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Combining census and household survey data for better targeting
**The West and Central Africa
Poverty Mapping Initiative**

by Harold Coulombe and Quentin Wodon

There are often large regional differences in poverty and other social indicators within a country. But geographic poverty profiles based on household surveys tend to be limited to broad areas because survey sample sizes are too small to permit analysts to construct valid estimates of poverty at the local level. At the same time policymakers often need finely disaggregated information at the neighborhood, town, or village level in order to implement anti-poverty programs. For example, telling a Ghanaian policy maker that the Savannah region has high rates of poverty would not be too impressive as that information is already well known; telling the policy maker in which villages or towns (or at a higher level, which districts) have the highest poverty measures would be more convincing, and more useful as well.

Using a methodology developed by Elbers, Lanjouw, and Lanjouw (2003), detailed poverty maps can be obtained by combining census and survey data. The idea behind the methodology is straightforward. First, a regression of per capita or adult equivalent consumption is estimated using household survey data, limiting the set of explana-

tory variables to ones common to both the survey and the latest census. Second, the coefficients from that regression are applied to the census data to predict the expenditure level of each household in the census. Third, the predicted household expenditures are used to construct a series of poverty and inequality indicators for different geographical population subgroups. Although the idea behind the methodology is simple, its proper implementation requires complex computations. Those complexities are mainly coming from the need to take into account spatial autocorrelation (expenditure from households within the same cluster or area are often correlated) and heteroskedasticity in the development of the predictive model. Another issue is the need to compute standard errors in order to assess the degree of precision of the poverty (or inequality) estimates. Those standard errors are important since they help assess how far the information can be disaggregated (the smaller the area and the number of observation are, the larger the standard errors of the poverty measures are likely to be).

The Ghana poverty map was the first to be completed in West and



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Central Africa, with the support of DFID and in collaboration with the Ghana Statistical Service. The experience gained in constructing the Ghana poverty map was then used for launching the World Bank's Africa Region West and Central Africa Poverty Mapping Initiative. To date, fifteen countries have been participating in the initiative, with funding provided by the Belgian Poverty Reduction Partnership and the Bank Netherlands Partnership Program. This note briefly presents the steps needed to construct a poverty map, using Ghana as an example. The note thereafter briefly describes the process used to prepare the poverty maps in the 15 countries in such a way as to also build capacity for the analysis of census data in National Statistical Offices.

Constructing a poverty map: the case of Ghana

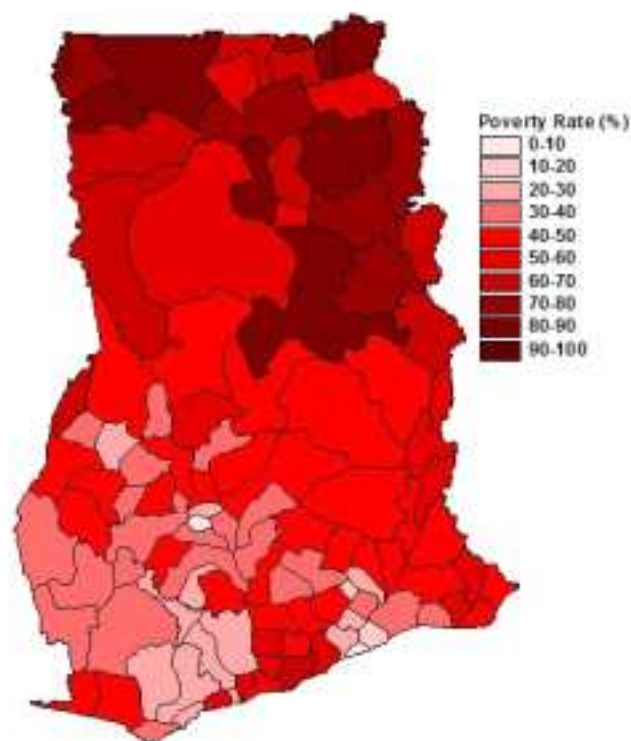
The Ghana poverty map is based on data from the fourth round of the Ghana Living Standards Survey (GLSS4) and the Housing & Population Census 2000. While the Census questionnaire is relatively detailed, it does not contain any information on household income or consumption. At the individual level, the questionnaire covers demographic, education and economic activities variables. At the household level, dwelling characteristics are well covered. The Census includes data on 18.9 million individuals and 3.7 million households. In addition, the Census includes data on available facilities (post office, telephone, traditional healing centre, hospital, maternity/clinic, primary school, junior secondary school, senior secondary school) in every locality, with ap-

proximately 89 000 different localities identified. If any of those facilities was not found in the locality, the distance to the nearest facility was asked. As for the multi-purpose GLSS4 survey, it was administrated in 1998/99. The original survey dataset was enhanced to include data from the facility census through a matching of the Enumeration

