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The rebuilding of a country: the role of GIS in South Africa

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South Africa has undergone rapid socioeconomic and political change since the release of Nelson Mandela from prison in 1990. President Mandela's government, democratically elected in 1994, instituted a Reconstruction and Development Programme (RDP) as the basis for improving standards of living of those who were so strongly disenfranchised under the former apartheid government. This chapter explores the contribution to nation building of GIS, at national, provincial, and local levels, and against a background of rapid change. It is the contention that the GIS community is playing and will continue to play important roles in development planning and resource allocation in the country. What emerges as a critical issue is the need for political commitment to GIS within government to assure the technology's long-term contribution to the reconstruction and development process.

Â1 GIS IN THE SOUTH AFRICAN CONTEXT

There are few settings as apt as South Africa in which to contemplate the challenges and prospects for GIS contributions to nation building. GIS has a short history in the country, going back no further than the mid 1980s (Fincham et al 1993). It is the contention of this chapter that, in spite of this truncated history, ample evidence is emerging of the technology's contributions to knowledge creation for development planning, management, and policy formulation. This assertion about GIS is critically assessed through four case studies which reflect work done at spatial resolutions ranging from the national through to the local level. Most importantly, the assessment comes at a time of rapid change in South Africa and it is against this backdrop that the GIS work is presented.

1.1 A nation undergoing rapid change

The path to democracy began in February 1990 with the release of Nelson Rolihlahla Mandela from prison, and culminated in the national elections in April 1994. What has emerged in the ensuing years is

the successful, if not miraculous, transition to a fledgling democracy. Equally important and apparent is the fact that the broader socioeconomic development process and the sustainable management of the environment pose major challenges to the new nation. The legacy of apartheid, with its 'divide and rule' philosophy, will not be erased with ease. In terms of the apartheid paradigm, South Africa was made up of a number of 'independent' and 'self-governing' states such as 'KwaZulu' and 'Transkei', one for each 'tribe' or 'nation' (Piper and Fincham 1994). Each of these entities had its own department, of education, health, defence, and so on, and the post 1994 government is setting about instating a more rational and ordered national system. In education, for example, the task of the new government is to create a single, national education system out of the previous 19 different and supposedly independent 'national' authorities (Krige and Fincham 1994). Similar challenges lie ahead for other state departments.

Many of the former independent and self-governing states were home to black populations located in peripheral parts of the country's space economy. The standards of living and the access to

infrastructural development remain tenuous in these areas, highlighting one of the key challenges faced in the new South Africa: unequal access to the resources of the country, often determined by whether people are in a rural or an urban environment, or by their race.

South Africa has one of the highest levels of income inequality in the world (Health Systems Trust 1995). In the early 1990s, for example, white per capita incomes were 12.3 times higher than that for blacks; the 13 per cent of the population who were white earned 62 per cent of total income while the 75 per cent who were black earned 27.6 per cent. What is emerging in more recent times is a decline in wealth disparity between race: whites' share of the country's wealth has declined by about eight per cent in the last two decades, yet inequality within racial groups continues to grow. The poorest 40 per cent of black households earn approximately six per cent of black income and the richest ten per cent earn nearly half (McGrath and Whiteford 1994). Furthermore, it is estimated that approximately 17 million of the total 40 million people in the country and about half of all households live below the minimum standard of living. Two thirds (67 per cent) of black households, 38 per cent of so-called 'coloured' people, 18 per cent of Indian, and seven per cent of white households respectively are considered to live in poverty (McGrath and Whiteford 1994).

1.2 A reconstruction and development strategy

Against this backdrop, the need for a broad-based framework for development planning and environmental management is essential. At the outset of the establishment of the democratically elected Government of National Unity (GNU) in 1994, the dominant partner in the coalition, the African National Congress (ANC), articulated such a framework for nation building. The Reconstruction and Development Programme (RDP: ANC 1994) was initially conceptualised as a separate department within government heading the government's development planning operations. The concept of reconstruction and development continues to remain central to government strategy with the RDP function now largely incorporated within the mainstream government departments.

Inherent within the RDP framework is the necessity to tackle critical socioeconomic and political problems. These are numerous and, for the purpose of focusing on the role of GIS in nation building, include the following four key areas.

First, the need to address national planning and resource allocation to the newly constituted nine provinces. Within this strategy is the notion of the government at national level being responsible for policy formulation and resource allocation. The nine provincial governments are accountable for carrying out policy which in turn is implemented at the local level. Second, the need to set in place a process of land reform. The focus is to be on '. . . land redistribution of residential and productive land for those who need it but cannot afford it, and restitution for those who lost land because of apartheid laws' (ANC 1994: 20). Third, the need for improvement in service delivery with respect to water and sanitation, energy and electricity, education, health and nutrition, and social security and social welfare. Finally, the need to catch up on the housing backlog, estimated at some 3 million units nationally. The 1991 Census suggested that some 2.8 million people or nine per cent of the population were living in shack settlements (Department of National Health and Population Development 1993), a situation which could deteriorate as the process of increasing urbanisation takes hold. It is within these contexts that the existing and future potential contribution of GIS to nation building is considered.

