
Agricultural Survey 1993	• livestock ownership • crop production • agricultural technology	national sample of households
Demographic and Health Survey 1993	• Family planning and fecundity • Mortality, morbidity, and AIDS • Education level • Anthropometric data	national sample of 5,706 households and 230 clusters (enumeration areas)
Demographic and Health Survey 1993	• Family planning and fecundity • Mortality, morbidity, and AIDS • Education level • Anthropometric data	national sample of 5,706 households and 230 clusters (enumeration areas)

Source: Bigman (1997)

questionnaires, such as distance to nearest health centers, were checked for consistency and verified by spatial analysis.

4. Develop a prediction model for all the villages within the sample with explanatory variables coming from surveys covering a subset of villages and digital maps covering all villages. The explanatory variables included household characteristics (size of household, dependency ratio, education level, etc.) that were aggregated from household to community level and community characteristics (agro-climatic indices, road conditions, distance to markets, schools, and health clinics, etc.) that were available for all villages.
5. Applying the parameter estimates from the prediction model in the previous step, impute mean values of household consumption and calculate head count indexes based on predicted mean values for all villages (about 4,000) with complete information.

A comparison of regional poverty rates showed a close match between estimates from the prediction model and those from the Household Income and Expenditure Survey alone (Bigman *et al*., 1997). A preliminary poverty map at the village level demonstrated significant spatial heterogeneity that is not captured in the coarse map based on the Household Income and Expenditure Survey which presents poverty rates by five agro-climatic zones, as well as for urban and rural areas.

Table 11 Digital Map Data Assembled for all Villages in Burkina Faso

Level of Aggregation	Data	Source and Coverage
Village	• Village name and geographic coordinates • Population size and demographic structure	1985 Census; 7,131 villages; national coverage
Village	• Infrastructure (market, mill, brick factory, hydrological network) • Distance to nearest school • Distance to nearest health center • Organized social groups • Distance to nearest drinking water point • Population flows • Administrative center • Prevalence of guinea worm	1995 database of Ministry of Water Management; 6,299 villages; national coverage
Village	• geomorphology, geology, • water points management • pollution problems • water table	1996 database of Ministry of Water Management; 1,981 villages; 5 south-western provinces
Health centers	• location and status	1995 database of Ministry of Water Management; around 1,000 health centers
Primary schools	• Number of class rooms and benches • Sex and age ratios of school children for each class • Percentage of students living 1,2,3,4,5 km and further from school • Average distance form school to place of residence • Age and diploma for 13,000 school teachers	1995 database of Ministry of Education; 1994-95 school year, national; coverage of 3,233 primary schools
Meteorological Stations	• Rainfall (160 locations), temperature (31 locations), evapotranspiration (15 locations) ;(1961-95)	1995 database of Directorate of Meteorology; national sample
Hydrological Infrastructure	• Description and coordinates of 38,000 water points, 100 pumps, 700 dams, 400 irrigation systems	1995 database of Ministry of Water Management; national coverage
Hydrological Infrastructure	• data on 75 lakes, 13 waterfalls, 254 water sources	1996 database of Ministry of Water Management; 5 south-western provinces
Roads	• Road track and network (1:1,000,000) • Quality of road	1992 IGN map; national coverage
Province	• Annual yield, production, and area under cultivation for 15 crops (1984-94) • Cost and sale prices of 3 crops in 9 main provincial markets	1995 Markets Data Base; national coverage
Department	• climate • literacy • cattle numbers • household size and structure	1995 database of Ministry of Agriculture

Source: Bigman (1997)

5.3.3 Scaling Up From Local Perspectives

Because of the qualitative nature and the local scale of participatory poverty assessments, they have generally been perceived to complement more traditional top-down approaches based on questionnaires and household surveys. Researchers at CIAT have developed a method to extrapolate from local participatory assessments to a larger geographic area, thus making local perceptions of poverty the basis for poverty assessments. Their method is based on work carried

out in Tanzania and Colombia and tries to overcome the two traditional shortcomings of participatory poverty assessments: lack of quantification and representativeness (Ravnborg and Guerrero, 1997). Ravnborg *et al*. have prepared a manual that outlines a nine-step approach to scale up local poverty assessments. The method is currently being tested in Honduras, and includes the following major steps (Ravnborg *et al.*, 1997):

- Select sampling sites.
  To produce participatory poverty assessments for large geographic areas requires a special sampling strategy, since not every site, usually communities with 40-100 households, can be queried. Ravnborg *et al*. recommend a maximum variation sampling strategy using sampling factors that influence individual's perception of well-being, for example agro-ecological conditions, population density, access to credit and services, and education level. The objective of the sampling strategy is to identify as many distinct perceptions of well-being as possible, which will later help to extrapolate the sampled perceptions to a wider geographic area.
- Conduct well-being rankings within the selected communities.
  A selected number of informants in each community will be asked to rank all households according to their level of well-being or quality of life. This requires a clear delineation of the community to be assessed, a list of all the households in the community to be evaluated, local terms for well-being, and an explanation of the well-being ranking technique to the informant. With the help of a set of cards, each representing a household in the community, informants group households into piles according to their perception of each household's level of well-being. Then, each informant is asked to describe similarities between the households within each pile and differences between households of different piles. These descriptions are carefully recorded by the interviewer. They will be later used to define quantifiable indicators of well-being.
- Group households into average well-being categories.
  All individual rankings from the selected informants will be averaged for each community.
- Extrapolate well-being rankings from sample communities to the entire study area.
  To extrapolate these local perceptions of well-being to neighboring communities requires first a detailed analysis of the descriptions applied to rank households and then a search for systematic patterns in the use of these descriptions related the sampling factors. First all descriptions given by the informants to rank households are analyzed and then reduced to quantifiable indicators such as lack of land, limited skills, or poor access to markets. For example in Honduras, more than 300 descriptions of well-being were translated into 400 indicators of which only around 100 were mentioned by more than 5 percent of the informants. The next step checks for systematic patterns in the use of these indicators with the help of non-linear canonical correlation analysis that plots different variables and sampling factors. Indicators that are used only in a few communities cannot be considered valid well-being indicators for the entire study area. Indicators that are used consistently for all the sampled communities can be extrapolated according to the sampling factors from which the sample was drawn.
- Quantify well-being indicators, develop a questionnaire, and draw a representative sample for the entire population of the study area.
  Based on the analysis in the previous step, incorporate all indicators that can be applied to the entire study area into a questionnaire which will be used to draw a

representative sample for the entire population of the study area. Thus a poverty profile can be developed for the study area that combines all the dimensions and variables that were used by the informants of the participatory assessment. For example, the case study for Honduras is using such a questionnaire for four different sample areas (watersheds).

The remaining steps in Ravnborg *et al*.'s manual discuss how to construct a single composite well-being index, examine the internal and external logic of such an index, and describe how to use such an index to produce a regional poverty profile.

6. CONCLUSIONS

6.1 ASSESSMENT

6.1.1 Imprecision of Mapping Auxiliary Data

Mapping auxiliary data has the advantage that it can use and modify concepts and indicators developed for vulnerability and food security, build on their efforts in data compilation, and cover a wide geographic area at relative low costs. Mapping auxiliary data has the disadvantage that it generally provides a resolution too coarse for understanding causes and effects of poverty, and the mapped indicator may not necessarily measure poverty, especially when a more narrow economic definition of poverty is needed. Mapping auxiliary data could be a feasible approach for a global poverty map that tries to raise awareness about the spatial distribution of poverty. Such a map could start with the descriptive study on the location of the poor by the International Fund for Agricultural Development (Jazairy *et al*., 1992) and then combine digital maps with expert opinion, similar to the approach that produced the maps for the Global Assessment of Soil Degradation (Oldeman, 1991).

