

# Community-integrated GIS for Land Reform in South Africa

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**Abstract:** *This article examines the role that GIS plays in how people view, exploit, and manage their physical resource base. The research contributes to the growing Participatory GIS literature and offers insight gained from the implementation of a Community-integrated GIS in South Africa. The Central Lowveld CiGIS explored landscape politics and struggles through the inclusion of socially differentiated community spatial stories and cognitive maps in a GIS to produce representations of local and regional political ecologies. Non-hegemonic ways of knowing and exploiting nature and environment were incorporated into the multimedia GIS. The paper provides conceptual and methodological guidance for integrating local community knowledge with geo-spatial technologies. The connection, however, to local policy making proved difficult to sustain because of dramatic policy and personnel changes within national and regional implementation agencies in the transition to post-apartheid government.*

## Introduction

Almost a decade after the first democratic government was elected in South Africa, the euphoria of transformation and reconciliation has begun to recede. While there have been improvements in basic service provision for some South Africans since the transfer of power in June 1994, the redistribution of economic and environmental resources has been slow and uneven (Khosa 2002). Transformation is increasingly viewed as requiring a prolonged period of political, economic, and attitudinal change, for the social and spatial impacts of colonialism and apartheid remain deeply embedded in the landscape of the “new” South Africa.

The South African space-economy still suffers from extreme levels of uneven development, landlessness, and structural unemployment, and historical systems of labor migration continue.<sup>1</sup> Many rural and peri-urban South Africans view the land question as interconnected with formal and informal employment opportunities. Residents of the former “homelands” prefer access to both jobs and land simultaneously (Levin and Weiner 1997a). Unfortunately, job creation is much slower than expected and effective land reform is difficult to implement rapidly. Millions of South Africans still experience an ongoing social reproduction crisis, and land tensions are on the rise. In the absence of substantial delivery of land and natural resources to South Africa’s impoverished masses, grassroots struggles, including squatting, are likely to intensify. The experiences of Zimbabwe are particularly relevant in this regard (Moyo 1995, Masilela and Weiner 1996).

The transition from apartheid to development in South Africa (Crush 1995, Levin and Weiner 1997b) is fraught with such contradictions. For example, the mantra of community participation and empowerment has become standard vocabulary within emerging public, private, and non-governmental organization (NGO)-based development institutions. Unfortunately, drawing on this new discourse has rarely translated into 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 contemporary South Africa, where a neo-liberal macroeconomic 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 transition to democracy in South Africa has been supported by the rapid diffusion of Geographic Information System (GIS) applications (Cinderby 1995). In South Africa, as elsewhere, GIS is frequently used for digital map production and, in some cases, stands accused of transforming bad data into impressive-looking maps. Significantly, many thriving GIS consulting agencies linked to segments of the former Apartheid State 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>2</sup>

The reinvention of modernization theory and practice in South Africa is taking place in the context of a discursive shift toward participatory forms of social change. This need not be a contradiction, as participation in practice often acts to legitimize 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 and it will be interesting to see if practices of community participation in South Africa can be successfully linked with GIS applications. Macdevette et al. (1999:923) argued 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 article presents research results from a recently completed GIS and Society project located in the Central Lowveld of South Africa’s Mpumalanga Province (Figure 1). The project was



**Figure 1**

concerned with participatory applications of GIS in support of the redistribution of natural resources in post-apartheid South Africa. Regional political ecology was the conceptual lens for conducting the research. Mapping and analyzing geographies of struggle, the local politics of land and water use, and future “environmental imaginaries” (Peet and Watts 1996) were central to the research. The project is an experiment in the application of Community-integrated GIS (CiGIS) in a highly differentiated society that is in transition. The research focused on: 1) the integration of socially differentiated local knowledge in a GIS in the form of cognitive maps; 2) the embedding of qualitative data within a GIS through linkages to spatial multimedia; and 3) exploring representations of Central Lowveld political ecologies. Central to this research is the production of maps and GIS representations of community spatial stories (Aitken 2002).

## GIS, Society, and Participatory GIS

The merging of participatory development and geo-spatial technologies is a core GIS and Society concern (Harris and Weiner 1996, 1998, Schroeder 1996, Craig et al. 2002). The early prominence given to Public Participation GIS (PPGIS) is 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. These deficiencies have been well documented in GIS and Society literature (e.g., Chrisman 1987, Taylor 1990, 1991, Edney 1991, Goodchild 1991, 1995, Openshaw 1991, 1992, Pickles 1991, 1995, 1999, Taylor and Overton 1991, 1992, Yapa 1991, Smith 1992, Dobson 1993, Lake 1993, Mark 1993, Obermeyer 1993, Sheppard 1993a, 1993b, 1995, Curry 1994, 1995, 1998, Aitken and Michel 1995, Crampton 1995, Goss 1995a, 1995b, Harris et al. 1995, Onsrud and Rush-ton 1995, Rundstrom 1995, Taylor and Johnston 1995, Krygier 1996, Dunn et al. 1997, Harris and Weiner 1998, Harvey and Chrisman 1998, Leitner et al. 1999). The remote sensing com-

munity is also engaged in these debates (Liverman et al. 1998). 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.

