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# Demographic data as a tool for adaptation planning

Understanding local and national population composition, characteristics and dynamics is crucial for developing more targeted and effective adaptation policies and actions. Increasingly nuanced understanding of what drives human vulnerability to climate change recognises both physical hazards, which will change over time, and individual and community characteristics that shape how people will be affected by physical hazards and how they will be able to respond to reduce harm. Many of these characteristics can be explored and mapped using demographic data from censuses and other sources.

## SPATIAL ANALYSIS OF POPULATION DATA

Demographic data can play a significant role in strengthening understanding of people's vulnerability and resilience to climate change, and is a vital input for effective adaptation planning. Tools for assessing vulnerability and planning resilience at local, urban and national scales have proliferated, taking advantage of rapidly improving technology for remotely sensing and assessing natural hazards and their impacts. However, relatively few tools make use of census and other population data — information that is vital for ensuring that adaptation planning accounts for and addresses vulnerability's social and demographic components.

Data collected in national censuses can help to build a more complete picture of vulnerability and resilience by providing detailed information on the entire population's composition and characteristics. A census commonly provides:

- **Demographic information:** the spatial location and distribution of the population; composition by age and sex; household composition, including the proportion of households headed by women; information on migrants; population density.
- **Information about the quality and security of housing:** the materials used for roofs, walls and floors of houses; water access; toilet facilities; energy available for cooking and lighting.
- **Information about human and economic capital:** the resources that people and communities have at their disposal to adjust to changing circumstances, including physical assets, level of education, employment and occupation, and access to new technologies.

Using Geographic Information Systems (GIS), this information can generally be analysed at highly local — or 'small area' — levels. This is vital for understanding the varying geography of climate hazards and for identifying pockets of vulnerability within highly unequal contexts (such as cities). Spatial analysis also provides the ability to integrate diverse types of data — on populations, economies, infrastructure and services, and environments — and to display the analysis on maps, providing an accessible user-friendly way for policymakers and planners to engage with complex data and make more evidence-based decisions.

## TESTING THE APPROACH: CASE STUDIES IN MALAWI AND INDONESIA

Spatial analysis of census data for climate adaptation has been applied in Malawi and Indonesia as part of a joint work programme by UNFPA and IIED. Both countries have recently completed national censuses (Malawi in 2008, Indonesia in 2010) in formats that allow for mapping at local level — a characteristic of many of the censuses in the 2010 round. The study selected variables and indices to identify local vulnerability and

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adaptive capacity at 'small area' level, including population size, population density, age, gender, education, occupation, female-headed households, migration and mobility, household conditions and access to resources and services.

In Malawi, five major cities and their adjacent rural areas were chosen for small area analysis. Results revealed the spatial distribution of selected variables, so allowing vulnerability assessments that enabled comparisons to be made within and outside urban areas. For example, Figure 1 shows a measure of housing quality, the secure tenure index (STI) in and around Lilongwe. STI gives an estimate of the extent of slums, and is used to track progress towards Millenium Development Goal 7.10. The calculation in this research is adjusted based on available census data. The low quality housing in Lilongwe's informal areas and the surrounding rural areas is one feature that can result in higher levels of vulnerability. Figure 2 presents the proportion of households with improved toilets in Blantyre city — the oldest urban center in Malawi — as well as its surrounding areas. Such information is vital for understanding the likely consequences of flooding (without improved toilets flood water can spread effluent around communities). The results have the potential to contribute to Malawi's National Adaptation Programmes of Action. Malawi lacks strong data on either historical climate hazards or existing hazard exposure areas, so in this instance understanding of the population aspects of vulnerability is more advanced than understanding of environmental aspects.

