

GIS IN PARTICIPATORY CATCHMENT MANAGEMENT: A CASE
STUDY IN THE KAT RIVER VALLEY, EASTERN CAPE, SOUTH AFRICA

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Abstract

In water resources management in South Africa, there is an emphasis on public participation. On a river catchment basis, one of the mechanisms for such participation is the establishment of catchment forums. However, members of catchment forums, particularly those coming from poor or rural communities, cannot be expected to engage in catchment management without having been enabled to do so.

This thesis considers the use of GIS in the process of enabling the Kat River Valley Catchment Forum to better participate in catchment management. The research focus is on the use of GIS to facilitate an understanding of the Kat River Catchment and associated catchment concepts, and constructive communication and sharing, among the Catchment Forum. The GIS is used in the context of “GIS for Participatory Research”, an outgrowth of Public Participation GIS (PPGIS), which focuses on GIS as a tool for empowerment within participatory processes. The study has used Action Research, situated in the Critical paradigm, as a methodology. The research has included seven Forum workshop processes and one series of in-village meetings. These engagements have involved map-based appraisals, issues and resource mapping, map-based planning, and the use of on-screen GIS for presentation and sharing.

The use of GIS has facilitated the creation of customised maps, the integration of village-scale mapping into a catchment scale product, the presentation of synthesised data in digital and hard-copy format and, in so doing, has allowed catchment-scale appraisal. Outcomes enabling participation in catchment management have included developed mapping skills and an enhanced understanding of the catchment as a whole, and developed conceptual access to a decision-making language (or way of thinking), among participants. Furthermore, the Forum as a whole has identified common needs, and has developed a set of map-based action plans.

The research process has yielded a number of lessons regarding “GIS for participation” and the participatory framework within which it takes place. Chief among these is that the GIS operator should take on the role of a participatory practitioner.

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To Pop Haynes

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List of Acronyms

AV	ArView
CF	Catchment Forum
CRCG	Catchment Research Creative Group
CRG	Catchment Research
DEM	Digital Elevation Model
DWAF	Department of Water Affairs and Forestry
FEST	Foundation for Education, Science and Technology
GIS	Geographic Information Systems
GPS	Global Positioning System
HACOP	Hertzog Agricultural Cooperative
ICIS	Integrated Catchment Information System
ICM	Integrated Catchment Management
IEM	Integrated Environmental Management
IR	Infrared
KRVP	Kat River Valley Project
Landsat TM	Landsat Thematic Mapper
LDC	Less Developed Countries
NCGIA	National Centre For Geographic Information and Analysis
NDA	National Department of Agriculture
NLP	National Landcare Programme
NWA	National Water Act
PPGIS	Public Participation GIS
PRA	Participatory Rural Appraisal
TIN	Triangulated Irregular Network
TLC	Transitional Local Council
TRC	Transitional Rural Council
WISA	Water Institute of South Africa
WRC	Water Research Commission
WUA	Water User Association

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1 GIS AND PARTICIPATORY CATCHMENT MANAGEMENT, THE KAT RIVER VALLEY CATCHMENT FORUM AND THE RESEARCH AIMS AND OBJECTIVES

1.1 GIS and Catchment Management: the need for participatory approaches in South Africa

The water resources of South Africa require careful management if they are to be sustained for posterity. One of the most widely acknowledged models for managing the water resource effectively and on a sustainable basis is Integrated Catchment Management (ICM) (DWA and WRC, 1996; Gorgens *et al*, 1997; WISA, 2000). ICM is defined by DWAF (1996, p. 19-20) as follows:

ICM represents a systems approach to the management of natural resources, in particular water resources, within the bounds of a geographical unit which is based on the catchment area of a single river system. ... In its widest possible sense, ICM recognises the need to integrate all environmental, economic and social issues within a river basin into an overall management philosophy, process and plan.

It follows that ICM requires thinking and planning around multiple variables. Since many of these variables have a spatial dimension, Geographic Information Systems (GIS) can be an important tool for decision support for ICM. However, it has been argued that GIS, as it has been traditionally used for planning and decision support, can serve to marginalize local people who are affected by those decisions, while entrenching the power of the decision-makers (Harris *et al*, 1995; Miller, 1995; Rundstrom, 1995; Sheppard, 1995). Consequently there has been a recent emphasis on public participation in GIS processes (Obermeyer, 1998). There has been a similar emphasis on public participation in water management in South Africa (Republic of South Africa, 1998a; Auerbach, 1997; Gorgens *et al*, 1997; WISA, 2000; Motteux, 2001). In this thesis it is argued that a spatial conception of a catchment is necessary for thinking and planning for ICM. Since GIS is a spatial tool, there is the potential for GIS to facilitate such a conception among local people in order to enable them to more effectively participate in catchment management. An exploration of this premise, and other roles that GIS can potentially play in empowering people to participate in catchment management, has formed the central aim of this research project.

In this chapter an introduction to Catchment Management and participation in Catchment Management in South Africa will be provided. This will be followed by an introduction to the Kat River Valley where the research was undertaken and the Kat River Valley Catchment Forum. Finally GIS, as it has been traditionally used for water resources management in South Africa, will be

described. These introductions will provide the context for an outline of the research aims and objectives.

1.1.1 The concept of catchment management

Environmental management in various forms is becoming increasingly important as the cumulative impacts of human activities undermine the natural environment to an extent that is becoming critical. Thinking in environmental management has changed from attempts to contain the impacts on single components of the environment to approaches that treat the environment as a whole.

These changes developed from the application of systems thinking to the environment. In other words, the environment was recognised as representing an infinitely complex system, with sets of systems within systems, including the natural and human environments. An impact on one component of the system, or an interruption of a system linkage, will have ramifications throughout the system.

Such approaches involving the holistic treatment of the environment gained momentum in the late 1960s. Odum (1969, p. 271), in his concept of ecosystem development, wrote that “society needs, and must find as soon as possible, a way to deal with the landscape as a whole, so that manipulative skills (that is technology), will not run too far ahead of our understanding of the impacts of change”.

Holistic approaches to the management of the environment have come to be known, in various forms all over the world, as Integrated Environmental Management (IEM). In South Africa IEM is embraced by environmental professionals (Preston *et al*, 1992; Sowman *et al*, 1995), while its principles are explicitly drawn upon in the National Environmental Management Act (Republic of South Africa, 1998b).

One of the challenges of environmental systems thinking is where to draw the sub-system boundaries so that the overall entity can be dealt with in “bite-sized chunks”. One of the more appropriate environmental system “units,” or “building blocks,” is the river basin, or river catchment, which represents the boundary for hydrological systems at different hydrological scales (Braune and Dziembowski, 1997; Pegram *et al*, 1997; Jewitt *et al*, 1998). The catchment constitutes the fundamental geomorphic unit (Chorley, 1969), within which not only the hydrological system, but often land-use and community functioning (Grobicki, 1999), and ecosystem functioning (Montgomery *et al*, 1995), interact as a single entity in terms of processes. In other words, the environmental system bounded by a river basin or catchment represents, to greater and lesser degrees, a whole within a broader whole - the regional ecosystem, or even the biome.

In the light of this, the idea of environmental management on the basis of the catchment has become a widely recognised concept in the form of Integrated Catchment Management (ICM). ICM

is practised throughout the world, with numerous examples coming particularly from the United States, the UK, Australia and India (see DWA and WRC, 1996).

In practice ICM has tended to focus explicitly on the management of the water resource, with improved wetland, river, or estuarine health being the fundamental objective of ICM initiatives. Water management is approached from the perspective that the quality of the resource at any one point is a product of the interaction of all environmental processes within the catchment above that point. As such the river is not considered a linear event, but rather as part of a continuum, stretching across space from the boundaries of the catchment to the river channel, and then to the river mouth. The character of that continuum is defined by changes in the landscape and landscape processes across the catchment. Gorgens *et al* (1997, p. 5) state that:

... [T]he Hydrological cycle, land-use and aquatic ecosystem functioning form a continuum bounded by the extremities of the catchment or river basin. This fact calls for the recognition that naturally occurring water can usually be effectively and efficiently managed only within the ... catchment boundaries, because of the need to technically account for all aspects of the hydrological cycle, including the way humans change aspects of the cycle by land-use.

Gorgens *et al* (1997) in the “Guidelines for catchment management to achieve integrated water resources management in South Africa,” distinguish between *Integrated Catchment Management* and *Catchment Management*. ICM focuses on the utilisation and protection of *all* environmental resources as an outcome of catchment management. This approximates true *Integrated Environmental Management*. One of the key facets of ICM is the management of environmental resources in harmony with social and economic development. This is based on the understanding that society and the environment form a highly interdependent cycle of interactions, and the treatment of one side must take into account the other. In contrast to ICM, *Catchment Management*, focuses specifically on the utilisation and protection of the water resource per se. In terms of implementation in South Africa, *Catchment Management*, rather than ICM, has taken place (DWA and WRC, 1996; Gorgens *et al*, 1997; WISA, 2000). There is, however, a national effort in place to transform water resources management so that processes and outcomes are more closely aligned with the principles of ICM.

1.1.2 *Integrated Catchment Management in South Africa*

The National Water Act (Republic of South Africa, 1998a, p. 1) “recognises the need for the integrated management of all aspects of water resources and, where appropriate, the delegation of management functions to a regional or catchment level...”. The Act makes provision for the management of Water Management Areas on a catchment basis, through the formation of *Catchment Management Agencies* and through the development of *Catchment Management Strategies*.

The Department of Water Affairs and Forestry explicitly recognises the requirement of cooperation as one of the major challenges to integrated water resources management (DWA and WRC, 1996; DWAF, 1999). Sustainable and integrated management cannot take place if various sectors, communities, and different organisational, administrative and political structures operate independently. Effective management of any one environmental component, let alone the environment as a whole, requires that all forms of activity take place in an overarching, integrative management framework. Considering the extent to which society is differentiated in South Africa, achieving such harmonious interaction could prove a daunting task. One aspects that would require particular attention would be the mobilisation of local community participation in, and ownership of, catchment management processes.

In February 2000, the Water Institute of Southern Africa, in collaboration with the Department of Water Affairs and Forestry and the Water Research Commission, held a two day symposium and set of workshops for the development of implementation strategies for ICM in South Africa. Over three hundred delegates from around the country participated in the workshops, contributing to a report entitled "Catchment Management in South Africa: Turning Policy into Practice".

Perhaps the single most important message coming out of the workshop was the importance of community involvement in the catchment management process. For catchment management initiatives to be successful, they *must* be owned and driven by local community participants. This had been clearly emphasised by Auerbach (1997, p. 14) on an earlier occasion:

Unless DWAF recognises that people are not going to apply ICM messages developed in Pretoria, no matter how scientifically valid these may be, and no matter how convincingly and entertainingly they may be presented, ICM will not be applied; local people will implement plans that they have helped to develop.

Some of the difficulties and imperatives surrounding the implementation of local community participation are reflected in the "overriding themes" mentioned in the WISA workshop report. Mentioned in particular is the need for capacity building and information transfer, the need for a shift from a technocratic approach to a social process, the importance of common goals and desired future states, and changed behaviour (WISA, 2000). Although local community participation in water resources management is explicitly mentioned in the National Water Act (Republic of South Africa, 1998a), this cannot be achieved without capacity building. Participation is a fallacy unless all stakeholders are *empowered* to participate. Firstly this requires community mobilisation and the development of skills in order that appraisals and analysis of local issues and common needs can take place, relating in particular to water resources management. Without this communities cannot effectively contribute to discussions on issues at a catchment scale, nor can they effectively participate in vision-building. Secondly grassroots communities need to be empowered by knowledge surrounding concepts of water resources management, cooperative governance and the

stipulations of the NWA before they can meaningfully contribute to decision-making. But perhaps the most important form of capacity building is about the development of self-respecting, confident individuals and communities, as argued by Motteux (2001, p.16):

Capacity building for catchment management is not about the health of the river, but about the collective and individual health of the communities – physically, mentally, their confidence levels and self-esteem, past experiences, fears, strengths and opportunities. This is so with all stakeholders, and in particular, those who were previously marginalised.

The second overriding theme of the WISA workshop that related to community participation is the need for a shift in perceptions of present water managers. The water management agenda should lie with the communities of water users, not with technicians and top managers. The role of water professionals is to facilitate the participatory water management process and to provide scientific and technical guidance (WISA, 2000).

The third emphasis to come out of the workshop was the particular importance of consensus. An important factor in consensus building is the development of common visions and goals to reach a commonly agreed desired future state (WISA, 2000). Without such common agreement, the integration of management agendas for purposes of a common, healthy whole is impossible.

One of the questions relating to the above imperatives deals with mechanisms for effectively including local and disempowered people in catchment management processes. The option that has been supported to the greatest extent by DWAF is the formation of catchment forums at the sub-catchment scale.

1.1.3 Catchment Management structures and Catchment Forums in South Africa

The Department of Water Affairs and Forestry has set out a clear institutional model for the formation of Catchment Management Agencies in Water Management Areas in South Africa. This is set out in figure 1.1. The four stages in the establishment of a CMA are (DWAF, 1999):

1. Initiating Participation,
2. Formalising Participation,
3. Interim Management Arrangements,
4. The establishment of the CMA.

Essential to every stage of the process is the involvement of catchment forums. For DWAF, the incorporation of catchment forums in the catchment management process has a number of distinct advantages (WISA, 2000): They provide a mechanism that will help bridge the gap between people on the ground and the administrative and operational ‘superstructure’; the fulfilment of participatory planning and delivery functions will be more effectively achieved, with less antagonism towards service providers and authorities; and the involvement of catchment forums will promote proactive cooperation among stakeholders, with fewer punitive reactive measures being necessary.

CMA establishment: Four stages

In some areas the CMA establishment process will move sequentially through all four stages. In others, it may pass or quickly move through one or more stages, depending on local needs and circumstances.

Stage 1: Initiating participation

Most CMA establishment processes will start with awareness creation, public participation and the formation of catchment management forums. The emphasis is on developing a constructive and trusting relationship between all parties, and a common view of the way forward.

Where these fora provide adequate representation of all stakeholder interests, a proposal can be developed and the CMA established (thus going directly to stage 4), without going through stages 2 and 3.

Stage 2: Formalising participation

As the participation process progresses, stakeholders may feel it necessary to create a formal, but non-statutory, relationship in the form of a Catchment Steering Committee/s, representing all

stakeholders and guiding the further process of establishing a CMA.

The emphasis of this stage is the strengthening of relationships and planning for the future.

Stage 3: Interim management arrangements

In some Water Management Areas, capacity and resource constraints may cause the establishment of a financially and technically viable CMA to be delayed for some years. Interim management arrangements may be necessary such as delegating certain functions to either a single Advisory Committee: Management for the entire Water Management Area, possibly associated with a number of non-statutory subcatchment Steering Committees, or to a number of Catchment Management Committees that represent different catchment areas.

