

# **Community-Integrated GIS for Land Reform in South Africa**

by

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## **Introduction**

As the end of the 20<sup>th</sup> century grows nearer, South Africans find themselves entering the post-Mandela era.<sup>1</sup> Five years after the first democratic government was elected in South Africa, the euphoria of transformation and reconciliation has receded. In its place has come the hard reality that the social and spatial impacts of colonialism and apartheid run very deep. Since the transfer of power in June of 1994, there have been improvements in basic service provision for many South Africans, particularly in electricity and water provision. But the redistribution of economic and environmental resources has - expectedly - been rather slow. Transformation is now increasingly viewed as requiring decades of political, economic and attitudinal change. Understanding this, the South African people have again voted to empower the African National Congress (ANC) in the nation's second democratic and non-racial election.<sup>2</sup>

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<sup>1</sup> Thabo Mbeki was sworn in as President of the Republic of South Africa on June 16, 1999.

<sup>2</sup> The ANC received almost two-thirds of the vote nationally, and is only one seat short of the two-thirds majority in Parliament that would empower them to change the Constitution.

The South African space-economy still suffers from extreme levels of uneven development.<sup>3</sup> Structural unemployment is very high,<sup>4</sup> and complex systems of labor migration to, from and within rural areas continue. Rural and peri-urban South Africans, therefore, view the land question as interconnected with the types of formal and informal economies they have access to; jobs and land are two sides of the same coin. Residents of the former homelands tell us they prefer access to both simultaneously (Levin and Weiner, 1997a). Unfortunately, job creation is much slower than expected, and effective land reform is difficult to implement rapidly. As a result, millions of South Africans still experience an ongoing social reproduction crisis, and this will likely contribute to the intensification of land struggles during the next five years, and beyond.<sup>5</sup> Land tensions are currently on the rise and there is little reason to believe that this is a short-term phenomenon. Land hunger may also be connected by politicians to national, regional and local electoral politics. The experiences of Zimbabwe are likely to be relevant in this regard (Moyo, 1995; Masilela and Weiner, 1996).

The issue of land featured prominently in ANC and Government policy documents during the Mandela years, but successful implementation of land reform is proving to be challenging. One major land reform constraint is that Government must buy land for redistribution, sometimes at highly inflated prices.<sup>6</sup> President Mbeki inherits a land reform program that is project based, supply-driven, and stubbornly slow.<sup>7</sup> He also inherits a political climate where intensified conflicts over access to natural resources are a realistic possibility. People's expectations of greater access to land and other economic and environmental resources remain high. In the absence of substantial delivery of land and water resources to ordinary people in the Central Lowveld, grassroots struggles, including squatting, are likely to intensify. Our interviews with large-scale commercial farmers indicate that the security situation in former 'white' territory has recently been deteriorating. Elements of the so-called 'third force' of the former regime are now present as farm security units.<sup>8</sup> Violence against white farmers, their families and livestock are a contemporary expression of Central Lowveld historical political ecologies.

The transition from apartheid to development in South Africa (Crush, 1995; Levin and Weiner, 1997b) is fraught with such contradictions. Another example is the mantra of community participation, engagement and empowerment which has rapidly become standard vocabulary within emerging public, private and NGO-based development institutions. Unfortunately, borrowing from this new discourse textually does not necessarily translate into better, more inclusive and democratic plans and projects. Discursive calls for community participation and empowerment too often re-appear as conventional planning projects that peripherally involve targeted beneficiaries. This is the case in South Africa today, where a neo-liberal macroeconomic

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<sup>3</sup> Macdevette, Fincham and Forsyth (1999) report that white per capita incomes were 12.3 times higher than that for blacks and that over 40% of the total population and half of all households live below the "minimum standard of living" (p. 914). They also suggest that inequality between racial groups is increasing.

<sup>4</sup> Black unemployment is estimated to be over 35%.

<sup>5</sup> The rapidly escalating AIDS epidemic is making a difficult situation even worse.

<sup>6</sup> Landowners are reaping large profits through the sale of land to the Government. Landowners would appear to be the major beneficiaries of land reform.

<sup>7</sup> In most circumstances, land is made available for redistribution when a landowner decides to sell. This has led to increased land prices, handsome profits for sellers, and problems for the Government which needs to access large tracts of high and medium potential arable and grazing land to fuel the land reform process.

<sup>8</sup> This information was obtained directly from white farmers.

framework, combined with a long history of top-down and highly bureaucratic decision-making, has created a planning environment that remains situated within a modernization framework.

The rapid diffusion of GIS is reinforcing practices of modernization in the 'new' South Africa. A 1995 report on the use of GIS for resource management conducted by the Johannesburg-based Land and Agriculture Policy Center concluded that: "Within South Africa, numerous institutes, universities and government departments have collected large amounts of [digital] spatial data. This data on a wide range of physical and social parameters is held on various disparate systems" (Cinderby, 1995: 12). Indeed, the transition to democracy has been accompanied by the rapid development of GIS. Geographic Information Systems in South Africa, however, are frequently used only for digital map production, and in some cases, stand accused of transforming bad data into impressive looking maps. Nevertheless, GIS is emerging rapidly in the 'new' South Africa, and plans for a National Spatial Information Framework are progressing well, even though competing state agencies view GIS as a way to maintain or increase their power within a government bureaucracy that is in flux. Significantly, many thriving GIS consulting firms were linked to segments of the former Apartheid State but were privatized before the transition of power in 1994. As a result, the GIS industry is booming in the transition from apartheid to development and the types of GIS applications emerging tend to reinforce traditional planning applications.<sup>9</sup>

The reinvention of modernization theory and practice in South Africa is interesting because it is taking place in the context of a similar shift towards participatory forms of social change. This need not be a contradiction as participation in practice often legitimizes top-down projects. But South Africa has a long history of civil society struggle and activism. As a result, it is likely that some participatory initiatives that are popular and effective will emerge. It will be interesting to see if practices of participation in South Africa can be successfully linked with GIS applications.<sup>10</sup> Macdevette *et. al* (1999, p923) argue for such an integration: "Further investment is needed in the research and development of GIS based tools as well as information required for community participatory planning...Community level systems can be built, with expert help, to empower people and enable officials to run truly participatory development planning processes."