**Figure 1. Secure Tenure Index for Lilongwe and surrounding areas**

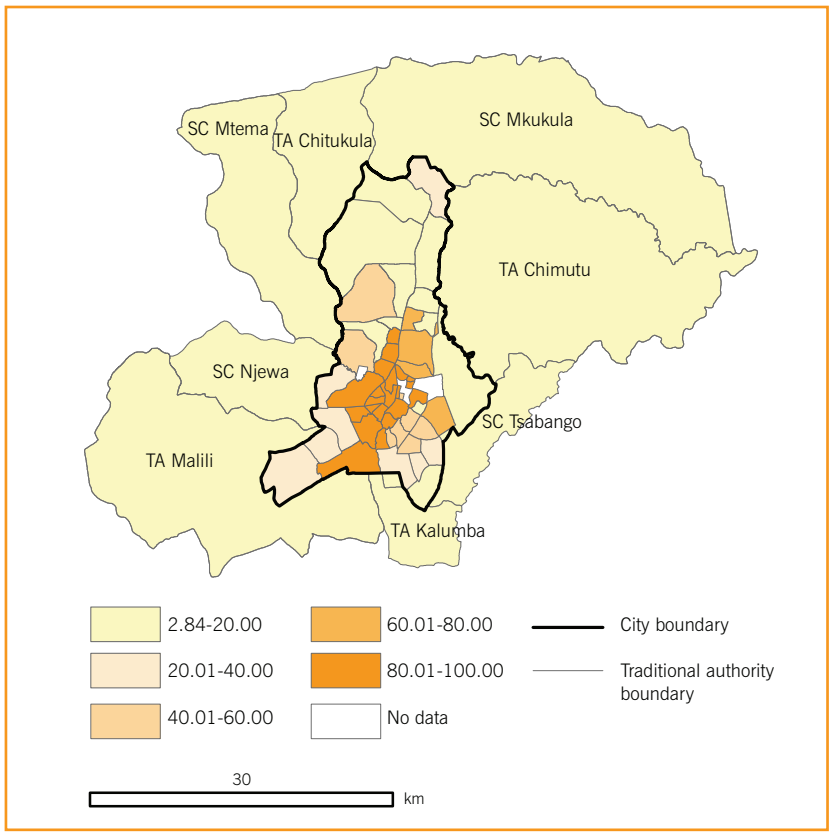
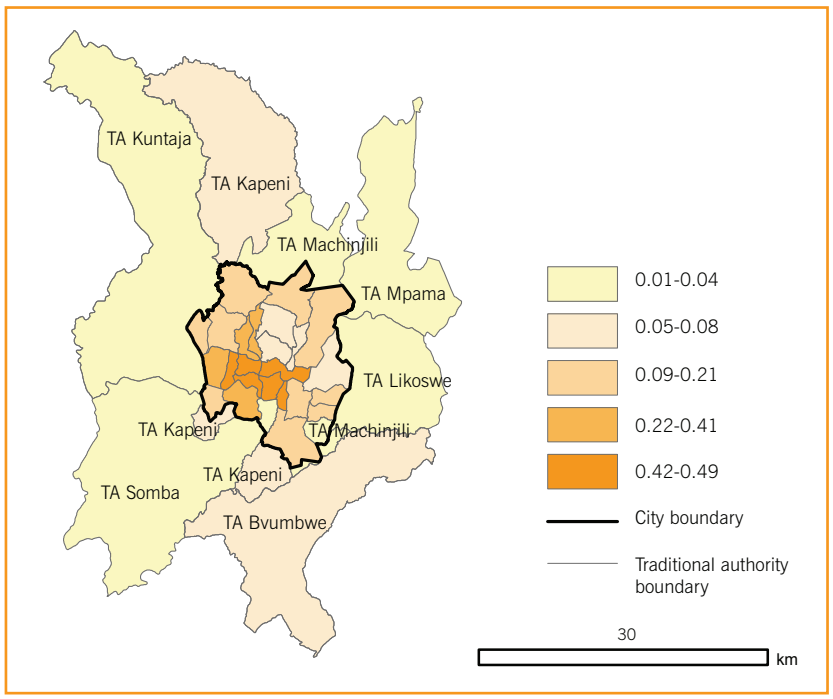



**Figure 2. Proportion of households with improved toilets in and around Blantyre**




In Indonesia, spatial analysis was conducted for Semarang City and Semarang District, a fast growing region facing various climate change hazards, including recurrent and highly damaging flooding, as well as landslides and droughts. Census data were applied to reveal factors that shape the sensitivity and adaptive capacity of individuals and neighbourhoods. Information included: population density, used as a basic vulnerability indicator; dependency ratio, which reflects the age structure of neighbourhoods; and the adjusted Secure Tenure Index. In addition to an overall analysis for the district, the study made a closer analysis of spatial variation within the high flooding and landside risk zone.

Figure 3 shows communities with a high dependency ratio, or ratio of older (above the age of 64) and younger people (under the age of 15) to working age people, in concert with exposure to floods. This relationship is important — it is well understood that the very young and the elderly are particularly susceptible to harm from flooding and waterlogging. Evacuation may pose particular challenges, and very young and elderly people may also be more likely to suffer harm from waterborne and water-washed diseases during flooding.