Stage 4: The CMA

The ultimate goal of the process is the establishment of a CMA, with the appointment of a Governing Board based on the recommendations of the Advisory Committee Governing Board

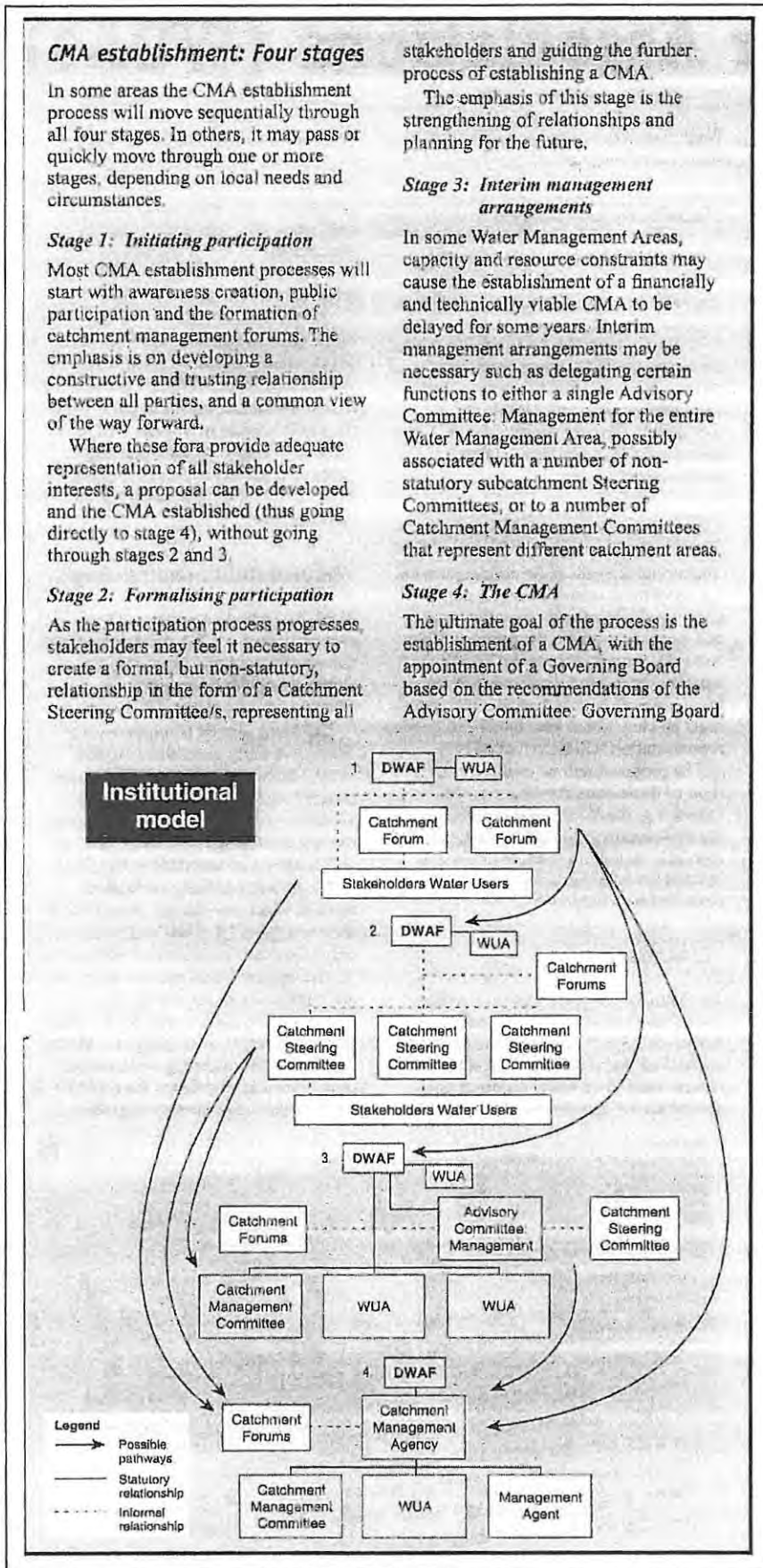


Figure 1.1: The Catchment Management Agency process, showing the involvement of Catchment Forums in each phase (from DWAF 1999).

It is recognised that the establishment of forums takes substantial investment in terms of time, effort and material resources. One of the biggest challenges, as mentioned in the previous section, is the effective inclusion of previously disadvantaged people. Apart from logistical obstacles, significant effort is required to build the capacity of these people so that they can contribute and negotiate on an equal basis during multi-stakeholder meetings. It is thus essential to “start forums now, and in the process build the capacity and understanding of previously disadvantaged people – (because) this will take time” (WISA, 2000, p. 58).

One of the recommendations coming out of the WISA symposium, as a practical solution for empowering grassroots communities and disadvantaged stakeholders, is the use of Participatory Rural Appraisal (PRA)¹. The importance of such an approach is recognised by Abbot Grobicki (2001), who undertook an urban ICM initiative in the Lotus River Catchment in Cape Town. In Kwazulu-Natal, PRA was effectively used at the outset of the Ntshongweni Catchment Management Programme (Auerbach, 1997). In the Kat River Valley, a PRA based approach to awareness creation, communication and capacity building has taken place as a forerunner to the formation of catchment management structures, and the initiation of catchment management activities (Motteux, 2001). The principles of PRA are drawn upon on an ongoing basis in the course of activities of the newly formed Kat River Valley Catchment Forum.

1.2 Catchment Management and the Kat River Valley

1.2.1 Description of the Kat River Valley

The Kat River Valley (Figure 1.2) forms a tributary catchment to the Fish River Basin, part of the Fish to Gamtoos Water Management Area of the Eastern Cape. The catchment extends approximately 80 km north to south, covering an area of approximately 1700km². The valley is characterised by a mosaic of land uses, ranging from export-oriented citrus farming and commercially oriented rangeland stock farming in the lower reaches of the catchment, to community-based or small-scale agriculture and stock farming in the middle reaches of the catchment, to commercial forestry in the north-western upper reaches. Four game reserves exist in the catchment: Mpofu and Fort Fordyce to the east, the Sam Knott in south of the catchment extending from the west bank of the Kat River, and Double Drift extending east from the opposite bank. The town of Fort Beaufort is the dominant urban area in the catchment, while other urban settlements include Seymour and Balfour in north.

¹ See chapter 4.

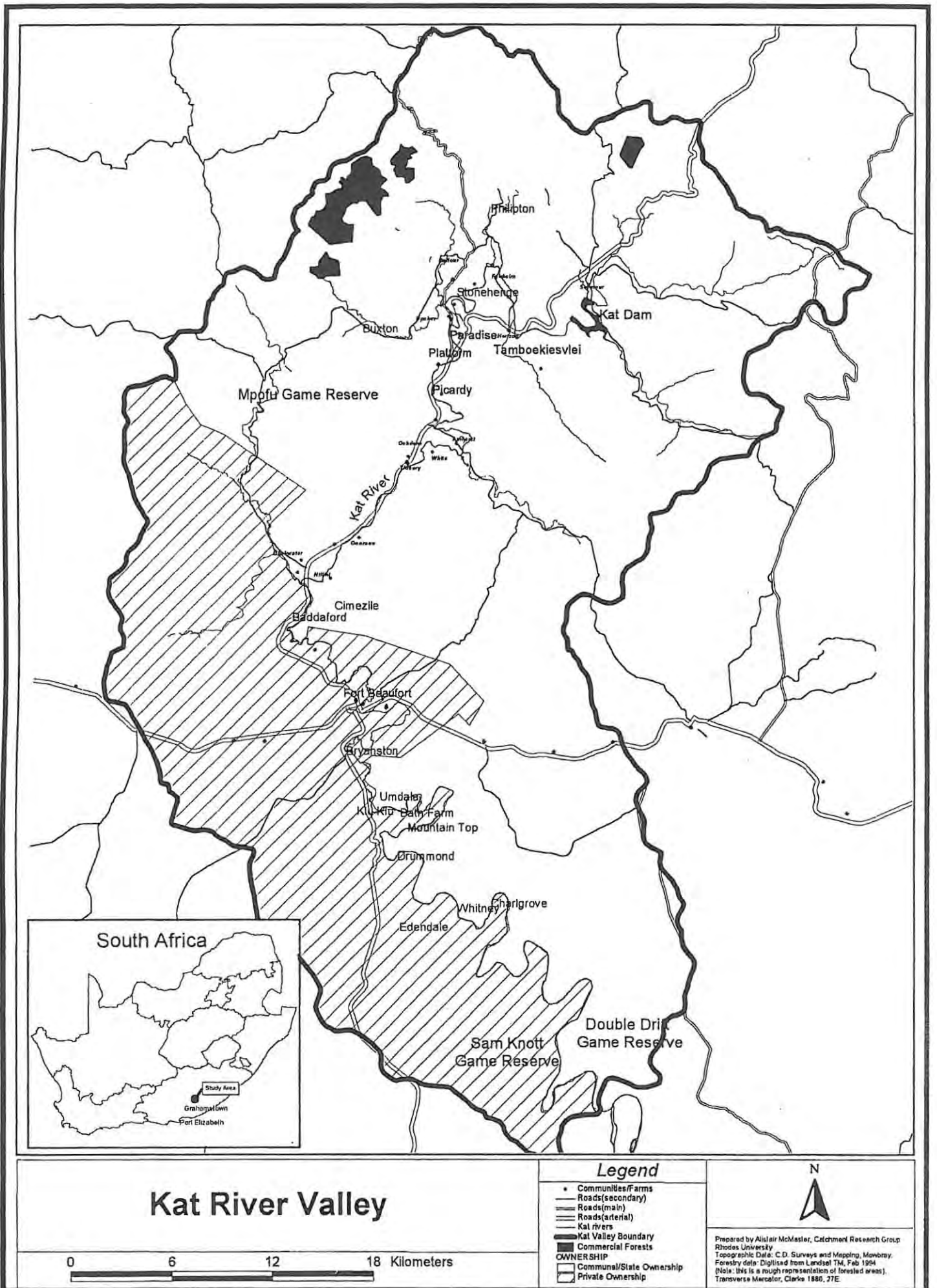


Figure 1.2: Map of the Kat River Valley, showing the areas under communal ownership in the north and east, and under private ownership in the south-west.

Much of the following description of the social and economic situation in the Kat Valley comes from a report compiled by Nel (1998), from Motteux and Nel (1999) and Motteux *et al* (1999a, 1999b), and from my own knowledge of the area, built from two years of working in the valley. The Kat River Valley has a highly complicated history of dispossession and resettlement, which is reflected in the present demographic situation in the catchment. In particular, recent history associated with the divisions between South Africa and the former Ciskei Homeland has influenced patterns of settlement, economic activity and social welfare in the valley. The catchment on the greater part of the eastern side of the Kat River has been part of the homeland since its establishment in 1979. Furthermore, the area in the north and north-east of the catchment incorporating the then highly productive irrigation farming districts of Balfour and Seymour was expropriated from white and coloured farmers and handed over to the Ciskei in 1980. The result is that present systems of land tenure are characterised by private ownership in the south-western sector, and by communal or state ownership in the remaining areas (Figure 1.2). The situation is further complicated in the middle and upper Kat by the issues of land ownership on the ex-Ulimocor parastatals of the Ciskei. Once the parastatal had fallen away in 1994-1995 after South Africa's political transition, the use of the land was transferred to the managers who had been operating farms at the time. However no rights to the land had been transferred - a tenure security issue which has resulted in low levels of capital investment, deterioration of infrastructure and poor levels of production. Some of the land that had been expropriated in the 1970s and 1980s was neither used by Ulimocor nor utilized by communities. Parts are now farmed cooperatively, but since these farmers are resource poor, with little access to equipment and without infrastructure, levels of production are a fraction of what they had been before expropriation.

The result in terms of social and economic patterns in the valley is that the catchment in the south west consists of extensive, privately owned white farms with high levels of production, employing labour forces of up to two hundred people, depending on the season. The other, more densely populated sections of the Kat, in contrast, are characterised by low levels of production, exceptionally low levels of employment (Magni, 2000; Soviti, 2002), and a high degree of poverty. The villages of Seymour and Balfour are impoverished and suffer from disinvestments and economic collapse. Fort Beaufort, at the centre of the catchment, supports a relatively large population of 25,506 (Statistics South Africa, 1996), retains its functionality as a service centre, but also suffers from economic stagnation and high levels of unemployment (Figure 1.2).

All the above considerations have, directly or indirectly, an impact on the water resource in terms of water quality and quantity. For example in the upper catchment, the high population density² together with high degrees of poverty has resulted in intensive, often uncontrolled, resource utilisation. This has caused clear environmental degradation in many places.

Any initiatives aimed at the management of the water resource in the Kat would be complicated by the complexity of issues mentioned in this section, including a diversity of stakeholder needs and numerous catchment-wide social and biophysical concerns.

1.2.2 The Kat River Valley Project

Activities giving rise to the Kat River Valley Project (KRVP) began in 1996 and 1997 when PRA work was conducted in two communities (Hertzog and Fairbairn) by Nicole Motteux, a research student at the Rhodes University Geography Department (see Motteux and Nel, 1999; Motteux *et al*, 1999a; Motteux *et al*, 1999b). This work focussed on raising environmental awareness and building capacity related to the management of water resources at the local scale (Motteux, 2001). One of the outcomes of this was the expressed desire by the villagers that they should become part of broader water management structures in the catchment. This gave rise, in 1999, to a Water Research Commission research project carried out by Motteux and led by Prof. Kate Rowntree, known as the Kat River Valley Project. The project “focussed on facilitating the effective participation of these (Hertzog and Fairbairn) and other communities in both the transformation of the Kat River Irrigation Board into the Kat River Water User Association, and the development of a Catchment Forum in which broader issues relating to catchment management could be tackled in a more informal structure” (Motteux, 2001, p. ix). Some of the aims of the project were as follows (Motteux, 2001, p.3):

- ③ To facilitate the development and co-ordination of a Catchment Forum in the Kat River Valley through awareness building, learning and empowerment so as to enable the Kat River people to take a positive role in the management of their catchment.
- ③ To ensure that the empowerment process initiated by Motteux (1996-1997) and now driven by the community of Fairbairn will be positively channelled into a Catchment Forum. This will enable the process to be sustainable and ensure that their new ‘power’ does not make the community of Fairbairn worse off – i.e., despondency.
- ③ To identify differences of interest and priorities among the different users, especially those who are disadvantaged, and to give them collective awareness and confidence to confront others and argue their case.

² As an illustration, in 1996 the rural areas of the Mpofu region were populated by approximately 11800 people, while there were 2200 people living on commercial farms in the south west – the Fort Beaufort region

- ③ To transfer the policy, principles and goals of 'integrated catchment management' to ground level and bridge the gaps between department of Water Affairs and Forestry (DWAF) and the Kat River communities.
- ③ To hand over the process to Kat River Valley communities, with the insiders determining the agenda, categories and details.

In the early stages of the project the main thrust was in facilitating stakeholder participation in the initiation of the transformation of the Irrigation Board. This took the form of three stakeholder workshops in October, November and December 1999. Two important mandates came from the participants in this process: the need to put in place structures for improved communication among stakeholders in the catchment, and the need for the dissemination of information to, awareness building among, and consultation with, the rural communities along the Kat River (Motteux, 1999). This resulted in a series of workshops in 17 communities taking place from late 1999 to the middle of 2000. These workshops involved talks, forum theatre, transect walks, the use of simple models of the river to develop concepts of up-stream and down-stream effects, group tasks, and question and answer sessions.

Workshops were managed and facilitated by Motteux together with a group of five Xhosa speakers, known at the time simply as the "drama team". The drama team have since developed into a more formal group known as the 'Catchment Research Creative Group'. This team has proved integral to every phase of the Kat River Valley Project and to the development of the Catchment Forum. They have established a rapport with, and trust among, the communities of the Kat, which has proved invaluable to the success of participatory endeavours in the catchment. The Catchment Creative Group will be referred to as "the facilitators", unless otherwise specified, in this thesis. Towards the end of 2000 the Kat River Valley project came to an end. Around the same time, the Catchment Research Group (CRG) in the Rhodes University Geography department was formed. Further work with the Catchment Forum has since been undertaken by members of the CRG.