2 APPLYING GIS TECHNOLOGY IN SOUTH AFRICA

2.1 The current use of GIS in South Africa

After a start in the active use of GIS in the mid 1980s (Jobson et al 1986), geographical databases, trained staff, successful private sector companies, and software have emerged in such a way as to make GIS an effective tool in the development of the country (MacDevette 1993, 1994). GIS is now used at all levels of government and in many sectors of society. Geographical databases are available for key national issues such as demographics, education, soil, climate, geology, telecommunications, and electrification infrastructure. National government uses GIS to support the national census, water resource planning and development, agricultural and forestry management, environmental management, and health management, amongst others. National parastatals (organisations partly or wholly state-owned, e.g. utilities and science councils) use GIS for research and development, forestry, electricity

provision, and telecommunications. Local governments use GIS for a wide range of planning and monitoring work. Although certain areas, such as nature conservation and agriculture, are using GIS at the provincial level, it is not widely used for provincial management. GIS is used extensively in the private sector in areas ranging from the siting of franchise operations and logistic planning to mining operations.

2.2 GIS in support of the development of a National Spatial Development Framework

2.2.1 Background
The fundamental shift in development policy and strategy, articulated in the RDP, has had significant implications for development planning throughout the country. The new philosophy, together with new structures being installed at all levels of government, poses a significant challenge for government in its attempt to coordinate planning and action at all levels.

Coordination of development planning was the task of the Minister responsible for the RDP, and the national RDP office. The Forum for Effective Planning and Development (FEPD), made up of senior decision-makers at provincial and national level, was set up to develop a coordinated National

Spatial Development Framework to guide investment in development in South Africa. Recognising the need for information to support decision-making, the FEPD commissioned a Development Planning Framework Atlas and an attendant computerised spatial information system. These steps were the first in a process of developing a coordinated GIS for providing information to support development planning at national, provincial, and local levels.

2.2.2 Achievements
The Atlas information and an operational GIS, with the ability to produce maps and related outputs required during a workshop by delegates, had to be prepared within the space of six weeks. An example of one of the key inputs was the state of provision of water supply (Figure 1). Like many of the other variables available for the workshop, such data provided key insights into the state of key development arenas.

The National RDP office was responsible for the implementation of the project. The Council for Scientific and Industrial Research (CSIR), with considerable experience in GIS, was tasked with conceptualising and producing the Atlas and the GIS under the direction of the RDP office. Political
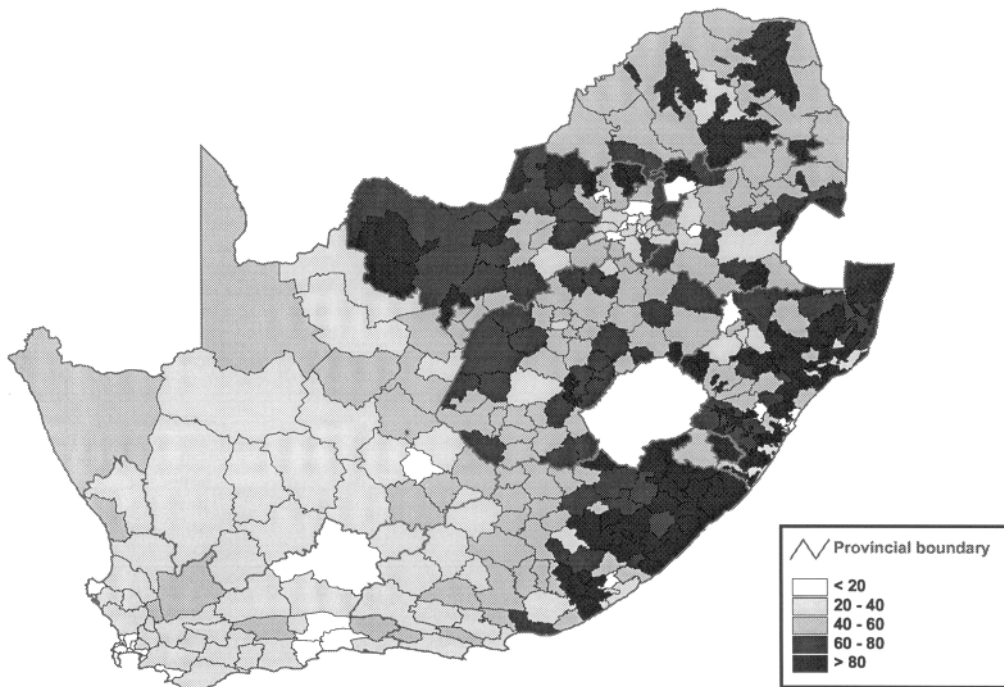

Fig 1. Percentage of households in South Africa with adequate water supply.

support to ensure cooperation of the various institutions came from the Minister in the Office of the President, the Reconstruction and Development Programme Minister without Portfolio. The data required for national level planning were housed in 22 different institutions throughout South Africa, including government departments, parastatals, development agencies, and the private sector. The data were stored in paper files, on maps, and in digital files on different systems and in different formats. Some of the larger data holders became closely involved with the project. They included the Department of Environment Affairs and Tourism, the Department of Mineral and Energy Affairs, the Development Bank of Southern Africa, Central Statistical Services, CSIR, Human Sciences Research Council, and the National Electrification Forum. The majority of the attribute data were collected at magisterial district level. Supporting the attribute data was a map library of spatial information, including infrastructure, rivers and lakes, land cover, and forestry, all acquired from national framework datasets.