Areas used as sampling units (clusters) in the GLSS - which were based on the 1984 Census but re-weighted using Census 2000 information - and the 2000 Census Enumeration Areas.

The GLSS 4 sample is based on seven strata (Accra, Urban Coastal, Urban Forest, Urban Savannah, Rural Coastal, Rural Forest and Rural Savannah) defined in terms in agro-climatic zones and urban/rural breakdown. Household consumption was predicted in each stratum using explanatory variables common to both the GLSS4 and the Census. In order to make sure that the variables deemed common to both the Census and the survey were indeed measuring the same household characteristics, the questions and modalities in both questionnaires were compared and tests were conducted to check that the means of the variables

Figure 1: Incidence of Poverty in Ghana at the district level, 2000



Source: Coulombe (2005)

were equal in the Census and the survey (using a 95% confidence interval). Next, regressions were estimated in the survey using a backward stepwise selection model. To control for location effects, the explanatory variables include the cluster average of some of the household level variables. The explanatory power of the regressions (R^2) varied from 0.27 to 0.60. Next, the parameter estimates from these regressions were used to predict consumption, and thereby poverty at the household level in the Census. Poverty and inequality measures were then obtained at various levels of aggregation.

At what level of disaggregation could Ghana's poverty map be used? The country is currently implementing a decentralization effort which formally started more than ten years ago. The Local Government Act of 1993 and the National

Development Planning (Systems) Act of 1994 defined the current local government structure. The structure consists of four tiers. The top tier is the Regional Coordinating Council, followed by the Metropolitan/Municipal/District Assemblies. The Town/Zonal/Urban/Area Councils and the Unit Committees are the bottom two tiers. However, the implementation of this administrative structure has held back among others due to limited financial and human resources. Figure 1 presents the Ghana poverty map at the district level with estimates of poverty for 138 districts. Poorer areas are in red. Given that some projects today in Ghana use the district level to target resources in the social sectors, it would be feasible to use the poverty map to inform the allocations granted to different districts for some programs. Although the councils were defined in a series of Legislative Instruments (LI) in 1988, those councils do not have formally mapped boundaries. Based on the LI, a Ghana Statistical Service team from cartography and GIS departments has been able to establish the link between those “councils” and the Census 2000 Enumeration Areas. Although the definition of those councils was not made official, we believe it would be a very decent approximation to an on-going data collection exercise being done by CERSGIS from the University of Ghana at Legon. All together, we defined 1048 councils. The council-level poverty figures were statistically robust but were not published as they were not made official.

Building capacity for the analysis of Census data

The table on the next page lists the countries participating in the initiative, the year of the census and survey data used, and the administrative level at which poverty estimates are available. In each country, the poverty maps were created in close collaboration with staff from National Statistical Offices, and in some cases government units in charge of Poverty Reduction strategies. In order to build capacity, several multi-country workshops were held to construct the maps, with most workshops lasting two to three weeks. At these workshops, each country team, typically comprised of two members, with one person assigned to the project by the National Statistical Office, and one person assigned by the government unit in charge of the country’s Poverty Reduction Strategy.

A first introductory one-week workshop took place in Washington, DC, in April 2004, with participation from Burkina Faso, Cape Verde, Côte d’Ivoire, Mali, Mauritania, Niger, Rwanda, and Senegal. Participants were introduced to the technique of poverty mapping, as well as other applied simulation techniques. The actual work on the maps started in February 2005, with a workshop in Dakar with teams from Burkina Faso, Cape Verde, Côte d’Ivoire, Guinea, Mali, Mauritania, Niger, Rwanda, and Senegal. In March 2005, the head of Rwanda’s National Statistical Office went to Montréal to work on the poverty map for Rwanda. In June 2005, another workshop was organized in Ouagadougou for Burkina Faso,

Cape Verde, Côte d’Ivoire, Guinea, Mali, and Niger. In December 2005, the next workshop was again organized in Dakar for the teams from Burkina Faso, Cape Verde, Côte d’Ivoire, Gabon, Guinea, Mali, Niger, Rwanda, Senegal, and Sierra Leone. In December 2006, the last multi-country workshop was organized in Ouagadougou with the teams from Burkina Faso, Gambia, Senegal, and Sierra Leone.