1.2.3 The establishment of the Kat River Valley Catchment Forum

The period of awareness creation stretching from the end of 1999 to mid-2000 was the build-up to the formation of the Catchment Forum. Among the emphases of the workshops was the development of the concept of the river linking the villages into one community – the Kat River Valley community. The successful development of this concept was an important factor in motivating the communities to form a group that would promote the cooperative and responsible use of the river – namely the Catchment Forum. The awareness workshops took place in three phases (See Motteux, 2001):

(Statistics South Africa 1996). The two regions are of comparable aerial extent.

- December 1999: The Umlambo Drama festival, which was held with school children.
- March 2000: Nine Environmental workshops were held with groups of villages. At these workshops the process of electing Catchment Forum representatives was initiated.
- May 2000: “Way Forward Workshops” held in 15 villages. The results of the previous workshop were distributed in the form of a booklet. Villagers were introduced to their Catchment Forum representative.

The Catchment Forum first met on the 12th of July in Ntilini. This involved representatives getting to know one another, the development of catchment concepts using maps, and a “transect” of the catchment involving a bus trip up the river that included visits to the villages. The next workshop took place on the 21st and 22nd of July at Fort Fordyce. The purpose of this workshop was to carry out a process of planning for desired outcomes in the catchment. The third workshop involved the development of a proposal for funding for the execution of one of the desired outcomes: namely the control of soil erosion in the catchment³.

The Catchment Forum members have since been involved in a number of workshops, although they are frustrated by the fact that few of their activities are being translated into actions on the ground. At the time of writing they were in the process of developing a vision, a set of aims, and structures and procedures for their functioning as a body that intends to be action oriented.

1.3 GIS as it has been traditionally used for catchment management

GIS is defined as “a system of computer hardware, software and procedures designed to support the capture, management, manipulation, analysis and display of spatially referenced data for solving complex planning and management problems” (World Bank, 1993). As a result of this ability to perform complex spatial analytical and modelling procedures using a large number of spatially expressed variables, GIS has come to be widely used as an environmental management tool (World Bank, 1993; Eedy, 1995; Joao, 1998)

Examples of the use of GIS for water resources management in South Africa are numerous. Van Riet *et al* (1994) compiled an ecological and social database, evaluated the data according to ecological, development, agricultural and aesthetic values, and combined these in a GIS to form a decision support system for the Sabie River. Subsequently GIS layers were used as input data for multi-criteria decision analysis for landuse scenarios in the Sabie River (Stewart *et al* 1993, 1997;

³ See chapters 6,7 and 8.

Joubert, 1998). A well-used application of GIS in catchment management in South Africa is in catchment hydrological modelling, particularly in combination with the ACRU hydrological modelling tools (Schulze, 1995). Perhaps the most advanced application of GIS in catchment management in South Africa is the Integrated Catchment Information System (ICIS), developed by the Computing Centre for Water Research in Natal (Jewitt *et al*, 1997, 1998). The Arc-View based system offers a combination of facilities that allow the interactive assessment of various aspects of a problem in a catchment through different data models, data visualisations, multicriteria evaluations and reports. The ICIS has been applied thus far in the Umgeni Catchment, the Sabie River Catchment and the Mooi River Catchment. One of the most recent examples of GIS in catchment management is that of Abbot Grobicki (2001), who used GIS in decision support in the urban catchment of the Lotus River in Cape Town.

Most of the above uses of GIS can more or less be described as focusing on assisting water managers and other technically advanced participants in catchment management. In GIS circles, there has been a recent emphasis on the participation of all stakeholders in GIS processes. This has come to be known as Public Participation GIS (PPGIS). PPGIS ranges from stakeholder consultation to full participation where the process is initiated, driven and owned by stakeholders (see for example Barndt, 1998; Elwood and Leitner, 1998; Obermeyer, 1998; and Al Kodmonay, 2000).

Examples of participatory GIS in South Africa are few, despite calls for such approaches (da Cruz, 1999; Hill and Strydom, 2000). One example is Duncan (1997) who, through community participation, developed a GIS database which included locally generated data.

In the rural communities of less developed countries, conditions require approaches to GIS that involve community-agency partnership. Harris and Weiner (1998) propose such a model - termed "Community Integrated GIS". One of the objects of this GIS is to empower communities to effectively enter into discourse with planners. In their case-study, they focus on the issue of land redistribution.

This research study focuses specifically on GIS for empowerment. This is discussed in the next section.

1.4 Aims and objectives of the project

At a 1998 workshop at Durham University to discuss participatory research and the potentials for participatory GIS, one of the proposals for the future development of PPGIS was that GIS should be promoted as a potentially valuable tool for participatory research practitioners: in other words "GIS

in participatory research”⁴, rather than “participatory GIS” (Abbot *et al*, 1998). At the workshop it was felt that much more needs to be known about the achievements and limitations of GIS and participation, as well as the conditions under which empowerment can take place through GIS.

The principal objective of the Kat River Valley project, and subsequently the CRG, has been to empower the Kat River Catchment Forum. In particular, to empower them to participate in multi-stakeholder catchment management and in the management of their own local environment. Since this is the overarching objective for the Catchment Forum, this is the participatory, or people development, framework within which the research into GIS for Participation must fit. It follows that the aim of the GIS for Participation research is:

To explore the potential of GIS to facilitate the empowerment of catchment forums to better participate in catchment and local environmental management.

The challenge in empowering the Catchment Forum to participate in catchment management is to mobilise people to think in terms of catchment: to understand linkages and catchment-wide processes so that they can deal with, and negotiate around, both catchment-wide and local problems. The catchment space, or catchment surface (see Rowntree *et al*, 2000), represents the continuum, or framework within which catchment management processes are integrated. For example it is through the surface continuum that the linkages between land and water are expressed: water flows through the surface, and the quality of the water at any point is integrally related to the state of the surface through which it has flowed (Gorgens *et al*, 1997). The surface continuum also provides the framework for understanding and managing catchment problems. An example in the Kat is the spatial distribution of different land-uses and the ramifications of this for water allocation – both in terms of water use and the determination of the Ecological Reserve as specified in the National Water Act (1998). Before the different stakeholders and communities can negotiate for water allocations, they must understand how they fit together on this space, and each must understand the consequences of their land-use on people elsewhere in the catchment: poor rangeland management by communities and emerging farmers in the upper catchment results in reduced water quality and lower base-flow in the lower catchment; the allocations from the Kat dam of large volumes of water to irrigation farmers in the middle catchment reduces the amount of water available to meet the environmental needs in the upper catchment.

⁴ In this thesis the term “GIS for Participation” will be used. This is because the use of GIS was not only for a *research* agenda, but also for a broader participatory and empowerment process – “GIS for participatory practice”.

Since GIS is a tool that deals with spatial information, it has the potential to provide a platform for the development of such catchment concepts. GIS provides a representation of the real world (in the case of this thesis, the catchment) at a scale that goes beyond the environment that is immediately visible. By allowing us to “see” a greater area, we are able to see the connections between the various elements of a system (Jones, 1997). In visualising the catchment as a whole from a spatial perspective, and by understanding how phenomena are connected at a catchment scale, people are better enabled to participate in Catchment Management.

Thus the first objective to achieve the stated aim is:

To explore the potential for GIS to facilitate the development of mapping skills, an understanding of the Kat River catchment, and an understanding of catchment concepts in general, among the Catchment Forum.

One of the community motivations for participating in the Catchment Forum was the recognition that greater communication and sharing was required among the communities in the Kat, and between the communities and other stakeholders. In order for Catchment Forum members to achieve this, it is important that they should be able to present their local circumstances effectively. Since so many local, and catchment scale, environmental situations have a spatial dimension, and since GIS is a tool for managing and displaying spatial information, there is the potential for GIS to facilitate sharing and communication. This is the basis for the second objective.

To explore the potential for GIS to facilitate constructive communication and sharing among the Catchment Forum, and between the Catchment Forum and other stakeholders.

The research process has taken the form of Action Research⁵, situated in the Critical paradigm. Consequently it is anticipated that some sort of empowerment outcomes for the Catchment Forum will be achieved.

It should be noted that the Action Research approach has directly influenced the way in which the aims and objectives of the project have been developed. One characteristic of Action Research is praxis. In other words the research progresses in cycles, where theory, or understanding, informs practice, which in turn leads to developed understanding and better practice. This interplay between theory and practice means that the research questions (and their answers) become clearer as the research progresses (Dick, 2000a). One of the outcomes of this is that the research process remains flexible and responsive – ensuring appropriate research outcomes in terms of a participatory approach to research. Although the essential aims of this research have remained the same, some of the research objectives and questions have either been subsumed by new questions, or have had to be discarded. Clarification of the research objectives have coincided with the evolution of the GIS

⁵ See chapter 3.

process to become an integral part of the participation and empowerment process surrounding the development of the Catchment Forum.

1.5 The definition of GIS in terms of the research

As has been defined, GIS involves the capture, collation, management, manipulation, analysis, modelling and display of spatial data, principally for problem solving (World Bank, 1993, Clarke 1997). This is a broad set of capabilities. Considering the aims of this thesis, and the nature of the participatory process in which the research has taken place, some of these capabilities are not used. This includes spatial data analysis, manipulation and modelling⁶ (apart from developing a Digital Elevation Model). In the context of this thesis, GIS can be defined as a tool that supports the generation, storage, integration and display of local scale spatial information, and the use of this information, together with conventional information, for both local, and catchment level, appraisal, planning and communication. In this thesis, where the term "GIS" is used, it generally relates to the range of spatially related processes, including mapping.

1.6 Overview of the thesis

The process of Action Research is a continuous cycle of understanding and planning, action, and reflection on those actions so that understanding is deepened (McTaggart, 1997; Cherry, 1999). This research project has consisted of an overall Action Research cycle, within which there have been other cycles⁷. This is illustrated in figure 1.3. The overall research cycle has consisted of an initial literature review and proposal writing stage (representing understanding and planning), followed by a sequence of engagements with the Forum (the actions), and finally the thesis writing stage (reflection on the overall process). Within the research process, there have been eight engagements⁸ with the Catchment Forum. Each engagement has included planning, action and reflection, where reflection on one engagement has informed the actions of subsequent engagements. The thesis writing stage represents the final action cycle in the overall process; the writing up phase of research, especially in Critical Science, can be considered to be a continuation of that research (Lotz-Sisitka and Burt, in press).

⁶ It should be noted that it was initially intended that a three-dimensional GIS model should form a part of the process of developing spatial awareness of the catchment. However, due to the lack of processing power of the computer used for display in the field, this was not carried through.

⁷ For a discussion on research cycles within cycles, see Dick (2000b).

⁸ In this thesis, the term *engagement* is used to describe the times in the Catchment Forum development process when interaction took place between members of the Catchment Research Group and the Forum participants or community members, *in* the catchment. These include (but are not necessarily confined to) workshops, the build-up to workshops, and post-workshop liaisons.

The structure of this thesis conforms to the Action Research Methodology. It consists of context chapters that provide an initial understanding of the subject, followed by chapters detailing the actions and reflections that took place (description of the research activity), followed by reflection chapters of the overall process (discussion and conclusion). Furthermore, the structure of the chapters detailing the eight engagements reflect the process by which the research took place. Since each cycle informs the next, these engagements are represented in chronological order, while planning, action and reflections are detailed for each engagement where appropriate. The argument that the thesis structure should be authentic to the methodological process is covered in greater detail in Chapter 6.

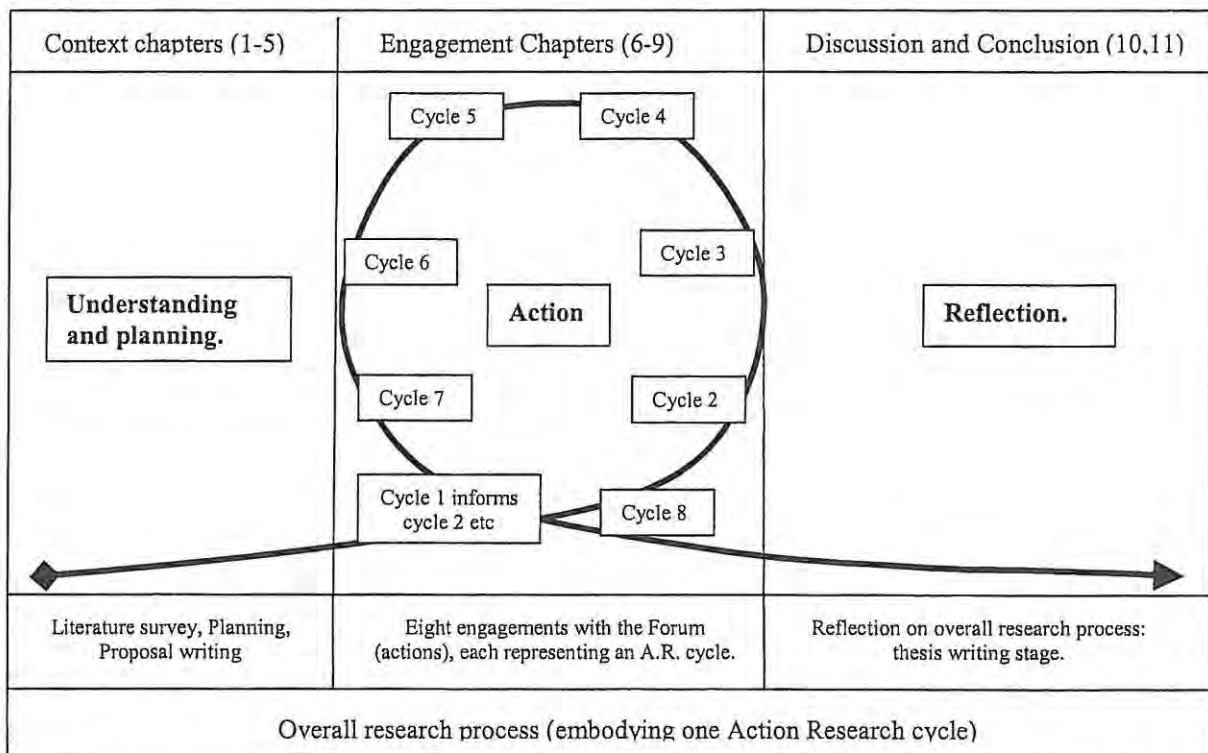


Figure 1.3: An illustration of cycles that constituted the research process. The arrow represents the overarching research cycle, within which there are numerous action cycles, including the thesis writing process. The boxes at the top of the diagram show the relationship between the thesis structure and an Action Research Cycle.

The sequence of chapters in the thesis is as follows:

Chapter 1 has provided a background to participatory Catchment Management, the Kat River Valley and the Kat River Valley Project, and the Kat Valley Catchment Forum. This gives an idea of the context within which the research has taken place. Chapter 2 provides a review of the GIS and Society debate and Public Participation GIS. This is the theoretical context out of which thinking around GIS for Participation, which has been central to the research, has emerged. Chapter 3 describes the research methodology, namely Action Research situated within the Critical paradigm. Chapter 4 introduces Participatory Rural Appraisal and Action Learning. These are a set of tools,

used in the context of Action Research, to which a philosophy of sharing, learning and empowerment are attached. Since the capacity-building framework within which the GIS research took place has operated according to PRA and Action Learning, and GIS has formed a tool for appraisal and learning, this chapter further develops the context for the research. Chapter 5 details the development of the GIS database of conventional data, the platform for the use of the GIS for empowerment. Chapters 6 to 8 are descriptions of the first three workshops with the Catchment Forum. Chapter 9 details a set of feedback meetings with members of the Forum, and workshops in which GIS played a less central role. Each of these engagements had action outcomes, and led to the development in thinking about GIS for Participation. Chapter 10 is a reflection on the overall research, which is concluded by chapter 11.