6.1.2 Poor Data Quality and Few Worked Examples for Measuring Access

A major constraint on measuring access to markets and services is data quality. Very few GIS databases in developing countries are developed with modeling applications in mind. As a result, considerable effort is required to update and correct poorly structured databases. Sophisticated algorithms have been developed to calculate accessibility but because of a lack of readily available and vertically integrated GIS databases in many developing countries, there are few examples where access measures have been applied at a scale and with a level of accuracy that makes them useful in an operational setting.

6.1.3 Limited Data Availability of Geo-Referenced Survey Data

Very few developing countries routinely collect data that can be used to reliably map poverty. The only multi-national effort to map survey data in Africa is USAID's WASAP. As a result of

this project, all DHS are now being geo-referenced using GPS at a cost of $10 per cluster (including equipment purchase and training). Geo-referencing the clusters post-survey with the help of maps or gazetteers is more expensive.

A related problem is the lack of a standard set of village names that allow survey data to be automatically joined to geo-referenced census data. The need to develop such "core" or "foundation" databases is a recurrent theme and one that the CGIAR is perhaps uniquely positioned to address, and benefit from. However, with a few notable exceptions (e.g., Corbett *et al*., 1996), the CGIAR has not produced publicly available, internationally-comparable GIS databases useful for poverty mapping.

6.1.4 Mapping Modeled Results - High Costs and Institutional Barriers

The approach described for Burkina Faso requires intensive investments in digital data, vertical data integration, and modeling, which will be very expensive and difficult to implement for all developing countries. Such GIS work can be very time consuming with many potential setbacks during the location and identification of existing data sets, error checking and correction of data, and final integration of the assembled information which should permit spatial analyses, for example network analysis. In Burkina Faso, the GIS team encountered problems with data documentation, delays in obtaining some of the requested data sets, and unavailability of some data at disaggregated level.

The case study for Ecuador benefited from generous collaboration between national and international organizations and access to census data at the household level. The Burkina Faso example required collaboration and data from various government agencies. Poverty assessments and poverty maps with high spatial resolution have to overcome institutional rivalries and a natural reluctance of organizations to release data at disaggregated level. Reasons include legitimate concerns of data confidentiality, high access fees, and institutional inertia. High resolution poverty maps can become politically sensitive outputs, especially when they highlight the arbitrariness of previous decision making or become the basis for entitlements or social sector spending.

Detailed modeling of poverty estimates at the village or community level is most appropriate for narrow geographic targeting and for studying and understanding the complex relationships between land use, environment, and poverty. It will require close collaboration with national organizations and demands institutional and technical capacity within collaborating organizations to carry out complex quantitative analyses and modeling.

6.1.5 Correlation versus Causation

Knowing <u>where</u> the poor live provides no information about <u>why</u> they are poor. Studies have shown that causes of poverty may differ from factors leading to its spatial concentration. The concentration of the poor generally results from a combination of structural and individual factors. The degree to which geographic (structural) or individual factors are causing poverty has implications for developing CGIAR's strategy of agricultural research. If geographic factors play an important role, then geographic targeting of agricultural research to the poor in marginal areas can become a useful tool to address poverty issues. If individual characteristics explain

most of the local poverty, and individuals are free to migrate, then the mobility of people and capital can limit the success of targeting marginal areas geographically.

6.2 NEXT STEPS

Implementing CGIAR's objective of poverty alleviation will require a critical examination of where and why poverty occurs. An international database of subnational poverty maps is not readily available and existing activities are incomplete geographically, too coarse to provide meaningful information, or measure concepts that are not of direct relevance to the objectives of the CGIAR centers. The question of how to build on these existing efforts, make additional investments, and develop a strategy for poverty mapping that benefits the CGIAR could be addressed in a workshop that brings together the CGIAR community, donor agencies, and other institutions interested in or working on poverty issues, both at the national and international level. At this workshop the following issues need to be resolved:

- What are the purposes and applications of the poverty maps?
  Possible applications include identifying areas of need, making decisions on regional priorities, defining agricultural research priorities, targeting interventions and resources, understanding the relationships between land use, environment, and poverty, and monitoring project and program impacts. The CGIAR-System as a whole will need poverty maps to set agricultural research priorities for specific commodities and regions in a way that benefits the poor and ultimately reduces the number of poor and the severity of poverty. Specific CGIAR-Centers will need poverty maps that help them design and implement programs that maximize benefits to the poor by increasing productivity of existing farming systems, introducing new crops and animals, and reforming fiscal, investment, and trade policies. The selected applications in turn will determine the appropriate scale or resolution of the mapping efforts.
- Which conceptual framework and definition of well-being is the most appropriate for these applications?
  Based on the above a conceptual framework, definition of well-being, and comparable indicators can be selected.
- What is the most appropriate level of effort?
  Poverty mapping can be a quick desktop exercise or a much larger investment in primary data collection, database construction, and development of statistical methods. The CGIAR community may decide to tackle just one issue, for example a global poverty map, or agree upon a multi-pronged approach. This could include producing different maps that help to set research priorities, study causes and effects, or serve as a baseline for monitoring project impacts.
- Which inputs are needed to produce these poverty maps?
  The exercise needs to balance cost versus resolution and international versus local datasets. Increased contribution of local expertise and institutions will be required to analyze and understand poverty issues in a specific country.

CGIAR's follow-up activities to such a workshop can then move into several directions:

- Lead the work on medium resolution demographic databases.
  This would continue efforts by NCGIA, CIAT, FEWS, and FAO's Regional Remote Sensing Project in Southern Africa. Selected CGIAR centers that have strong GIS capacity could take the lead on developing internationally comparable medium resolution demographic databases and become the custodians for regional datasets. An agreed upon regional set of subnational administrative boundaries will provide a common framework for analysis into which poverty related data can be integrated.
- Initiate and support the geo-referencing of survey data like the multi-national WASAP effort.
  Geo-referencing of survey data with a GPS should become a standard practice for all household surveys. Benefits of geo-referencing far outweigh the costs, which are minor compared to the overall data collection expenditures.
- Develop a coordinated research plan for detailed case studies on poverty, environment, and land use.
  This could build on activities started by CIAT's Hillsides Program and the World Bank's Burkina Faso study. Case studies should expand on efforts of participatory poverty assessment and further examine the causes for spatial clustering of the poor.
- Initiate and support efforts to produce consistent databases of poverty and human welfare for large geographic regions.
  Of all the variables used in the Nelson *et al*. study, rural poverty estimates were at the coarsest resolution. Thus producing a more detailed geo-referenced database of poverty and human welfare indicators would be the first step to improve on the study's estimates.
  This could be accomplished with the help of a long-term project that compiles a comprehensive database of poverty and human welfare indicators at subnational reference units. Its first objective could be producing a database at first subnational level (states, provinces, etc.) for a continent (as has been considered by CIAT). Building such an international database would require a common agreed upon framework of administrative boundaries and involve different international, regional, and national collaborators. Eventually, this effort could be expanded to include data at second and third subnational levels.
  Different scenarios can be envisioned to produce such subnational poverty maps which cover both economic and non-economic measures of poverty and interim and long-term products. Interim products will require fewer resources but will be incomplete and coarser in coverage. Interim products could be summarized in a world atlas of poverty:
  <u>Economic measures of poverty</u>
  The objective is to produce subnational poverty maps that show consumption or income-based poverty indicators. A close collaboration between the CGIAR-System and the World Bank should be encouraged, since the World Bank has made significant investments in data collection, poverty assessments, and methodological research. A first, interim product could be the compilation of all subnational poverty estimates and maps of corresponding boundaries from the World Bank poverty assessments. Ultimately, efforts to map economic measures of poverty, could produce the following two long-term products: (1) High resolution poverty maps based on integration of household survey and census data. This would be a continuation of efforts carried out by the World Bank in Ecuador and could start

with countries where a recent LSMS survey has been completed and disaggregated census data can be made available. (2) High resolution poverty maps at the village or community level using a GIS and vertically integrated data from surveys, census, and maps. This would expand on the World Bank's Burkina Faso work and require close collaboration with national institutions and data custodians.

