

# GIS FOR BETTER HEALTH

STEFANIE HENKE AND JÜRGEN SCHWEIKART EXPLAIN THE ROLE OF GIS AND DEMOGRAPHIC DATA FOR PROVIDING BETTER HEALTH IN TANZANIA.

As a general rule, all resources are limited. No society may afford not to optimise its resources. This also applies for public health provision. When comparing worldwide, there exist significant differences in medical provision. In Germany, one doctor cares for 297 inhabitants in average, while in developing countries there is much less personnel, e.g. in Tanzania one doctor has about 50.000 patients. Also when looking at financial resources, the differences are huge: While costs for medical treatment in Germany amount to approx. 2817 USD per person, in Tanzania this ratio accounts for 31 USD per inhabitant (WHO 2002).

To allocate resources becomes especially important in countries with very much restricted potentials. Because almost all collected data in the field of public health is spatially related, a geographic information system (GIS) becomes a powerful tool for analysis and decision support as to be shown for a region in northeast Tanzania. This project was realised in cooperation with and with support of the *Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ)*.

## Point of departure and aim of the study

One of the most urgent problems for public health in developing countries are political decisions that prioritise healing institutions like hospitals to be build in urban centres whereas health facilities in peripheral regions are neglected. But because of cultural and logistical preconditions health care may not be decided about in remote centres. So many countries now aim to decentralize medical services. In Tanzania, the district administration shall become policy maker. Thus if deficiencies in health care are detected in rural regions, action may be taken faster and more efficient. GIS may be a helpful instrument to assist medical care and

planning as to be shown for the case of Muheza district in Tanzania, an agrarian area.

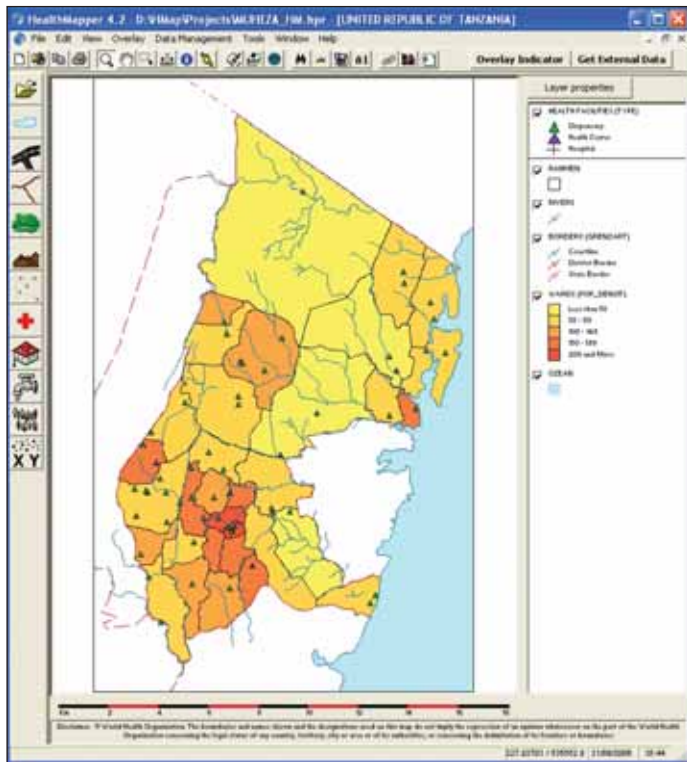
This geographic information system contains spatially related data that characterize the district regarding demography, morbidity as well as medical provision. It is focused on the smallest entities of health care in rural regions, the health facilities (HF). The build-up of the information system and the in-depth data analysis are the basis for the compilation of thematic maps of the investigation area. These instruments allow for better evaluation of the districts' health provision.

## The investigation area

The *State* of Tanzania is the supreme administration unit and is divided into 5 administration levels, followed by 26 *regions* across the country which contain 125 *districts* that include the *division* level which has a subordinate role and obtains power only when it comes to complex tasks. The divisions are subdivided into *wards*. The smallest administrative unit is the *village* (Census 2003).

The selected investigation area, the Muheza District, is located in Tanga region. Tanga region is situated in the North East of Tanzania. This region takes up an area of 27,348 km<sup>2</sup> which is 3% of the area of the country. Tanga region is composed by the 7 districts *Handeni, Kilindi, Korogwe, Lushoto, Muheza, Pangani* and *Tanga Municipality*. These again are divided into 37 divisions, 158 wards and 702 villages.

