Calchetti T., 2013. *Methods for building forecast scenarios of spatial development in peri-urban sub-Saharan Africa: the case of Temeke municipality, Dar es Salaam, Tanzania*. MSc in Environmental Engineering. Sapienza University of Rome

Abstract

The growth of African Sub-Saharan megacities has reached significant levels in recent decades. According to UN-Habitat, each year approximately fifteen million people leave rural areas to settle in peri-urban areas of African cities. This phenomenon causes serious problems as regards the management of urban development and makes it impossible for local governments to guarantee basic living condition for the population. Urban growth is mainly driven by informal settlements, i.e. not subject to planning control. In most cases houses are of poor quality, built autonomously and have no water or electricity connections. It extremely expensive to later build primary infrastructure for such settlements, and local governments devoid of financial resources are not able to cope. Meanwhile, household location choice is influenced by the few formal interventions that are achieved through funding from donors (infrastructure and informal settlement upgrading initiatives) or private investors (CBD, shopping centers, luxury residential zones). It is, therefore, essential for urban planning to foresee the implications of such decisions in terms of new informal settlement location.

Forecast scenarios of spatial development can be of great help to local governments in the management of public expenditure. First, they allow alternative planning options to be evaluated against possible negative impacts in order to optimize allocation of the limited resources available. In addition, they can be used to anticipate the level of demand for network services (water, energy, transportation, etc.) in informal settlements and consequently to provide the main infrastructure and facilities that will be needed.

The present study has developed land use scenarios for the area of Temeke, a municipality of Dar es Salaam, Tanzania. Forecasting techniques were used to explore possible futures depending on the planning decisions to be implemented. To this end, it was essential to identify the local urban development drivers that influence settlement location. These were obtained from a combination of literature review and field interviews . Over a one-month period, officers from national and local governments in Dar es Salaam as well as urban planning academics were interviewed, and key data about the major projects in progress in the city was collected.

By using ArcGIS 10, a vector layer was created for each of the drivers of urban development identified, and a model for the extraction of land use scenarios was developed. A 2011 land cover map of Dar es Salaam, developed under the ACC DAR project and extracted from Landsat images, served as input data. A low-resolution raster file, with a pixel size of 30 m, was used. The reason for this low geometric resolution is that the methodology needed to be simple enough for local governments without large computing capacity to manage.

The first step of the methodology was to define the areas of influence for each driver and assign a weight to each of them. A multiple buffer of vector layers representing the drivers of urban development was generated. Then, for each of the drivers, the corresponding weight was allocated and the vector layers were transformed into raster files with the same pixel size as the land cover map. In this way, it was possible to perform a pixel by pixel sum of all the raster data records. The result of this process was a raster file whose pixel values represent the contribution to urban

development of all the drivers considered. The higher the value in the cell, the greater the probability that the area will be developed. Given the average population density and the projected incoming population during the time interval considered, the corresponding number of pixels were selected as having a high probability of developed, and a new land cover map was created for each scenario and time step considered.

Besides drivers of urban development, a series of restriction factors were also considered and additional layers were generated. Structured in this way, the model is extremely simple and easy to apply. However, some of the assumptions upon which it is based might affect the final results, particularly those prompted by the low resolution of input data. For each 30 m pixel, the land cover map identifies two classes of built-up area: continuous, i.e. with buildings occupying over 70% of the pixel surface, and discontinuous, i.e. with buildings occupying between 30% and 70%. It was, therefore, necessary to establish a parameter to define if a pixel of new developed land was continuously or discontinuously built-up, as each entails a different value of population density. Drawing on the time series analysis of available land cover maps and tests to calibrate the model over the 2002-2011 period, the assumption was made that all the pixels of discontinuously built-up land, located within a radius of 500 m from large pre-existing continuously built-up areas, would become continuously built-up over a period of 3 years.

The output obtained from the application of the model is a raster file with the same resolution as the input land cover map, where the pixels identified as newly developed have been assigned to either the continuously or the discontinuously built-up class.

Three types of scenarios based on differing assumptions were created: “Do nothing”, based on the current situation remaining unchanged in the next twenty years; “Implement already decided projects”, in which only the projects currently being implemented will be completed, and “Implement the new Master Plan 2012-32”, in which the New Master Plan will be carried out. Scenarios for 2015, 2020 and 2030 were built. In all three scenarios, the model suggests that urban expansion will proceed very rapidly and will extend across a large portion of Temeke. This leads to conclusion that most of the infrastructure projects currently being formulated or implemented are likely to have serious consequences in term of urban sprawl.