Non-economic measures of poverty

The objective is to produce subnational poverty maps of non-income-based poverty indicators along the lines of UNDP's Human Development Indexes (HDI) and Human Poverty Indexes (HPI). A close collaboration between the CGIAR-System and UNDP should be encouraged, since UNDP in collaboration with national agencies has produced subnational HDI and HPI estimates for selected countries. A first interim product could be the compilation of all existing subnational HDI and HPI estimates and corresponding maps of boundaries. Ultimately two long-term products can be envisioned: (1) A global map that shows subnational HDI and HPI for all countries. (2) HDI and HPI-type measures based on geo-referenced survey data. The latter assumes continuation of geo-referencing of DHS data at the cluster level and may even require post-survey geo-referencing for selected countries. These indicators could be displayed spatially at the cluster level or aggregated to new units of analysis.

- Support efforts for increased geo-referencing of agricultural, population, and housing censuses.

  This includes production and availability of digital maps showing boundaries of enumeration areas and a consistent coding system.
- Participate in efforts to improve coordination in data collection and dissemination of household surveys from different sectors.

  An interagency working group between UNICEF, UNDP, and the Worldbank is currently trying to improve the relevance and cost-effectiveness of survey methods and encourage cooperation among agencies on data collection and analysis (Wanmali, 1997). The benefits of a spatial framework should be emphasized in such collaborative efforts which can help to reduce duplication in data collection efforts and produce more useful data products. For example, many surveys include a community module that elicits answers about community conditions from key informants. Community characteristics could be easily geo-referenced or even obtained from spatial analysis, thus making the repeated inquiry from different surveys less necessary. If geo-referencing of survey data becomes a common practice, sampling designs for national surveys could be slightly modified (without increasing cost of data collection) to make it easier to integrate surveys from different sectors or produce useful data for trend analyses. It will also lead to the development of databases with better spatial coverage over time.
- Encourage close collaboration between any international efforts to produce poverty maps and food security and vulnerability maps.

  It becomes obvious from a review of existing food security and vulnerability maps that robust subnational poverty maps are a fundamental part of any food security assessment (at a minimum to capture long-term or chronic vulnerability). Current discussions by FAO to produce the Food Security and Vulnerability Information Mapping System (FIVIMS) should closely collaborate with any efforts to produce international poverty maps (Devereux, 1997).

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Appendix 1 Terms of Reference - Poverty Mapping Assessment

One of the main thrusts of the Consultative Group on International Agricultural Research (CGIAR)is poverty alleviation. Information on the spatial distribution of poverty is of high interest, and is in particular required from many donors to prioritize research investment in the CGIAR centers.

CGIAR's Technical Advisory Committee (TAC) has approached GRID-Arendal to conduct a study on the spatial distribution of poverty in relation to marginality of land in West Africa. That pilot project can be seen as a trigger for a more generic, comprehensive process to assess the status quo of mapping and geographic analysis of human welfare.

2. Objectives

The objective of this project is to produce a comprehensive review and assessment of activities in the area of mapping and geographic analysis of human welfare indicators. While the focus of the assessment will be on poverty, it will also encompass the related aspects of food security and human development. The resulting report will serve as background material for a workshop on poverty mapping to be convened in early 1998.

3. Activities

The consultant will draw on a survey of the literature and will also contact research and donor institutions and individuals who are active in these fields, including

- International Food Policy Research Institute (IFPRI), International Center for Tropical Agriculture (CIAT), and other CGIAR centers
- The World Bank
- Relevant United Nations agencies (UNDP, WHO, UNICEF, FAO, UNSD)
- Famine Early Warning Systems (FEWS)
- University of Arizona
- Michigan State University
- Brown University Hunger Project
- Center for International Earth Science Information Network (CIESIN)
- Club du Sahel
- Centre d'Etudes et de Recherche sur la Population pour le Developpement (CERPOD),
- Institute du Sahel (INSAH), and
- MACRO.

4. Outputs

A comprehensive printed report covering the following topics:

Why spatially disaggregated data on human welfare are important

Issues concerned with poverty alleviation, targeting, decentralization, etc.

Definitions, indicators, measurement

- Income and consumption based indicators
- General welfare indicators
- Food security indicators
- Carrying capacity approaches

Survey of relevant studies that have been carried out (and identification of key institutions)

- Socioeconomic surveys
- Development of small area indicators
- Geographic targeting

Data quality and data access issues

- Scope and geographical coverage of existing surveys/studies -
  Living Standards Measurement Surveys
  Demographic and Health Surveys
  Agricultural Surveys
- Data availability
- Database issues, meta-data, etc.

Methodological issues

- GIS
- Choice of indicators, composite versus simple
- Small area estimation, importance of census data
- Issues in dealing with sample survey data

Options for producing consistent databases of poverty and human welfare for large geographical regions

5. Institutional Arrangements

The project UNEP/GRID-CGIAR cooperation on GIS in Agricultural Research is the initiator of the project.

Appendix 2 Availability of Survey and Census Data

Country	Census	LSMS Survey	DHS
AFRICA			
Algeria	PH 1987		
Angola	1970		
Benin	PH 1992		1996*
Botswana	PH 1991		1988
Burkina Faso	PH 1996		1993*
Burundi	PH 1990		1987
Cameroon	PH 1987		1991*
Cape Verde	PH 1990		
Central African Rep	PH 1988	1995	1995*
Chad	PH 1993		1997
Comoros	PH 1991		1996
Congo	PH 1996		1997
Cote d'Ivoire	PH 1988	1985, 1986, 1987, 1988	1995*
Djibouti	1960		
Egypt	PH 1986		1989, 1992, 1996, 1997
Equatorial Guinea	P 1994		
Eritrea	1984		1996
Ethiopia	PH 1994		
Gabon	P 1993		
Gambia, The	P 1993	1992,1993	
Ghana	1984	1987, 1989, 1991	1988*, 1993*
Guinea	1983		
Guinea-Bissau	PH 1991		
Kenya	P 1989		1989, 1993
Lesotho	P 1986		
Liberia	1984		1986
Libya	1985		
Madagascar	PH 1993	1993	1992, 1997
Malawi	PH 1987		1992, 1996
Mali	PH 1987		1987*,1995*
Mauritania	PH 1988	1987, 1989	
Mauritius	1990		
Morocco	PH 1994	Yes	1992, 1995, 1997
Mozambique	P 1997		1997
Namibia	PH 1991		1992
Niger	PH 1988		1992*, 1997
Nigeria	P 1991		1990*
Rwanda	PH 1991		1992
Sao Tome & Principe	PH1991		
Senegal	PH 1988	1993	1986, 1993*, 1997*
Seychelles	PH 1994		
Sierra Leone	PH 1995		
Somalia	PH 1987		
South Africa	PH 1996	1993	1997
Sudan	P 1993		1990
Swaziland	PH 1986		
Tanzania	PH 1988	1993	1992, 1994, 1995, 1996
Togo	PH 1993		1988*
Tunisia	PH 1994	Yes	1988
Uganda	PH 1991	1992	1989, 1995, 1996