The very nature of PPGIS has forced researchers to not only confront GIS and Society concerns, but to design and adapt geographic information systems that specifically address the needs of participant communities. While the overall characteristics of PPGIS are becoming clearer, precise definitions are not easy to determine. As a result, a diversity of approaches to PPGIS implementation are emerging that are characterized by:

- the design of systems that specifically seek to empower communities and individuals and encourage public participation in GIS-based decision making;
- the integration of local knowledge to minimize the structural knowledge distortion of traditional GIS applications;
- systems and structures that provide public access to GIS information;
- provisions for public input and interaction in GIS decision-making processes with concomitant reduction in the enforced public passivity in decision making arising as a direct result of the technology itself;
- research that acknowledges and minimizes the surveillant capabilities and potential intrusiveness of GIS into the private life of individuals;
- the use of innovative geo-visualization and GIS-multimedia methods that incorporate and represent differing forms of quantitative and qualitative knowledge; and
- the integration of GIS with the Internet.

How PPGIS might be designed and produced to address these issues has led to creative discussions focused on the technology as well as on the institutional structures within which PPGIS might operate (Elwood and Leitner 1998, Obermeyer 1998, Craig et al. 1999, 2002). Researchers have begun to disentangle some of the threads that were woven into the early enthusiastic discussions on PPGIS. One of the more crucial elements of PPGIS is the 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 significant literature on public participation, it is perhaps the least understood component of PPGIS (Abbot et al. 1998). Specific PPGIS design, content, structure, and implementation are being conditioned by the nature of the public participation process, the specific applications and technologies employed, and the cultural context of PPGIS production and use. Like GIS itself, PPGIS exhibits both general application characteristics as well as context-dependent features. For these reasons, differing forms of participation and participatory GIS are emerging (Mitchell 1997, Talen 1999, Rambaldi and Callosa 2000, Craig et al. 2002, URISA 2002).

## Community-integrated GIS

Designing a participatory GIS in the light of the GIS and Society critique is no easy task, and our field-based research in South

Africa has provided valuable insight into some of the central issues in PPGIS development. While acknowledging that “public participation” will take many forms, we envisage a community GIS that does not necessarily rest in the hands of, or is operated by, the community itself. This 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 were critical components of colonial and apartheid socio-spatial control. Significant issues in apartheid South Africa included structural knowledge distortion and the emphasis on top-down decision making, the pre-eminence given to western forms of knowledge representation, the commodification of digital data and its control by spatial data institutions, and the existence of a bureaucratic-informational complex. As the current scramble for data and GIS in post-apartheid South Africa demonstrates, the power relations associated with GIS access and use significantly impacts contemporary spatial planning and landscape politics.

With this as background, the research was grounded in fieldwork 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 requires significant resources to both acquire the necessary data and establish and maintain an operational system. These resources have largely been available only to state and private business. In the United States, it is certainly not beyond the capability of a skilled individual to acquire the computer and software resources to develop a GIS project (Elwood 2002). The United States is also fortunate in having a number of national spatial databases available at nominal or no cost. The Framework concept promoted by the Federal Geographic Data Committee and the National Spatial Database Infrastructure Committee is facilitating the development of a national spatial database and the dissemination of spatial information through the clearinghouse concept 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. Although commendable in spirit, the practicality of implementing a PPGIS in resource-poor communities is only selectively feasible at this time. We suggest, however, that our experience in South Africa is not unique and that participatory GIS projects will inevitably be grounded in place-based fieldwork and the realities of local politics, community organizational structures, and institutional capacity.