This paper presents some preliminary results from an ongoing GIS and Society project located in the Central Lowveld of South Africa's Mpumalanga Province (Figure 1). At the time of the GISOC99 Conference, data was still being collected and analyzed, and a multi-media GIS was in the early stages of production<sup>11</sup>. The project is funded by the National Science Foundation and is concerned with participatory applications of GIS in support of the redistribution of natural resources in post-apartheid South Africa. Regional political ecology is the conceptual lense

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<sup>9</sup> An example of this is the Spatial Development Initiative (SDI) which has become important for regional planning and funding for specific projects in South Africa. The adoption of SDI was facilitated by impressive maps produced with a GIS (CSIR, 1997). As part of the SDI, the CSIR and others modeled Provincial growth strategies and their likely spatial impacts. SDI in South Africa is a classic growth-pole regional development strategy.

<sup>10</sup> Participatory projects that incorporate GIS and GIT are becoming more common in all regions of the world. South Africa is no exception.

<sup>11</sup> Participatory map interpretation exercises will take place in July of 1999 when case study sites will be revisited with GIS products for additional mapping workshops.

through which the research is conducted.<sup>12</sup> Mapping and analyzing geographies of struggle, the local politics of land and water use, and future “environmental imaginaries” (Peet and Watts, 1996), are central to this research. The overall project is an experiment conceptualized in Community-Integrated GIS (CiGIS), which is discussed in some length below.

## **GIS and Society and Public Participation GIS**

In *Digital Places*, Michael Curry (1998: 143) writes:

Connected in part to another goal, of developing systems that might be more appropriate to public participation, by neighborhood and environmental groups for example, advocates of GIS2 have suggested the possibility of a reformulation that will meet the needs of these groups, while at the same time skirting the various problems that they see as attending current, or what might be termed ‘PaleoGIS.’

This is a broad claim that is curious. The concept of GIS2, or alternative community-based geographic information systems, emerged in the context of GIS and Society discussion and debate and draws heavily upon the concerns and challenges arising out of this literature (Harris and Weiner, 1996; 1998; Pickles, 1999; Schroeder, 1996). These origins are important because Public Participation GIS (PPGIS) and its current directions cannot -- and certainly should not -- be conceptually, empirically or politically disconnected from core GIS and Society concerns.

The early prominence given to PPGIS is perhaps as much associated with the desire to address the criticisms leveled at established GIS as to explore alternative forms of GIS production, use, access, and representation. That PPGIS originated within the GIS and Society discussion has been invaluable in identifying critical issues and in guiding the design of alternative systems for implementation. In developing the concept of PPGIS the desire has been to address structural deficiencies identified as inherent in contemporary GIS. These deficiencies have been well documented in GIS and Society research and writing (see for example: Aitken and Michel, 1995; Chrisman, 1987; Crampton, 1995; Curry, 1994, 1995, 1998; Dobson, 1993; Dunn et al, 1997; Edney, 1991; Goodchild, 1991, 1995; Goss, 1995a, 1995b; Harvey and Chrisman, 1998; Harris et. al, 1995; Harris and Weiner 1998; Krygier, 1996; Lake, 1993; Mark, 1993; Obermeyer, 1993; Onsrud and Rushton, 1995; Openshaw, 1991, 1992; Pickles, 1991, 1995, 1999; Sheppard, 1993a, 1993b, 1995; Smith, 1992; Taylor, 1990, 1991; Taylor and Johnston, 1995; Taylor and Overton, 1991, 1992; Yapa, 1991). The remote sensing community is also engaged in these debates (Liverman, *et al*, 1998).

The very nature of PPGIS has forced researchers to not only confront GIS and Society concerns, but to design and adapt GIS that might meet some of the needs of participant communities. While the overall characteristics of PPGIS are becoming clearer, defining specific components of PPGIS is no easy task. As a result, a diversity of approaches to PPGIS implementation are

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<sup>12</sup> In subsequent papers, relevant political ecology literature will be reviewed and linked conceptually with the research results.

emerging (Leitner, *et al*, 1999). In general, we suggest that PPGIS is characterized by a focus on:

- design of systems that specifically seek to empower communities and individuals and encourage public participation in GIS-based decision-making;
- integration of the rich knowledge base of communities, while minimizing the structural knowledge distortion of traditional GIS applications;
- systems and structures that provide for public access to GIS information;
- provisions for public input and interaction in the GIS decision-making process with concomitant reduction in the enforced public passivity in decision-making arising as a direct result of the technology itself;
- research that acknowledges and seeks to minimize the surveillant capabilities and potential intrusiveness of GIS into the private and confidential life of individuals;
- innovative techniques and mechanisms such as scientific visualization and GIS-multimedia that incorporate and represent differing forms of quantitative and qualitative knowledge in the GIS knowledge base;
- Geographic Information System integration with the WWW.

How PPGIS might be designed and produced to address these issues has led to creative and enthusiastic discussions focused on the technology as well as on the institutional structures within which PPGIS might operate (Obermeyer, 1998; Craig *et al*, 1999). Researchers have begun to disentangle some of the threads that were woven into the early enthusiastic discussions on PPGIS. There are, however, many areas within PPGIS in which greater clarity is required and for which this paper seeks to extend understanding.

