Using Census Data for Environment and Climate Change Analysis: An Introductory Guide[1]

I. Introduction

"Climate change is increasingly recognized as a major challenge facing households and communities, local and national governments, and international agencies and organizations. The earth's climate has already been altered to an extent that mitigation, or efforts to reduce the concentrations of greenhouse gases in the atmosphere, alone will be inadequate, and therefore adaptation, or responding to the impacts of climate change, is increasingly necessary. Budgets for adaptation are multiplying, programmes are expanding, and political infrastructure is being negotiated and implemented. In the meantime, significant advances have been made in the development of adaptation programmes, yet to this point existing approaches have had serious limitations. In the midst of a rapidly expanding global adaptation agenda, it is of primary importance to get adaptation and its constituent parts right, in order to generate the most appropriate and effective interventions." (Schensul and Dodman, 2010, p.1). This guide aims to help meet that goal by showcasing how population data, and methods of analysis specific to those data, can be used to develop effective and monitor effective adaptation policies and practices.

Need for inclusion of population dynamics and data in climate change response

Perhaps ironically, data on population distribution and dynamics are largely omitted from the current dialogue on climate adaptation (World Bank 2010, IPCC 2007). Yet, understanding the contribution of population processes and composition is vital for both climate mitigation and adaptation scenarios (Guzman et al., 2009). Recent emission models are being adapted to consider the role of population composition – such as population age structure and the proportion of the population who are elderly as well as the proportion of the population that is urban (O'Neill et al., 2010) – to better understand and tailor mitigation policies. Whereas climate mitigation is often thought of in global realm and can therefore rely on global models and national level demographic data, climate adaptation is almost always treated as a local or regional process

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and the evidence base for it draws largely on local and regional case studies. In order to reduce risks resulting from climate change, it is most important that spatially-rendered demographic information be available and put to use locally, as the impacts of climate change will be borne on particular localities. To understand and prepare for climate adaptation, therefore, a better understanding of population distribution, composition and demographic dynamics at a subnational level is necessary. Because of the global nature of climate and the likelihood that an increasing share of impacts of climate change will be born in Africa, Asia and Latin America, it is also important to share information about these risks and methods for assessing them globally. This manual brings these two aims together with an invitation to the national statistical offices and local planning agencies to make demographic data available in the right way to a wide range of other agencies for environmental and related applications.

There is an increasing recognition that in order to understand climate impacts there must be better integration of physical and socioeconomic data, population vulnerability, sectoral economic risk and critical infrastructure, but also how this vulnerability changes over time (Few et al, 2006). Climate modelling and physical geography help identify where climate change-induced hazards are likely to occur, but in order to assess the resulting risks, one must locate human settlements and activities in relation to these hazards. For example, it is important to know to what extent people live in areas where coastal flooding and extreme weather events are expected to worsen, and it is important to know to what extent agricultural production is located in areas where water availability is expected to decline. This knowledge must be more precise than at the national level, instead going particularly to particular climatically vulnerable areas and incorporating the extent to which populations are changing in these areas.

The mortality, morbidity and forced displacement caused by floods are already considerable, and the Intergovernmental Panel on Climate Change (IPCC) has estimated that by the 2080s, many millions more people will face floods every year as a result of sea level rise and storm surges. In the decade that spanned 1994 and 2004 alone, it is estimated that there were more than 1,500 flood disasters, which killed 120,000 people and affected some 2 million people (IPCC AR4, 2007). Asia was particularly hard hit, accounting for about a third of the reported disasters, half of the people killed, and 98% of the people affected. The 2009 Report of the International Human Dimensions Programme on Global Environmental Change shows that "…30 large-scale disasters, which were

estimated to have displaced at least 100,000 people, accounted for 97 per cent of the total number displaced during 2009, or 16.3 million people". It is not known what share of this damage was urban or rural, if the people displaced were children or older persons, what their economic situation was, their income or their level of education. Strategies to prepare for disaster management differ in these settings, and their effectiveness depends on the availability of disaggregated demographic data, which can help to lay a solid foundation upon which climate-related risks can be evaluated and their eventuality prepared for.