As elaborated elsewhere (Harris and Weiner 1998), CiGIS provides an arena in which varied forms of knowledge are inte-

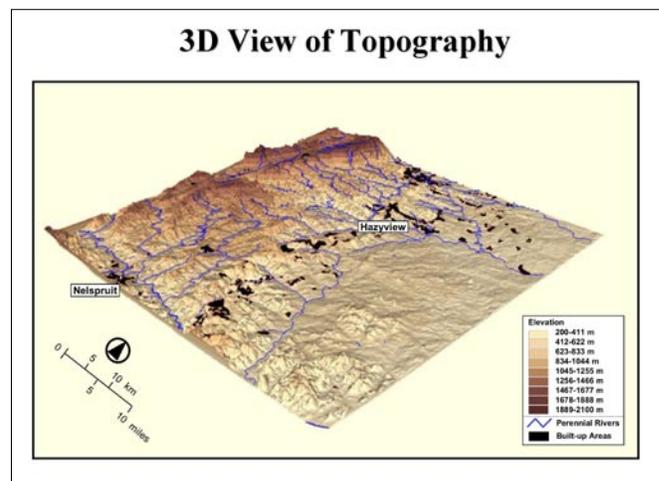


Figure 2

grated within the GIS and local landscape politics and resource management issues are played out openly. CiGIS is thus augmented through Internet-facilitated multimedia functionality. 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 parallel 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. State agencies in South Africa were very receptive and enthusiastic toward such an approach, but major obstacles encountered at local and regional scales plagued implementation.

## The Mpumalanga Case Study

The Mpumalanga Province is a transitional area between the relatively cool and moist highveld plateau (over 1200 m in altitude) and the hot and dry lowveld (200-600 m in altitude). Mean annual rainfall ranges from 400-700 mm in the lowveld to 1000-1500 mm on the escarpment and parts of the highveld. These environmental features, combined with the history of colonial and apartheid forced removals and resulting peri-urbanization, have produced a landscape of extreme social and ecological variation (Figures 2, 3, and 4). The total population of the Province is over three million, of which one-third live in urban areas and almost half reside in the former homelands.

The case-study area of 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 the Northern Province and includes portions of the former Lebowa and Gazankulu homelands. Intensive and exotic industrial forest plantations and large-scale commercial fruit and vegetable

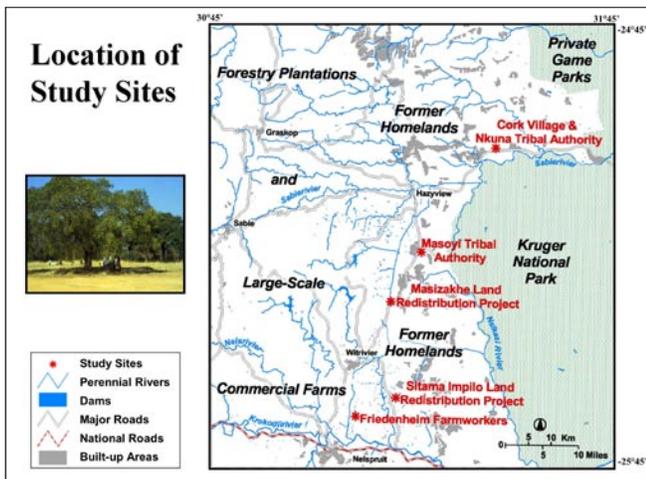


Figure 3

farms dominate the western third of the case-study area. Forestry companies also control large tracts of state land in the area, which is an important land-use issue discussed later in the article. 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 large-scale commercial farms (Woodhouse 1997). The re-engineering of Central Lowveld hydrology was a lifelong project of the influential apartheid architect and project participant, Braam Raubenheimer.

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 and Weiner 1997a). 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. 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 that, over time, there has been a reduction in water flow to the former homelands (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 several private game parks occupy the eastern portions of the case-study area. Since 1994, eco-tourism has become a major growth industry and the number of such visitors to the Mpumalanga and the Northern Province is growing. The use of land for game tourism has generated debate within the region regarding the potential for community-based

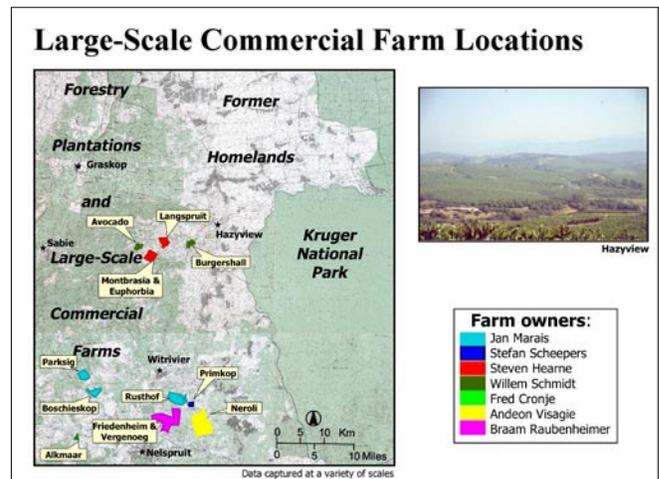


Figure 4

range management models. Many of the participants we spoke with, however, perceive limited personal benefit from the adjacent game parks.