Perhaps one of the most crucial elements of PPGIS is the actual nature of the public participation process itself. Participatory research is an extensive research field and an application domain in its own right. Although there is a significant literature on public participation, it is perhaps the least understood component of PPGIS (Abbot *et al*, 1998). Merging participatory research methods with GIS is occurring rapidly. Specific PPGIS design, content, structure, and implementation is being conditioned by the nature of the public participation process, the specific applications and technologies employed, and the cultural context of its production and use. Like GIS itself, PPGIS will exhibit both general application characteristics as well as unique context-dependent features. For these reasons, as PPGIS projects evolve we expect to see many differing forms of participation and participatory GIS emerging (see for example: Casey and Pederson, 1999; Craig and Elwood, 1998; Cultural Survival Quarterly, 1995; Hutchinson and Toledano, 1993; Elwood and Leitner, 1998. Gonzalez, 1995; Jordan, 1999; Jordan and Shrestha, 1998; Mitchell, 1997; Kwaku Kyem, 1999; Laituri, 1999; Parker, 1999; Stonich, 1998).

We foresee several contentious issues coming to the fore as PPGIS projects are pursued. We have suggested before that GIS has been so successful to date because it has been used to generate one perceived logical and objective outcome (Harris and Weiner, 1995). PPGIS is unlikely to achieve similar simplistic outcomes. Very real questions revolve around who should control or operate a PPGIS and to what extent PPGIS can contribute to building local capacity. Again we argue that differential resources and access issues are of such importance that we

propose a form of PPGIS that would likely be based within agencies or institutions having statutory responsibility and resources to sustain the system. This again has obvious implications for the design, content, and purpose of a PPGIS. Certainly, blending qualitative and quantitative information and providing mechanisms for representing multiple forms of knowledge is a challenge to current GIS. It should not be assumed that PPGIS would be beneficial in all situations, and some circumstances will be more appropriate than others. This poses the question as to the situations in which PPGIS should be employed.

Issues of confidentiality and privacy are unlikely to be resolved through PPGIS and indeed, might even be exacerbated. To date it has been assumed that the surveillant nature of GIS empowers business and the state. However, with the establishment of local community systems that capability is transferred to neighbors and new mechanisms and norms need to be established to promote the flow of information and yet protect the rights of individual privacy. There are, of course, technical and software challenges for the design of PPGIS. At the Initiative 19 workshop it was proposed that this could range from an acknowledgement and sensitivity of the issues using existing technology (GIS v1.0), to minor modifications and system developments (GIS v1.2), to completely new software designs (GIS v2.0). Thus it is clear that more questions surround PPGIS than have been answered to date.

Finally, what might be the unintended consequences of establishing a PPGIS? We have contended elsewhere that GIS, like many technological innovations, is contradictory in that it both marginalizes and empowers people and communities simultaneously (Harris and Weiner, 1998). As with the misrepresented Luddites it is not the technology *per se* that triggers concern, so much as the social, economic, and power relations that are changed as a result of a technological innovation. We see these changed power relations as fundamental to GIS and Society research and equally applicable to PPGIS. For example, providing communities with greater access to data about their own area, while a laudable goal also simultaneously increases the capability for greater surveillance by residents over their community neighbors. Likewise, empowering groups through GIS technology can also simultaneously disempower historical leaders of those communities who are uncomfortable with computer technology. Will the championed PPGIS empower a new technical elite and thereby act to reinforce an information underclass? This GIS-empowerment-marginalization nexus is most evident in PPGIS and identifying the unintended consequences of PPGIS will likely be one major component of PPGIS research as well as monitoring and evaluation.

### Community-Integrated GIS

Designing a PPGIS in the light of the GIS and Society critique is no easy task. Our PPGIS research in South Africa has provided invaluable insight into these challenging issues. While acknowledging that 'public participation' will take many forms, for a number of reasons we are developing a community PPGIS in a slightly different form to those arising in other PPGIS applications (Harris and Weiner, 1998). This is especially so in comparison with projects in which the GIS technology is largely deemed to rest in the hands of, and be operated by, the community itself. Our approach was born of our experiences in South Africa. In pre-1994 South Africa, the hegemonic power relations embedded within GIS were eminently apparent. Grand

Apartheid was in essence a geographical project and it was through the agencies of the State that apartheid was implemented and maintained. Control over geographical information by 'white' state agencies clearly placed the technology far from the realms of a value neutral and objective system. In addition, the surveillant capabilities of GIS, knowledge engineering and the control of populations, along with concerns over privacy and confidentiality was also clearly apparent. Structural knowledge distortion and the emphasis on top-down knowledge; the pre-eminence given to western forms of knowledge representation; the commodification of data and its control by spatial data institutions and a bureaucratic informational complex were all significant issues in apartheid South Africa. As the current scramble for data and GIS in post-apartheid South Africa demonstrates, the technology and data is deeply embedded within the country's historical politics and power relations.

With this as background our PPGIS research was grounded in reality at a very early stage. The logistical and practical problems arising from differential access and limited local capacity had a major influence on our conception of PPGIS. GIS require significant resources to acquire and maintain an operational system and these resources have largely been only available to state and private business, though this situation is slowly changing. Furthermore, significant though these resources are they are dwarfed by the cost and difficulties involved in acquiring the spatial data necessary to populate a GIS at appropriate geographical and temporal scales and with sufficient attribution to meet the needs of the user community. In the United States it is certainly not beyond the capability of a skilled individual to acquire the necessary computer and software resources to develop a GIS project. The U.S. is also fortunate in having a number of national spatial databases available at nominal or no cost. Furthermore, the Framework concept promoted by the Federal Geographic Data Committee and the National Spatial Database Infrastructure Committee (NSDI) is facilitating the development of a national spatial database and the dissemination of spatial information through the clearinghouse concept. This constitutes a national structure in which local, regional, and national spatial data resources can be shared and exploited.