The Tanzanian state-run health system consists of several supply levels which have a pyramid-like structure whereas all health institutions shall complement one another. At top of the system stand the few central hospitals (at present 4 consultant hospitals) which are oriented at a high-



**FIG. 1:** Screenshot of the HealthMapper 4.2 with data of the Muheza District.

quality, international standard. Regional hospitals, district hospitals, health centres (HC) and dispensaries constitute the following health care levels.

## Data

Within the GIS project different geographic themes, organized at different layers, may be displayed by the user. At top level, the locations of the HF are shown. The following layers contain information about settlements, transport network, watercourses as well as administrative borders, e.g. ward or district borders. Additional, vegetation and land use information, won from interpretation of satellite images, is available. Although the latter is not directly linked to health, this information might help understanding the incidence of diseases. For background information, the GIS user may display topographic maps in raster format which are used as base of the GIS.

Statistic data mainly consists of factual information related to health facilities. These data are extracted from the MTUHA data base (Swahili: **M**fumo wa **T**aarifa za **U**endeshaji wa **H**uduma za **A**fiya) and stored separately. MTUHA was launched in Tanzania between 1994 and 1997 for support of the health system management. Data is collected for all HF, such as:

- general information about the HF (type of HF, technical equipment e.g. laboratory, water supply etc.)
- medical personnel (number, education)
- treated diseases (malaria, cholera, measles, children's underweight, et al)
- additional supply provided (number of vaccinations against measles, number of distributed medicaments, family planning, pregnancy pre- and after-care)

These variables were used to calculate selected *health indicators* which sum up the data collected in the HF and this way may help responding to questions related to planning and management of health programmes. Indicators are used to characterise health facilities and especially to compare between them as well as to set planning goals. They reflect success or failure of a health district.

## Methods

When choosing the appropriate software financing is an important subject for potential users. The project is aiming to implement the GIS in the investigation area and hereafter perhaps also in the whole region. This was

one reason for working with ESRI ArcView GIS 3.3. The system developed is static, i.e. other data may not be added from local users. Also, the existing data is visualised with ArcExplorer which is an insufficient solution. But not only costs are crucial for the use of GIS, also know-how for the implementation and use of a comprehensive GIS is often lacking. An alternative to ArcView GIS 3.3 may be found in the freeware HealthMapper 4.2 published by the WHO (fig. 1). This software allows an easier access to the GIS use and to the related compilation of maps in public health.

Spatial objects are a precondition to GIS use; without this information visualization of data will not be possible. One feasible method of collecting spatial data is recording GPS coordinates. For the purposes of this project, the accuracy of GPS measurement is adequate enough. During the field work the coordinates of already 10% of the HF of Muheza District were recorded with help of GPS.

## Results

By thorough research, data collection and analysis, a GIS was developed that may be used for assistance of public health in Muheza district in Tanzania. Thematic maps were compiled that visualise the analysis results.

A first outcome of the study is that there is no quantitative problem of medical provision in Tanzania. But often the quality of the HF is deficient. Basic prerequisites e.g. access to clear water or the availability of a laboratory to detect malaria are lacking in many facilities. The availability of piped water in Muheza district is shown in a thematic map. It is striking that in 2002, 29 facilities are not connected to a water conduit. Some of these institutions have to cover up to 5 km distances to obtain clean water.

Related to this is a study conducted in a village region in Tanzania aimed to detect implications of (waste) water supply for the incidence of trachoma<sup>1</sup>. The results show that the disease occurs less often in households that live in short walking distance of less than 5 minutes to the next water well (Polack et. al 2005). This example shows how local conditions may be linked to the incidence of illnesses. In this case a GIS may be a powerful tool to analyse data and gain further insights into the facts.

## Conclusion

Most data describing health provision is spatially related. Therefore, the existing correlations between spatial objects and health data could be better structured, analysed and visualised through the use of GIS; collected data might be used more efficient. Integration and geo-referencing of health related data, especially the localisation of health facilities, is therefore important. The aim of the GIS use is the facile visualisation of data and easy understanding of complex facts.

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<sup>1</sup> Trachoma is an eye affection that occurs in tropical and subtropical regions with insufficient hygienic conditions. Trachoma is the most prevalent cause for blindness (Hildebrandt 1998).