Our CiGIS fieldwork included a diversity of rural production systems and relations of production. Within the former homelands, project participants involved groups from five locations with various relationships to the Government's land-reform program (Figure 3).

*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 in this area, 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 beginning during the Anglo-Boer war. Tribal lands were again expropriated when the Kruger Park was extended westward. The Masoyi chief and elders recently filed a very large land claim to the regional land claims commission seeking to restore their ancestral lands and to obtain compensation for territory that is not returned.

*Masizakhe Land Redistribution Project:* This land redistribution project was established in 1997 when 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 8 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 involves 100 beneficiaries and 80 hectares of high-quality land. Most of the land is arable and available for irrigation. There are three dams and a large house on the property.

*Large-Scale Commercial Farmers:* Seven white male farmers were interviewed through a process of community networking (Figure 4). Some of these participants own more than one farm.

## Project Goals, Research Design, and Methodology

Five conceptual questions were developed to provide the research focus and direction to the project. The questions were derived from participatory research in the sub-region and reflect an ongoing interaction between the project team and community participants. The research questions seek to explore:

- 1) The historical geography of forced removals. 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. Identifying Central Lowveld histories of forced removals is also important to understanding contemporary overlapping land claims in the region.
- 2) Differential perspectives on land potential. Land users have differing perspectives on both the criteria and location of potential land. Defining land potential is linked, of course, to participant environmental perceptions and how land should be used. This is important because perceptions of "higher," "medium," and "lower" land potential help to shape land utilization. Understanding differential perspectives on land potential must include a comparison of "expert" and "local" knowledge.
- 3) Identifying perspectives on socially appropriate and inappropriate land use. Our concern here is 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 socially "inappropriate" location of forestry plantations, and other land uses on land with high potential, as well as perspectives on land dedicated to game tourism. We are especially interested in how actual and potential land-reform beneficiaries would prefer to use any land to which they gain access.
- 4) The politics and power relations that help shape natural resource access, ownership, and use patterns. Central to our work is how regional political ecology can be represented within a GIS. A multimedia GIS enables representations of landscape power and politics to be incorporated by linking peoples' social histories, material lives, and future aspirations with specific geographic features of place.
- 5) The identification of areas where land reform should take

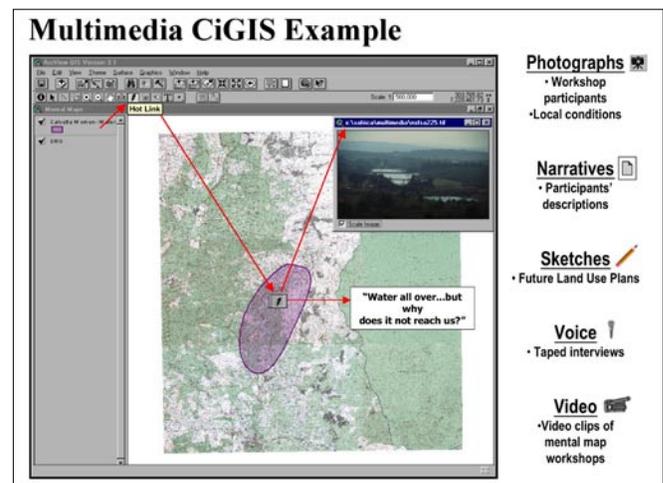


Figure 5

place. The purpose here is to use CiGIS for the identification of potential land-reform projects. At present, willing sellers are dictating where land reform can take place and at what price. As a result, the geography of land reform is overly market-driven and not guided by principles of social sustainability.

The research methodology combines the construction of a traditional GIS with the use of participatory methods. Traditional GIS data include hydrology and dams; transportation; hypsography; land cover and land use; nucleated settlements; land types and land quality; political, recreation, and cadastral boundaries; state and public lands; and forestry plantations. Socially differentiated local knowledge was compiled through participatory mental mapping exercises that involved placing tracing paper over GIS-generated topographic map products.

Participant group views on the five conceptual questions were recorded on the tracing paper maps. Pencils and colored markers were used so that each question had a particular color code (e.g., answers about forced removals were drawn in black, while answers about land potential were drawn in green). In this way, community maps were connected to the five conceptual research questions. Corresponding register marks were established on the tracing paper map and the base map, and both the tracing paper map and the base map were given identical labels to aid identification and orientation if required. The information was digitized and integrated within the CiGIS. The several mental mapping workshops included between five and eight people, and groups of men and women were interviewed separately.