However, the reality that small groups or communities, especially if impoverished or underfunded, will have the resources and expertise, or even the desire, to develop, maintain, and operate long-term GIS is problematic even in western industrialized societies. Though commendable in spirit, the practicalities of implementing a PPGIS would suggest such an option is only selectively feasible at this time. In our South Africa research, this issue assumes considerable importance. Essentially we are seeking to develop PPGIS capability in communities that are struggling to meet daily basic needs. Seeking to implement a PPGIS in these circumstances has influenced our conception of what PPGIS might be. While the experience of our South Africa research may seem extreme and unique, until a broader array of PPGIS implementations take place in a variety of social, economic and political contexts, there is much to suggest that our experience may be less exceptional and closer to reality, even in highly industrialized societies, than we may currently realize. In this we see an important need for PPGIS projects that are grounded in fieldwork and evaluate critical socio-economic, political, technical and institutional impacts of specific PPGIS implementation.

In the light of our work in South Africa, then, we propose an extension or variation to PPGIS in the form of Community-Integrated GIS (CiGIS). CiGIS seeks to broaden the use of digital

spatial data handling technologies with the objective of increasing the number and diversity of people who participate in spatial decision-making. This necessitates that the production of GIS is made inclusive and that local socially differentiated community knowledge be incorporated into the GIS knowledge base. In this respect, CiGIS recognizes GIS as an 'expert' system but extends the capacity of the technology in the context of people and communities normally peripheral to spatial decision-making processes and politics. To incorporate local knowledge CiGIS must extend beyond the cartographic and attribute information traditionally associated with GIS to incorporate knowledge in a variety of forms. The GIS thus becomes a forum around which issues, information, alternative perspectives and decisions revolve. One significant difference here is the explicit integration of a community's knowledge and involvement into the system that complements the traditional spatial information generated for GIS. In this way the knowledge distortion and elitist representations typical of contemporary GIS will be redressed and communities are integrated into the system. Given the earlier discussion on differential access to resources, one important point to note with our concept is that the production and use of CiGIS assumes that the system will likely be agency-driven and developed and maintained by an agency with statutory responsibility and concomitant resources. As a result the practicality as to who maintains and operates the GIS remains vested in the agency but the GIS is not dominated by 'top-down' information nor privileged solely toward conventional scientific 'expert' knowledge. With CiGIS, communities are represented or 'integrated' within the GIS through the inclusion of local 'expert' knowledge that incorporates socially differentiated multiple realities of landscape. This integration of geographic information systems with non-traditional qualitative forms of knowledge implies the greater integration of GIS and multi-media. The *production* of CiGIS is also made more inclusive.

As a result, Community-Integrated GIS:

- is likely to be agency-driven, but it is not top-down nor privileged toward traditional scientific knowledge
- addresses questions that participant communities feel are important
- assumes that local knowledge is valuable and expert
- broadens the access base to digital spatial information technology and data
- incorporates communities in the production of GIS
- assumes socially differentiated multiple realities of landscape
- integrates GIS and multi-media
- assumes the potential for more democratic spatial decision-making through greater community participation
- assumes that spatial decision-making is conflict-ridden, embedded in local politics, and is issue-driven

CiGIS provides an arena in which local landscape politics and resource management issues are played out openly rather than through the more traditional spatial decision-support system. CiGIS must therefore be capable of incorporating the many varied forms of knowledge without sole reliance on the map as the only mode of representation. In this respect the system is considerably more sensitive to the forms in which local knowledge is found. Linking narratives, oral histories, photographs, moving images, and animation, to GIS provides enormous capability to increase not only the richness and diversity of the information available but also more closely

parallels the manner in which communities know or conceive of their space. We propose therefore, not a replacement of existing agency responsibility for local GIS but a redefining of what such systems might 'look' like and how they might be extended into communities to achieve greater public participation and ownership. We have found state agencies in South Africa to be extremely receptive and enthusiastic toward such an approach.

## **Mpumalanga Case Study**

The Mpumalanga Province is a transitional area between the relatively cool and moist highveld plateau (over 1200m altitude) and the hot and dry lowveld (200-600m altitude). Mean annual rainfall ranges between 400-700mm in the lowveld to 1000-1500mm on the escarpment and parts of the highveld. These environmental features, combined with the history of colonial and apartheid forced removals and forced urbanization have produced a landscape of extreme social and ecological variation (Figures 2 and 3). The total population of the Province is over three million. Only one-third of these people live in urban areas and almost half reside in the former homelands (Central Statistical Services, 1996).

The case study area, the Central Lowveld sub-region, is located mainly within the Lowveld Escarpment District of Mpumalanga Province, but also includes a small portion of Bushbackridge to the north. The latter is disputed territory in Northern Province and includes portions of the former Lebowa and Gazankulu homelands. There is currently a struggle by some local residents and politicians to become part of Mpumalanga. This desire comes in part from the historical patterns of political organization in the former Eastern Transvaal, the relative proximity of the Provincial capital Nelspruit, and the reality that people are more economically connected to Mpumalanga.

Intensive and exotic industrial forest plantations and large-scale commercial fruit and vegetable farms dominate the western third of the case study area. Some of these are located on land of high arable potential. Forestry companies also control large tracts of state land in the area, which is a very important land use issue discussed later in the paper. Forest plantations and large-scale commercial farms thrive on a highly skewed system of water access. During the apartheid era, the social production of this watershed was centered on a complex system of dams and tributaries (Figures 2 and 3). These dams capture valuable water for (mostly white) large-scale commercial farms (Woodhouse, 1997). The re-engineering of Central Lowveld hydrology was a lifelong project of the influential apartheid architect, Braum Raubenheimer.<sup>13</sup>

The former homelands of KaNgwane, Gazankulu and Lebowa are located east of the agriculture and forestry plantations. These bantustans remain overcrowded and poorly serviced relics of grand apartheid. Land demand is high, water is in short supply, and the history of forced removals remains fresh in peoples' memories and imaginaries. Historically, political struggles have been connected to the ongoing decline in access to land, water and biomass resources (Levin *et al*, 1997). Approximately one-quarter of the 477 households interviewed in the case study area in 1993 were a direct victim of at least one forced removal. Furthermore, over three-quarters of the sample population expressed the desire to participate in a land reform program.

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<sup>13</sup> Braum Raubenheimer was former Minister of Water Affairs, and a project participant.