National statistical offices collect and report information in many different ways (Guzman 2009), making comparisons of data along irregular geographic features – such as flood zones or others associated with climate-related hazards – possible. Yet, while national statistical offices produce reports, tables and maps of population characteristics by administrative units (such as provinces or districts), they do not produce them tallied by flood zone or other ecological features. Therefore, much remains to be done to reorient census data producers and users and to improve capacity to make demographic data relevant for use in climate models, studies, and policies.

Reorientation in use of census data for climate change policies

Despite their potential uses for environmental studies and climate change analysis, censuses have not been sufficiently exploited as key data sources. As the techniques and approaches to investigate the linkages between environmental changes and the socio-economic and demographic conditions of the population have expanded in recent years, the increased availability of census data at higher resolution can thus make a significant contribution. Censuses collect information on all households, which allows for the production of statistics for small areas that can then be analysed for specific objectives using tailored methodologies. The 2010 Census round, which included significant build-up in the use of geographic information systems, can be one of the most important sources of data for environmental analysis and, particularly by helping in the identification of the populations vulnerable to environmental risks caused by climate change, thus providing better evidence base for adaptation policies. In order to allow for a more in-depth analysis of census data, the information must be processed for very small areas in such a way it can be directly linked to areas exposed to environmental risks.

By the end of January 2012, 77% of the countries had already conducted their 2010 round of census, meaning that 87% of the population of the world had been enumerated. Over the past 50 years, the United Nations (UN) has contributed in significant ways to the successful implementation of national censuses. The United Nations Statistical Division has coordinated the development of principles and standards. These are important and fundamental standards to ensure the quality and consistency of data across time and place. Among the key documents produced, the most relevant for this guide are the Principles and Recommendations for Population and Housing Census-Revision 2 (United Nations, 2008), the Handbook on Population and Housing Census Editing-revision 1 (United Nations, 2010) and the Handbook on Geospatial Infrastructure in Support of Census Activities (United Nations, 2009).

The United Nations Population Fund (UNFPA) has provided significant support to countries in the census undertaking, mainly in the area of technical assistance. Today, most developing countries conducting a census receive some support from UNFPA.

Not only do almost all countries of the world undertake their own censuses, but these censuses are becoming more and more georeferenced. That is, some information on the location of each household is recorded by the census taker (in the census questionnaire) and that information is that reported in administrative units that can be rendered to show the boundaries of those units. The manner in which this information is recorded varies, as does the use of this information, other than to generate a comprehensive census count. While individual locations are never publicly revealed by census takers – since census taking upholds the principals of confidentiality – censuses combine locational information into a variety of reporting units. These units vary widely by country with some reporting or making available only the coarsest levels of aggregation – national boundaries and/or first-order subdivisions such as regions, provinces or states – but other make available the very finest units of aggregation necessary to maintain the confidentiality of census respondents such as enumeration areas (EA). These very fine units are sometimes called 'building blocks' (Champion and Hugo, 2003) because they can be nested to create a variety of coarser administrative units.

In the past 10-20 years, the spatial capacities of national censuses have improved dramatically. Nevertheless, there is huge variability in what is reported or available within and outside of countries to spatially render their censuses. One difficulty that sometimes arises when trying to map population

data by small areas is the lack of digitalized maps, or the fact that when these digitized maps exist they may contain errors. That said, spatial information is imperative for adapting to and preparing for climate change related hazards, and few national censuses have put their censuses to use in this context either in format or by rendering the content relevant. Climate hazards – storm surges, cyclones, flooding, and drought, among others – will occur in specific localities and may disproportionately affect only some population subgroups. While these localities belong to larger administrative areas – such as states or provinces and, of course, countries – often these hazards are very limited in the geographic distribution. To be useful in this context, therefore, population data must also be available in very small geographic units in such a way that they allow for meaningful analysis. This is true regardless of whether persons live in a city or a village, though increasing emphasis should be given to the challenges of urban areas since that is where most future population growth is likely to occur (Montgomery 2008, UN 2009), and because the demographic characteristics of cities are not as well understood.