After completion of the mental mapping workshops, participatory land-use planning exercises were undertaken. The groups of men and women drew maps that articulated how each group would use any land allocated through land reform. This exercise included participants who had already benefited from the land-reform program (the Masizakhe and Sitama Implilo projects),

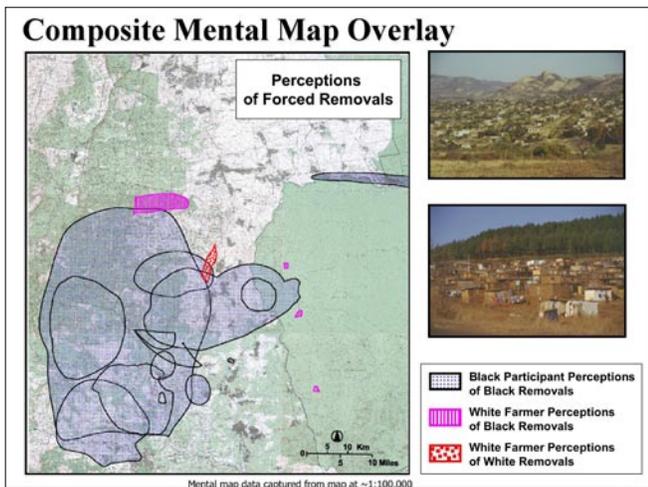


Figure 6

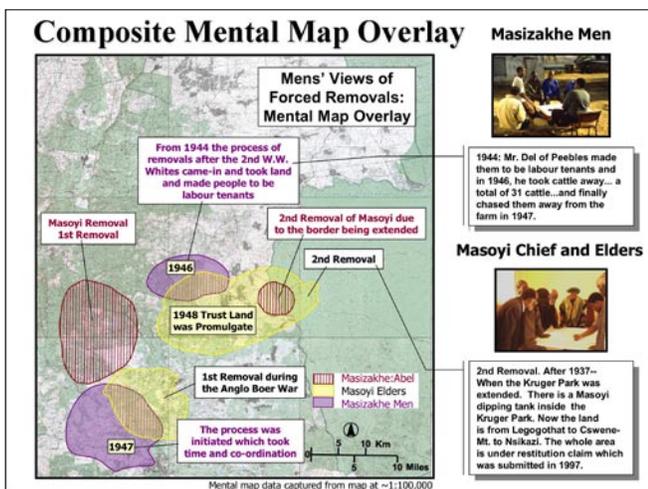


Figure 7

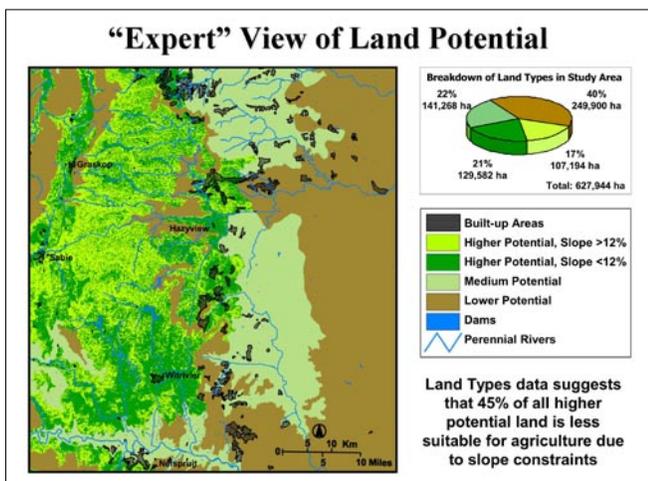


Figure 8

participants who had submitted claims but were yet to receive any benefit (the Masoyi), and non-beneficiaries (the Cork/Nkuna project and Friedenheim Farmworkers).

The mental mapping exercises were recorded on tape (and subsequently transcribed), and video recordings and photographs were also taken. This information was integrated into a multimedia GIS to provide mutually supportive and complementary data (Figure 5).

## Research Results

### 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)

There is no comprehensive data set in South Africa on the geography of forced removals. Official maps greatly underestimate the geographic extent of forced removals because black settlements were rarely indicated on map products. This is not surprising 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. CiGIS participants were willing, and even anxious, to talk about the historical geography of forced removals, although white farmers were reluctant to do so. The mental maps of whites and blacks in the sub-region are compared in Figure 6 and suggest very different perceptions of Central Lowveld landscape history. The forced-removal mental maps of black participants indicate a concentration of perceived removals in the southwest quarter of the case-study area. One explanation for this pattern is that communities evicted from areas north and west of Hazyview were not participants in this project. Previous research found that the entire western half of the case-study area experienced widespread forced removals, particularly in places with good 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, interestingly, 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. In comparison with the women, the men had a much deeper knowledge of historical landscapes and were able to broadly geo-reference their experiences and memories. The women's maps were very tightly associated with their more limited activity spaces. The possibility of overlapping claims is also evident in the mental map. This is a problem in many locations where forced removals were widespread and have contributed to the slow pace of land restitution.