The rapid application development environment in Environmental Systems Research Institute's (ESRI) ArcView was used for the compilation of the final maps and posters for the workshop, as well as providing a customised tool for displaying and querying the large volumes of data. The prototype information system developed was a simple data cataloguing application. With this application the user can query and display selected attribute data and simply add available supporting spatial data. The attribute data can be accessed through a comprehensive list of keywords and sector search options. The data and ArcView script files were also made available on CD-ROM.

The products produced by the GIS application provided a dynamic strategic planning workshop situation: maps were posted on the meeting room walls, overhead transparencies were used in the sessions, and the Atlases were widely consulted by all participants. The GIS experts set up their computers and a plotter in the meeting hall. The GIS application provided the basis for detailed discussions around spatial development planning options and opportunities envisaged for the country.

It is important to note that the data and attendant information have been used in follow-up workshops at the national level. The provincial planners have indicated their interest in using the Atlas as well as the GIS for provincial development planning.

2.2.3 Lessons and other outcomes

It is possible to learn several lessons from using the GIS in support of the development of a National Spatial Development Framework.

- Intersectoral collaboration in development planning, both within and outside government, is a major problem. The outcomes of the work hold promise for GIS to play a greater integrating role, given the support of those with the political will in key organisations.
- GIS provides the basis for the rapid compilation and production of information as well as the basis for an effective information system across institutional boundaries.
- Decision-makers in Third World contexts prefer to work from maps. Maps provide the most effective inputs for 'hands on' planning workshops and many aspects of the planning process itself. The identification of the spatial dimension to planning for many who participated in the workshops was new and will make for more creative and realistic resource allocation in the future.
- Where data are required for national level work, strong political and project management support are required to get the various institutions to supply data and work together. The project manager needs to have good human relations skills to be able to work effectively across institutional borders.
- Strategic insight is required within national and provincial agencies to develop digital databases that, in their early stages, appear to have little value, but provide significant national value in future.
- Well designed (user friendly and effective in terms of the required outputs) personal computer (PC) based systems, capable of accessing data on CD-ROM or similar media, are the most effective way of providing an information system that can link planning at the national level to implementation at the provincial levels.

2.3 Targeting funding for nutrition programmes: the case of the National Nutrition and Social Development Programme (NNSDP)

2.3.1 Nutrition as an outcome indicator of development initiatives

Good nutrition status, as a human right and as an outcome indicator of the impact of development strategies, has gained prominence in recent years (Florencio 1996; McKerrow and Fincham 1995).

In the final years of the apartheid state and under the new government of national unity, the NNSDP (a forerunner to the contemporary Presidential-led RDP programme, the Primary School Nutrition Programme: PSNP) has brought renewed interest to the importance of nutrition on the South African national development agenda. The NNSDP was instituted in 1991 with the implicit philosophy of addressing the immediate food needs of the poor, to promote longer term development and to engender self reliance rather than dependency in recipients.

2.3.2 The dilemma of effectively targeting NNSDP funds

Problems around targeting funds for the needy are the focus of this provincial example of the use of GIS. It continues to provide one of the strong examples in South Africa of how GIS can play a crucial role in a government programme's resource allocation strategy.

In the KwaZulu-Natal province (Figure 2), the Natal Nutrition Working Group (NNWG 1993) assisted with the implementation, monitoring, and evaluation of the NNSDP. As implementation got underway it became clear that funding for the needy and for 'development' type projects was going to relatively wealthy urban-based non-government organisations, working on behalf of communities which had solicited their help in securing funds. A baseline provincial nutrition survey, conducted by the NNWG at the same time as the NNSDP, indicated that the greatest nutritional needs were in rural communities, especially those that were isolated and poorly resourced. The Department of Health asked for assistance to target the programme funding away from the urban areas to these more needy rural communities.

2.3.3 A provincial role for a simple PC GIS

A fledgling GIS application, designed and developed at the Institute of Natural Resources, University of Natal, was used to address the problem. The PC-based system, with in-house raster and vector capabilities, incorporated data from all enumerator subdistricts of the national census and the relevant associated official census data for KwaZulu-Natal. It was, therefore, possible to use these data to identify the areas with the highest percentage of poor people. This is targeting by geographical location rather than by the individual or family, a technique which is only possible in locations where poverty or any other set of conditions is known to be widespread.