Institutional characteristics that support or hinder progress

There are any number of reasons why little progress has been made by way of integrating population dynamics into climate change analysis and thinking. The nature of the analysis is interdisciplinary and interdisciplinary analysis is typically more complicated and requires more types of expertise than analysis that is limited to single discipline. There are not many models for integrating population data with climate data, making it hard to find examples or best-practice guides for those so inclined. Even agencies that may see the merits of outputs may lack the expertise (or resources to acquire it) within their NSOs further hindering progress in this direction.

First, the interdisciplinary nature of climate change analysis means that specialists in one area, such as demography, do not also have expertise in climate theory, models and data, and vice versa. Knowing which climate or hazard data set to use, and often how to use it, requires additional expertise. Even with some substantive knowledge, the tools for using such data are often beyond reach. Spatial data frameworks are important for both climate adaptation and migration, but that framework has been largely absent among demographers. (Similarly, lack of expertise in demography is found among climate specialists.)

Second, there is a lack of strong models and experience for integrating population data with climate data. Even in the prediction of emission scenarios, where future population size has been known to play a role, in early rounds of the climate models (even as late as IPCC AR4) the main demographic input was variants of population projections that are specified in less than 10 coarse regions for the entire globe, and these were not really used to understand climate impacts.

The lack of understanding of the importance of population issues among climate change analysts is notable. Most climate change analysts first and foremost think of climate mitigation rather than adaptation, and while population growth is recognized as a driver of climate change, it is less important than the economic activities that are associated with population change and economic development. As models of the IPCC have been modified with new rounds of the Climate Change Conventions, increasingly nuanced views of population have emerged. It is now understood that population age structure, household composition, population aging and urban location are all necessary factors in climate models (O'Neill et al, 2010, Jiang and O'Neill 2004, Grubler et al, 2007). In part because these models remain coarse and with the intended purpose of understanding global emissions scenarios, the role of population vulnerability in climate adaptation has been almost an afterthought. Recent attention to downscaling climate scenarios and climate adaptation is an important step in the right direction, but the demographic contribution to these efforts is almost always limited or absent (Benestad et al., 2012 Smith 2011).

Third, there is a lack of capacity and skills in NSOs. National statistical offices in poorest countries in particular run their censuses and major survey programs with the assistance of international experts (and funding) largely because sufficient domestic expertise is lacking. Characterizing the situation with respect to the closely-related health-sector, AbouZhar and Boerma (2005) note:

> *Statistical capacity-building has been identified as a core need by many countries and the efforts of the PARIS21 initiative (Paris21) and the World Bank STATCAP programme (World Bank, 2012) are intended to remedy lack of capacity. Both the USAID-supported Demographic and Health Survey and the UNICEF-supported Multiple Indicator Cluster Survey pay explicit attention to local capacity-building for data production and analysis. Within the health sector itself, the need to build capacity for health information is often*

> *overlooked. The need for people with numeric and statistical skills to generate and analyse data is rarely mentioned in analyses of human resource requirements (WHO, 2004).*

Even where there is capacity at the national level, similar capacities are usually lacking from local and municipal agencies. "Municipal officials often lack skills and resources, and few policy makers and managers appear to appreciate the degree of difficulty, capacity building and commitment required to develop effective [and necessary] partnerships" (Plummer, 2000). Furthermore, like academic disciplines, NSOs tend to specialize. So the agencies, or departments within agencies as is often the case, with experts on population data collection and analysis are not the same experts as those in geographic data. This means that to integrate climate and population data, agencies or parts of agencies that traditionally have not worked together, will increasingly need to cooperate.

The lack of skills and capacity in NSOs is also further acerbated by the lack of best-practices for the production, distribution and use of spatial data in these types of applications. The Plummer (2000) primer is an excellent example for forging local public-private partnerships and has many useful tips in general, but it does not offer specific guidance for this applied topic. Further, no such guides exist for population-climate interactions.

This document is intended to guide national researchers, analysts, NSO staff and others in understanding the nature of this analysis by providing guidance and tools that can help them in making possible to link population to climate change and to other environmental issues. It is developed in a way that allows for a more integrated and interdisciplinary approach.