### Land Potential

Land-types data were obtained from the Agricultural Resource Council of the South African Institute of Soil, Climate, and Water (Figure 8) and were used to establish four land-potential categories. Forty-three percent of the study area is classified as land of "higher" agricultural potential, while 17% is "medium"

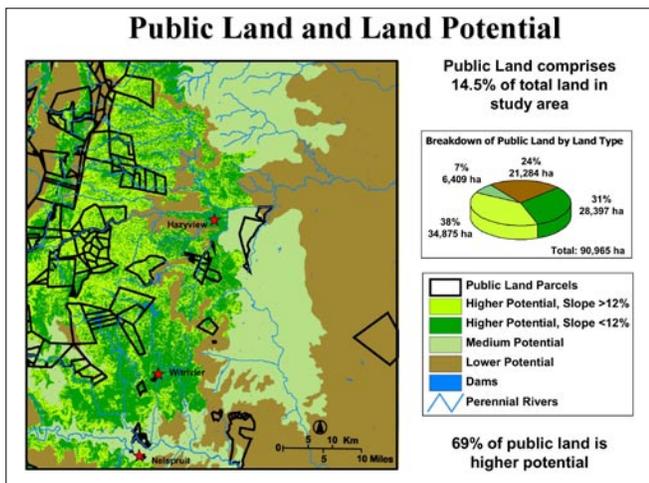


Figure 9

potential and 40% is “lower” potential. This representation of “expert” knowledge about land potential emphasizes 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 small-holder farmers who use animals and hoes. Local knowledge incorporated in the CiGIS is valuable for identifying viable higher potential land with slopes that are too steep for mechanized large-scale commercial farms but are eminently suitable for small-holder production.

Some peri-urban black settlements are located on higher potential arable land. Interestingly, some of this high-quality land is located to the immediate south of Hazyview where chiefs had previously removed African small-holders to enable members of the tribal authority and local black businessmen to access better land (Weiner et al. 1995). The settlement and land-potential information provides a unique perspective on the spatial patterning of the labor reserve economy.

The extent, location, and quality of public lands are an important component in the land-reform process. More than two-thirds of public lands in the sub-region are of high quality (Figure 9). Only 24% of state land is of lower potential. Large parcels of higher potential land are used for forestry plantations – a land use that is very unpopular amongst participants in the former homelands (see discussion below). As a result, this information has political implications for the sub-region. Figure 10 compares “expert” and “local” knowledge about land potential. The composite mental maps of higher potential land indicate a pattern similar to that produced with the ARC land-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 are also surrounded by land of higher potential.

### Land Use

Participants in the former homelands wanted to discuss and map land-use issues because they were angry about the perpetuation