2 GIS AND SOCIETY, PUBLIC PARTICIPATION GIS AND GIS FOR EMPOWERMENT

The idea of GIS for Participation has emerged out of a debate in which GIS is considered in the context of Critical theory. In this chapter, the debate that motivates for a change in the way that GIS is traditionally used will be considered - namely the GIS and Society debate. Thereafter, the development of Public Participation GIS (PPGIS) will be reviewed. Finally the concept of GIS for Empowerment and Participation, and the questions it raises with regards to this research, will be introduced.

2.1 The evolution of GIS and Society

Until the early 1990s, before thinking around GIS and Society had developed, GIS had more or less been increasingly, and unquestioningly accepted and adopted by governments, businesses and other organisations, as an objective and necessary tool for spatial analysis and planning (see for example, World Bank, 1995). GIS development and research at the time focussed almost purely on technical issues and issues of application. Researchers as well as practitioners saw GIS simply as a value-free tool which could provide objective answers for numerous spatially expressed problems or questions. Little attention was given to the view that GIS is a socially constructed technology and that its use has political, social and economic implications.

The idea that the development and use of GIS is indeed intricately tied to society was first formally recognised in 1993 at a "GIS and Society" workshop sponsored by the American National Centre for Geographic Information and Analysis (NCGIA). This led to the publication of a number of papers in 1995 in a special issue of *Cartography and Geographic Information Systems* (GIS and Society), giving rise to a GIS and Society research agenda which was formalised as Initiative 19 of the NCGIA. The title of the initiative was "GIS and society: the social implications of how people, space and environment are represented in GIS".

Among the primary concerns of the new "GIS and Society" research agenda was the development of a critical theory for GIS. A critical examination of the evolution of the technology, its inherent flaws, and the impacts that its use may have on society would provide a body of theory that could inform and support a more sound and responsible use of the tool by practitioners (Sheppard, 1995; Miller, 1995; Pickles, 1995).

The GIS and society debate will be considered here in three sections. The first section will examine the social and technical context in which GIS developed, the second will consider the impacts that the use of GIS has on social, economic and political relations, and the third section will look at new theoretical contexts within which GIS could be more equitably used.

2.2 The social and technical context of GIS development

Sheppard (1995) argues that the development of GIS, like all technologies, is a process of evolutionary change. Its development took one of many possible paths, producing one of many possible outcomes. Throughout its evolution, choices have had to be made, which means that some paths of development were pursued while others were discarded. The probability that one path is chosen over another will depend on the “way in which current practices, knowledge, and social conditions favour those alternatives” (ibid, p. 8). In other words it is important to consider the technical and social contexts of the evolution of GIS in order to understand the present character of GIS.

Sheppard (1995) argues that the social conditions shaping GIS are related to the post World War Two emphasis on the use of technology to solve problems experienced by government and private institutions of industrialised countries. Since only the largest institutions could afford to finance the development of these technologies, they have become oriented to the needs of Western commercial and public institutions. A second condition shaping the development of GIS, argued in particular by Taylor and Johnston (1995), relates to the applied-quantitative revolution in Geography in the 1970s and early 80s. With the down-turn in the world economy at the time, there was a shift from pure geography to an applied geography that justified its existence by being useful. With GIS in its infancy, this emphasis provided the perfect climate for the development of a tool which was so useful in spatial analysis, modelling and prediction. In turn, from these roots, GIS had become a tool which was securely seated in an applied quantitative paradigm.

Most of the technical conditions influencing the development of GIS have been closely tied to the development of computer technology. As advances have been made in computing, so opportunities have been opened for further developments in GIS. For example, where previously remote sensing applications, GIS and 3D modelling were considered separate technologies, dramatic advances in processing power and supporting software modules have meant that all three functions can be seamlessly integrated into one single application. This has facilitated highly sophisticated spatial analysis and predictive modelling, which in turn has further entrenched the role of GIS as a “necessary tool” in so many sectors. However, although computer technology has paved the way for developments in GIS, it has also played a role in limiting the technology. The directions that GIS can take are constrained by the structure and logic fundamental to computing technology.

The outcome is that although GIS can be described simply as a tool, the path of its development has resulted in specific characteristics. These are that it is mostly an applied, quantitative technology, used mostly for empirical analysis in the tradition of centralised planning and problem solving, and that the tool is confined to the boolean logic on which computer systems are based. This limits the

types of information that GIS can use and represent. With reference to the GIS and Society debate, GIS is limited in its ability to represent a diversity of qualitative social information.

2.3 The effects of GIS as an applied quantitative tool

2.3.1 *GIS and rational instrumental logic*

GIS is used overwhelmingly within the framework of rational instrumentalism⁹ – the logic used by scientists and planners in their pursuit of infrastructural, social and economic solutions (Aitkin and Michel, 1995). However, since there is no absolute external standard by which any logic can be validated, there is no basis for arguing that one form of reasoning is superior to alternative forms (Guba, 1990; Sheppard, 1995; Connole, 1998). Since GIS has become pervasive as a technology which is used according to the rules of rational instrumental reasoning, there is a danger that other forms of logic will be marginalized¹⁰. Rundstrom (1995) suggests that by ignoring other ways of knowing the world, GIS has the potential to impact on the diversity of epistemologies (perceptions of reality) and, in so doing, reducing the means at hand with which to creatively solve problems. Furthermore, there is the danger that by marginalising other ways of representing the world, the societies and cultures behind these representations are marginalised from having a voice in terms of determining their own circumstances.

2.3.2 *The reliance of GIS on data*

The approach to planning and problem solving that GIS represents is entirely reliant on data. It would therefore be important to consider what the social relations of those data are. Traditionally, GIS operators, working from an empiricist, positivist approach, would not question the assumptions behind the data - as long as it is accurate, it represents what is there. To an extent this may be true when dealing with biophysical data, but the assumption falls apart when dealing with social data. Anyone's knowledge of a social reality is partial, which means that the representation of that reality in the form of data would also be partial and open to interpretation (Miller, 1995). It can be argued that social data have implicit biases and assumptions relating to the purposes for which it was acquired, the power-positions of those designing and executing the data acquisition and interpretation process. In other words, a degree of subjectivity can easily be inherent in data. In

⁹ Aitken and Michel (1995) describe rational instrumentalism as a perspective, based on a modernist discourse, which adheres to the premise that through applications of rational scientific methods and technology it is possible to build better communities.

¹⁰ GIS is generally considered to be a way of processing standard socio-economic and biophysical data (Sheppard, 1995). By not representing other forms of information, such as indigenous knowledge (Rundstrom, 1995; Weiner *et al*, 1995), these knowledge systems are discounted in decision-making.

terms of GIS and Society, the extent to which that subjectivity affects those who were not part of the data creation process should be considered.

The issue is further complicated by the limits placed by its inherent logic on the types of data with which it is able to work. "We still have a long way to go in deciding how to incorporate behavioural, social and economic data into the databases associated with our geographic information systems" (Miller 1995, p. 100). Thus in addition to the potentially marginalising framework within which GIS is traditionally used (as mentioned previously), the quantitative structure by which GIS has been developed to handle information can be limiting and marginalising. This is expressed by Sheppard (1995, p. 13):

To the degree that knowledge cannot be incorporated in a GIS used for resolving social conflicts, the outcome of those conflicts will tend to discount the knowledge and expertise of those whose perspectives cannot be captured in a data matrix, or whose data are not considered significant enough to be worth including.

Taylor and Johnston (1995) provide an interesting illustration of the power of the data collector. They point out that *statistics* and *state* come from the same root. The state represents a concentration of apparatus for the collection of data, and it is these data that are most used by GIS practitioners. Based on analyses of these data, policies, allocation of resources, and strategies for the operation of the state are determined. The data of the state dominates the data that is available to, and used by, GIS practitioners. This means that GIS outputs could be "code-named the handmaiden of the state" because they predominantly reflect the state's perspective of the national reality. This idea is supported by Sheppard (1995) who points out that, because of the vast capability of GIS for data manipulation, GIS users have easily fallen into the trap of having their analysis driven by the availability of data, rather than their data collection driven by theory. More often than not they have made the false assumption that the use of secondary data is a value-free process.

2.3.3 *GIS and issues of access*

The power of the spatial analyses and visual presentations of GIS outputs can make a critical difference to the effectiveness of the arguments of those using it. The position of those with better access to GIS is strengthened in the decision making process. This affects the outcomes of social conflict and relations of power (Sheppard, 1995). Elwood and Leitner (1998) define access as the ability to obtain GIS data, hardware and software. During the early development of GIS, access was generally confined to the larger commercial, state and planning institutions, thus reinforcing existing relations of power and inequity. Harris *et al* (1995) state that (pg 203):

Without equitable access to GIS data and the technology, small users, local governments, non-profit community agencies, and non-mainstream groups are significantly disadvantaged in their capacity to engage in the decision making process.

The rapid development of information technology has meant that ever-increasing numbers of people have access to computer hardware and software. GIS technology is by no means the exception. The commercialisation of the technology has resulted in the reduction of its real cost, while software for viewing and presenting GIS data is available free over the internet. There are also increasingly vast amounts of public domain spatial data available over the internet. However, improved access to GIS information and technology does not mean that non-mainstream groups are empowered to use it. Elwood and Leitner (1998) argue that access for smaller groups is dependent on awareness about GIS data, relative abilities to acquire technology and data, and abilities to apply GIS effectively. The ability of such groups to apply GIS effectively depends on the use of well-trained GIS operators – usually an expensive commodity. Furthermore, although large amounts of small-scale information is freely available, it does not mean that it is suited to the specific needs of the user. The ability of a user to buy accurate, site-specific information influences the effectiveness with which they can use GIS. The effect that this may have on social relations is well articulated by Sheppard (1995, p. 13):

...[D]isadvantaged social groups will least be able to purchase the information that they need, particularly information that is expensive to collect. To the degree that the best information is most expensive, this will tend to create an information gap between better off and less well off social groups that again may make it harder for the latter to argue an effective case with GIS.

This section has discussed issues of access for social groups in highly industrialised countries. The picture is slightly different in less developed countries. For example in South Africa there still remains a strong polarisation between decision makers, who commonly use information technology, and the large majority of stakeholders who have neither the infrastructure, the financial capacity, nor the skills to use such technology. Such differential access can easily exacerbate prevailing unequal power relations.

2.4 The use of GIS as informed by critical theory

As has been argued in the preceding sections, GIS can be seen as a tool that entrenches existing unequal relations of power. However, the proponents of GIS see it as a tool which can explore spatial relationships in an unprecedented way, invaluable in helping the fight against poverty, crime and the spread of disease, and in assisting in the provision of services, among many other social applications. Taylor and Johnston (1995) feel that rather than lodging the technology in one camp or another, it should be seen for what it is: “an efficient tool for manipulating information, no more, no less” (p. 64).

A critical approach to GIS addresses the above-mentioned issues by taking into account the assumptions and biases inherent in the tool, and in the use of the tool, in a responsible manner. Miller (1995) argues that by thinking of GIS as other than value neutral and bias free, there will be a shift from questions of how to use the tool in more sophisticated ways, to questions regarding the relationship between GIS models and multiple realities, and how those realities are constructed. This in turn leads to the question of ethics, where (p. 100):

...GIS practitioners and theorists should not be merely technical functionaries, but cognizant, socially aware actors. In other words, GIS analysts have a responsibility to consider the ultimate disposition of their efforts, rather than simply to follow orders”.

Some of the issues that practitioners should focus on have been covered in the previous section. The first among these relates to the type of analysis and modelling that GIS is confined to. Recall that the Boolean logic that GIS is based upon can be limited in its ability to reflect social situations. Models tend to have precise structures that often cannot accommodate the non-precise complexities of social problems (Miller, 1995). Apart from explicitly recognising these shortcomings, practitioners need to develop ways of representing this information. Ideas that are being developed include stochastic modelling and fuzzy set theory.

The second problem that GIS analysts should be particularly aware of regards the biases that exist in the data that they use. They should be aware of where it came from, what the purpose of its production was, and who produced it. Practitioners need to be self critical about data that they exclude, or questions that they don't ask, because of *their own* biases. The dangers of *not* being critically aware are spelt out by Taylor and Johnston (1995, p. 59):

A GIS geography that does not consider its underlying theory is avoiding its responsibility and investing it in the collectors of data, usually the state. Such 'empiricism' produces an inherently conservative geography. The theory upon which analysis is built will be descriptive of the status quo and treat it as a taken-for-granted world. Alternative worlds – for which there are no data – are ruled out of court in this empiricist development of geography.

The third issue that should be explicitly recognised is the power of GIS presentation to bolster the position of proponents using the tool. Miller (1995) argues that information provision is a highly political process. By attempting to produce persuasive presentations of an outcome generated by GIS, the practitioner is explicitly acknowledging that GIS is not value-free. GIS users should be aware of the unequal power relationship between one form of presentation and another, and between “experts” and laymen, and they should be aware of unequal access to data and the technology. In essence, they should be aware of their power, and be careful not to abuse it.

The above issues have led practitioners (for example Sheppard, 1995; Harris *et al*, 1995; and Weiner *et al*, 1995) to call for a new research agenda in which ways are explored for GIS to play a more empowering role in society.

One possibility being explored is simply to include local knowledge in GIS databases to make them more representative of the reality of the area of analysis - although practitioners should be careful to consider whether the present structure of GIS can effectively represent one reality, without marginalizing another. To date, a number of efforts have been made in this respect. Examples include Tabor and Hutchinson (1994), Lawas and Luning (1996) and Bocco and Toledo (1997), while a South African example is Botha and Fouche (2000), all of whom combine local knowledge with biophysical data to improve the effectiveness of GIS in terms of the management and use of natural resources.

The above are examples of local knowledge inclusion to improve the effectiveness of the GIS analysis. A different approach, however, involved the inclusion of local knowledge in GIS processes particularly to empower local people in decision-making. This is known as public participation GIS, or PPGIS.

2.5 Public Participation GIS

2.5.1 *The emergence of public participation GIS*

Public Participation GIS is an outgrowth of the GIS and Society debate. At the 1996 meeting of the NCGIA at the University of Minnesota for the development of a research agenda, a break-out group known as the public participation group was formed (Obermeyer, 1998). This led to a GIS public participation workshop in 1997, resulting in a 1998 special issue of *Cartography and Geographic Information Systems*, devoted to the subject. In the same year, a Project Varenus specialist meeting was held, entitled *Empowerment, Marginalisation and Public Participation GIS*. Much of the substance of the following text will be drawn from these two sources.

In 1998, the PPGIS movement focussed on developing GIS so that it could be used by community groups to further enable their participation in decision-making processes. The works of Barndt (1998), Bosworth and Donovan (1998), Craig and Elwood (1998), Elwood and Leitner (1998), Kim (1998), Kingston (1998), Krygier (1998), Shiffer (1998), and Al-Kodmany (2000) reflect this focus. The work of these authors is usually situated in an urban context, and usually relates to neighbourhood groups and social movements in the United States and the UK. There are generally two ways in which PPGIS in these countries has been practiced. Experts and decision makers have used GIS to enable stakeholders' effective partnership in the decision making process, or community groups have adopted and used GIS as a tool to strengthen their position against authorities or those holding positions of power.