A low value for the adjusted STI (Figure 4) indicates housing that is of a relatively poor quality and therefore likely to be damaged in climate-related disasters. Fortunately, relatively few communities with a low STI are exposed to high flood risk in Semarang City. Many of the communities in the centre of Semarang with medium-high flood risk have a relatively high STI; however communities on the outskirts of the city centre have lower STI, as highlighted in red. Figure 5 shows that most of the villages prone to landslides in Semarang District are located in the urban fringe and have relative low population densities. Changes in rainfall and temperature could significantly alter land stability and may increase the

**Figure 3. Dependency ratio in high flood risk zone in Semarang**

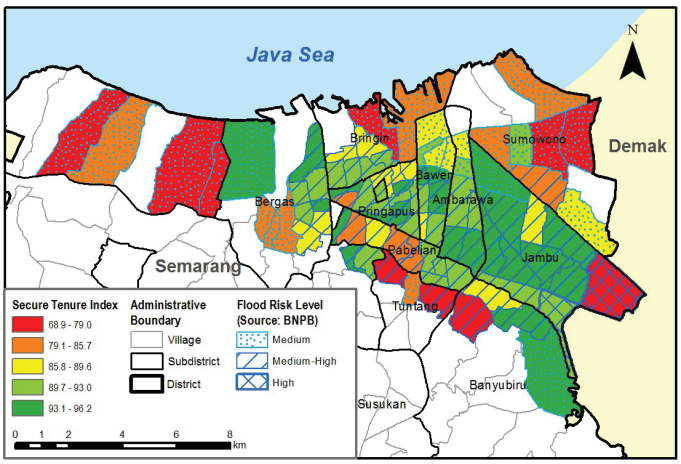
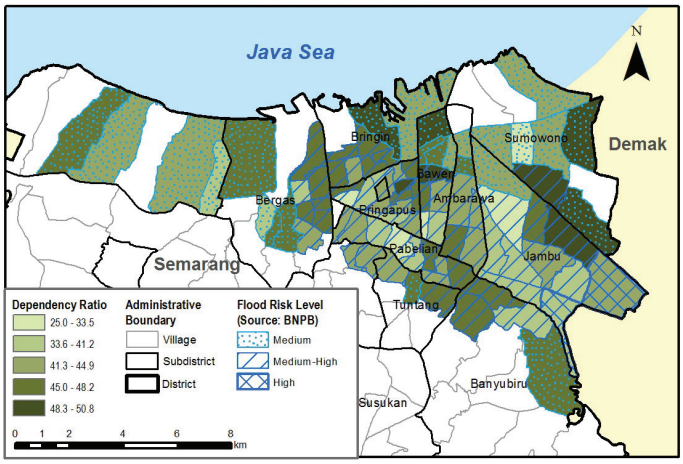



**Figure 4. Secure tenure index in high flood risk zone in Semarang**




frequency of landslides. For most of the metropolitan area, the risk posed by landslides is relatively low. However, in some of the more mountainous regions of central Semarang (mostly in Kabupaten Semarang), the risk of landslides is significant. Results from the case study were launched in collaboration with the city and national governments in October 2013.

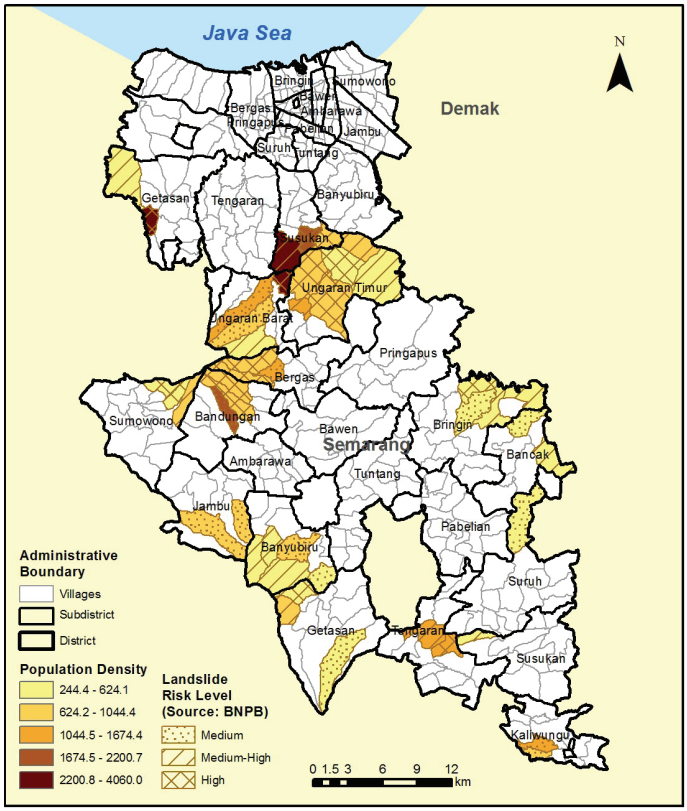
## BRINGING DATA TO ADAPTATION PLANNING

These examples illustrate potential entry points for population data to be used in adaptation planning at different scales. While the specific information gathered varies from country to country, the general approach, and the need to plan, can be applied across local, urban, regional and national contexts.