Thereafter, a staff from the Statistical Office from Sierra Leone came to Washington, DC in June 2007 to finalize the map for that country. As part of work done on the Central African Republic, a delegation from the National Statistical office and the government unit in charge of the Poverty Reduction Strategy came to Washington, DC in 2007. While the quality of the household survey did not permit in that country the construction of a poverty map using the standard technique, the Census data were used to construct an asset-based map of poverty using factorial analysis and setting the asset-based poverty line to reproduce the rural and urban poverty incidence measures obtained with the household survey. Finally, the Nigeria poverty map is based on the Core Welfare Indicators Survey rather than on a Census, and for that reason it was done so far solely by the Bank team; the Nigeria map still needs to be transferred to the National Statistical Office together with appropriate training that should take place in Abuja.

Today, all fifteen poverty maps have been finalized or are near completion. Most countries also

Table 1: Countries participating in the West and Central Africa Poverty Mapping Initiative

Country	Census year	Survey year	Administrative levels and number of administrative units	Government staff working on the project
1. Burkina Faso	1996	1998	Region (13) Province (45) Department (383)	Aboudrahyme Savadogo Michel Koné Tiral Sidi
2. Cape Verde	2000	2000/01	Ilho (9) Concelho (17) Freguesi (31)	Deolinda Reis Noemi Rute Ramos
3. Côte d'Ivoire	1998	2002	Region (19) Department (58) Sous-prefecture (254) Secteur (444)	Jonas Yao N'Dri Lancine Diaby Richard N'Cho Kacou Idrissa Ouattara
4. Central African Republic	2003	2003	Region (7) Prefecture (17) Sous-prefecture (79) Commune (177)	Prospère-Félix Moloua Gervais Doungoupou Serge Matchinide
5. Gabon	2003	2005	Province (9) Department (48) Canton (219)	Symolin Ondo Meto'o Alain-Sosthène Mouekoukou-malekou
6. The Gambia	2003	2003/04	Local government area (8) District (39)	Abu Camara Alieu Saho
7. Ghana	2000	1998/99	Region (10) District (138)	Rosalind Quartey KB Danso-Manu Jacqueline Anum
	2003 ^a	2005/06	Region (10) District (110)	-
8. Guinea	1996	2002	Region (8) Prefecture (38) Commune (341)	Thierno Oumar Baldé Mohamed Sow
9. Mali	1998	2001	Region (9) Cercle (49) Commune (703)	Assa Gakou Doumbia Arouna Sougane
10. Mauritania	2000	2004	Wilaya (13) Moughata (53) Commune (216)	Mariam Mint El Mouvid Silly Eleyatt Saadna Ould Baheida Med Abdallahi Ould Boukhary
11. Niger	2001	2005	Department (8) Arrondissement (36) Canton/commune (175)	Karimoune Issaka Boureima Hamidou
12. Nigeria	2006 ^a	2003/04	State (37) Senatorial (109)	-
13. Rwanda	2002	2000/01	Province (5) District (30) Secteur (416)	Philippe Gafishi Ananias Gichondo Taw Augustin
14. Senegal	2001	2001/02	Region (11) Department (34) Arrondissement (133) Commune (426)	Djida Bakary Momar Balle Sylla Arona Toure
15. Sierra Leone	2004	2002/03	Province (4) District (14) Chiefdom (166)	Andrew Bob Johnny Eugene Sawyerr Lamin Tarawally

Source: Authors. a. Poverty map based on the CWIQ (Core Welfare Indicator Questionnaire) survey. Numbers in brackets refer to number of administrative units.

have a basic standardized report administrissue of disability (surveys typically have too small samples to enable a proper analysis of disability, but with census data, even small groups in the population have large number of observations

available in the Census). A key next step for this project will be to plan a series of applications of the poverty map, especially for targeting purposes. For this the Bank team plans to work through both multi-country and country-level

workshops. Finally, the team is considering using the maps to inform sub-regional analysis for the countries of the West African Economic and Monetary Union, and the Economic Community of West African States.