Over 40% had to travel more than 100 meters to access water (Weiner, *et.al*, 1997). The combination of local knowledge and hydrological data indicate reduced water flows to the former homelands has occurred over time (Weiner, *et. al*, 1995; Woodhouse, 1997). This has also happened at a time when water demand associated with peri-urbanization is growing rapidly.

The Kruger National Park and private game parks occupy the eastern portions of the case study area. Since 1994, tourism has again become a growth industry and visitors to the Mpumalanga and Northern Province Lowveld are growing. The use of land for game tourism has generated interesting discussion within the region regarding the potential for community-based range management models. Many of the participants we spoke with, however, perceive limited personal benefit from adjacent game parks.

Our CiGIS fieldwork is ongoing and includes a diversity of rural production systems and relations of production. Within the former homelands, project participants include groups from five locations with various relationships to the Government's land reform program (Figure 3). They are:

*Cork Village and Nkuna Tribal Authority:* This site is located in the former Gazankulu about 40 kilometers west of the Kruger National Park. It is the driest of the study sites and also the poorest. The area has a history of internal conflict between the chiefs, their patrons and elements of the liberation movement. There is great land hunger, but there appears to be limited knowledge about the Government's land reform program. The area is part of Bushbackridge, which is disputed territory.

*Friedenheim Farmworkers:* The owner of this farm was a project participant and allowed us to conduct a workshop with a small group of farmworkers. The farm is located near Nelspruit and produces fruit, vegetables, tobacco and beef.

*Masoyi Tribal Authority:* Located in the former KaNgwane homeland, the Masoyi claim to have been forcibly removed several times. The first wave of removals took place during the Anglo-Boer war. Tribal lands were once again expropriated when the Kruger Park was extended. The Masoyi chief and elders recently filed a claim to the regional land claims commission for a large piece of territory. The tribe wants their ancestral land restored and some compensation for land that can not be returned.

*Masizakhe Land Redistribution Project:* This land redistribution project was established in 1997. A 28-hectare land parcel was purchased with a Government settlement grant and 80 beneficiaries were resettled. Eight of these 28 hectares can be irrigated. An additional eight hectares can be used for dryland production. At the present time, the main economic activities are vegetable and poultry production and a service garage.

*Sitama Impilo Land Redistribution Project:* This redistribution project includes 100 beneficiaries and 80 hectares of land. Most of the land is arable and available for irrigation. Land quality also appears to be high. There is a large house on the property and three dams. This land had not

been formally allocated to the Sitama Impilo Farmers Association when the first interviews took place in July 1998.

*White Farmers:* Seven (male) white farmers were interviewed through a difficult process of networking. The name and location of white farmer participants is located in Figure 4. All are large landowners and some own more than one farm. In previous research, we sought to include the perspectives of local large-scale commercial farmers, but the tense political and security situation prevented this.

## **Project Goals, Research Design and Methodology**

The project has five broad goals. These are:

- Incorporation of socially differentiated communities into GIS production and use;
- Integration of ‘local’ and ‘expert’ knowledge within GIS;
- Explore ways to represent natural resource power-relations and politics within a GIS;
- Build a multi-media CiGIS and explore Internet GIS;
- Contribute towards CiGIS capacity building for land reform in South Africa.

To help achieve these goals, five conceptual questions were developed to provide research focus and direction. The questions were derived from participatory research in the sub-region. They reflect an ongoing interaction between the project team and a diversity of community participants.

*1) The historical geography of forced removals:* The key issue here is to broadly identify Central Lowveld histories of forced removals and to better understand overlapping land claims. Forced removals remain an important part of peoples’ contemporary poverty, future aspirations, and, political consciousness. Mapping the historical geography of forced removals is essential for understanding Central Lowveld regional political ecologies and for popular land reform implementation in the sub-region.

*2) Differential perspectives on land potential:* Land users have differing perspectives on the criteria and location of ‘higher’, ‘medium’, and ‘lower’ potential land. Defining land potential is linked, of course, to participant perceptions of what land potential means and how land should be used. This is important, because perceptions of land potential help shape land utilization. Understanding differential perspectives on land potential also includes a comparison of ‘expert’ and ‘local’ knowledge.

*3) Identifying perspectives on socially appropriate and inappropriate land use:* We are concerned here with understanding Central Lowveld land use from the perspective of peoples’ needs and aspirations. This includes identifying and questioning the use of state land, underutilized land, the inappropriate location of forestry and other land uses on high potential land, as well as perspectives on land for game tourism. We are also interested in how land reform beneficiaries and potential beneficiaries would prefer to use land they gain access to.

4) *Politics and power relations that help shape natural resource access, ownership and use patterns.* We are interesting in how regional political ecology can be represented within a GIS. A multi-media GIS will enable representations of landscape power and politics to be incorporated into GIS data collection and spatial analysis by linking peoples' social histories, material lives, and future aspirations with specific geographic features of place.

5) *Identification of areas where land reform should take place:* The purpose here is to use the CiGIS for the identification of potential land reform projects. At present, willing sellers (at often inflated prices) are dictating where land reform can take place. As a result, the geography of land reform is overly market-driven and not guided by principles of social and economic sustainability.

The research methodology combines the construction of a traditional GIS with participatory methods. Traditional GIS coverages include: hydrology and dams; transportation; hypsography; land cover; nucleated settlements; land types and land quality; political, recreation, and cadastral boundaries; state and public lands; forestry plantations and forest tree species. Socially differentiated local knowledge is being compiled through participatory mental mapping exercises. This involves the use of tracing paper overlaid on topographic map sheets and GIS map products.

Participant group views on the five conceptual questions are recorded on the tracing paper. Pencils and colored markers are used so that each question has a particular color code (for example, answers about forced removals are drawn in black, while answers about land potential are drawn in green.) In this way, community maps can later be connected with the five conceptual research questions. Corresponding register marks are established on the tracing paper and the base map, and both the tracing paper and the base map are given identical labels to aid future identification and/or (re)orientation, if need be. The information has been digitized and integrated within the CiGIS. The mental mapping workshops usually included between 5-8 people in which groups of men and women were interviewed separately.