Country	Census	LSMS Survey	DHS
Congo, Dem Rep	1984		
Zambia	PH 1990		1992, 1997
Zimbabwe	PH 1992		1989, 1994
ASIA + OCEANIA			
Afghanistan	1979		
Armenia	PH 1989		
Azerbaijan	PH 1989		
Bahrain	PH 1991		
Bangladesh	PH 1991		1994, 1997
Bhutan	1969		
Brunei	PH 1991		
Cambodia	1962		
China	P 1990	Yes	
Cyprus	PH 1992		
Fiji	1996		
Georgia, Rep	PH 1989		
India	PH 1991		
Indonesia	PH 1990		1987, 1991, 1994
Iran, Islamic Rep	PH 1996		
Iraq	PH 1987		
Israel	PH 1995		
Jordan	PH 1994	planned	1990, 1997
Kazakhstan, Rep	PH 1989		1995
Kiribati	1990		
Korea, Dem Peop. R.	P 1993		
Korea, Rep	PH 1995		
Kuwait	PH 1995		
Kyrgyz Rep	PH 1989	1993	1997
Lao People’s Dem R.	PH 1995		
Lebanon	1970		
Malaysia	PH 1991		
Maldives	PH 1990		
Mongolia	PH 1989		
Myanmar	PH 1994		
Nauru	PH 1992		
Nepal	P 1991	1996	1987, 1996
Oman	PH 1993		
Pakistan	PH 1995	1991	1991
Papua New Guinea	P 1990		
Philippines	PH 1990		1993
Qatar	PH 1986		
Saudi Arabia	PH 1992		
Solomon Islands	P 1986		
Sri Lanka	1981		1987
Syrian Arab Rep	PH 1994		
Tajikistan, Rep	PH 1989		
Thailand	PH 1990		1987
Tonga	PH 1986		
Turkey	H 1997		1993
Turkmenistan, Rep	PHT 1995	planned	
Tuvalu	PH 1991		
United Arab Emirat.	PH 1985		
Uzbekistan, Rep	PH 1989	planned	1996
Vanuatu	P 1986		

Country	Census	LSMS Survey	DHS
Vietnam	PH 1989	1993	1997
Yemen	PH 1994		1992
CENTRAL AMERIA +CARRIBEAN			
Antigua and Barbuda	P 1991		
Bahamas	PH 1990		
Barbados	PH 1990		
Belize	PH 1991		
Costa Rica	1984		
Cuba	1981		
Dominica	PH 1991		
Dominican Rep	PH 1993		1986, 1991, 1996
El Salvador	PH 1992		1985
Grenada	PH 1991		
Guatemala	PH 1994		1987. 1995, 1997
Haiti	1982		1995
Honduras	PH 1988		
Jamaica	PH 1991	1988	
Martinique	PH 1990		
Mexico	PH 1990		1987
Nicaragua	PH 1994	1993	
Panama	PH 1990	Yes	
Puerto Rico	PH 1990		
St. Kitts and Nevis	PH 1991		
St. Lucia	PH 1991		
St. Vinc.& Grenad.	PH 1991		
Trinidad and Tobago	PH 1990		1987
SOUTH AMERICA			
Argentina	PH 1991		
Bolivia	PH 1992	1988	1989, 1994
Brazil	PH 1991	Yes	1986, 1991, 1996
Chile	PH 1992		
Colombia	PH 1993		1986, 1990, 1995
Ecuador	PH 1990	1994, 1995	1987
French Guiana	PH 1990		
Guyana	PH 1991	1993	
Paraguay	PH 1992	Yes	1990
Peru	PH 1993	1985, 1990, 1991, 1994	1986, 1992, 1996
Suriname	1980		
Uruguay	PH 1985		
Venezuela	PH 1990	1991, 92, 93	

Notes:
P = Population Census; H = Housing Census; PH = Population and Housing Census
* DHS has been geo-referenced as part of the WASAP project.

Sources:
United Nations (1996), United Nations (1998),
DHS Website (http://www.macroint.com/dhs), and
LSMS Website (http://www.worldbank.org/html/prdph/lsms/).

Appendix 3 Household Surveys Completed in Africa since 1985

Country	Survey Type a/	Survey Name	Date of Data Collection	Year	Sample Size (HH)	Coverage	Publica-tions b/	Access Policy c/
Angola	PS	Inquerito prioritario sobre as condiçoes de vida aos domicilios	4/95 - 5/95	95	5,783	Urban Regional	Ana	GPR
	IES-HBS	Household Budget and Nutrition Survey	2/90 - 4/90	90	1,300	Luanda	SR, Stat, Ana	N.E
Benin	IES-HBS	Etude sur les conditions de vie des ménages ruraux au Bénin (ECVR)	5/94 - 2/95	94	1,350	Rural	SR	N.E
	IES-HBS	Enquête budget et consommation	3/86 -8/87	86	2,700	National	SR, Stat, Ana	N.E
Botswana	IES-HBS	Household Income and Expenditure Survey	6/85 -8/86	85	2,077	National	SR, Ana, Stat	N E
Burkina Faso	PS	Enquête prioritaire sur les conditions de vie des ménages	10/94 - 1/95	94	8,642	National	SR, Stat, Ana	GPR
Burundi	IES-HBS	Enquête sur les dépenses de consommation des ménages	1/91 -1/92	91	1,200	Bujum-bura	SR	N.E
	IES-HBS	Enquête budget consommation et conditions de vie des ménages	8/86 - 12/90	86	3,008	Rural	SR	N.E
Cameroon	PS	Enquête Camerounaise auprès des ménages	2/96 - 3/96	96	1,700	National	SR	N.E.
Cape Verde	IES-HBS	Inquérito às Familias	9/88 -8/89	88	1,620	National	SR, Stat, Ana	N.E
CAR	IS-LSMS	Enquête intégrée avec module budget-consommation	1/95-7/96	95	4,500	National		GPR
CAR	PS	Enquête prioritaire sur les conditions de vie des ménages (EP1)	9/92 (urban) 3/93 (rural)	93	7,500	National	SR, Stat, Ana	GPR
Chad	PS	Enquête sur la consommation et le secteur informel (ECOSIT)	6/95-6/96	95	2,600	4 districts	SR	N.E
	PS	Enquête légère sur les conditions de vie des ménages à N'djaména	2/91 - 3/91	91	2,430	N'djamena	SR, Stat, Ana	N.E
Comoros	PS	Enquête exploratoire budget et consommation	8/95	95	2,004	National	SR	N.E
Congo	IES-HBS	Enquête sur les dépenses des ménages urbains	9/89 -10/89	89	536	Urban	SR	N.E
Côte d'Ivoire	PS	Enquête prioritaire sur les dimensions sociales de l'ajustement structurel	6/95 - 11/95	95	1,000	National	SR draft	GPR
	PS	Enquête prioritaire sur les dimensions sociales de l'ajustement structurel	3/92 - 11/93	92	1,680	Abidjan	SR draft	GPR
	IS-LSMS	Enquête permanente auprès des ménages-Etude sur la mesure des niveaux de vie	5/88 - 4/89	88	1,600	National	SR,Stat,Ana	GPR
	IS-LSMS	Enquête permanente auprès des ménages-Etude sur la mesure des niveaux de vie	3/87 - 2/88	87	1,600	National	SR,Stat,Ana	GPR
	IS-LSMS	Enquête permanente auprès des ménages-Etude sur la mesure des niveaux de vie	2/86 -1/87	86	1,600	National	SR, Stat, Ana	GPR
	IS-LSMS	Enquête permanente auprès des ménages-Etude sur la mesure des niveaux de vie	2/85 -1/86	85	1,588	National	SR, Stat, Ana	GPR
Djibouti	PS	Enquête djiboutienne auprès des ménages - Indicateurs sociaux (EDAM-IS)	4/96 - 7/96	96	2,380	National sedentary popul.	SR, Stat	GPR
Ethiopia	PS-HBS	Welfare Monitoring Survey and Household Budget Survey	06/95 - 01/96	95	12,260	National sedentary popul.	SR, Stat (for HBS only)	N.E.
Gabon	IES-HBS	Enquête Budget et Consommation (EBC)	6/94 - 11/94	94	2,700	2 urban areas	SR, Stat, Ana	N.E

