



The contribution and future potential of Geographic Information Systems to health delivery in South Africa

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The Medical Research Council (MRC), within its National Malaria Research Programme, has developed the capability to use a Geographic Information System (GIS) in a unique way to collate data which can be used to support health research and development in South Africa.

The major areas of this research are briefly presented with suggestions towards fully exploiting its potential to promote health research and delivery in the country.

Malaria information system (MIS)

The first district malaria distribution maps for the country have been produced (see Fig. 1 overleaf), which have direct implications for focused and cost-effective control measures. These data directly impinge on the developing tourist industry in South Africa, allowing area-specific advice to be dispensed regarding malaria prophylaxis.

The dynamic nature of the disease, characterised by dramatic increases in incidence over the past 3 years, demands ongoing surveillance and updating of these distribution maps. In this regard, stand-alone malaria data capture and input screens have been developed and tested in collaboration with the Department of Health (DoH) in KwaZulu-Natal, where malaria case data are available at homestead level. Nearly 35 000 homesteads and facilities have been positioned in collaboration with the DoH (Fig. 2). This has allowed researchers to analyse the spatial distribution of the population in relation to clinic positions to assess the distance that people have to travel to access health care.

The importance of such georeferenced population data is highlighted by the fact that the same data have been used by:

1. Eskom, to plan electrification;
2. for water provision as part of RDP activities in the region. So far, the data have been supplied to 7 engineering consultants involved in water supply;
3. the data have enabled school catchments to be determined;
4. facility placement has been determined using the database;
5. the Lubombo Spatial Development Initiative has used the data to plan development for the area and to place a new road to link historically disadvantaged communities.

This has all been made possible through the integrated activities of the MRC and the DoH's Malaria Control Programme, and illustrates how malaria control can facilitate many aspects of community development, such as health, education, and services.¹⁻³

The malaria control authorities in Mpumalanga and Northern Province have strongly requested that this platform and the computerised data capture system be fully extended to their provinces. Such a move would allow for more focused, long-term benefits and cost-effective malaria control, and thus contribute to rural health development in general.

Mapping Malaria Risk in Africa (MARA/ARMA)

The GIS capability of the National Malaria Research Programme and its implications for disease control have been recognised internationally and have led to a wholly African collaborative effort to map malaria

throughout the continent. This initiative is managed from the MRC in Durban with 7 regional centres throughout Africa (Fig. 3). Data collection is well under way (Fig. 4), and based on these data a ground-verified malaria distribution model has been developed (Fig. 5). Funding is mainly international, initially from Canada's International Development and Research Centre (IDRC), and more recently one of the 14 projects funded as part of the Multilateral Initiative on Malaria in Africa.⁶⁻¹⁰

Lubombo Spatial Development Initiative

A tri-nation initiative involving Mozambique, South Africa and Swaziland will address malaria control from a regional perspective, which is believed to be the only way to significantly reduce malaria in the 3 countries. This approach has largely been possible because the problem can now be spatially displayed (Fig. 6). It is envisaged that the project will put in place a spatial platform (GIS) for the affected areas of the 3 countries, and establish a community-based malaria control programme in Mozambique. This is regarded as a potential model for the future, as initial costing shows this approach dramatically reduces costs in comparison to the current format for malaria control. Again, this design was only made possible by using GIS.¹¹⁻¹³

This project further supports the need to extend the GIS platform to Mpumalanga and Northern Province, both in terms of current and future restructuring of malaria control strategies, and considering the benefits of such a platform for development in general.

Policy recommendations on back ↗

Figure 1. Average malaria case incidence 1987-1993 district level

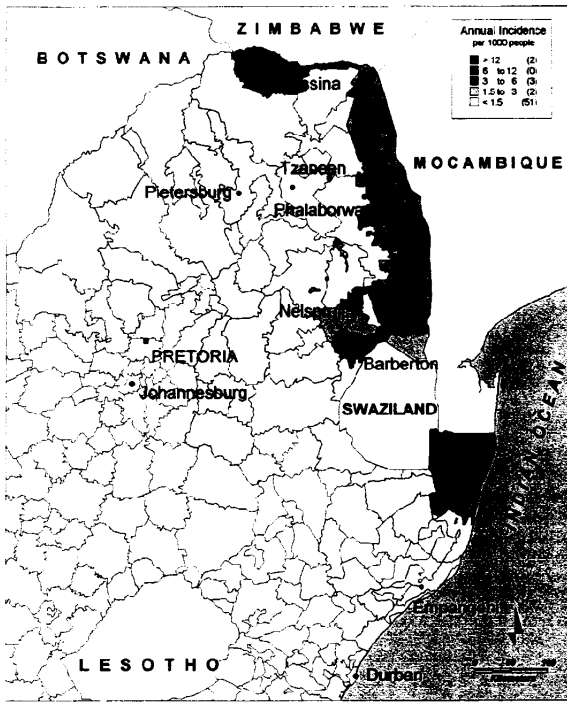


Figure 2. Homesteads and Facilities in the Ingwavuma and Ubombo districts of KwaZulu-Natal, 1995