After completion of the mental mapping work, participatory land use planning exercises were undertaken. The mens' and womens' groups were asked to draw a map of how they would like to use land if they had access to land in a land reform program. This exercise involved three types of residents in the former homelands: (1) participants who have already benefited from the land reform program (Masizakhe and Sitama Implilo) (2) participants who have submitted their claims and are yet to benefit (Masoyi); and (3) non-beneficiaries (Cork/Nkuna and Friedenheim Farmworkers).

The mental mapping exercises were recorded on tape and are now being transcribed. Video recordings and photographs were also taken. This multiple information is now being integrated into a GIS multi-media format as mutually supportive and complementary data. This multi-media CiGIS has the potential to become a useful tool for more broad-based decision-making around land reform (Figure 5).

## Preliminary Research Results<sup>14</sup>

Some preliminary research results are provided in this section, and are discussed in the context of the five conceptual questions that guide this work. We are still collecting contemporary and historical GIS data, and additional mental mapping workshops will take place in July 1999. As a result, we do not attempt to provide firm research conclusions at this time. We do, however, explain in part how we seek to further probe the key research questions using multi-media GIS.

### *The Historical Geography of Forced Removals*

“The river used to be the main source of water, then villages were apart. We had our homes, villages, land. I remember where we moved from, the land was fertile” (Participant in Sitama Impilo men’s workshop, July 1998)

One-quarter of the population in the study area have experienced at least one forced removal in their lifetime and land hunger in the sub-region is prevalent (Levin, *et al*, 1997). More than half of the Central Lowveld homeland residents interviewed in 1993 told us that they would be willing to move their residence if relocation would improve their access to land (Weiner *et al*, 1997). In this project, CiGIS participants remain willing, even anxious, to talk about the historical geography of forced removals. White farmers, however, were reluctant. The mental maps of whites and blacks in the sub-region are compared in Figure 6. The maps suggest very different perceptions of Central Lowveld landscape history. Forced removal mental maps for black participants indicate a concentration of perceived removals in the southwest quarter of the case study area. One explanation for this pattern might be that communities evicted from areas north and west of Hazyview are not project participants. Previous research found that the entire western half of the case study area has had widespread forced removals, particularly in places with arable land and adequate water supply (Levin *et al*, 1997). The white farmer mental maps show a few small areas where blacks were removed, and a small area where whites were removed, most likely for homeland expansion.

In Figure 7, mental maps from three workshops with Masizakhe men and Masoyi elders are compared. The maps are interesting for a number of reasons. The men had a deep knowledge of historical landscapes and the ability to broadly geo-reference their experiences and memories. The possibility of overlapping claims is also evident in the mental map comparison. This is a problem in many locations where forced removals were widespread and this contributes to the slow pace of land restitution.<sup>15</sup> The men’s mental maps also offer complementary interpretations of historical dispossession. For example, the Masoyi second removal was discussed and mapped in two separate workshops – one with the Masoyi elders, and the other with Abel Mogoane. Mr.

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<sup>14</sup> Fieldwork for this section of the paper was performed in June and July of 1998.

<sup>15</sup> The South African Land Reform Program has three parts: (1) land restitution; (2) land redistribution; and (3) land tenure reform. Restitution is for forced removal reversals and has proven to be very slow and difficult to implement.

Mogoane is very knowledgeable about the sub-region and seemed to enjoy the individual mental mapping workshop we had with him.<sup>16</sup>

To improve the database on forced removals, historical data on the location of ‘huts’ on Government generated 1:50,000 topographic maps dating back to the 1960s are currently being digitized. These data show some of the consolidation of black settlement within rapidly expanding peri-urban settlements. The official maps appear to underestimate the geographic extent of forced removals because black settlements were rarely indicated on the map. This is not surprising, of course, as it would be illogical for the Apartheid State to publicly document the location of communities that were in the process of being removed from ‘white’ territory. It is also our intention to analyze aerial photographs for additional investigation of when and where forced removals took place. Digital times-series data on peri-urban settlement locations are also being collected and analyzed.

### Land Potential

Land types data obtained from the Agricultural Resource Council (ARC) of the South African Institute of Soil, Climate and Water are presented in Figure 8. We used the Institute’s soil classification and slope information to establish four land potential categories.<sup>17</sup> Forty-three percent of the study area is classified as land of ‘higher’ agricultural potential, while 17 percent is ‘medium’ potential and 40 percent is ‘lower’ potential. This representation of ‘expert’ knowledge about land potential locates the fertile river valleys from which Africans tell us they were forcibly displaced. It also identifies large portions of land that have a slope constraint for mechanized agriculture but, importantly, could be very attractive for smallholder farmers that use animals and hoes. We would expect an operational CiGIS in the region to help locate viable higher potential slopes for smallholder production.

The peri-urban black settlement is located on higher potential arable land. Interestingly, participants have told us that the area of black settlement located on high quality land to the immediate south of Hazyview is where chiefs removed blacks. This was done to enable members of the tribal authority and local black businessmen to access this better land (Weiner, *et al*, 1995). The settlement and land potential information also provide a useful perspective on the spatial patterning of this labor reserve economy.

In Figure 9, the land potential of public lands in the sub-region is displayed. More than two-thirds of this land is of high quality; 31% of all state land in the case study is higher potential without a slope constraint. Only 24% of state land are of lower potential. Large parcels of this land are used for forestry plantations - a land use that is very unpopular amongst participants in the former homelands (see discussion below). The extent and location of public lands are important because this is land that the state may have access to. As a result, this information could have political impacts in the sub-region. Figure 10 compares ‘expert’ and ‘local’

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<sup>16</sup> We did not plan on an individual workshop with Able. When we arrived for a group interview, we were informed that because of a local dam break, there were some temporary jobs made available. Able is disabled and stayed at home. We interviewed the other men as a group one-week later.