**Data for local and national adaptation planning.** A range of approaches for local adaptation planning are being developed by NGOs, local governments and international agencies. While gathering local data from project participants and beneficiaries is an important part of generating 'buy-in' for interventions, this can also be supplemented by using census data to build up a more complete picture of a town, city, or rural region. The 2010 round of censuses has made a great leap in supporting highly localised spatial analysis that can be linked to the geography of areas exposed to climate-related hazards. More specifically, census data can be aggregated to administrative or environmental boundaries (so vulnerability can be evaluated at small spatial scales); is standardised within countries (allowing for cross-site comparative studies); and is collected at regular intervals (so temporal changes in vulnerability can be tracked, though only generally in 10 year increments).

**Supporting international adaptation programmes.** There are also clear reasons why international programmes on adaptation should encourage their projects to make more targeted use of population data. Specifically, the National Adaptation Plans (NAPs) that the UN Framework Convention on Climate Change (UNFCCC) is supporting could benefit from this broadly applicable approach. Incorporating population data would generate some consistency among the inputs countries use in their planning processes, and would strengthen the information base on which decisions are made.

**Figure 5. Population density in high landslide risk zones in Semarang District**




**Bringing spatial analysis to adaptation practitioners using the analytics revolution.** UNFPA is working with the computational knowledge engine Wolfram Alpha to develop DECA — Demographic Explorer for Climate Adaptation — an online tool that integrates and analyses multiple kinds of spatial data. The tool generates analytical maps and accompanying tables and figures that help practitioners examine population and related climate vulnerability data and integrate these into climate adaptation planning. It is designed to automate analysis of a wide range of spatial

data, so letting policymakers, planners and those who are not familiar with spatial analysis interact directly with relevant information. DECAs for Semarang, Indonesia and Malawi will be available by the end of 2013, and with the right data inputs DECAs can be generated for any other context.

This tool will be posted on POPClimate (http://popclimate.net), the UNFPA population dynamics and climate change adaptation online platform. POPClimate provides a place to share information and knowledge, and contribute experiences to the UNFPA's official climate change adaptation manual. Researchers, practitioners, and the public can connect to each other through this platform and help build a body of knowledge on best practices for adaptation by using the innovative census manual and the DECA tool.

## TOWARDS MULTI-LAYERED AND DYNAMIC APPROACHES

Many approaches to adaptation planning focus on single scales — either on individuals (whether as passive victims or as active agents), on communities (for example the community-based adaptation approach), or on the nation state (for example the National Adaptation Plans). But for adaptation to be most effective, it should be multi-layered — with national, district, community, and individual and household components. By providing individual and household level data, aggregated to multiple scales and comparable across locations within countries, population data can help to integrate these sometimes disparate approaches.

The next step in this type of approach is to make the analysis better at measuring how dynamic populations interact with changing climate. Although representing population data both spatially and over time is challenging (because of changing geographical areas used for gathering and coding data), doing so offers a more complete picture. It can reveal how population characteristics in particular locations have changed, how they are likely to change in the future, and how those changes may shape vulnerability, given expected changes to the climate and to climate-related hazards.

## CONCLUSION

Climate change policy must recognise how population dynamics contribute to vulnerability and influence communities' adaptive capacity. To be most effective, programmes should prioritise high-risk areas with demographic characteristics that make those areas particularly vulnerable and that limit adaptation. The specific characteristics that constitute vulnerability are likely to vary based on the type of hazard a community faces. So policies must be flexible and should be developed in close partnership with local communities and officials. By understanding the spatial relationship between exposure to hazards and local populations' potential for adaptation, future policies and initiatives can be developed to be more targeted and effective.

There are limits to this approach, particularly when used on its own. Relying on aggregated data ignores individuals or households that may be particularly vulnerable but are within a neighbourhood that displays less overall vulnerability. Social networks and support mechanisms could play a vital role in reducing such pockets of vulnerability, and further research is needed to understand their potential.

As climate change impacts become more pronounced, there is an urgent need for a comprehensive, well-informed response that enhances adaptive capacity among vulnerable communities. Achieving this requires a thorough understanding of communities' vulnerability and their specific challenges. Using demographic data for adaptation planning, as with the tools and approaches described here, means multiple types of data can be integrated so as to provide crucial (and until now often inaccessible) information for local climate change adaptation.

## FURTHER READING

[1] Martine G, Schensul D (eds) 2013. *The Demography of Adaptation to Climate Change.* New York, London and Mexico City: UNFPA, IIED and El Colegio de México. See: http://tinyurl.com/oz4tnty ■ Mulyana W. *et al.* 2013. *Urbanisation, Demographics and Adaptation to Climate Change in Semarang, Indonesia.* IIED and UNFPA. See: http://pubs.iied.org/10632IIED

**This is one in a series of technical briefings prepared by UNFPA and IIED on urbanization and emerging population issues.**

UNFPA, the United Nations Population Fund, is an international development agency that promotes the right of every woman, man and child to enjoy a life of health and equal opportunity.

The International Institute for Environment and Development (IIED) is an independent, nonprofit policy research institute working in the field of sustainable development.

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