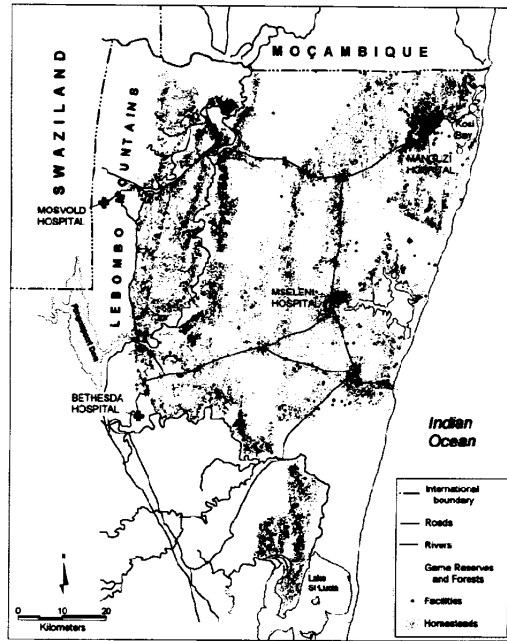


Figure 5. MARA/ARMA malaria distribution model for Africa

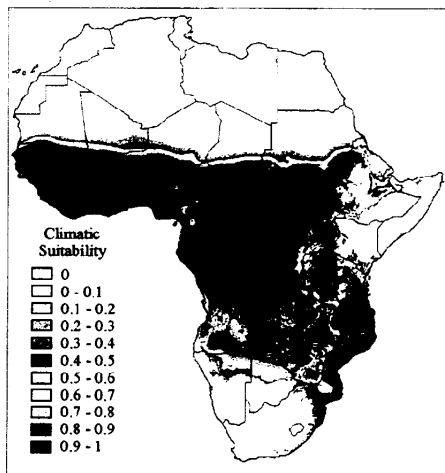


Figure 6. Malaria distribution in South Africa prior to control in the 1930's (A) and following control 1987-1993(B) and the proposed area for control in Mozambique (C)