<sup>17</sup> 12% is the cut-off threshold used by ARC scientists.

knowledge about land potential, although the map remains difficult to interpret. The composite mental maps of higher potential land produce a pattern that is similar to that produced with the ARC lands types data. There are, however, some notable differences. For example, black and white local knowledge suggests that the river valleys to the east along the Sabie River also are surrounded by land with higher potential.

### Land Use

Participants in the former homelands wanted to discuss and map land use issues because they are angry about the perpetuation of apartheid geographies in the Central Lowveld. For example, there is overwhelming hostility towards forestry land uses, particularly on higher quality arable land with little slope constraint. The Sitama Impilo women participants wrote on their mental map: “cannot eat from trees” and “can be more appropriately used to produce food” (Figure 11). The women from the former Gazankulu homeland agree (Figure 12) also expressed concern about the Kruger National Park. The park is only a few kilometers away, yet they do not perceive tangible benefits. These women also complained about water supply and told us they believed that the Sabie River has been deliberately stocked with crocodiles to keep them away from the water as it flows towards the parks. A young woman was recently killed in a crocodile attack.

Participants from the former homelands also drew their own land use plans. The Sitama Impilo women (Figure 13) produced a complex land use plan that included farming, grazing, irrigation, farm labor housing, a school and a nursery. The men (Figure 14) devoted a large portion of their land to vegetable and fruit production, while also allocated land for tobacco production and barns. These and other participatory land use maps suggest that the demand for land is for multiple purposes: housing; food production for local consumption; agricultural production for sale; shops for the community; and tourism. In the former Gazankulu (Cork/Nkuna Tribal Authority), men also wanted to use land for game tourism, while the women were more concerned about food production. The Masizakhe men located a hotel and gas station on their property, while the Masoyi men allocated land for a game reserve, park, and day-care center. Overall, women devoted more land for food production than did men, but both groups had multiple livelihoods embedded in their plans. These peoples’ land use maps send a very clear message to planners of land reform in South Africa: beneficiaries and potential beneficiaries view themselves as worker-peasants, and not one or the other as so many planners try to impose. The land use maps are a reflection of the material relations of production of the participants combined with their dreams and aspirations.

### Land Reform

Towards the end of the mental mapping workshop, we asked participants where they felt land reform should take place. To respond to this question, the Masizakhe men and Masoyi elders created mental maps from higher scale base maps (Figures 15 and 16). These men had concrete ideas and proposals about where land reform should take place and strong opinions about how land should be used. For example, the Masizakhe men told us that, “The first attempt should be to take out the trees and pines and make that land available. There is a lot of high potential flat

land, which could be used.<sup>18</sup> The bananas and other foods which are produced should be left alone.” This acceptance of large-scale commercial fruit and vegetable production and the objections to industrial forestry is interesting and important. The Masizakhe women also have strong feelings about the need for land reform. In their workshop, one woman summarized as follows: “We want farming land and need fencing to protect crops from animals. We need grazing land for cattle...[and] a separate place for cultivation.”

The Masoyi elders and Masizakhe men are in agreement that a significant quantity of land must be returned to the people who lived there previously and were forced to leave. Once again we were told how fundamental land is for them. For many residents of the former homelands, their ancestral lands remain in (former) white territory. Land is also critical for their social reproduction and prospects for individual, household and community wealth creation. Some participants expressed a preference for land close to where they live. This is a logical preference for these aspiring worker-peasants and a desire that was repeated at other workshops. There is also a deep understanding that land reform must also ensure greater access to water for residential and agricultural uses.

A composite land reform mental map is displayed in Figure 17. It suggests that white farmer and black women perceptions of “where land reform should take place” are much more modest when compared with black male participants. The Sitama Impilo men drew the most ambitious map in terms of territorial extent. The men in general drew maps that reflected their desire to see a comprehensive and extensive redistribution of natural resources. White farmers are much less enthusiastic about land reform and some became tense in interviews when land reform was discussed. They did talk openly about the deteriorating farm security situation, however, and were clearly concerned. Some Mpumalanga farmers and their families have been attacked and as nothing was stolen from their property this suggests a political dimension to some of the violence.

### Summary

Numerous images have been included in this paper to provide examples of preliminary CiGIS research products while introducing a few project participants and sub-regional landscapes. The images also help to explain the multi-media CiGIS methodology that we have developed. The Central Lowveld CiGIS is experimental and still under construction. It is our hope that, over time, this research and institutionalized CiGIS capacity will contribute toward the formulation of popular land reform projects in the sub-region. Some progress has been made to date with this objective.

CiGIS multi-media information about this “neo-apartheid landscape” (Pickles and Weiner, 1991) is useful for unpacking some critical elements of Central Lowveld political ecology. For example, combining conventional ‘scientific’ data with local understandings of land potential improves our understanding and the multiple dimensions of the agro-ecological potential of the sub-region. The Central Lowveld CiGIS clearly identifies fertile river valleys and adjacent higher quality soils. This pattern is consistent with what we have been told by black and white

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<sup>18</sup> When land use data is added to the Central Lowveld CiGIS, we will be able to further explore this common local concern about the use of high potential arable land for industrial and exotic forestry plantations.

participants; another example of ‘expert and ‘local’’ knowledge(s) being in agreement. The ‘expert’ view on land potential, however, does not identify areas of higher potential land adjacent to some perennial river valleys in the eastern half of the case study area. African people once inhabited these valleys and their ancestral territories remain there. The elders in particular know where better soils are located.

The social and spatial consequences of forced removals are visible in the maps and narratives on removals, as is the spatial extent of peri-urbanization in the former homelands. The mental maps of forced removals suggest a complex patterning with overlapping land claims and important differences between what white farmers and bantustan residents perceive as local landscape history. Community land claims also point to a re-energized Chieftancy and Tribal Authority. This political reality will have a significant impact on how land is redistributed, who the primary beneficiaries will be, and gender relations in the countryside.