2.5.2 PPGIS for partnership in decision-making or PPGIS as a means of facilitating public discourse

The use of GIS for facilitating public discourse, described by Al-Kodmonay (2000) as the “technical assistance model”, is characterised by the supply of the GIS and operational expertise, by decision-makers, to public participants in order to facilitate the decision-making process. The function of the GIS is to promote interest in the decision-making process, and to improve public discourse over proposed plans. The GIS aids in visualisation and greater understanding of proposals, and often operates as a platform around which discussions are conducted. Stakeholders may or may not contribute to the development of the GIS by supplying local knowledge. Authors who provide examples of this form of GIS include Bosworth and Donovan (1998), Kim (1998), Krygier (1998) and Al-Kodmany (2000). These authors have shown that the technical assistance model is effective in incorporating local knowledge and opinions in the decision making process. Once again, the use of the tool can be a highly political process, as Barndt (1998), Harris and Weiner (1998) and Howard (1998) make clear. As with the ethics related to the use of any tool, the issue is usually about the context in which the tool is used, rather than the tool itself. With PPGIS, the successful use of the tool is intricately related to the public participation process in which it is situated. According to Barndt (1998, p. 110):

Public participation GIS presumes that opportunities for public participation are in place. A critical examination of experience suggests that models of participation are limited, and that successful applications are even rarer.

Once again, this highlights the fact that, even for PPGIS applications, the GIS expert needs to be highly cognisant of the situational context within which the tool is used.

2.5.3 The use of GIS by community groups and social movements

With the widespread acceptance of the philosophy of devolution of power to the local level, community groups and non-profit associations are expected to take increasingly strong positions in planning and policymaking. In America, GIS has been promoted as an important tool in enabling these groups to participate in such decision-making (Elwood and Leitner, 1998). To these ends, large amounts of support have been provided. This has yielded a number of case studies which have proved informative regarding the opportunities and contradictions that the technology presents. Examples include Elwood and Leitner (1998), Craig and Elwood (1998) and Kim (1998).

For Elwood and Leitner (1998, p. 84), what has been perceived as most useful about GIS for community empowerment is its ability to produce maps:

Neighbourhood organisers and residents have a wealth of detailed experiential knowledge about the genesis and solution of neighbourhood problems. But they perceive that maps and quantitative data

have greater legitimacy and influence in negotiations with more powerful social actors. In this context, they see GIS as a tool to quantify and specify community knowledge and to represent it visually in a way that increases their effectiveness in negotiations.

Other ideas for the community based GIS applications include neighbourhood environmental monitoring and evaluation, service location analyses, verifications and other analyses in order to push for change or to support grant applications.

One of the concerns surrounding community based GIS is the issue of operating and maintaining GIS databases (Elwood and Leitner, 1998). Setting up a GIS database can require particular expertise. Neighbourhood groups do not necessarily have the finances to employ or train experts. In addition community groups experience a high turnover of staff, which offsets the advantages of training members, while causing problems regarding the updating and maintenance of databases.

2.6 GIS as a tool for empowerment in communities of less developed countries

Community based GIS, as described above, occurs almost exclusively in the countries of the north. Communities in less developed countries (LDCs) are often unable to use GIS because of poor communications infrastructure, training, access to data, and because of the real cost of data, hardware and software. This is especially the case in rural communities of LDCs, where a lack of both financial and human resources is an overriding limit to any initiative. Indeed, where PPGIS has been successful in America, it has usually been supported by substantial grants. For example, the Hawaiian Crash Outcomes participatory GIS was supported by a \$700 000,00 grant (Kim, 1998), while neighbourhood groups in Minneapolis receive grants in the order of millions of dollars as part of revitalisation programs (Craig and Elwood, 1998).

Where GIS has been used for empowerment in rural communities of LDCs, it has usually taken the form of a partnership between experts and the subject communities. Where such partnerships in developed countries have usually been for purposes of encouraging public discourse in planning, the roles played by PPGIS agencies in the LDCs have been genuine attempts to build the capacity of, or empower rural communities. These GIS agencies have usually been academic or NGOs, with interests in social science, participatory practice or community based resource management.

Some examples include Harris *et al* (1995), Weiner *et al* (1995) and Harris and Weiner (1998), who have carried out a case study in South Africa, and Kwaku Kyem (1998) who used GIS for community participation in forest management in Ghana, and Jordan (1998) and Bitter (2000) who conducted work in Nepal.

2.6.1 *Community Integrated GIS*

Acknowledging the dependence of rural communities on outside expertise and funding, Harris and Weiner (1998) propose a model called "Community Integrated GIS".

Community Integrated GIS is envisaged to:

- ③ Be agency driven, but not top down or privileged toward conventional expert knowledge;
- ③ Assume that local knowledge is valuable and expert;
- ③ Broaden the access base to digital spatial information technology and data;
- ③ Incorporate socially differentiated multiple realities of space;
- ③ Integrate GIS and multimedia;
- ③ Explore the potential for more democratic spatial decision-making through greater community participation;
- ③ Assume that spatial decision-making is conflict-ridden and embedded in local politics.

The Community Integrated GIS (Harris and Weiner, 1998, p. 74):

... [W]ould contain not just the cartographic and attribute information traditionally associated with GIS, but would be expanded to become a forum around which issues, information, alternative perspectives and decisions revolve.

This GIS model was tested by Harris and Weiner in Kiepersol, Mpumalanga. The project sought to broaden the process of land reform to incorporate the many perspectives of those who had a stake in the matter. Workshops were held with white farmers, their labourers, and residents of the former homeland in the province. The workshops involved combining conventional GIS coverages with local knowledge comprising mental maps and interviews with Global Positioning System (GPS) transect walks. Some interesting data layers have been created, highlighting issues of access, dispossession and marginalisation in terms of agricultural productivity – all pertinent to the land-reform process.

Community Integrated GIS represents an important model for GIS applications in rural communities of LDCs. Its principles take into account the particular circumstances of this sector of society. Questions remain, however, regarding the functionality of this form of GIS as a means of empowering rural communities. Harris and Weiner themselves are cautious about claims of grassroots participation and empowerment. If the object of an agency-community GIS partnership is to empower that community, then the community is effectively the client of that agency. In evaluating such a GIS, one would have to ask to what extent the agenda of that community has been served, as opposed to that of the agency. Is it a response to the explicit needs of the community, or was its purpose defined before any contact had been made with the communities in the first place? To what extent do the communities have ownership of the GIS process? Did some outside experts

come in and extract information from them, or can they see and participate in the GIS process to its conclusion? Do the participants have any say in how the information and GIS will be used once it leaves their community? Do they get to see the final product? Has the GIS helped them develop a greater knowledge of their area? Has the GIS helped in enabling them to appraise and deal with their circumstances independently from outside help, or has the agency-community partnership simply sustained relations of dependence in the developing world?

It is these questions, in the light of the ability of GIS to empower communities, that this research project is attempting to address. Based on a case study that is informed by these questions, which have come out of a dialogue with the GIS and Society and PPGIS literature, it is hoped that the experiences and reflections that have taken place will throw further light onto the opportunities and constraints that GIS poses in the context of technology as a tool for empowerment.

3 RESEARCH METHODOLOGY

The recent changes in perception surrounding the role of GIS in society show a shift from its previously unquestioned seating in the applied positivist paradigm towards a more Critical perspective. For example the entire GIS and Society debate occurs from perspectives outside of positivism. By virtue of the questions and aims of this research thesis, a philosophy other than that of positivist science is implied - namely critical science. This chapter will consider the critical paradigm within which this project is situated, making clear the assumptions on which the research has been based. In the context of this research paradigm, the methodology and research process will be discussed.

3.1 Research Philosophy

It is widely acknowledged that science is not necessarily value-free and isolated from context (Guba, 1990; Phillips 1990; Fien and Hillcoat 1996). For example Fien and Hillcoat (1996) state that (p. 26):

The paradigm upon which a research methodology is based is often not seen as important because the logic and precision of the scientific method allow research to be independent of ideology. However, research methodologies are very much a puppet of underlying assumptions.

These assumptions are related in particular to what constitutes reality, how we perceive that reality, and how that perception can be interpreted. Differing assumptions surrounding observations, methods and modes of explanation can be grouped into commonly agreed sets. It is these groupings of assumptions that constitute paradigms (Grigg 2000). Three major research paradigms are generally recognised. These are referred to by a variety of labels. In this thesis they will be termed the positivist, interpretivist and critical paradigms.

3.1.1 *Positivism*

The positivist research paradigm views reality as if it exists outside of the human being. Since information is seen as independent of the researcher, it can be gathered objectively according to predefined procedures, eliminating researcher bias, and allowing value-free research. Positivist methods involve the construction and testing of hypotheses through either inductive or deductive reasoning. Inductive reasoning involves the specific observation of data, from which principles may be generalised. Through repeated testing, those principles can either be confirmed as a law, or discarded as false. Deductive reasoning involves the generation of specific predictions (hypotheses) based upon theory, and then testing these predictions by observation (Grigg, 2000; Kitchin and Tate, 2000).

It has been argued, however, that there is a fundamental flaw in both the inductive and deductive approaches. Induction often involves the selection of a particular set of data on which to base an analysis. Even though the facts may be “out there and independent of the observer”, by choosing what variables to observe, the values or world-view of the researcher are brought into play (Connole, 1998). This is especially problematic in multi-dimensional systems where many variables come into play, and where it would be dangerous to consider one variable in isolation from the overall system. The deductive approach, in turn, is problematic in that it requires the inductive testing of its hypothesis.

Although positivism remains the most widely accepted approach in the natural science, the notion of objective observation becomes questionable in the highly complex social world, where few variables can be considered in isolation (Robson, 1993).

3.1.2 Interpretivism

Interpretivism has become established as a research paradigm in the social sciences. Where positivism views reality as external to the individual, interpretivism views reality as internally constructed. Interpretivism holds that human behaviour is too diverse to be described through general principles and theories. Human behaviour is situation specific and any attempts to systematise it will give rise to incomplete and unreliable knowledge (Fien and Hillcoat, 1996). As a result, interpretivist research is situation specific, and although it is not replicable, ideas and themes can be transferred to other settings.

3.1.3 Critical Research

The critical approach, while sharing the critique of the positivist paradigm held by the interpretivists, holds that human construction of reality does not only take place internally, but is also influenced by outside social forces (Kitchin and Tate, 2000). Individuals and social groups cannot be considered separate from their societal context. While the political agenda of the positivist and interpretive paradigms are implicit in its unacknowledged assumptions, that of the critical approach is explicit: social action should be an outcome of critical research. The creation of knowledge or understanding should be emancipatory, enabling the researcher and researched to free themselves from limiting social forces. Interpretive and positivist science is critiqued in terms of the unacknowledged power relations of the research. Critical science, on the other hand, holds that science cannot be value-free, and openly acknowledges its ideological assumptions and political agenda (Guba, 1990).

3.2 Philosophical context of the research

The GIS and Society and PPGIS approaches are clearly situated in the critical paradigm. “The social construction of GIS”, “GIS and Hegemony”, “GIS and marginalisation”, “GIS and grassroots

participation” are some of the strong critiques and themes running through these debates. Indeed, recall that both GIS and Society and PPGIS represent calls for the use of GIS as informed by critical theory (Taylor and Johnston, 1995; Miller, 1995; Sheppard, 1995; Harris and Weiner, 1995).

As research contributing to, and occurring in the context of the above field of GIS, this project is situated in the critical paradigm. With a focus on exploring the possibilities, within a participatory process, of using GIS as a tool for awareness creation, sharing and empowerment among rural communities, there is an explicit anticipation of some sort of social change as a product of the research process. Unequal power relations, and deterministic social circumstances are openly considered. Social relations within the research process are also acknowledged, with issues of ownership of the research and participatory process, ownership of knowledge, and of means, being constantly returned to. The contradictions and opportunities of using a tool that has been constructed from an applied positivist paradigm for purposes of critical research are also acknowledged and discussed.

3.3 The approach to research in critical science

Although it has been shown that there is no absolute standard by which to evaluate scientific methods, sound research should nevertheless involve the effective application of research techniques, while remaining in line with the research aims and methodology. Fien and Hillcoat (1996) provide a useful introduction to the critical research technique, which will be summarised here.

The three primary data collection techniques in critical research involve observing behaviour, listening to informants, and studying documents. These techniques generate what is known in critical science as text – analogous to the data produced by speech and action. Central to the creation of this text, is the recognition that the observer is not isolated from the observed. What data is collected, and how, is influenced by the researcher’s interaction with the participants in the research¹¹. The participants affect the researcher, while the researcher affects the experience or position of the participants. Thus the interplay between the researcher and the researched is of central concern in critical research (Lather, 1986). In critical science, theory and data are seen as a duality, involved in a “dialectical interplay”. In other words, theory informs data collection and interpretation, but during this process the findings provide insights which guide the further collection

¹¹ Since critical science openly acknowledges the influence of the researcher on the research, report writing of critical science research often takes place in the first person. At times in this thesis, where I have directly interacted with the research participants during GIS processes, the writing will be in the style of the first person.

of data, while allowing for the further development of the theory. The process has two implications for research design:

- a) The theory-data duality means that the researcher must proceed carefully and reflectively as the research process plays itself out.
- b) The research design cannot follow a predetermined sequence of data collection and analysis. The research process involves an ongoing cyclical relationship between developing a theoretical framework, and collecting and analysing the data. As a result the researcher “needs to be open to issues in the development of the study, with the research design evolving as the participants and the researcher gain experience and insights into the processes being investigated” (Fien and Hillcoat, 1996, p. 34).

This approach to research has generated three major research methods in critical science, namely discourse analysis, critical ethnography and action research. The method that has been used in this study is Action Research

3.4 Action Research

Action Research is seen as a form of practical enquiry characterised by a self-reflecting spiral of cycles of “planning, acting, observing and reflecting” (Kemmis, 1993, p.178). It is a process where action produces experiences, reflections on which deepen our knowledge and understanding of things. In turn, this deeper knowledge yields enriched planning and action (Cherry, 1999). Thus the outcome of Action Research should be refined practice or effective social outcomes, and developed knowledge (Dick, 2000a; Hughes 2000).

Action Research was developed in the 1940s by a social psychologist Kurt Lewin. The idea at the time was to link more closely the social scientific process with social action to address the major social problems of the time (Kemmis and McTaggart 1988). The idea has since developed to become a methodology strongly rooted in critical science. One of the most important aspects of this methodology is that it provides for local and specific research outcomes to be applied (appropriately) to the specific problem that was researched in the first place. This is opposed to the application of general principles derived from research associated with the other paradigms, as argued by McTaggart (1997, p. 26)

... [I]t has been demonstrated time and time again that the *application* of the researches of others (especially positivist research, which blithely claims universal applicability) in new social, cultural and economic contexts, is unlikely to work. People must conduct substantive research themselves on the practices that affect their own lives.

Rather than separating research theory and practice, Action Research represents a means by which the two can operate together, in a duality that promotes effectiveness in terms of both the research and the practice.

The Action Research procedure involves cycles of understanding, planning, acting, reflecting and understanding. The distinguishing element of this process is that explicit reflection takes place. Rather than passively becoming aware of areas of the research or actions that need to change, the researchers *consciously* and methodically collect evidence on which to base critical reflection (McTaggart 1997), from which strategic action flows.

Action Research has become popular among many researchers because of its responsiveness to the situation. In social situations, standardised and predetermined research designs often limit the questions that can be asked, the issues that can be taken into account, and the problems that can be addressed. This can be highly problematic, because the researcher only develops an understanding for a social situation as the research proceeds. It is rare that one is aware of all the dynamics of social problems at the outset of the research. Dick (2000a) sees the responsiveness that Action Research allows as one of its most important features:

The *virtue* of action research is its *responsiveness*. It is what allows you to turn unpromising beginnings into effective endings. It is what allows you to improve both action and research outcomes through a process of iteration. If your action research methodology is not responsive to the situation, you can't aspire to action outcomes.