Country	Survey Type a/	Survey Name	Date of Data Collection	Year	Sample Size (HH)	Coverage	Publica-tions b/	Access Policy c/
Gambia, The	PS	SDA Priority Survey II	1994	94	1,979	National	On-going	GPR
	IS-LSMS	Household Education and Health Survey	11/93 - 3/94	93	2,000	National	SR, Stat	GPR
	IS-LSMS	Household Economic Survey	11/92 -3/93	92	1,400	National	SR, Stat	GPR
	PS	SDA Priority Survey I	2/92 -5/92	92	2,000	National	SR, Stat, Ana	GPR
Ghana	IS-LSMS	Ghana Living Standards Survey III	9/91 - 9/92	91	4,425	National	SR, Stat, Ana	GPR
	IS-LSMS	Ghana Living Standards Survey II	9/89 - 9/90	89	1,600	National	SR, Stat, Ana	GPR
	IS-LSMS	Ghana Living Standards Survey I	9/87 - 9/88	87	1,600	National	SR, Stat, Ana	GPR
Guinea	IS-LSMS	Enquête intégrale budget et consommation (EIBC)	2/94 - 1/95	94	4,416	National	Ana	GPR
Guinea	PS	Enquête sur les informations prioritaires	6/91 -9/91	91	9,600	National	SR	GPR
Guinea Bissau	PS	Inquerito ligeiro junto às familias	3/91-4/91	91	1,600	National	SR, Stat, Ana	GPR
Kenya	PS	Welfare Monitoring Survey II	6/94 -7/94	94	10,860	National	SR	GPR
	PS	Welfare Monitoring Survey I	11/92 -12/92	92	8,123	National	SR, Stat, Ana	GPR
Lesotho	IES-HBS	Household Budget Survey	9/86 -10/87	86	7,640	National	SR, Ana, Stat	N.E
Madagascar	IS-LSMS	Enquête permanente auprès des ménages	4/93 -5/94	93	4,504	National	SR, Stat, Ana	GPR
Malawi	Other	National Sample Survey of Agriculture	11/92 -8/93	92	12,000	Rural	SR	GPR
	IES-HBS	Household Expenditure and Small Scale Economic Activities	7/90 -7/91	90	4,250	National	SR, Stat, Ana	GPR
Mali	PS	Enquête Malienne de conjoncture économique et sociale	2/94	94	9,700	National	SR, Stat, Ana	N.E
	IES-HBS	Enquête budget - consommation	1988 - 1989	89	2,188	National	SR, Stat, Ana	N.E
Mauritania	IS	Enquête permanente sur les conditions de vie des ménages	1995 - 1996	95	3,413	National	SR	N.E.
	PS	Enquête Mauritanienne sur les priorités - DSA	1993	93	4,760	National	No	GPR
	PS	Enquête Mauritanienne sur les priorités - DSA	7/92	92	6,360	National	SR	GPR
	IS-LSMS	Enquête permanente sur les conditions de vie des ménages	10/89 -9/90	89	1,600	National	SR, Stat, Ana	GPR
	IS-LSMS	Enquête permanente sur les conditions de vie des ménages	12/87 - 1/89	87	1,484	National	SR, Stat, Ana	GPR
Mauritius	IES-HBS	Household Budget Survey	7/91 - 6/92	91	5,712	National	SR	N.E
	IES-HBS	Household Budget Survey	7/86 -6/87	86	4,800	National	SR	N.E
Mozam-bique	IES-HBS	Inquerito junto dos agregados familias	1/91 to 1/92	91	NA	Maputo	SR	N.E
Namibia	IES-HBS	National Household Income and Expenditure Survey - NHIES	10/93 to 11/94	93	4,750	National	Ana	NE

Country	Survey Type a/	Survey Name	Date of Data Collection	Year	Sample Size (HH)	Coverage	Publica-tions b/	Access Policy c/
Niger	PS	Enquête permanente de conjoncture économique et sociale	11/95 - 12/95	95	4,383	National	SR, Stat, Ana	GPR
	Other	Enquête nationale sur le secteur informel	1995	95	2,7310	National	SR	NE
	PS	Enquête permanente de conjoncture économique et sociale	03/94 - 05/94	94	4,408	National	SR, Stat, Ana	GPR
	IES-HBS	Enquête budget et consommation (ENBC)	2/89 - 11/93	92	3,799	National	SR, Stat, Ana	GPR
Nigeria	IES-HBS	National Consumer Survey	6/96 - 3/97	96	12,000	National	-	N.E.
	Other	National Sample Survey of Agriculture	4/93 - 3/94	93	250,000	National	SR, Stat	GPR
	Other	General Household Survey	4/92 - 3/93	92	15,000	National	SR	GPR
	IES-HBS	National Consumer Survey	4/92 - 3/93	92	10,000	National	SR, Stat, Ana	GPR
	Other	General Household Survey	4/90 - 3/91	90	15,000	National	SR	GPR
	IES-HBS	National Consumer Survey	4/85 - 3/86	85	10,000	National	SR, Ana	GPR
Rwanda	PS	Enquête prioritaire	8/93 - 01/94	93	7,000	National	-	N.E.
	IES-HBS	Enquête nationale budget et consommation (milieu urbain / milieu rural)	11/82 - 12/83 10/84 - 1/86	83/84	1,170 / 1,200	Rural / Urban	SR, Stat, Ana	N.E
Senegal	IS-LSMS	Enquête Sénégalaise auprès des ménages	3/93 - 4/94	93	3,300	National	No	GPR
	PS	Enquête sur les priorités	10/91 - 1/92	91	9,960	National	SR, Stat, Ana	GPR
Seychelles	IES-HBS	Household Expenditure Survey	2/91 -1/92	91		National	SR	N.E
Sierra Leone	IES-HBS	Survey of Household Expenditure and Household Economic Activities	10/89 -9/90	89	2,700	National	SR, Stat, Ana	N.E
South Africa	IS-LSMS	Living Standards and Development Survey	7/93 -4/94	93	8,848	National	SR, Stat, Ana	Open
Swaziland	IES	Household Income and Expenditure Survey	11/94 - 10/95	95	6,350	National	SR,Stat, Ana	N.E.
	IES-HBS	National Income and Expenditure Survey	1/85 -1/86	85	3,802	National	SR, Stat	N.E
Tanzania	IS-LSMS	Human Resource Development Survey	9/93 -1/94	93	5,183	National	SR, Stat, Ana	Open
	IES-HBS	Household Income and Expenditure Survey (Mainland)	12/91 -11/92	91	5,328	Mainland	SR, Prov.	GPR
Togo	IES-HBS	Enquête Budget et Consommation (EBC)	10/88 -11/89 (rural) ; 2/87 - 3/88 (urban)	88	3,668	National	SR, Stat, Ana	N.E
Uganda	PS	Second Monitoring Survey	8/94 -2/95	94		National	On-going	N.E
	PS	First Monitoring Survey	8/93 -2/94	93	5,040	National	SR	N.E
	IS-LSMS	Integrated Survey	3/92 -3/93	92	10,000	National	SR, Stat, Ana	N.E
	IES-HBS	Household Budget Survey	4/89 -3/90	89	4,600	National	SR, Stat, Ana	N.E
Congo, Dem Rep	PS	Enquête sur les conditions de vie et la situation socio-économique des ménages agricoles	10/90 - 6/91	90	7,500	Rural	No	N.E
	IES-HBS	Enquête sur les budgets ménagers	2/85 -1/86	85	2,559	4 urban areas	SR	N.E

Country	Survey Type a/	Survey Name	Date of Data Collection	Year	Sample Size (HH)	Coverage	Publica-tions b/	Access Policy c/
Zambia	PS	Living Conditions Monitoring Survey	9/96 - 10/96	96	11,800	National	On-going	N.E
	IES-HBS	Household Budget Survey	7/93 -10/94	93	4,500	National	On-going	N.E
	PS	SDA Priority Survey II	10/92 -11/92	92	10,200	National	SR, Stat, Ana	N.E
	PS	SDA Priority Survey I	10/91 -11/91	91	9,950	National	SR, Stat, Ana	N.E
	IES-HBS	Household Budget Survey	6/91 -7/91	91	2,930	National	SR, Stat, Ana	N.E
Zimbabwe	IES-HBS	Income, Consumption and Expenditure Survey - ICES		96		National		N.E
	IES-HBS	Poverty Assessment Study Survey - PASS		95		National		N.E
	IES-HBS	Income, Consumption and Expenditure Survey - ICES	7/90 -6/91	90	15,000	National	SR	N.E