Conclusion

Overall, considering that the actual work on the poverty maps started in January 2005 with a multi-country workshop organized in Dakar, it will have taken about three years to implement the project. In some countries, the work was completed very rapidly (apart from Ghana, Cape Verde was the first country to validate its poverty map in 2005). But in other countries, delays in getting the data (from the Census or from the survey) and/or changes in the members of the national teams working on the project meant that the work took significantly longer.

Several lessons have been learned from this project. A first lesson is that using the approach of multi-country workshops to get the work done was a good choice, for two main reasons. First, the cost per poverty map was reduced in comparison to what this would have cost if a consultant had had to go to country after country to work with government staff there. Second, the multi-country workshops helped create a dynamic whereby teams worked and learned together. One key lesson learned from this project is that government staffs are highly motivated when given the opportunity to work on a project like this where they can learn new techniques. During the multi-country training workshops that lasted typically two to three weeks, most teams worked very hard, often from 8 am to 8 pm, almost non-stop, to get the job done. At the same time, once government staffs go back to their country, it is often very difficult to have additional work done, because they tend to be busy with other work,

and may also not benefit from the same group dynamics that helps participants get the work done during workshops.

Another lesson is that even if government teams have been closely involved in the project in almost all countries, and even if capacity has been built among these small teams for the analysis of census data, the countries have not yet used the poverty maps to any significant extent for policy applications. This has implications for future work. While the construction of the poverty maps is a data intensive and fairly technical activity that can be conducted through multi-country workshops with small national teams, at the next stage, when applications of the poverty maps are considered for informing policy decisions, it is necessary to involve a much larger group in each country, and make sure that there is broad appropriation of the tool by decision makers. This suggests that for the next phase of the project, a different approach will be needed. But there is still a long way to go between having tools such as the poverty map ready, and having geographic information systems properly functioning and actually being used in the countries.

A third lesson is that there is a lack of capacity in countries to use in creative ways Census data that has been collected by National Statistical Offices. Census data are typically used for providing population estimates and characteristics, without much use of the data after they have been published in the forms of tabulations by National Statistical offices. Yet a lot could be done with these data. Apart from poverty maps, the data can be used to construct other (and actually sim-

pler) maps for infrastructure, education, health, and employment, among others. When two maps are available over time, detailed work can be done to analyze what drives changes in outcomes over time for various areas. The Census data can also be used to analyze issues related to small population groups such as the disabled, for which sample sizes are often too small in traditional surveys to permit proper statistical analysis. There is a broader problem here in that while funds are being allocated to data collection in sub-Saharan African countries, little is actually done with these data, and this is observed also for household surveys.

A fourth finding relates directly to the poverty maps. For Ghana's second poverty map listed in table 1, and Nigeria's poverty map, large CWIQ (Core Welfare Questionnaire Indicators) household surveys were used instead of using Census data. Because of their large sample sizes (more than 50,000 households), these CWIQ surveys are representative at the district level in Ghana and at the senatorial level in Nigeria (each Nigerian state consists of three senatorials). Since it is much cheaper to implement a large CWIQ survey than a census, the experience of Ghana and Nigeria suggests that even in the absence of new Census data which are collected at best only about every ten years, it may be feasible to update poverty maps regularly, at least at the level of key administrative units within countries where decentralization is taking place.

This note was prepared by Harold Coulombe and Quentin Wodon, as part of a series of five briefs on household survey data analysis for the World Bank's 2007 *African Development Indicators* (at the suggestion of Jorge Arbache) as well as for the 2007 annual report on the Belgian Poverty Reduction Partnership, which helped fund this work. The work also benefited from the support of the Bank Netherlands Partnership Program. Damien Echevin contributed to the poverty mapping project and some of its workshops. Feedback on this note from Louise Fox is gratefully acknowledged. The methodology for constructing poverty maps is detailed in Elbers, Chris, Jean Olson Lanjouw, and Peter Lanjouw, 2003, "Micro-Level Estimation of Poverty and Inequality," *Econometrica* 71 (1): 355–64. The Ghana poverty map is adapted from Coulombe, 2005, *Ghana Census-Based Poverty Map: District and Sub-District level Results*, mimeo, Ghana Statistical Service and Department for International Development.