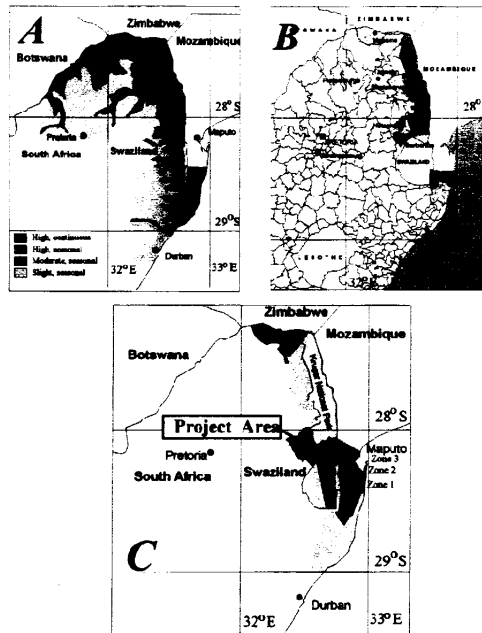


Figure 3. MARA/ARMA regional data collection centres in Africa

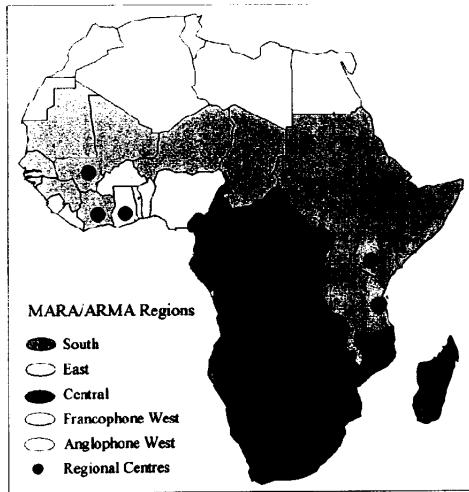


Figure 4. MARA/ARMA data collected to date

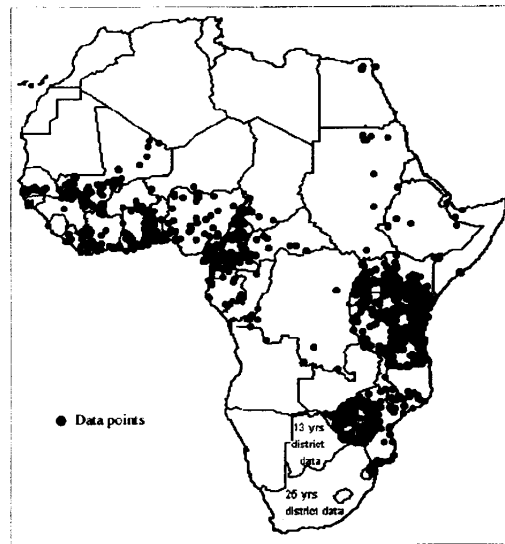


Figure 7. South Africa: Current Health Regions and Districts

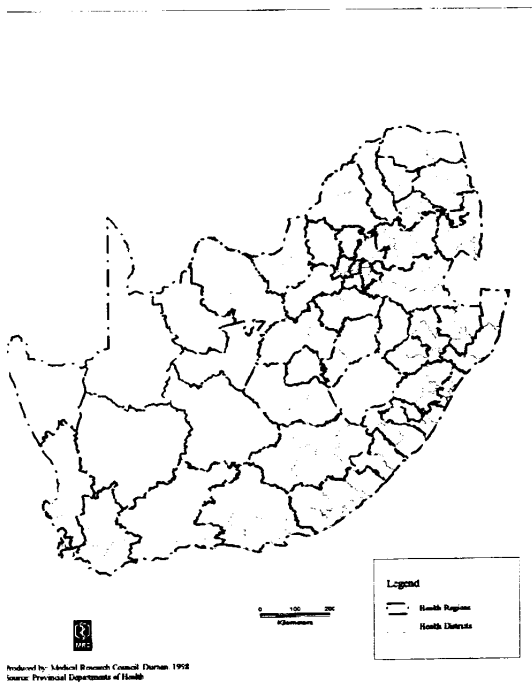
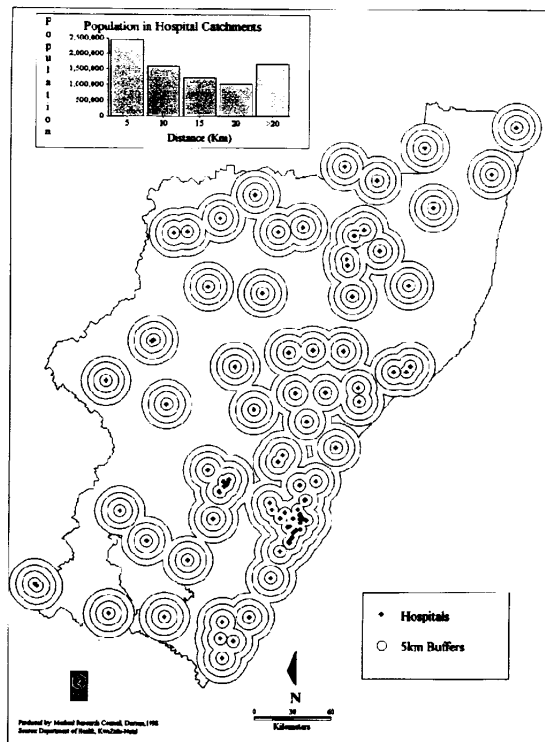


Figure 8. KwaZulu-Natal Province: Distance Buffers around hospitals





Health boundaries

The DoH recently commissioned the MRC's National Malaria Research Programme and the Health Systems Trust to collate and provide maps for all provinces of South Africa showing the new health districts and regions (Fig. 7), and to plot, name and

determine catchments for all health facilities in South Africa using the most up-to-date data available (Fig. 8). In many instances, these data have emanated from the DoH's ReHMIS* database.¹⁴

This study has indicated the need for an independent agency to be

made responsible on behalf of the DoH for the ongoing collation of these data, their verification and accessibility by health workers, researchers and policy-makers. The value of this information highlights the importance of completing the verification process with regard to the ReHMIS database.¹⁴

Recommendations

1. The **GIS platform** which has been shown to aid development in rural areas **should be extended to Mpumalanga and the Northern Province**, using malaria as the vehicle to set such a system in place. This process has already begun through a collaborative project with the DoH and Mpumalanga health authorities. Using GIS will allow malaria control activities to be focused and cost-effective, and establish a system for community-based intervention. The community-based **malaria control programme being developed for southern Mozambique should be fully evaluated as a model for malaria control in South Africa.**
2. An **independent agency**, acting on behalf of the DoH, **should be made responsible for the ongoing collation of data on health facilities**, boundaries and other spatial data, as well as their verification and ongoing accessibility by health workers, researchers and policy-makers.
3. Collating data on the health facilities and boundaries of South Africa has placed the **MRC**, together with the DoH and the Health Systems Trust, **in an ideal position to produce a health atlas for the country.** This could initially cover malaria and the other notifiable communicable diseases. The DoH's database on 'Antenatal Clinic Sentinel Site HIV Positivity' would be ideally suited for inclusion and spatial analysis, and the schistosomiasis atlas for South Africa could also be included. A malaria atlas for Africa is currently under production as part of the MARA/ARMA initiative.
4. The management of the MRC has recognised the implications of its GIS capacity for health research in South Africa, and will extend this capacity beyond malaria. GIS can clearly play an important role in other health areas, and there is now an **opportunity for wider utilisation of the MRC's GIS resources by the broader health sector** in South Africa.

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* Regional Health Management Information System.