Source: Olivier Dupriez, The World Bank, Institutional and Social Poverty Team, Africa Technical Department, Draft, May 8, 1997 (mimeo)

Notes:

a/ Survey Type
IS-LSMS : Integrated / Living Standard Measurement Survey
PS : Priority Survey
IES-HBS : Income/Expenditure - Household Budget Survey
Other

HH = households

b/ Publication
SR - Survey Report
Stat - Statistical Abstract
Ana - Analytical paper
Other

c/ Access Policy
Open: open access
N.E: not yet established
G.P.R: Government permission required

Appendix 4 Types of Poverty and Location of Poor

Country	Types of Poverty	Location of the Poor
AFRICA		
Angola	1. Endemic/traumatic 2. Peripheral/traumatic 3. Peripheral/traumatic 4. Endemic 5. Traumatic	1. Central plateau and northern, northeastern and southeastern regions 2. South 3. Far south in the fringe with Namibia 4. - 5. All over the country
Benin	1. Endemic 2. Interstitial 3. Peripheral 4. Endemic	1 - 2. Distributed widely, with highest concentration in the provinces of Borgou and Atacora. 3 - 4. All over the country
Botswana	1. Interstitial/peripheral 2. Endemic/peripheral 3. Peripheral 4. Traumatic/peripheral	1. Outside the eastern hardveld (e.g., Hukuntsi, Khalagadi, Ngamiland) 2. The north around the Okavango Delta, the remote areas of the west, central and southern districts, and the Kweneng district 3. Western Botswana (western Ngamiland, southern Ghanzi distric, and northwest Khalagadi district) 4. Kalahari and Ngamiland
Burundi	1. Overcrowding/endemic 2. Overcrowding 3. Endemic, overcrowding	1. - 2. Bweru, Bututsi, and Buyogoma regions 3. All over the country
Cameroon	1. Overcrowding 2. Interstitial/traumatic 3. Endemic	1. North and western provinces 2. All over and western province 3. All over the country
CAR	1. Overcrowding/peripheral 2. Traumatic 3. Peripheral 4. Endemic	1. Highest concentration in the east and northeast of the country 2. Northwest region 3. - 4. All over the country
Ethiopia	1. Endemic/overcrowding 2. Overcrowding/traumatic 3. Endemic/traumatic 4. Traumatic	1. - 4. Widespread everywhere, particular concentration in Ilubabor, Welo, Gamo Gofa, Harerge, and Sidamo regions. Also in areas most severely affected by drought (largely in the northeast)
Gambia	1. Endemic/sporadic 2. Endemic/traumatic	1. - 2. Distributed all over with a higher incidence in the North Bank and McCarthy Island Divisions and with large pockets along the northern banks of the River Gambia
Ghana	1. Endemic/traumatic 2. Interstitial/traumatic 3. Interstitial/traumatic 4. Endemic/traumatic 5. Endemic/peripheral 6. Endemic	1. - 5. All over but highest concentration in the upper east and northern regions. Numerically, large numbers are also found in the more affluent Brong Ahafo, Volta, and Ashanti regions. 6. All over the country
Guinea	1. Endemic/peripheral	1. Northern region and the Fouta Djallon province in the middle Guinea region
Kenya	1. Overcrowding/sporadic 2. Sporadic/overcrowding 3. Overcrowding 4. Endemic 5. Endemic/peripheral	1. - 4. Primarily, but not exclusively, in Nyanza and western Provinces (Siaya, south Nyanza, Busia, and Kakamega). Lower percentages in Kilifi/Tana, River/Lamu, and West Pokot/Elgeyo Marakwet. 5. All over the country
Lesotho	1. Endemic 2. Endemic 3. Overcrowding 4. Peripheral 5. Peripheral1	1. - 5. Widely spread, but with the highest concentration in the south, the slopes of mountains, and Quthing district.

Country	Types of Poverty	Location of the Poor
Malawi	1. Endemic/overcrowding 2. Overcrowding 3. Endemic 4. Traumatic	1. - 4. Widely distributed all over the country
Mozambique	1. Endemic/traumatic 2. Endemic/peripheral 3. Endemic/peripheral 4. Endemic/traumatic	1. - 4. Widely distributed, but mostly concentrated in the central and northern regions and the Manca Province.
Nigeria	1. Overcrowding/traumatic 2. Endemic 3. Endemic/peripheral	1. Widely spread, but more concentrated in the overpopulated zones of the southeast (Anambra, Imo, and parts of the Cross River State) 2. All over the country, especially in the drought prone areas of the north (Sokoto home district and Kano and Katsina regions) 3. Akwa Ibom, Cross River, and River State in southeast
Rwanda	1. Overcrowding 2. Overcrowding 3. Endemic	1. - 3. All over the country, but mostly concentrated in Cyangugu, Gisenyi, Kibuye, west Gikongoro, and west Ruhengeri
Tanzania	1. Overcrowding 2. Endemic/peripheral 3. Endemic 4. Traumatic	1. Shinyanga, Southern Highlands, and Zanzibar 2. All over the country 3. Coastal area, lake regions, and inland 4. Lindi, Mtwara, Tabora, and Kigoma
Uganda	1. Endemic/traumatic 2. Endemic/traumatic 3. Peripheral 4. Endemic	1. - 4. Widely distributed, but mostly concentrated in Karamoja region, the southwest, the Luwero Triangle, and the north
Zambia	1. Endemic/peripheral 2. Endemic/peripheral	1. Widely spread, but mainly located outside the Aline of rail in inaccessible and remote areas of eastern, Luapula, northern, northwestern, and western provinces 2. Widely spread (more than one-third of rural households)
Zimbabwe	1. Endemic/peripheral 2. Overcrowding/interstitial 3. Endemic/peripheral	1. - 2. Highest concentration in Mberengwa, Zvishavane, Ghalimanzi, and Shurugwi Districts 3. All over the country
ASIA		
Bangladesh	1. Overcrowding/endemic 2. Overcrowding/endemic/ sporadic 3. Overcrowding/ endemic/sporadic 4. Overcrowding/endemic/ sporadic 5. Endemic/sporadic 6. Endemic/sporadic 7. Peripheral/sporadic 8. Endemic/sporadic	1. - 7. Widely distributed all over the country; however, the people in the northeast and southern part of the country are relatively more vulnerable to natural calamities (floods, droughts and cyclones). 8. All over the country.
Bhutan	1. Overcrowding/peripheral 2. Endemic	1. Highest concentration in eastern Bhutan. 2. Highest concentration in central and western Bhutan.
Indonesia	1. Overcrowding/peripheral 2. Overcrowding/endemic 3. Endemic 4. Endemic	1. - 4. Rural poverty is most highly concentrated in Java (highest in central and east Java), Lamung, most of Sulawesi, and most of the eastern Islands, especially East Nusa Tenggara. Deprivation is highest in east Nusa Tenggara, followed by west Nusa Tenggara and east Kalimantan. Rural Sumatra as a whole has almost three times as many "deprived" people as rural Java.