As income data were not collected in the census, a surrogate measure, the economic dependency ratio (number of dependents per employed person) was used. At a ratio of nine dependents per employed person, some 1.5 million persons out of the total eight million inhabitants in the province were identified. In order to decrease the target population still further, areas with high levels of female illiteracy were then identified in the system; the assumption was that when females are illiterate they are less capable of apportioning family resources adequately (see Fisher, Chapter 13, for examples of the construction of indicator variables from the UK Census). In this way the system was able to identify the poorest areas in the province encompassing some one million people. The resulting map, Figure 2, confirmed that these people were in rural and deep rural areas, giving support to the findings of the nutrition survey undertaken by the NNWG. Table 1 shows the recommended and actual allocation of funds by magisterial district at the time of the GIS analysis. On the basis of the work, funds were accordingly reapportioned to the most needy areas.

Table 1 Recommended and actual allocation of available funds for the poorest areas of KwaZulu-Natal at the time of the GIS analysis.

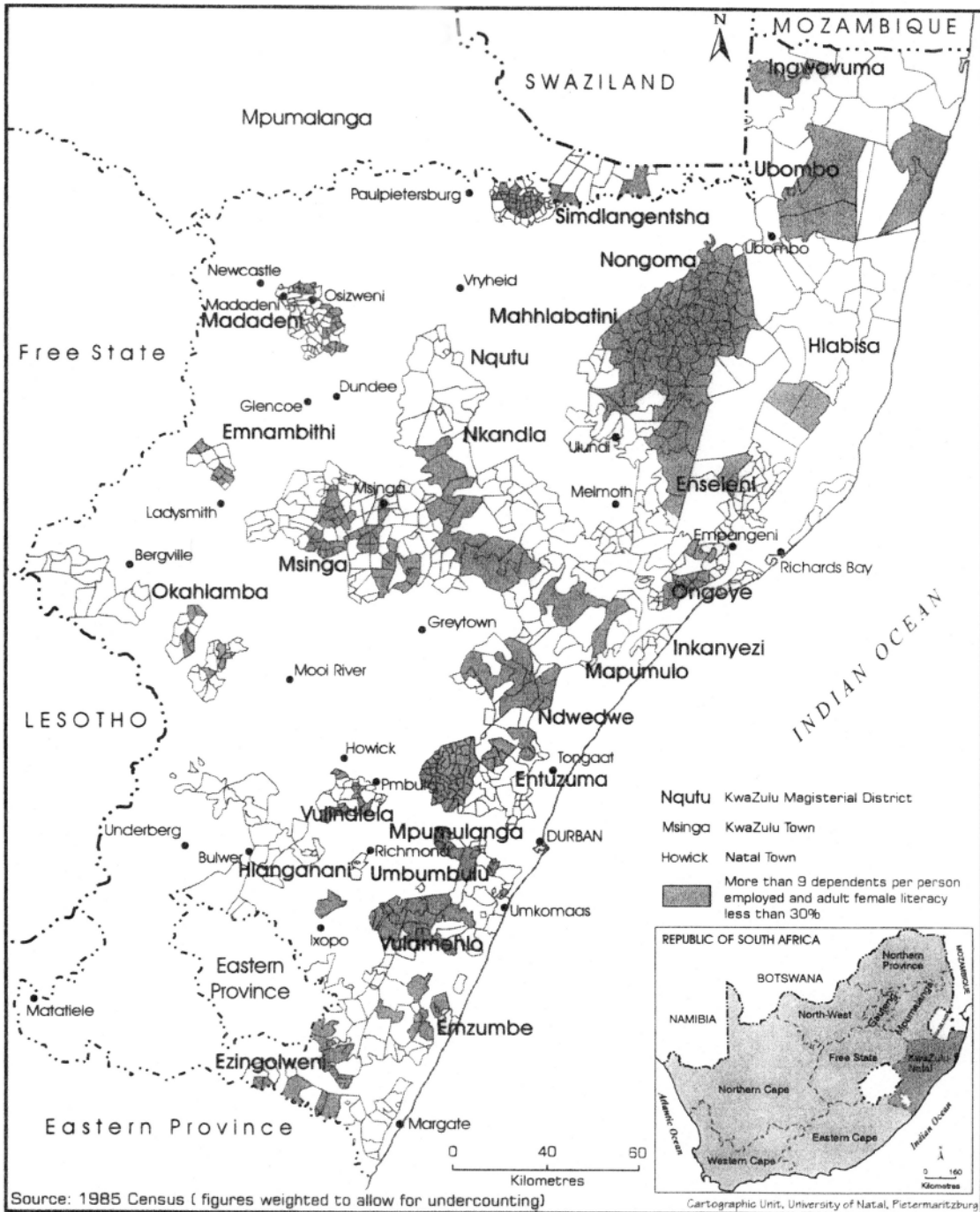| Area	Census district		Recommended %	Actual %
Port Natal - Ebodwe	Camperdown	*R	0.20	0
	Durban	*U	0.91	9.5
	Inanda	*U	0.68	4.22
	Lower Tugela	*R	0.40	2.52
	Maphumulo	*R	8.27	5.02
Natal Midlands	Hlanganani	*R	3.21	0.84
	Msinga	*R	5.65	2.18
	Pietermaritzburg	*U	0.77	4.34
	Vulindlela	*U	1.80	2.76

*R = Rural
*U = Urban

Fig 2. Selected examples of recommended and actual magisterial district allocation of NNSDP funds.