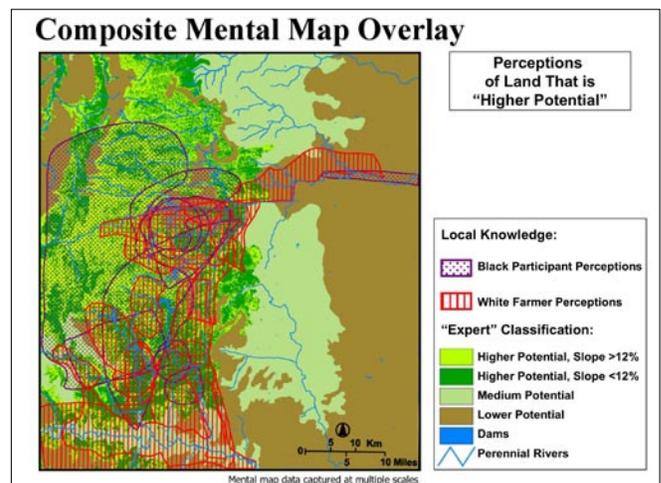


Figure 10

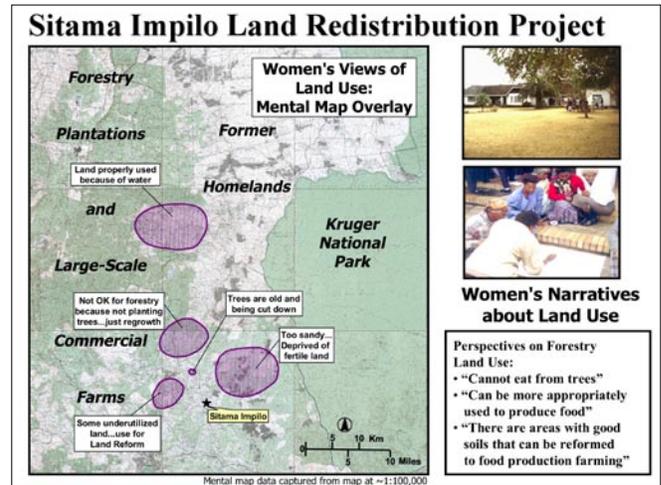


Figure 11

of apartheid geographies in the Central Lowveld. There is overwhelming hostility, for example, toward forestry plantations on high-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 and also expressed concern about the Kruger National Park (Figure 12). The Park is only a few kilometers away, yet local residents do not perceive any tangible benefits. These women also complained about water supply and told us they believed that the Sabie River had been deliberately stocked with crocodiles to keep them away from the water as it flows toward 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 sophisticated 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



cattle ... [and] a separate place for cultivation.”

The Masoyi elders and Masizakhe men agreed 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 critical for their social reproduction and their prospects for individual, household, and community wealth creation. Some participants expressed a preference for land close to where they currently live. This is a logical preference for these aspiring worker-peasants. There is also insistence that land reform must ensure greater access to water for residential and agricultural uses.

A composite land-reform mental map suggests that perceptions by white farmers and by black women of “where land reform should take place” are much more modest when compared with black male participants (Figure 17). 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 talked openly about the deteriorating farm security situation and were clearly concerned. Large-scale commercial farmers and their families have been attacked, in some cases without theft, suggesting a political dimension to some of the violence.

## Summary

CiGIS multimedia information about this “neo-apartheid landscape” (Pickles and Weiner 1991) is useful for unpacking some critical elements of Central Lowveld political ecology. Combining conventional “scientific” data with local understandings of land potential considerably improved our understanding of the multiple dimensions of the agro-ecological potential of the sub-region. The “expert” view on land potential, for example, 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 knew where these more fertile soils were located.

The social and spatial consequences of forced removals are readily visible in the maps and narratives, along with the spatial extent of peri-urbanization in the former homelands. The mental maps of forced removals represent a complex pattern of 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 the nature of gender relations in the countryside.

The use of higher potential land for exotic forestry plantations and residential housing for displaced blacks are two ongoing Grand Apartheid land-use contradictions. High potential arable land is scarce in South Africa, and malnutrition is high. Approximately 15% of the total national land area is suitable for dryland or irrigated agricultural production. This is one reason why participants agree that higher potential arable land needs to be preserved and used wisely. The CiGIS identified land that is potentially underutilized and suitable for the implementation of land reform.

This research also identified some important and politically sensitive land-use ownership and land-control issues. The extent and location of public land in the sub-region, and the perception that some of this land is inappropriately used for forestry plantations, is a valuable finding. This is another demonstration of how CiGIS can help in the identification of specific land-reform projects (e.g., in the forestland immediately to the northwest of the town of White River). Black men and women thought this land could be more effectively used for intensive small-holder production. The Masizakhe women identified this territory as underutilized land owned by an absentee landowner on which they would like to grow vegetables for domestic consumption and local markets.

A final summary point concerns the complex issue of scale.