Country	Types of Poverty	Location of the Poor
Myanmar	1. Endemic	1. In the delta area, the highest concentration is in Ayeyarwaddy and Bago. In the dry zones, the highest concentration is in Sagaing, Mandalay, and Magwe. In the Hills zone, the highest Fro is in the Shan state.
	2. Endemic	2. Many in delta and dry zones.
Nepal	1. Overcrowding/peripheral 2. Overcrowding/peripheral 3. Endemic/peripheral	1. The hills and the Terai. 2. - 3. Highest concentration in the Terai.
Pakistan	1. Overcrowding/peripheral 2. Endemic 3. Endemic 4. Traumatic	1. - 4. The majority of the poor are located in the provinces of Baluchi, northwest Frontier Province, the desert and semi-desert areas of Sind, and the Barani areas of the Punjab.
Papua New Guinea	1. Overcrowding/interstitial 2. Peripheral 3. Traumatic	1. - 3. Majority located in Olsobip in the western region, Groilala in the central region, Tufi and Mangalese in the northern region, and the Anga language group in Morobe Nerusi in southern Highlands and Goglme in Simbu.
The Philippines	1. Interstitial	1. Densely settled lowland areas, more particularly in central Luzon, southern Tagalog, western Visayas, and northern Mindanao regions.
	2. Peripheral/endemic	2. Marginal uplands and highlands located particularly in drought-prone western Luzon, Bicol, northern Mindanao, and other Visayas islands.
	3. Overcrowding/endemic	3. Non-irrigated lowland areas located primarily in the Visayas and western Mindanao.
	4. Overcrowding/endemic	4. Lands of low fertility, such as those located at intermediate elevations on the Visayas islands, and Bicol.
	5. Overcrowding	5. Around Bicol, the eastern and central Visayas islands, and Cagayan Valley.
	6. Traumatic	6. Particularly the sugarlands of many Negro estates.
Sri Lanka	1. Overcrowding 2. Endemic/overcrowding 3. Interstitial 4. Endemic 5. Overcrowding 6. Endemic	1 - 6. Widely spread over the country.
	7. Traumatic	7. From the north and east.
Vietnam	1. Peripheral	1. Northern coastal plain and central plateau region.
	2. Endemic/overcrowding	2. Over-populated and food-deficit areas of the Red River Delta and its adjacent hills and the northern part of the central coastal plain.
	3. Endemic/overcrowding	3. Mekong Delta and contiguous areas -- the northern part and the Mekong Delta, the southern part of the Coastal Plain, and the southern part of the Central Plateau.
LATIN AMERICA		
Argentina	1. Interstitial	1. Patagonia and some central provinces.
	2. Endemic	2. Northern region (provinces of Catamarca, Jujuy, La Rioga, Santiago del Estero, Salta y Tucum<n) and northeast region (provinces of Corrientes, Chaco, Formosa, and Misiones).
	3. Endemic 4. Amerindian population	3. - 4. Isolated zones where rural wage legislation is not respected.
Bolivia	1. Endemic/peripheral	1. Concentrated in the Altiplano and the Valles Interalpinos. The departments of Pot\si, Chuquisaca, Oruro, la Paz, and some part of Tarija and Cochabambba have the highest concentration. Some critical poverty nuclei have emerged in the colonization zones of Santa Cruz and Beni departments.
	2. Endemic/peripheral	2. As above and in the tropical lowlands of the eastern part of the country.

Country	Types of Poverty	Location of the Poor
Brazil	1. Endemic/overcrowding 2. Endemic/traumatic 3. Traumatic/interstitial 4. Interstitial/endemic	1. The northeast is the principal locus of absolute poverty, although significant nuclei of rural poverty are also found in central, central-western, and western regions. 2. Highest concentration again in the northeast. 3. Northeast (Zona da Mata). 4. Northeast (Agreste and Sertao).
Chile	1. Endemic 2. Endemic 3. Overcrowding 4. Overcrowding	1. In Norte Grande, mainly in the highlands communities of Tarapac and Atacama. Also located in the Araucania region. 2. Norte Chico region. 3. Southern part of the country and the central valley of Chile. 4. South of Bio-Bio, from Malleco Province to the island of Chiloe.
Colombia	1. Endemic/overcrowding 2. Traumatic 3. Endemic 4. Endemic/peripheral	1. In the south (Cauca, N, NariZo) and center (Boyac/Santander) 2. Widely distributed, but mostly concentrated in the highlands and humid tropics. 3. All over the country. 4. Cauca, NariZo, Tolima, Magdalena, C\rdoba departments, and Amazonia.
Costa Rica	1. Traumatic 2. Overcrowding 3. Traumatic	1. - 3. Main poverty pockets are located in the northern region (along the frontier with Nicaragua) and in the Central Region, Chorotega Region, Huetar Atlantic Region, and Central Pacific Region.
Dominican Republic	1. Overcrowding/interstitial 2. Overcrowding/interstitial 3. Overcrowding/interstitial 4. Overcrowding/endemic 5. Endemic	1. - 5. Throughout the country with highest incidence in the western, northeast, and central regions.
Ecuador	1. Endemic/overcrowding 2. Endemic/overcrowding 3. Endemic/overcrowding 4. Peripheral/overcrowding 5. Endemic/traumatic 6. Endemic	1. - 6. The Sierra, especially in the central and southern provinces (Chimborazo, Cotopaxi, Azuay, CaZar, Tunguragua, and Loja), while 30% can also be found in the Coast. Pre-Amazonian area (Morona Santiago, Yacuambi).
Guatemala	1. Overcrowding/endemic 2. Endemic/traumatic 3. Endemic/peripheral 4. Peripheral/endemic	1. - 4. Highly concentrated, principally in the northwestern Central Plateau (Altiplano Central) and in the Zacapa and Chiquimula departments.
Guyana	1. Endemic/overcrowding 2. Endemic/interstitial 3. Endemic/interstitial/ traumatic 4. Endemic	1. Concentrated in east Berbice. 2. Essequibo Coast. 3. East Demerara. 4. All over the country.
Haiti	1. Overcrowding/peripheral 2. Overcrowding/peripheral 3. Endemic 4. Endemic 5. Traumatic	1. - 5. Widely spread, but more concentrated in the isolate, which are generally located in the mountain areas of the country and in the west, the south, and the north of Artibonite.
Honduras	1. Overcrowding/peripheral 2. Endemic/overcrowding 3. Endemic	1. - 3. Widely spread throughout the country, but mainly concentrated in the western part (departments of Santa Barbara, Copan, Lempira, and Intibuca, as well as in the departments of Olancho and Choluteca).
Mexico	1. Endemic/peripheral 2. Interstitial/overcrowding 3. Endemic	1. - 3. Mainly concentrated in the central-southern states of the country (Guerrero, Oaxaca, Chiapas, Hidalgo, and Puebla).
Panama	1. Overcrowding/interstitial 2. Interstitial 3. Peripheral 4. Endemic	1. - 4. Highest concentration in the central and northeastern regions of the country (i.e., departments of Veraguas, Chiriqui, and Bocas del Toro).