As will be discussed in the following section, it is this responsiveness which has been crucial to this research study, since it has occurred within the framework of a dynamic and changing participatory process.

3.5 The character of the research project

One of the greatest difficulties surrounding this research project was that it occurred in the context of a newly formed group of people – the Kat River Valley Catchment Forum. It is a group that has been constantly evolving as relations, awareness, a sense of purpose, and levels of understanding have developed over the year and a half since it first came together. Indeed, the changes in the group have occurred in some part as a result of the research process itself. As a consequence, the very questions that were posed initially have had to change. The research was to explore the *possibilities* of GIS being a tool for empowerment for catchment management. This would be achieved by extractively developing data sets of local spatial realities, and modifying existing conventional data so that it was more closely aligned to the existing situation. The process would involve *all* stakeholders in catchment management, and the resultant database would be used to run GIS applications with the stakeholders to facilitate more communicative, more consensual, and more effective (in a biophysical sense) catchment management. Effectively, the GIS was to form some sort of decision support system for catchment management. It is reiterated that the GIS process was to exist for its own purposes, and the aim of the study was essentially to determine whether empowerment could be promoted as a *by-product* of the participatory nature of its existence.

The initial research aim was formed within a positivist orientation. For example, the nature of the GIS process was predetermined. Neat flow diagrams were used to illustrate how the GIS process would pan out over time. Assumptions were made about the ability of participants to think spatially, let alone participate in GIS applications and analyses for catchment management. Furthermore it was assumed that some level of catchment management, in an embryonic phase at least, was in place. And perhaps most importantly, the GIS process was to take place on its own terms, as opposed to being a tool, the need and purpose for which, would be driven by the issues and needs of the catchment community. The emphasis of the research was to develop knowledge about the use of GIS in a participatory manner, rather than to bring about social change.

Subsequent to these initial questions, the situation in the catchment unfolded during the research process. It was revealed over a period of months that catchment management structures were still in process. It also came to be understood that participation, both in catchment management and in the development and running of a GIS, *could not* take place until the communities of the catchment had developed a deeper understanding of, and skills for participation in, these tools, processes and structures. Furthermore lack of capacity in terms of finances, infrastructure, levels of networking and group mobilisation have proved to be fundamentally limiting factors.

As it became more apparent that the initial approach was inappropriate for the circumstances in the Kat River Valley, the initial research questions were slowly but surely discarded. In place of this approach a new set of ideas, and ultimately a new research philosophy, came into play, as the intricate processes of empowerment that were taking place in the valley came to be understood. With this new understanding, a new role for the GIS was conceived – to operate as a method within the participatory process surrounding the establishment and development of the Kat River Valley Catchment Forum. This new GIS approach has evolved as the new, participatory framework within which it came to be situated has evolved. There has been an interplay between this and the GIS practice which has led to new, clearer research questions and outcomes in much the same manner described by the action research approach of Dick (2000a). Once the initial questions were discarded, a set of “fuzzy questions” took their place, which could only be addressed with a “fuzzy approach”. But as answers came out of initial steps in the research, both the questions and the practical approach became more refined (Figure 3.1). The process has yielded the research aims and objectives that are set out in the introductory chapter. It is interesting that it only became clear that the work was being, and had been, conducted within an action research framework towards the end of the research process.

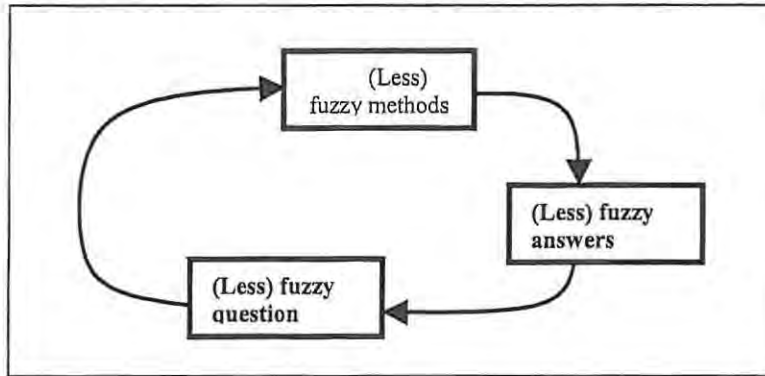


Figure 3.1: Action research often starts with a fuzzy question and methodology; but provided each cycle adds to the clarity, this is appropriate (Dick 2000a).

3.6 Cycles and methods

The research process has taken place as a number of phases or cycles, and cycles within cycles. At the level of practice, there have been eight sets of interaction with the Catchment Forum. These will be covered in Chapters 6 to 9. In these chapters, the description of each interaction will incorporate an explanation of the way in which the GIS was used or the role that it played. Activities included the production of maps with the GIS; participatory appraisals of local communities and the catchment using these maps; group mapping of issues, activities, plans and resources; presenting back a synthesis of this mapping through the GIS; and the use of GIS to facilitate explanation, planning and presentation. The primary sources of data have been the output from the participatory mapping exercises (this included spatial data and attribute information). Other forms of data collection have included video transcripts of the workshops, post-workshop reports, transcribed interviews, notes on discussions and reflections with other workshop facilitators, as well as “notes to myself” based on observation and reflection (or “memos to myself” as advocated by Sankaran, 2000).

This diversity of techniques for recording data lends to triangulation. Triangulation is considered “a process of using multiple perceptions to clarify meaning, verifying the repeatability of an observation or interpretation... (it) serves also to clarify meaning by identifying different ways the phenomenon is being seen” (Stake, 2000, p. 433). The group processes that have been integral to the research have lent themselves to the generation of triangulated data in particular (Chambers, 1992). For example, in participatory mapping, before a phenomenon can be recorded spatially, verification takes place among the group as to its position, dimensions and attributes.

Data analysis took place in terms of inductive analysis (Patton, 1987), which refers to categories and themes emerging out of the data rather than being decided on prior to data collection.

It should be reiterated that methods and activities in workshops and other engagements were not defined at the outset of the research. The GIS formed a part of a participatory process, which has meant that its use has been a response to developments, opportunities or needs as the process unfolded. Furthermore, the methods related to the GIS research in most workshops were informed by the experiences at, and reflections on, previous workshops or engagements. The way GIS and maps were used in each engagement will be detailed as each engagement is described¹².

The methods used in building the initial, conventional GIS database and in the production of maps will be dealt with in Chapter 5.

3.7 The relationship between research and practice

Some of the literature on Action Research emphasises that it is a process of collective, or group reflection, observation and action (Masters, 2000; Hughes, 2000). It should be pointed out here, however, that this research project is not *Participatory* Action Research, where the participants in the participatory process are part of initiating, determining and carrying out the research (for a description of Participatory Action Research see McTaggart, 1997). Although the participants in the Catchment Forum have owned the processes of appraisal analysis and planning, the work that is reported here relates specifically to my own research agenda within these processes, my own reflection, and the reflections of members of the Catchment Research Group at the Rhodes Geography Department. In other words, in this research project, there have been two agendas relating to research and practice. Namely the generation of knowledge and the facilitation of the development of the Forum. This is an important duality, the consequence being that there are tensions between my role as a researcher and my role as a facilitator or practitioner. To be a good facilitator, I should not focus too heavily on my own research agenda (where recording information for knowledge creation could be primary) when working with the community participants. Practice should not be subverted by the research - the practice is part of the agenda of the research, but the research is not necessarily the direct agenda of the people.

In critical science the tension between these two sides of the research process is acceptable – even expected - as long as the practice informs the research and the research informs the practice (Lather, 1986). Critical research, and especially Action Research (a form of critical research) is about change and empowerment. In Action Research, even if the research only changes or empowers the researcher, it can be said that it has been effective and worthwhile. This is argued by Janse van Rensburg (quoted in Burt, 1999, p.107):

...[M]ost of us hold a strong instrumentalist view of research – we wish to produce knowledge that can be applied directly in some form of remedial social action, or that would bring about a positive

¹² See chapters 6 to 9.

change in a situation. ... [M]odernist ideals about the role of research are very often frustrated. In my own experience and observations of academic research, the process of doing research and the learning of the research participants are what relate most closely to change and development – not the results for dissemination.

In this research project, there have been times when research for the development of knowledge has been relinquished. This is especially the case in workshops, where the emphasis has been on effective facilitation, rather than on observing and recording data upon which to reflect at a later stage. It is accepted that, as a result many subtle, and sometimes not so subtle, pieces of information, have not been taken into account.

3.8 Participatory Rural Appraisal and Action Learning as Action

Research methods

The GIS research has evolved from a stand-alone process to one that has become an integral part of a participatory process that focuses on developing and empowering the Kat River Valley Catchment Forum. Much of this participatory process has drawn from the principles and methods embodied by Participatory Rural Appraisal (PRA) and Action Learning, approaches situated both in critical science and in Action Research (Chambers, 1994a, Burt, 2000). The GIS evolved to become an important means through which Appraisal and Action Learning took place, and it is in the context of these approaches that the research aims and objectives took on their final clarity. PRA and Action Learning, will be introduced in the next chapter.

4 PARTICIPATORY RURAL APPRAISAL (PRA), ACTION LEARNING AND GIS IN THE CATCHMENT FORUM PROCESS

Participatory Rural Appraisal (PRA) and Action Learning are approaches which have at their disposal a menu of methods, tools, and/or resources, that can facilitate community empowerment. Through these approaches, much of the Catchment Forum development has taken place. The GIS has been incorporated as a tool within this people-development process. Since PRA and Action learning have provided a framework for the research process, a brief description of each will be given in this chapter. Furthermore, the complementarities between GIS for Participation, PRA and Action Learning will be considered.

4.1 PRA

The most widely acknowledged description of Participatory Rural Appraisal (PRA) is that it is a “growing family of approaches and methods to enable local people to share, enhance and analyse their knowledge of life and conditions, to plan and to act” (Chambers 1994a, p. 953).

4.1.1 *The origins of PRA*

PRA, as a product of the growing use of critical theory in social studies and practice, has developed out of the deficiencies of the technician, top-down, standardised approach to development. The modes of development of the 1970s and 80s excluded local involvement in, and ownership of, initiatives on the assumption that experts knew best. Recent approaches in contrast emphasise bottom up development, focussing on local diversity, the richness and depth of local knowledge, and initiatives that are unique to local circumstances. Mukherjee (1993) argues that the ultimate goal of development is about transforming the quality of life of individuals. For rural development the issue is how rural perceptions can be revealed and understood so as to (p. 25):

1. take account of the indigenous knowledge system,
2. incorporate rural diversity,
3. make rural communities involved in pursuit of their own well being, and
4. make professionals' tasks more worthwhile and rewarding in the process of collecting, analysing and using the rural information base for development.

For Mukherjee (1993, p. 26), focussing on rural farmers, it was:

[O]f the utmost importance to understand the intricacies of the socio-economic and ecological environment within which resource poor farmers operate and to resolve their problems by collaborating with them according to their needs and priorities.

In response to such views, a number of methodologies were developed which aspired to such field-oriented, locally focussed appraisals and analyses. These include Activist Participatory Research, Agroecosystems Analysis, Applied Anthropology, Field Research on farming systems, and, in particular, Rapid Rural Appraisal (RRA) (Chambers, 1992; Pretty *et al*, 1995). RRA developed in the 1970s as part of a search for methods by which outsiders could learn about rural life and conditions in order to plan and implement more appropriate development initiatives. RRA can be seen to have three main origins (Chambers, 1994a). The first relates to dissatisfaction with biases in the generalised perspectives that outsiders usually had regarding the rural situation. For example, these did not take into account spatial, social or seasonal variations in poverty. Such generalisations could easily hide the worst poverty and deprivation. Secondly, RRA originated out of disillusionment with questionnaire surveys and their results. It had been shown that large-scale surveys have often been drawn out, unreliable, filled with redundant information, and misleading. The third origin relates to the realisation that locally generated knowledge drawn from indigenous knowledge systems can be reliable, cost efficient, and effective.

RRA had focussed on extractive learning by outsiders in order to facilitate more appropriate development. PRA, in turn, emerged out of the realisation in development circles that it was more desirable for local communities to conduct their *own* appraisals, analyses and planning process. The advantage being that not only would initiatives be appropriate, but they would also be more sustainable, because there would be far greater community ownership of those initiatives. Effectively, the initiative would come from the community. In addition, community awareness of their own circumstances, as well as empowerment through learned analysis techniques, would be enhanced.

4.1.2 The principles of PRA

The three basic components of PRA have come to be seen as methods, behaviour and attitude, and sharing (Chambers, 1994b). Participatory methods should facilitate the type of local analysis that had previously been done by outsiders. For outsiders to promote such analyses, changes in attitude and behaviour traditionally adopted by the professional are required. For local people to confidently and openly express their knowledge and conduct their own appraisal and analyses, outside professionals have to “step off their pedestals, sit down, ‘hand over the stick’, and listen and learn” (Chambers, 1994b, p. 1438). The third component of PRA is sharing. This involves sharing of knowledge and experiences among both locals and professionals. Based on these three pillars of PRA, the principles by which the approach operates are as follows:

- ξ Facilitation
- ξ Optimising trade-offs
- ξ Offsetting Biases and Triangulating
- ξ Listening and learning, learning rapidly and progressively, and learning through participation.
- ξ Self-critical awareness and responsibility
- ξ Sharing of information

For a more detailed description of these principles, see Chambers (1992), Mukherjee (1993), Pretty *et al* (1995).

4.1.3 PRA and GIS

Recall that in emphasizing “GIS in Participatory Research” Abbot *et al* (1998) considered whether GIS could prove a useful complement to the range of tools and methods presently being used in PRA. There are many methods available to the PRA practitioner. Chambers (1994a), for example, describes thirty, and more are being added to this list as time goes by. These range from visual analyses, to interviewing and sampling methods, to group and team dynamics methods (Chambers, 1992; Mukherjee, 1993; Chambers, 1994a). The category of interest to this study is visual analysis.

Diagramming and visual sharing is claimed as one of the aspects of PRA that make it distinctive from other field-oriented methodologies. The advantages of visual methods are numerous. Chambers (1992 pp. 22-23) describes the usefulness of these methods in terms of promoting equal participation, sharing, validation, and learning:

With a questionnaire survey, information is appropriated by the outsider. It is transferred from the words of the person interviewed to the paper of the questionnaire schedule where it becomes the possession of the interviewer. The learning is one-off. The information becomes personal and private, unverified and owned by the interviewer. In contrast, with visual sharing of a map, model diagram, or units (stones, seeds, small fruits etc) used for ranking, scoring counting or quantification, all who are present can see, point to, discuss, manipulate, and alter physical objects or representations. Triangulation takes place with people cross-checking and correcting each other. The learning process is progressive. The information is visible, semi-permanent, and public, and is checked, verified, amended, added to, and owned by the participants.

Visual methods are empowering in that all group members can participate – both men and women, young and old, literate and illiterate. It allows people to convey abstract concepts which, for some, would be difficult to describe by verbal means (Pretty *et al*, 1995). The methods also stimulate group discussion, help people present their views, and provide a focus around which less

confrontational negotiation can take place. With regards to this latter aspect, diagrams can often be a means of diffusing tension “by making agreed fact visible and differences explicit, focussing the public debate on physical things rather than on individual people” (Chambers, 1994b, p. 1445). Diagramming also helps the outsider to visualise the issues under discussion, and reveal preferences and perceptions that are otherwise obscure (Mukherjee, 1993).

One of the most used visual methods are participatory mapping and modelling (which includes participatory resource mapping) and participatory analysis of maps (Bitter, 2000). With participatory mapping and modelling, villagers prepare maps or models of their situation, portraying situations from the distribution and quality of resources, to variations in social and economic status. Locally available or simple resources are used to create these maps, such as stones or seeds and chalk. The maps are often created on a flat piece of ground.