2.3.4 Lessons

Use of this system provided several lessons:

- The system provided a more objective assessment of how programme funds should be allocated on the basis of clearly specified indicator variables. Although there was much displeasure expressed by those urban-based groups which had successfully lobbied for funds in the first round of allocations, they could not but agree with the logic of funding those in even greater need. To use a well known adage, it 'levelled the playing field' for all potential stakeholders.
- GIS has a sound record of use in the environmental realm in South Africa (MacDevette 1994); it is only recently that GIS has found favour in socioeconomic applications and within the health sector in particular (see also Martin, Chapter 6).
- As a result of this work, other important health initiatives, such as the internationally acknowledged Maputaland Malaria Programme (Le Sueur et al 1995; Sharp and Le Sueur 1996) and work on a rural demographic and reproductive health spatial database in the Northern Province, have been able to secure considerable funding for GIS-based research and application development. (See Gatrell and Senior, Chapter 66, for further health care applications of GIS.)

2.4 GIS in land reform

2.4.1 A distorted land ownership system

In South Africa, the apartheid government policies supported the development of a highly distorted land ownership system, whereby 80 per cent of the country's land was owned by 13 per cent of its people. Land reform is, therefore, a high priority within the reconstruction and development process. The Department of Land Affairs has initiated an integrated programme of land reform and intends to use GIS as a tool to support the reform process at the national level (Department of Land Affairs 1995). Although there are a number of participants within the land reform process who are aware of the value of GIS, it is still not a widely accepted tool. Some examples, at the provincial and local level, are given below where pilot GIS projects are being used in the land reform process. Dale and McLaren (Chapter 61) provide a general overview of the use of GIS in land administration.

2.4.2 A case study

Regional overviews, prepared by the Land and Agriculture Policy Centre (LAPC), were used to provide the context for land reform in each of the nine provinces. In the regional overview for land reform conducted in the Western Cape Province (Wildschut 1995), the compilation of a GIS database was achieved on a limited budget through the adoption of a 'consortium' approach to data capture, data sharing, and data management. The consortium responsible for the regional overview was a broadly-based grouping of NGOs, universities, and parastatal and government organisations across scientific and social disciplines.

Information layers, captured primarily at a regional scale of 1:250 000, were defined by need, availability, and capacity to generate new data. Examples of layers of data assembled included: topography, rainfall, vegetation, land cover/land use, conservation areas, mountain catchment land, state land, and the locality of all 'reserve' areas and 'struggle' sites (sites where, in apartheid South Africa, the government moved black people from areas classified as 'white' in terms of the Group Areas Act). The pattern of land usage in Western Cape Province is shown in Figure 3. A ranked composite map was constructed from socioeconomic and demographic variables (Zietsman 1995), as an index of the level of development, as shown in Figure 4. Variables incorporated into the composite index map were: population growth (1970–91), mortality rates, secondary school qualifications, agricultural work force, rural unemployment, agricultural unemployment, and per capita income.

Using the regional database, a pilot study to support district planning in the Southern Cape Region of the Western Cape Province was initiated. The aim of the pilot project was to develop and implement five year district plans for achieving sustainable development within areas defined for land reform. The objective of the GIS component of the project was to establish and develop a GIS for use as a planning and monitoring tool of the land reform process.