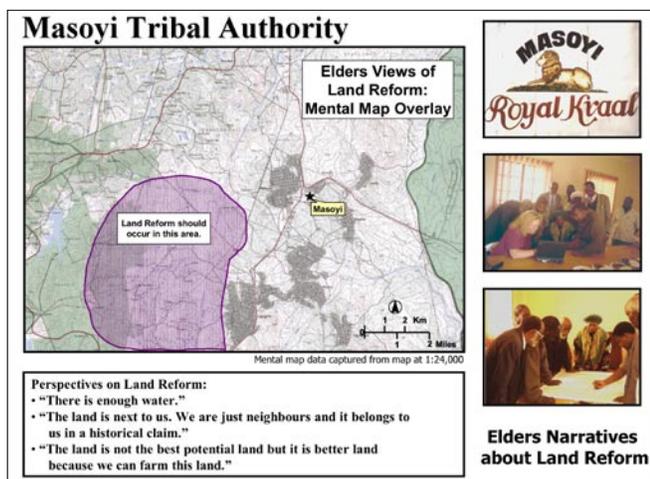


Figure 16

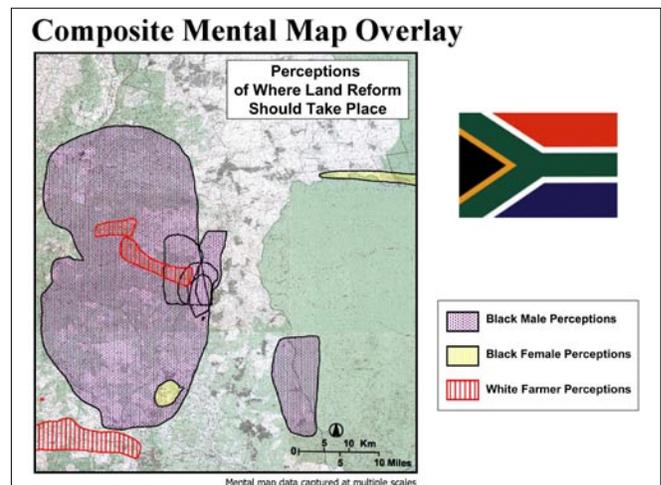


Figure 17

Most of the mental maps presented in this article are community cultural geographies of a sub-region using a base map scale of 1:50,000. More detailed and localized maps at 1:24,000 were also used in the workshops. When constructing a CiGIS, it is important to consider how scale impacts the questions asked and how individuals and communities respond. Seeking greater cartographic accuracy is not necessarily a requirement for CiGIS, even though it can be achieved through the use of Global Positioning System transect walks. This is premised, however, on having access to the territory being investigated, which was a considerable problem in our fieldwork

## Conclusion

The growth of geo-spatial technologies is rapidly transforming how “earth” and “environment” are visualized, represented, and understood. Most geographic information systems include some spatial environmental data, and natural resource GIS applications continue to grow in importance and impact. It is, therefore, noteworthy that GIS and Society research and writing are rather silent on the interplay between GIS, environment, and society. Geographic information systems invariably produce representations of nature that privilege conventional forms of “scientific” spatial information, while ignoring valuable local knowledge. Local and regional natural resource politics and representations of socially produced landscapes are largely ignored in contemporary GIS applications.

This article examines the role that GIS plays in how people view, exploit, and manage their physical resource base. The research contributes to the growing GIS and Society literature and offers insight gained from the implementation of a participatory GIS in South Africa. The Central Lowveld CiGIS explored landscape politics and struggles through the inclusion of socially differentiated community spatial stories and cognitive maps in a GIS to produce representations of local and regional political ecologies. Non-hegemonic ways of knowing and exploiting nature and environment were incorporated into the multimedia GIS.

The field-based research provided some salutary lessons. Not the least of these was how to address the complexities of undertaking this project when we live and work at a considerable distance from the communities. The Central Lowveld participatory research was certainly welcomed by former homeland residents who still struggle for more “socially appropriate land use” (Weiner et al. 1995). However, the production of a CiGIS that is genuinely incorporated into local civil society requires continual contact between the research team and community participants. Map-making and spatial analysis should continuously involve community participants in the identification of community issues and in the collection, organization, and analysis of the resulting GIS database. In an endeavor to link our academic research with local environmental struggles, we sought to locate the Central Lowveld CiGIS within the Premier’s Office of Mapumalanga Province. Several productive meetings were held and a plan of action was drafted. Since then, however, the project team personnel have dispersed to the private sector and state institutions, and the

National Department of Land Affairs has fractured and restructured. Despite the considerable local interest and excitement in the project, we are less than optimistic that this research will generate a lasting CiGIS presence, at least in the short term.

Nonetheless, the research demonstrates the potential utility of a multimedia GIS system for participatory land-reform planning and project identification. The richness of the peoples’ maps produced and the enthusiastic community-driven ideas for GIS spatial analysis must, of course, be contrasted with the difficulties of implementing the system for local/regional planning and land reform. The type of CiGIS produced will ultimately be determined by the nature of the participatory process employed, place politics, and the relationships with local “development” institutions. In South Africa, our intention was to support a process of popular participation that was connected to existing organs of civil society and committed to grassroots concerns about transcending neo-apartheid geographies. In this we were successful, but the connection to local policy making and project identification was difficult and further evidence that CiGIS production and use is locally dependent (Craig et al. 2002). The ability for CiGIS to engage in popular spatial initiatives at the local level will, over time, determine whether participatory geographic information systems are an “opportunity or an oxymoron” (Abbot et al. 1998).

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## Footnotes

- 1 Macdevette et al. (1999:914) reported that white per capita incomes were 12.3 times higher than for blacks and that over 40% of the total population and half of all households live below the "minimum standard of living." They also suggested that inequality between racial groups is increasing. See Cox et al. (2002) for a useful analysis of contemporary labor migration patterns and historical changes.
- 2 An example of this is the Spatial Development Initiative (SDI) that has become important for regional planning and funding for specific projects in South Africa. The adoption of SDI was facilitated by GIS maps that modeled Provincial growth strategies and their likely spatial impacts (CSIR 1997). SDI in South Africa is a classic growth-pole regional development strategy.