Country	Types of Poverty	Location of the Poor
Paraguay	1. Overcrowding/interstitial 2. Overcrowding 3. Endemic	1. Around Asuncion. 2. Intermediary region. 3. Eastern region.
Peru	1. Endemic/peripheral 2. Endemic/peripheral 3. Overcrowding/endemic 4. Endemic 5. Overcrowding/traumatic	1. - 5. Widely spread, but highly concentrated in the central and southern Highlands (Sierra Sur) and the Forest region (Selva).
Venezuela	1. Endemic/peripheral 2. Endemic/traumatic 3. Endemic/peripheral	1. - 3. Distributed unevenly, but especially in the central-western and northwestern regions, as well as in some eastern areas.
Uruguay	1. Endemic/traumatic 2. Endemic/traumatic	1. - 2. All over the country with the highest number found in the province of Canelones. A high number is also located in the west (in the provinces of Artigas, Salto, Paysandu, Rio Negro, and Soriano) and in the south (in the province of Colonia). Finally, the highest relative incidence is found on the border with Brazil and in the center of the country (in Rivera, Tacuarenb\, Cerro Largo, Treinta y Tres, and Lavalleja
NEAR EAST AND NORTH AFRICA		
Egypt	1. Overcrowding 2. Overcrowding/traumatic 3. Endemic 4. Peripheral 5. Traumatic	1. - 5. All over the country, but more highly concentrated in Upper Egypt and in the oasis of the western deserts.
Jordan	1. Interstitial/traumatic 2. Interstitial/traumatic 3. Endemic/peripheral	1. - 3. Concentrated in the Jordan Valley zone of the semi-arid areas.
Morocco	1. Overcrowding/endemic peripheral/interstitial 2. Endemic/overcrowding 3. Overcrowding/peripheral 4. Endemic/peripheral 5. Endemic	1. - 3. Widely spread over the country, but mostly concentrated in low-rainfall and arid regions. The south and east regions and Tensift have the highest concentration of poverty. 4. Mostly coastal areas. 5. All over the country.
Oman	1. Endemic/peripheral 2. Endemic/peripheral 3. Endemic/peripheral	1. - 2. Highlands and oasis. 3. Small and isolated fishing communities along the Arabian Sea coast.
Somalia	1. Sporadic/traumatic 2. Sporadic/traumatic 3. Sporadic/traumatic 4. Endemic/overcrowding 5. Traumatic 6. Peripheral 7. Endemic 8. Endemic	1. - 7. Concentrated in the southern regions of Middle and Lower Shabelle, Middle and Lower Juba, and Bay. 8. All over the country.
Sudan	1. Endemic/traumatic 2. Peripheral/traumatic 3. Overcrowding/endemic 4. Endemic	1. - 3. Widely distributed, but mostly concentrated in the southern and western regions of Darfur and Kordofan. 4. All over the country.
Tunisia	1. Overcrowding/peripheral 2. Overcrowding/peripheral 3. Peripheral/endemic	1. - 3. In the rain-fed areas, particularly the center region, followed by the northwest and south.
Yemen (Former AR)	1. Overcrowding/peripheral 2. Peripheral Endemic/peripheral	1. - 3. Highland terraces, Tihama, foothills of western slopes, and the semi-desert in the east and northeast.

Country	Types of Poverty	Location of the Poor
Yemen (Former PDR)	1. Peripheral/sporadic 2. Overcrowding/peripheral 3. Peripheral 4. Endemic 5. Endemic/peripheral	1. - 4. Highland terraces and eastern provinces, Tihama and sand dune strip, and inter-wadi areas of the central Tihama Plain. 5. Fishing villages on the Arabian Sea.

Source: Jazairy et *al*. (1992)

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Source: United Nations Development Programme (http://www.undp.org) and Human Development Report Series

Appendix 6 Bibliography of Poverty Assessments Conducted by the World Bank

Country	Report Title	Report Number
AFRICA		
Benin	Toward a Poverty Alleviation Strategy for Benin	12706-BEN
Cameroon	Diversity, Growth, and Poverty Reduction	13167-CM
Cape Verde	Poverty in Cape Verde: A Summary Assessment and a Strategy for its Alleviation	13126-CV
Comoros	Poverty and Growth in a Traditional Small Island Economy	3401-COM
Egypt, Arab Republic of	Alleviating Poverty During Structural Adjustment	ISBN 0-8213-1873-X
Ethiopia	Toward Poverty Alleviation and a Social Action Program	11306-ET
Ghana	2000 and Beyond: Setting the Stage for Accelerated Growth and Poverty Reduction	11486-GH
Ghana (Update)	Ghana: Poverty Past, Present and Future	14504-GH
Guinea-Bissau	Poverty Assessment and Social Sector Strategy Review	13155-GUB
Kenya	Poverty Assessment	13152-KE
Lesotho	Poverty Assessment	13171-LSO
Malawi	Growth Through Poverty Reduction	8140-MAI
Mali	Assessment of Living Conditions	11842-MLI
Mauritania	Poverty Assessment	12182-MAU
Mauritius	CEM: Sharpening the Competitive Edge	13215-MAS
Morocco	Poverty, Adjustment, and Growth	11918-MOR
Mozambique	Poverty Reduction Framework Paper	--
Namibia	Poverty Alleviation with Sustainable Growth	9510-NAM
Rwanda	Poverty Reduction and Sustainable Growth	12465-RW
Senegal	An Assessment of Living Conditions (2 volumes)	12517-SE
Seychelles	Poverty in Paradise	12423-SEY
Sierra Leone	Policies for Sustained Economic Growth and Poverty Alleviation	11371-SL
The Gambia	An assessment of Poverty	11941-GM
Tunisia	Poverty Alleviation: Preserving Progress while Preparing for the Future (2 volumes)	13993-TUN
Uganda	Growing Out of Poverty	ISBN 0-8213-1419-X
Zambia	Poverty Assessment	12985-ZA
Zimbabwe	Achieving Shared Growth: Country Economic Memorandum (2 volumes)	13540-ZIM
ASIA		
Bangladesh	Bangladesh Poverty and Public Expenditures: An Evaluation of the Impact of Selected Government Programs	7946-BD

Country	Report Title	Report Number
China	Strategies for Reducing Poverty in the 1990s	ISBN 0-8213-2248-6
Fiji	Restoring Growth in a Changing Global Environment	13862-FIJ
India	Poverty, Employment and Social Services	ISBN 0-8213-1419-X
Indonesia	Poverty Assessment and Strategy Report	8034-IND
Indonesia (Update)	Public Expenditures, Prices and the Poor	11293-IND
Jordan	Poverty Assessment	12675-JO
Kyrgyz Republic	Poverty Assessment and Strategy	14380-KG
Lao PDR	Social Development Assessment and Strategy	13992-LA
Malaysia	Growth, Poverty Alleviation and Improved Income Distribution in Malaysia	8667-MA
Nepal	Poverty and Incomes	ISBN 0-8213-1808-X
Pakistan	A Profile of Poverty	8848-PAK
Pakistan (Update)	Poverty Assessment	14397-PAK
Philippines	The Philippines: The Challenge of Poverty	7144-PH
Philippines (Update)	An Opening for Sustained Growth	11061-PH
Philippines (Update)	A Strategy to Fight Poverty	14933-PH
Sri Lanka	Poverty Assessment	13431-CE
Viet Nam	Poverty Assessment and Strategy	13442-VN
LATIN AMERICA		
Argentina	Argentina's Poor: A Profile	13318-AR
Bolivia	Poverty Report	8643-BO
Brazil	Brazil: A Poverty Assessment (2 volumes)	14323-BR
Chile	Social Development Progress in Chile: Achievement and Challenges	8550-CH
Colombia	Poverty Assessment Report (2 volumes)	12673-CO
Costa Rica	Public Sector Social Spending	8519-CR
Dominican Republic	Growth with Equity: An Agenda for Reform	13619-DO
Ecuador	A Social Sector Strategy for the Nineties	8935-EC
Ecuador (Update)	Poverty Report	14533-EC
El Salvador	The Challenge of Poverty Alleviation	12315-ES
Guatemala	An Assessment of Poverty	12313-GU
Guyana	Strategies for Reducing Poverty	12861-GUA
Honduras	Country Economic Memorandum/Poverty Assessment	13317-HO
Jamaica	A Strategy for Growth and Poverty Reduction	12702-JM
Mexico	Mexico in Transition: Towards a New Role for the Public Sector	8770-ME
Nicaragua	Poverty Assessment	14038-NI
Paraguay	Public Expenditure Review -- the Social Sectors	10193-PA
Paraguay (Update)	Poverty and the Social Sectors in Paraguay: A Poverty Assessment	12293-PA

Country	Report Title	Report Number
Peru	Poverty Assessment & Social Sector Policies & Programs for the Poor	11191-PE
Trinidad and Tobago	Poverty and Unemployment in an Oil Based Economy	14382-TR
Uruguay	Poverty Assessment: Public Social Expenditures and Their Impact on the Income Distribution	9663-UR
Venezuela	From Generalized Subsidies to Targeted Programs	9114-VE
EUROPE		
Poland	Poverty in Poland	13051-POL
Russia	Poverty in Russia: An Assessment	14110-RU

Source: The World Bank (http://www.worldbank.org)