One of the shortcomings of these models is that they are not permanent. An answer to this is to conduct the mapping on paper so that it can be folded up and stored away for future reference. However, for a number of practitioners, for example Bitter (2000), it is just as easy, and for some purposes, more effective, to use aerial photographs as a backdrop. Not only can an analysis of the aerial photograph be integrated into the participatory mapping, but the information that is generated is geographically referenced, if not geometrically correct. This is particularly the case when the aerial photograph has been orthorectified. By conducting participatory mapping and analysis using aerial photographs, not only do the communities benefit from the sharing, appraisal and analysis, but the geo-referenced output can be integrated with other spatial data. This can add value to the mapping process by allowing analysis using other variables. The tool that can perhaps most effectively deal with these outputs and perform the integration with other data, is GIS. There is also the possibility that GIS can promote the more effective dissemination and presentation of such data, not only in a local context, but also in a more regional context. Therefore there are possibilities that a participatory mapping process that makes use of GIS not only facilitates the empowerment of locals in terms of their personal capacities and local situations, but also in terms of a broader set of circumstances.

4.2 Action Learning

Action Learning has become an important approach to Environmental Education in South Africa, particularly in the context of Outcomes Based Education (Lotz-Sisitka and Raven, 2001; O’Donoghue, 2001). In the Catchment Forum process, learning about the catchment environment through the mechanism of Active Learning has been an ongoing process. As with PRA, Action Learning is influenced by Action Research. In the context of rural development, Action Learning is not a form of education that simply leads to a product in terms of knowledge. Rather it is a framework for engaging with issues (usually in a group), which, as an offshoot, leads to developed

skills and understanding. Essentially it is a process of consciously learning through experience. Action Learning principles include the ideas that (adapted from Burt, 2001, pp. 3-4);

- ξ Education is a process of empowering or enabling learners;
- ξ Education is critical in that it provides learners with the skills to understand and address problems within their own context;
- ξ Education is about creating an experience, which can neither be defined nor completely understood, the sole purpose of which is to engage with a process of learning;
- ξ Since knowledge is constructed (Active Learning is based on the theory of Constructivism), the learning experience should focus on the context of the learner;
- ξ Learning processes are encouraged to become more interactive, more stimulating and more challenging as we begin to understand that we learn better when creatively and actively engaged in an experience.

The Action Learning framework is illustrated in Figure 4.1. The framework consists of cycles of assessment or reflection, investigation, reporting, and action around a focus or issue. In other terms, Active Learning facilitates the development of insights and competence for dealing with an issue. Or, dealing with an issue, within the Active Learning framework, leads to developed insights and competence. There are outcomes both in terms of learning and in terms of action or empowerment.

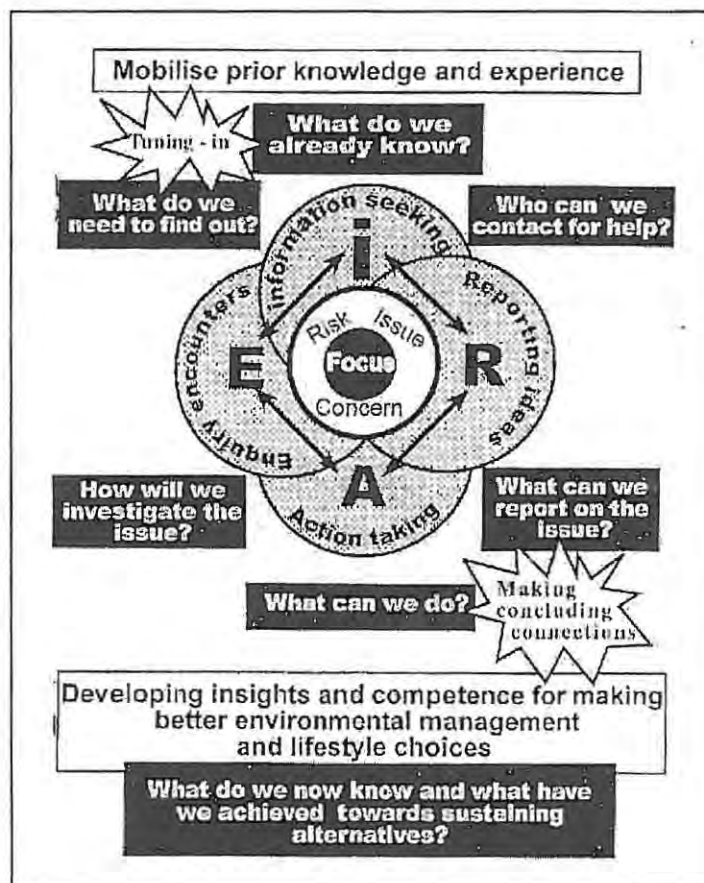


Figure 4.1: The Active Learning framework (from O'Donoghue, 2001). The framework facilitates learning around a focus or issue.

4.2.1 Action Learning and GIS

Learning takes place both from investigating an issue, and from taking action. In focussing on catchment management, GIS can represent a resource based on which investigation and analysis can take place. This includes investigation of the catchment and local environment from a spatial perspective through map-based appraisals and mapping (as described in the section on GIS and PRA). There is the potential for GIS to facilitate the reporting of findings through facilitating presentation (Al Kodmonay, 2000). There is the potential for GIS to facilitate the planning of local and catchment actions: maps can form the basis on which the placement and/or spatial design of on-ground works can be negotiated and optimised, or on which alternatives can be developed. Finally, in the process of investigation, there are potentials for learning to take place in terms of developed map skills and an enhanced understanding of the local and catchment environment.

4.3 PRA, Action Learning and the GIS research

In the Kat River Valley Catchment Forum development process, Action Learning and PRA have been used in an integrated manner. They are closely linked. Both are oriented towards deepening people's understanding of situations so that they are further enabled to take action. Both focus on empowering people. In PRA, the goal is not only to promote community appraisal, sharing and ownership of initiatives, but also to enable communities to become the central actors in planning and implementation. Chambers (1994b) argues that (p. 1444):

Those who, through a PRA process express and share what they already know, also learn through that expression and sharing. Those who investigate and observe add to their knowledge. Those who analyse become yet more aware and reach new understanding. Those who plan and then implement what they have planned take command, and further learn through experience and action.

Notice that the author is simply describing a process of learning through action. Action Learning and PRA go hand-in-hand.

Empowerment for participation in catchment management has been the agenda for engagements between the Rhodes University Catchment Research Group (CRG), and the Catchment Forum. Exploring the potential contribution of GIS to this empowerment process has been the aim of this research. In particular, the contribution of GIS to sharing, and to a developed understanding of the catchment, among the Forum members. The above sections and the preceding chapters have introduced the context within which the role of GIS in the Forum process should be considered. The next chapter (Chapter 5) will detail the nature of the initial GIS database, after which the next four chapters (Chapters 6 – 9) will document and reflect on the use of GIS in eight CRG engagements with the Forum.

5 PREPARATION OF CONVENTIONAL GIS DATA LAYERS

5.1 Introduction

Central to the participatory GIS process was the development of a database of spatial layers based on which mapping, the development of spatial concepts, awareness creation, and spatial analyses could take place. For GIS software ArcView 3.2 was used on MS Windows 98. PC ArcInfo was used for digitising off hard-copy maps, while IDRISI and TnTMips were used at times for data conversion.

The data accumulation process extended over a number of months in the first half of 2000 and yielded the following layers: Topographic data from which a Digital Elevation Model (DEM) was derived; a Landsat TM image; a delineation of the catchment boundary; cadastral data; ward boundaries; and geology. In August 2000, a series of aerial photographs of the catchment were obtained, from which geocorrected images were derived. The data were transformed to ArcView compatible format and projected to the Transverse Mercator projection using the Clarke 1880 datum with a central meridian of 27 degrees East. A more detailed description of the data processing follows in Table 5.1.

Table 5.1: Spatial data acquired for the Kat River Valley, giving associated details.

Spatial Data	Description	Type	Source	Initial Projection and file structure.	Source type, scale and date
Catchment Boundary	Delineation of boundary of Kat Valley	Vector	WRC: Water Resources of South Africa	Geographic Coordinates. Shapefiles.	Digitised from paper maps, 1:50000
Topographic Data Layers	Roads, Streets, Railroads, Built-up areas, Power lines, Rivers, Dams, Furrows, 20m Contours	Vector	Director General: Surveys and Mapping, Mowbray. Data agent: Computer Foundation, Pretoria.	Geographic Coordinates. Shapefiles.	Digitised from paper maps, 1:50000, 1979
Digital Elevation Model	Sampled at 200m intervals	Raster	Director General: Surveys and Mapping, Mowbray	Geographic Coordinates. Idrisi Raster format.	Plotted from stereo pairs.
Digital Elevation Model	Sampled at 50m intervals	Raster	Derived from 20m contours (topographic layers)	Transverse Mercator. Arcview Grid.	20m digital contours, 1:50000

Cadastral Data	TRC boundaries, TLC boundaries, Tribal authority boundaries, Farm boundaries, Farm Names.	Vector	Trigonometrical Survey Data	Geographic Coordinates. Regis file format.	
Landsat Image	Landsat Thematic Mapper, 30m resolution	Image	Satellite Applications Centre (through Agricultural Research Commission).	No projection. Idrisi Raster Format.	Band 3, 4 and 5, February 1994.
Aerial Photographs	Grey Scale	Image	Director General: Surveys and Mapping, Mowbray (through Kat River Valley Citrus Cooperative)	None	Scanned at RU from prints, 1985 and 1996.
Administrative Boundaries	Ward Boundaries, TLC boundaries, TRC boundaries.	Vector	Demarcation Board	Geographic Coordinates	Digitised at RU from paper map, May 2000.
Geology		Vector	Geological Survey, Pretoria	Transverse Mercator, Clarke 1880, 27E,	Digitised at RU from paper map, 1:250000, 1974.

5.2 Catchment boundary

The catchment boundary for the Kat River was extracted from the WR90 data set by highlighting the relevant polygon and saving to a shapefile. The Polygon was projected using the AV Projector extension.

5.3 Topographic Data Layers

Data merged from the following map sheets were obtained: 3226 BC, BD, CB, CD, DA, DB, DC, DD; 3326 BA, BB. The 21 data layers were batch-projected using the BatchProject script obtained from the ESRI Arc scripts website. Unfortunately this data contained topological errors. These were rectified by importing the shapefiles to ArcInfo using the "shapearc" command, editing and cleaning the data, and then converting it back to shapefile format. The contour data contained a number of elevation labelling errors, which were rectified by editing the attribute tables.

5.4 DEM

The following 200m DEMs were obtained from the Agricultural Research Commission: 3226 a-d and 3326 a and b. Converting the data from IDRISI format to ArcView grid format was hampered by the lack of an IDRISI-ARCVIEW conversion module in either IDRISI or in AV. Conversion was

finally accomplished by exporting the IDRISI raster file to an ASCII text file, then reformatting the header of the string of elevation integers in a word processor according to the following structure:

```
ncols ...  
nrows ...  
xllcorner ...  
yllcorner ...  
cellsize ...  
nodata_value ...
```

Header information was obtained from the text file accompanying the binary version of the IDRISI raster export process. The formatted files were then imported to AV using the "import data source" (ASCII RASTER) module of the Spatial Analyst extension. Information regarding this conversion procedure was obtained from the ESRI users forum.

In September 2000 a higher resolution DEM was required for the modelling of sub-catchments in the valley. A 50m resolution DEM was derived by creating a Triangulated Irregular Network (TIN) from the 1: 5000 contour data, and then interpolating a GRID.

5.5 Corrected Landsat Image

5.5.1 Acquisition

The acquisition of satellite imagery directly from the Satellite Applications Centre at Hartebeespoort was beyond the means of this project. For example, an uncorrected, un-referenced Landsat TM image costs between R3000-00 and R7000-00 while a Spot image costs upwards of R10000. However, through its links with the Agricultural Research Commission, the Catchment Research Group (CRG) was able to obtain bands 3, 4 and 5 (red, near-infrared and mid-infrared) of a February 1994 Landsat TM scene. Although these would yield false colours as backdrops to maps of the catchment, the image was nevertheless deemed to be useful to the project.

Unfortunately each Landsat TM band was supplied separately in .tiff and .img format: although each band could be viewed individually in grey-scale, they could not be imported as a multi-band image in the ArcView Image Analysis extension (version 1.0). This data transfer problem was eventually overcome by importing the data as a simple array in TNT MIPS GIS software, stacking the three bands, and then converting the multiple band file to ERDAS .lan format, which is compatible with ArcView.

5.5.2 Image rectification

Rectification is the transformation of a set of image pixels to a map coordinate system. Rectification is particularly important with satellite images since they contain systematic scan-line

displacement errors due to the satellite orbital path and the rotation of the earth (See Sabins, 1987, Chapter 7). Furthermore, since the satellite image is a two-dimensional representation of the surface of a spheroid, transformation to a planar coordinate system requires a process of image “rubber-sheeting”. Such rectification takes place by means of transformation algorithms. The Arcview Image Analysis (v.1.0) Align tool uses two default transformation algorithms, namely affine and polynomial.

For the rectification of the satellite image, image-to-feature theme transformation took place, using 1:50000 topographic features as control points (such as crossroads, dam walls and river confluences). Once rectification had taken place the pixels were resampled using Bilinear Interpolation, and the product saved as a separate file.

5.5.3 Assignment of colours and image processing

The band characteristics and their colour assignments are shown in table 5.2 below.

Table 5.2: Band characteristics and their assignment of colours for the research.

TM Band	Wavelength	Spectral Region	Target Reflectance	Assigned colour in this project
3	0.63-0.69	Red	Chlorophyll absorption	Blue
4	0.76-0.90	Near-IR	Delineation of water bodies	green
5	1.55-1.75	Mid-IR	Vegetative and soil moisture	red

Although it would seem obvious to assign red to the red band, this results in reversal where colours with shorter wavelengths represent bands with longer wavelengths. This yields an image which can be confusing at first sight (see figure 5.1), where, for example, the colour of water is represented as red. By assigning Blue to band three and red to band five, the colour spectrum is simply being shifted down the electromagnetic frequency spectrum. The result is an image that is more easily interpreted (see figure 5.2). For example water is represented by blue, while the graduation from healthy vegetation cover to sparse or scrub vegetation is accompanied by a change from dark green to pink. For the purposes of developing an awareness of the character of the catchment among local rural communities, this is clearly the better choice.

Once the colours had been assigned, histogram stretches were performed on each band. This involves stretching the greyscale value frequency input histogram of each band to cover a greater cross-section of the grey-scale values (1 – 255) to improve contrast and the visibility of features in the image. (For more information on satellite image processing, see Sabins (1987, Chapter 7).



Figure 5.1: Assignment of red to band 3, green to band 4 and blue to band 5.



Figure 5.2: Assignment of blue to band 3, green to band 4 and red to band 5.

5.6 Corrected aerial photographs

In September 2000 the Catchment Forum carried out a detailed erosion mapping exercise. Until then, the satellite image had been used for the mapping, but with a pixel size representing 30m² on the ground, the resolution was not fine enough for the scale of mapping required. A set of orthophoto maps had been obtained from the Department of Agriculture in Bisho, but these only covered the eastern side of the catchment, and they were created in 1975. Apart from these, it would appear that there are no orthophoto maps of the Kat River Valley available. In August 2000 a set of 1:30 000 1985 aerial photographs covering the entire upper and middle Kat Valley, was borrowed from the Kat Valley Citrus cooperative. These, together with two 1: 60 000 1996 aerial photographs, were scanned and included in the Kat Valley database.