The use of higher potential land for exotic forestry plantations and residential housing for displaced blacks are two contradictions of grand apartheid land use that continue to intensify.<sup>19</sup> High potential arable land is scarce in South Africa, and malnutrition is high. Approximately 15% of the total national land area are suitable for dryland or irrigated agricultural production. This is one reason why participants from both races and genders agree that higher potential arable land needs to be preserved and used wisely. The CiGIS also identifies land that is potentially underutilized. This is critical information for the implementation of land reform.

Preliminary research also points to some interesting, but possibly politically sensitive land use ownership and control issues. In particular, the extent of public land in the sub-region and the reality that some of this land is the ‘flat land’ identified by participants as inappropriately used by forestry plantations is a valuable finding. CiGIS can help with the identification of where land reform might take place in this and other ways. For example, participants in a few workshops were consistent in their complaints about the forestland immediately to the north and west of the town of White River. Black men and women thought this land would be more effectively used for intensive smallholder production. The Masizakhe women also identified what they believed was underutilized land owned by an absentee landowner nearby. They would like to use this land to grow vegetables for the home and market. The Central Lowveld CiGIS also records how participants view their landscape and specific land uses, and can help to interpret land use changes that are empirically observed, but puzzling. The relationship between farm violence and large-scale cattle de-stocking is an example of how a CiGIS can help understand puzzling empirical data on land use changes.

A final summary point concerns the complex issue of scale. Most of the mental maps presented in this paper are peoples’ interpretations at a sub-regional scale using a base map of 1:100,000. More detailed and localized maps at 1:24,000 were also used in the workshops (Figures 15 and 16). When constructing a CiGIS, it is important to consider what is an appropriate scale(s) for a variety of purposes. This determination should be done in the field with participant involvement.

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<sup>19</sup> Mapping and analyzing the historical intensification of land use associated with rapid urban settlement growth will be an interesting CiGIS product.

## Conclusion

This research contributes to the growing GIS and Society literature while also offering some lessons for the implementation of a CiGIS for land reform in South Africa. Rapid growth of GIS and geographic information technologies (GIT) are transforming how ‘earth’ and environment’ are visualized, represented and understood. As a result, GIS/GIT applications can alter how people view, exploit and manage the physical resource base. The origins of GIS are, of course closely connected with LIS. Furthermore, most contemporary GIS incorporate some environmental information and environmental applications of GIS continue to grow in importance and impact. We find it strange, therefore, that GIS and Society research and writing continues to be so silent on the relationships between GIS/GIT, nature and environment. Geographic information systems produce representations of nature that privilege conventional forms of ‘scientific’ spatial information, including data on the local environment. As a result, the politics of landscape and the social production of nature are ignored and valuable local knowledge tends to be further marginalized.

Community-integrated GIS assumes that specific applications are driven with active and ongoing community consultation and that particular CiGIS types are context dependent. The Central Lowveld CiGIS adds landscape politics and struggles into a GIS through the integration of a variety of information types, and the involvement of a diversity of communities. Alternative ways of knowing and exploiting nature and environment are incorporated. The Central Lowveld participatory research is welcomed by former homeland residents who continue to seek “socially appropriate land use” (Weiner *et al*, 1995) for their new nation. They have suffered dearly due to apartheid forced removals and the dramatic reductions in access to natural resources for their production and reproduction. The seven white farmer participants were, however, more reluctant to participate in the project. They came and talked, but clearly were apprehensive about our focus on land. They appear to be very concerned about the political and security implications of changing Central Lowveld landscapes of access and power.

Another important research conclusion is that it is not possible to successfully implement a CiGIS living 9,000 miles away. The production of a CiGIS that is genuinely incorporated into local civil society requires continual contact between the research team and community participants. Both map-making and spatial analysis needs to involve community participants regularly; ideally, they should be part of the group that collects, organizes and analyses spatial data and other relevant information. This is why one of the products of this research is a follow-up project based in Mpumalanga Province. A team based in Nelspruit, the capital of Mpumalanga Province, is initiating a CiGIS project. The project will be located in Strategic Planning and Development Unit of the Premier’s Office, where the Government’s Provincial GIS is housed. The project team includes representatives from the Provincial Departments of Land Affairs and Agriculture, the Land and Agriculture Policy Center in Johannesburg, Lowveld Escarpment District officials based near Hazyview and the WVU team. It is hoped that this new initiative will help to institutionalize a CiGIS within the Province. The initial intention is to use a CiGIS for the implementation of land reform projects. The team expects to apply this alternative GIS to other Provincial projects as well.

It will be important to observe which groups and individuals become CiGIS beneficiaries and who become threatened and/or further marginalized by its implementation. The type of CiGIS produced will ultimately be determined by the nature of the participatory process employed and the place where it is implemented. *Participation for legitimization* supports traditional developmentalism and elite-driven spatial decision-making processes and politics. Participation becomes an information source, a data overlay in the case of GIS. The World Bank and other hegemonic ‘development’ agencies are promoting this form of engagement with communities. There is also *participation for publication*, which is what we do as academics. Participation for publication is driven by the desire to ‘capture’ local knowledge. This form of exploitation is growing and becoming a serious problem in some regions of the periphery. Communities are getting tired of talking to researchers and receiving nothing in return.<sup>20</sup> *Popular participation* is connected to existing organs of civil society and involves a commitment to grassroots concerns and the broad-based success of specific projects. Popular participation is driven by the key issues of participants and assumes that local knowledge can be conflictual. The relationship between the project team and participating communities, and how that team is constituted, combined with an ability to engage in meaningful policy and project issues at the local level will, over time, determine whether participatory forms of GIS and GIT are an “opportunity or an oxymoron” (Abbot *et al*, 1998).

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<sup>20</sup> From a 1998 conversation with Robert Chambers, a leader in the participation paradigm shift of the last 25 years.

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