The GIS was used to capture a variety of data concerning the 27 communities in the pilot area. The datasets were identified and compiled in conjunction with representatives of the communities concerned.
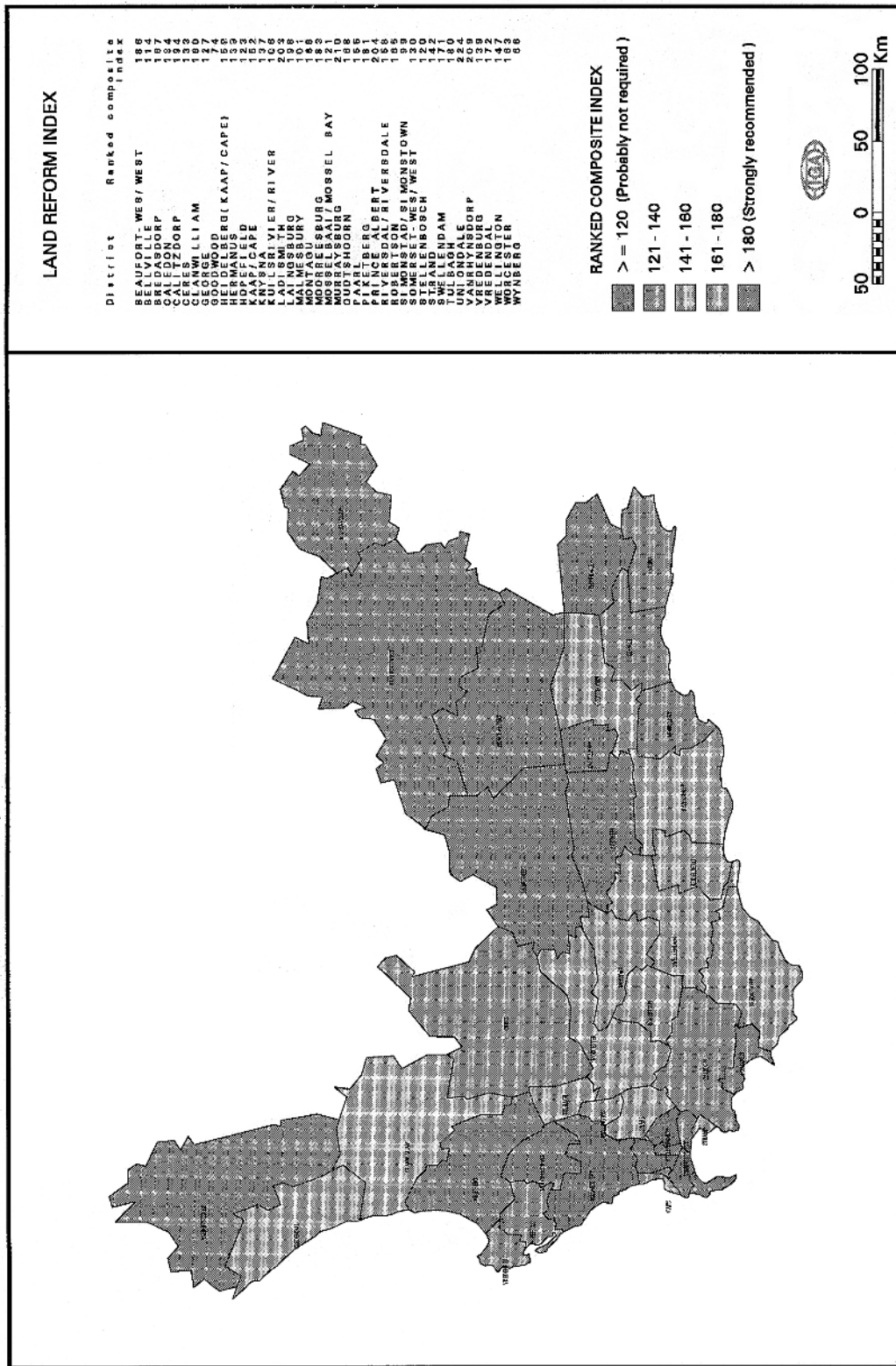
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LAND REFORM INDEX

District	Ranked composite index
BEAUFORT-WES/WEST	186
BELVILLE	114
BREDASDORP	167
CALEDON	184
CALITZDORP	193
CLANWILLIAM	190
GEORGE	127
GOODWOOD	174
HEIDELBERG(KAAP/CAPE)	159
HERMANUS	123
HOPEFIELD	152
KAAP/CAPE	137
KUYSRIVIER/RIVER	203
LADISMITH	196
LAINGSBURG	201
MALMESBURY	198
MONTAGU	173
MOORREESBURG	181
MOSSELBAAI/MOSSEL BAY	210
MURRAYSBURG	188
OUDTSHOORN	155
PAARL	181
PIKETBERG	204
PRINCEALBERT	185
ROBERTSON/RIVERSDALE	99
SIMONSTAD/SIMONSTOWN	130
SOMERSET-WES/WEST	120
STELLENBOSCH	122
STRAND	171
SWELLENDAM	180
TULBAGH	224
UNIONDALE	209
VANRHYNSDORP	177
VREDENBURG	163
VREDENDAL	147
WELLINGTON	133
WORCESTER	168
WYNBERG	

RANKED COMPOSITE INDEX

- >=120 (Probably not required)
- 121-140
- 141-180
- 161-180
- >180 (Strongly recommended)

50   0   50   100
Km

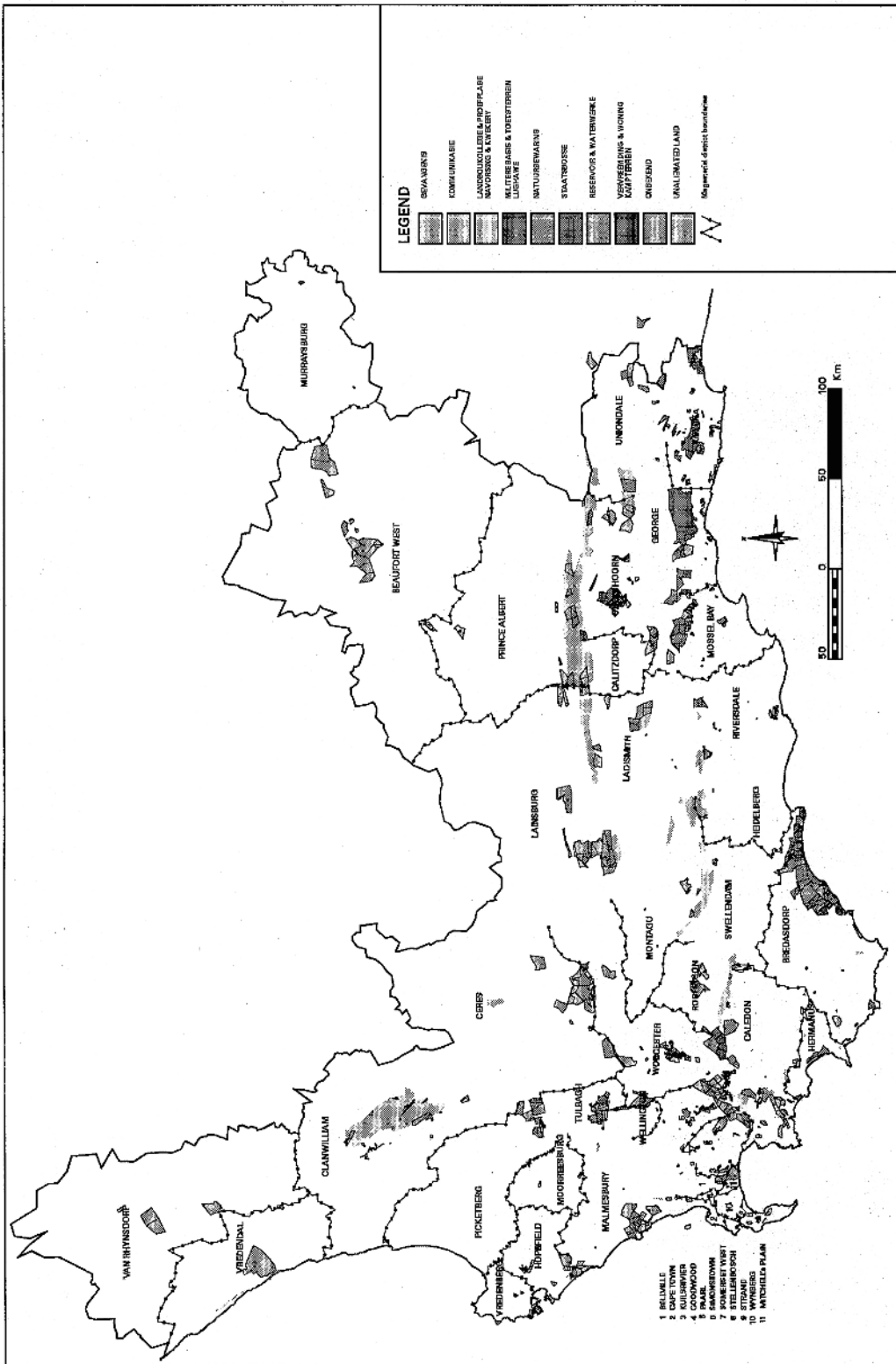**Fig 3. State land usage in the Western Cape Province.**

Fig 4. Composite index (level of development) for the Western Cape Province (from Zietsman 1995).

Information is outut as a series of posters, depicting various themes identified by the communities. The themes identified to date are; land use and infrastructure, slope classes, property ownership, and socioeconomic information. Data elements in the GIS include: land ownership, slope, land use, access routes, rivers, dams and other water sources, sewage, land fills, power lines, environmentally sensitive areas, industry, quarries, recreational facilities, population, schools, health, sport, water needs, unemployment, sanitation, economic activities, and housing. The information, produced in formats required by the community, was used as a key tool for support of the planning process.

2.4.3 Lessons

This case study demonstrated a number of lessons:

- GIS has the potential to allow for local knowledge, community needs, and specific social histories to be incorporated into the development process in an interactive way. Yet there is still the need for much participatory research and development around GIS before communities are likely to be able to use the full power of the technology. (See Shiffer, Chapter 52, for a review of, and general approach to, this problem.)
- GIS represents a most cost effective way of managing wide ranging information sets and providing outputs in formats required for participative planning, management, and evaluation.
- Advances in GIS technology (resulting in smaller, cheaper, and easier to use systems) mean that communities, with expert help, can build systems that they can subsequently use fairly easily for decision-making support in negotiations with government.
- Although the data management tools of GIS are important, it is the map output capabilities which are in greatest demand. Attention needs to be paid to map design to customise the outputs for particular audiences. Symbology so generic to western map making is not always prudent in the Third World context: for example, rivers that are 'blue' or 'clear' are not common in the study area and brown is a much more readily appreciated colour for water features. (See also Kraak, Chapter 11.)

2.5 Use of GIS to support participatory planning for the allocation of land to accommodate low income people (low cost housing) in Cape Town

2.5.1 A critical problem of insufficient shelter

South African cities are rapidly expanding, from both immigration and endemic population growth. This is resulting in critical housing shortages, especially among low income groups. Past policies of racial segregation resulted in the spatial development of Cape Town being significantly distorted and a city that is overly segregated and segmented. The location of appropriate sites for low cost housing, close to transportation networks and job opportunities, has become of great importance for the new government and involved communities. However, because of the need to look holistically at the future development of the city, the issue of finding sites for low income housing cannot be seen in isolation. As a result, additional levels of complexity are introduced into the decision-making process.

2.5.2 A context of participative planning for GIS

The principles of the RDP require that a participative and community driven planning process be used. In a participatory process driven by the key stakeholders, rather than by civil servants, participants need to be able to generate and explore a variety of options and scenarios. This capacity is needed to provide the communities with real power to create the future, rather than being simply selectors of the 'best option' in a set of options already generated by planners. However, in order to be able to generate scenarios, in a complex situation such as that in Cape Town, a wide variety of datasets need to be integrated and set up in a manner that supports community level users (see also Shiffer, Chapter 52).

Recognising the need to have information to support the decision-making process at community as well as metropolitan level, the Provincial Administration of the Western Cape, in partnership with the CSIR, decided to develop a strategic information system (Anon 1996). The system was required to provide information on the demand for, and supply of, land for housing low income families. The system needed to provide interactive decision-making support for a wide range of participative decision-making processes.

2.5.3 Developing the application

The spatial database required for the application was largely assembled from existing data. Coverages compiled included: current development status of communities, environmentally sensitive areas, nature reserves, slope, job accessibility, cost of development, and agricultural potential. The application was built using ESRI's ArcView 2 as the development platform for final use on a personal computer (Naude and Feast 1996).

The application was designed to do the following:

- start with all available open space in the Metropolitan area;
- exclude land for development using constraints such as proclaimed nature reserves, slope, and water bodies;
- exclude land unsuitable for development, such as environmentally sensitive areas or high quality agricultural land;
- rank the remaining sites in terms of suitability for development (into high, medium, and low suitability) using a set of user specified suitability criteria;
- estimate the demand for land for housing using a demand model.

For other examples of multicriteria evaluation, and developments of the basic overlay model, see Eastman (Chapter 35).

2.5.4 Outcomes

To date, the computerised system, as well as maps produced from the system, have been used in a variety of meetings with planners and environmentalists to support the process of exploring options for locating low cost housing. It is envisaged that, as a result of the positive response from these meetings, the system will be used to foster a more proactive and participatory approach to the problem of land identification for low cost housing at all levels in Cape Town and elsewhere.

2.5.5 Lessons

The application demonstrates a number of lessons:

- GIS technology permits the development of powerful portable scenario generation tools at the personal computer level, and provides inputs into a participatory planning process.
- Participatory planning and development is a complex process requiring sound facilitation and sociological skills – this is most frequently the critical area in the process. The best technology cannot work without a sound social process (see also Campbell, Chapter 44).

- Stakeholders need to be actively involved in the development of a GIS application. Confidence in the way the application operates needs to be obtained by 'building trust' with all stakeholders.
- Although applications for community participation can be built using existing datasets, communities need to be involved in articulating their needs so that the authorities can develop relevant new datasets pertaining to additional criteria.

3 CONCLUSIONS: A NEW TECHNOLOGY FOR A NEW NATION

The GIS community in South Africa has begun to establish a niche for itself within the RDP framework, through creative initiatives such as those cited above. Much needs to be done, however, to integrate GIS into the senior ranks of government decision making. As a result, this chapter has not focused on the many successful commercial or private sector uses of the technology in South Africa. It will be the extent to which government embraces GIS that will signal the success or otherwise of the technology within the RDP.

There are at least five principles critical to the future success of GIS in South Africa. These principles are also applicable where similar situations hold in other Third World countries.

Strong government leadership is required for the development of a coordinated development planning information system which is based on a set of accepted technical standards. It is equally true that information generated by such a system is vital for development planning as well as for facilitating broad participation in the planning process.

Government needs to invest in developing planning information through creating consortia of government, non-government organisations, universities, parastatals, and the private sector. Strong political support is required to get the various, and often competing, institutions to work together.

Objective allocation and targeting of scarce resources is possible using GIS. Where conflict exists, existing *laissez faire* allocations often result in bias towards those who are relatively privileged and already effectively competing for resources. The allocative capabilities of GIS need to be more widely disseminated within government.

Further investment is needed in the research and development of GIS based tools as well as information required for community level

participatory planning. The emphasis needs to be on participative research and in 'learning by doing'. GIS provides an effective tool for community based planning – appropriate end-user-friendly software (tools) need to be developed that will enable communities to enter and display data easily. For example, it would be useful to have customised ArcView software for community planning that contains input screens and a set of predetermined map outputs. Further modules such as visualisation of community scenarios would be a valuable addition to the software.

Community level systems can be built, with expert help, to empower people and enable officials to run truly participatory development planning processes.

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