5.6.1 Rectification

Aerial photographs, like satellite images, are distorted as a result of the curvature of the earth, changes in the terrain, and in particular, the geometry of the camera. Distortion is usually least at the centre of the photograph, but reaches a maximum at the edges. These distortions can be rectified by stereo-correlation using stereo photographic pairs, by monoplotted using a DEM, or simply by rubber sheeting. Although DEM based orthorectification software was available, the inclusion of fiducial marks in the scanning process was limited by the size of a conventional scanner, while camera calibration data for the aerial photographs was expensive. Rubber-sheeting, on the other hand, requires the least sophisticated software and equipment, although it also yields the least accurate results. However, since sub-metre accuracy was not necessary for this participatory mapping process, rubber sheeting using the Image Analysis alignment tool was considered satisfactory.

18 aerial photographs which best represented the different communities in the upper Kat were selected and rectified. In combination with using topographic features, intersections of the more

accurate cadastral boundaries were used as control points: fence-lines coinciding with the cadastral boundaries were often clearly visible in the photographs.

5.7 Cadastral data

Cadastral data were supplied from the Surveyor General in Regis .FEA file format. Data conversion required the installation and running of FEA to Shapefile conversion software.

5.8 Ward boundaries

A Demarcations Board (May) 2000 map of ward boundaries for the Kat Valley area was obtained from the Alice Municipality. The intention was to use ward boundaries as options for the development of water user association sub-catchment boundaries by the WUA steering committee. The ward boundaries were digitised from the map using the ArcEdit module of ArcInfo. ArcEdit was also used to build, clean and edit the data. Attribute data was added to the spatial data in ArcView.

5.9 Geology

The relevant section of the 1:250 000 geological map for the region was scanned in sections, brought into ArcView and geo-referenced. Using these geo-referenced images, the geology of the Kat Valley was digitised on-screen using the ArcView digitiser extension. The advantage of digitising on-screen is that by zooming in to the feature in question, an improved degree of precision can be achieved. Such precision was particularly useful when digitising the fine network of doleritic dykes in the area.

5.10 Discussion

This chapter has presented a brief description of the GIS data preparation. In the preparation process, numerous difficulties and issues were encountered. Much could be discussed about data exchange standards, data supply protocols and the public availability of information in South Africa; compatibility between software types; limits and bugs within GIS and other software; and technical difficulties that had to be dealt with in digitising, in preparing ArcView projects, in running analyses, and in converting layouts to hardcopy format. However this thesis is not the platform for detailed discussions around these more technical GIS issues. The research has been about GIS for Participation, and although the technical component of the GIS is fundamental to the research, many of the issues encountered and procedures used are not unique. These issues would be dealt with more appropriately (and in most cases have already been dealt with by others) in technical GIS journals and texts, and software-specific or user-community discussion forums.

However, considering the brevity of this chapter, the amount of time that was put into the lab-based GIS component of the research should not be underestimated. Many months were devoted to

finding, acquiring and preparing the data. For example the attempt to import the satellite data into ArcView as a composite image took place over a number of weeks; over a year was spent in trying to get the supplier to provide error-free contour data; and orthophoto maps, aerial photographs and up-to-date information from the Demarcation Board were acquired through months of effort.

As will be detailed in later chapters, six engagements with the Catchment Forum required the preparation of sets of hardcopy layouts. In many cases each village required a dedicated set of layouts. As a result of difficulties caused by high resolution images and the way that ArcView stores projects, as well as problems encountered with printing facilities, the creation and printing of each set of GIS layouts often took over a week.

Perhaps the major technical limit encountered in the GIS process was the lack of processing power in the laptop computer that was used in the field. This precluded the use of 3-dimensional GIS representations of the landscape. The possibilities that the 3-D analyst provided for the development of catchment concepts, and particularly an understanding of the Kat River catchment among the Forum participants were significant.

The processing and use of spatial information generated by the Catchment Forum participants will be dealt with in the following chapters.



6 MAP BASED CATCHMENT AWARENESS WORKSHOP AND CATCHMENT TRANSECT

6.1 The engagement chapters: a note about structure

To restate the approach to research in critical science: the research design should not follow a predetermined sequence of data collection and analysis. The research process involves an ongoing cyclical relationship between developing a theoretical framework, and collecting and analysing the data (Fien and Hillcoat, 1996). In Action Research, the aims and objectives, and approaches and methods, are revisited and developed as the research proceeds (Dick 2000a). This research framework has ramifications for the way that the thesis is structured. For example it would be false to reflect in the structure that there was a clear set of objectives, and a predetermined plan of action and sequence of methods. The aim of Action Research is to maximise the effectiveness of practice by ensuring responsiveness and relevance. A rigid structure would not allow such responsiveness to evolving people development frameworks to be reflected.

Chapters 6 to 9 are a documentation of eight engagements between the GIS process and the Catchment Forum¹³. Each engagement represents a research cycle of understanding, planning, action and reflection. It follows that the traditional thesis format of allocating a separate chapter to the method, the results, the analysis and the discussion will not be followed. Rather, and where applicable, the documentation of each engagement includes its own set of methods, results, analyses and reflections or discussions. Each cycle is documented in chronological order to give an understanding of the development in thinking and practice surrounding the GIS for Participation as it took place over time; in the research, the *whole* of each cycle, including planning and reflection, informed the next engagement in terms of thinking and practice. This thesis is about a process, and therefore its structure should be authentic to that process.

It could be argued that the reflections and discussion about each engagement should follow some sort of structure. For example, that the discussion should be structured in terms of the thesis aims and objectives. As far as possible such a structure will be followed. But this is not conformed to all the time for the following reasons:

- ③ The aims and objectives, or research question had not been finalised at the time that many engagements took place. Recall that Action Research starts off with a fuzzy set of questions and methodology, but as each cycle takes place, these become clearer (Dick, 2000a).

¹³ A timeline of the engagements between the Catchment Forum and the Catchment Research Group can be found in Chapter 10, Figure 10.2.

- ③ Reflections did not follow a pre-set structure. Rather, they were responsive to what happened during the engagement. For example: What went right? What went wrong? What are the lessons in this? What should change in our approach? From our engagement, what can we conclude about the changing needs of the Forum? In retrospect, perhaps an overarching set of guiding questions may have resulted in more sound reflections.
- ③ Some of the engagements did not result in a comprehensive set of observations. Nor did these observations necessarily conform to any particular theme in the research. But they may have thrown new light onto the research process, or have led to the further development of the research question or aims.

In summary Chapters 6 to 9 are not a rigid representation of a set of methods, results, analyses and discussions. Rather, they are a representation of a fluid process. Reflections have resulted in the emergence of a set of themes and lessons specific to each engagement. These themes and lessons will be further integrated in the discussion chapter.

6.2 Build up to the workshop

Recall that in March 2000 nine two-day environmental workshops had been held in the upper section of the Kat, incorporating 15 villages. Some of the problems and solutions identified in these workshops are shown in table 5.3 below.

Table 5.3: Selected problems and their solutions identified at the 9 environmental workshops held in March 2000 among the Kat Valley rural communities. (Taken from Motteux, 2000b)

Problem	Solution
No voice in water flow (i.e. dam release schedule)	Need information
People are lazy and have no care	People need to become responsible for our environment our health. Need community to take action and ensure that people are not harming the environment.
Up-stream people have no respect.	Need to communicate with all people in the catchment. Everyone must care for the river. Need to understand up-down effects.
No communication in villages and between villages.	Need to come together. Need everyone to become responsible.
Dirty water	Keep water supplies clean.

Coming out of these workshops was the clear recognition that collective action, or at least communication, was necessary at a catchment level. At the request of the communities, a follow-up set of Way-Forward workshops was held in early July, one of the purposes of which was to finalise

representatives for the Catchment Forum. The Forum met for the first time at Ntilini on the 12th of July 2000.

6.3 Purpose of the workshop

This workshop was to be part of the last phase of the Kat River Valley Project run by Nicole Motteux. Once the Forum had been established and had developed some sort of momentum, the KRVP would withdraw. It was hoped that the activities of other CRG researchers would ensure that the momentum of the Forum would be maintained. This and the next workshop would also serve as a point of entry for the GIS research, and, in a sense a transition process in terms of research activities at Rhodes Geography Department. Since the KRVP objectives at the time went hand-in-hand with those of the GIS research objectives, the Catchment Awareness workshop and the Action Planning workshops were entirely joint efforts involving much cost sharing and integration of functions.

Some the joint purposes of the workshop were as follows.

- ③ To allow the members of the Forum to meet one another, to develop a sense of cooperation, and a sense of group identity.
- ③ By means of maps, mapping exercises, and a “bus transect”, to conduct an appraisal of the catchment. Through this, it was hoped that each representative would have built a picture of the extent of the catchment, the condition of the villages in relation to their position and the issues in the upper catchment, and to have further developed their understanding of catchment processes and linkages.
- ③ To extend the concept of linear up-stream – down-stream linkages to the idea of catchment processes taking place over a two dimensional continuum – the catchment surface.
- ③ Through an introduction to mapping concepts and the development of an understanding of issues at a catchment scale, to enable the members of the Forum to effectively participate in the map-based Action Planning workshop that would take place later that month.

Some of the intentions specific to the GIS research process at the time were as follows:

- ③ To get an idea of the way in which the community representatives work with spatial concepts.
- ③ To gauge the ability of the representatives to work with maps and to understand GIS based spatial concepts. Based on this, the level at which the Forum could contribute to the development and application of the stand-alone GIS could be assessed.
- ③ To acquire data representing local realities and issues for incorporation into the conventional GIS database in order to make it more participatory.

6.4 Preparations for the workshop

What follows is a general description of the build-up to a workshop with the Catchment Forum. Naturally each workshop is entirely different, although essentially the workshop preparations have tended to follow the same practical steps. Group reflections among the CRG have shown that creative forethought, harmony of purpose and close communication between workshop organisers and facilitators provides the foundation for an effective workshop.

Preparation for the running of a workshop usually involves a build-up over a number of weeks. One of the first activities is a meeting of all researchers, administrators and facilitators involved in the workshop to ensure an agreement of purpose and approaches and to ensure coordinated planning. This first meeting is usually followed up by meetings where ideas are developed, knowledge gaps filled where necessary, and skills are reinforced.

In terms of practicalities, one of the first tasks is to find a venue, to write and translate invitations, and where necessary, to write starter documents. Since few of the Catchment Forum members are easily contactable, one of the facilitators must go out a week or two beforehand to invite the members to the workshop, provide them with starter documents and ask them to communicate with their community over issues relevant to the workshop so that they are well prepared on the day. Since none of the Forum members have means of transport, up to three busses must be booked and drivers engaged. Pick-up times must be arranged for each community and included in the invitation. Depending on the venue, cooks and catering facilities must be arranged and food bought the day before the workshop. Other activities in the build up to a workshop include the organisation of equipment and stationary, and the preparation of documents.

6.5 GIS preparations

As stated above, one of the important aims of this workshop was to situate each village and its issues in the context of the catchment. One of the possibilities for the development of this idea among Forum representatives would be to create a series of maps for each participant ranging from the local scale, to the sub-catchment scale, to the catchment scale. Thus local issues could be considered in the context of the needs and status of the upper catchment, which, in turn, could be considered in terms of the entire catchment.

Such a pamphlet of maps was created which included a set of tasks for the Forum members to complete (see appendix 1). The Landsat image was used as the background for all the maps, onto which selected 1:50000 topographic layers and the catchment boundary had been overlaid. On the catchment scale map only the larger centres were labelled, while all the villages were labelled in the remaining maps. Note that once the satellite image is zoomed in to a scale of 1:40000 and more, detail is limited by its 30m pixel resolution. Three sets of pamphlet were created: one for the villages from Seymour to Upsher/Paradise, one for villages from Picardy to Tidbury's Toll and one for

villages from Gonzana to Ntilini. Among the tasks set for each member would be to conduct a mapping exercise at home with their friends or families, and to use the maps to observe and act on environmental concerns in their community

The above maps would be for the members to take home. In order for the mapped issues for each community to be collated into a single data set, mapping exercises during the workshop would be conducted on separate maps which would be returned to Rhodes University. Since this mapping would take place only at the local scale, prints of the three large scale maps were made. The exercises that would take place with the use of these maps would include the following (see appendix 2):

- ③ Locating communities on the map and delineating community boundary;
- ③ Listing good and bad environmental issues, and then mapping these issues;
- ③ Mapping community activities, and;
- ③ Tracing the effect of community activities on downstream residents.

6.6 Workshop activities

What follows is a detailed record and set of observations of the workshop as it unfolded. This is intended to give an idea of the initial level of engagement between the researchers and the Forum, the abilities and attitude of the Forum members, and the style in which the workshop was conducted.

The workshop started at 10:30 am once all the workshop participants had been collected. After introductions, the workshop was to begin by an explanation of the maps, followed by a process of familiarisation including some demonstrations, discussions and exercises, after which the bus tour through the upper section of the catchment would take place, ending off with lunch at Fairbairn (see Figure 1.2).

6.6.1 *Explanation of the catchment scale map*

It was explained that the purpose of this map was to provide the Forum members with an understanding of where they were situated in the catchment; to provide a knowledge of the spatial extent of the catchment; and to give them an idea of the location and spatial relations of features and communities in the catchment. The map was then used to explain the relationship between the environmental condition of the catchment, and the health of the river. It was shown on the map that water flowing into the river comes from every part of the catchment, and therefore it is important to look after the whole catchment and not only the river if water quality is to be improved. The example of overgrazing and resultant washing of silt into the river was used to illustrate this point.

6.6.2 *Introduction of purpose of the map exercise*

The reasons for the exercise, as set out in the overall workshop objectives above, was given. It was emphasised, however, that the results of the map exercise would be collated into a (GIS)

computer system at Rhodes, and presented back to the participants at the next Forum meeting. It was explained that this would be a way of sharing village issues and members' perceptions with one another, and with other stakeholders.

6.6.3 *Map orientation, explanations, and questions and answers (medium scale map)*

Map orientation began by asking one of the members to point out to all the others in the group, where we, in Ntilini, were situated on the map. Once it was confirmed that all the members had found Ntilini, another group member was asked to point out to the others where the hill to the east of us was situated on the map. At this point, it became apparent that people were not familiar with the concept of orientating the map to the landscape. People were reminded of the concept of north, south, east and west, where it was explained that east is where the sun rises (east in Xhosa is *mpumalanga* - the rising of the sun), west is where it sets. From this, north and south was extrapolated, and used to orientate the map to the landscape with the aid of the north arrow on the map. Furthermore, after showing the group how to link up features on the map to those in the legend, it was pointed out that the arterial road running through the catchment, together with the Kat River, are generally oriented north to south. By aligning the river and road in the map to the river and road in reality, people could align their maps correctly with respect to the surrounding landscape (Figure 6.1). Once people were familiar with orientating the map to the landscape, they could point out, for example, that "this mountain on the map is that mountain over there" and that "this road on the map is that road over there".



Figure 6.1: Finding features in the surrounding landscape on the map.



Figure 6.2: Participants explaining to each other the location and features of their villages.

At this stage, people were given a chance to chat to the person sitting next to them about what they had learned. People became involved in showing each other, among other things, where their community was on the map, where the Kat Dam was, where lands were being ploughed and planted, where Fort Beaufort (the nearest town) was and where various roads were (Figure 6.2). People soon began to ask what the various colours on the map represented, so it was decided to explain to people the concept of a satellite image. A camera was used to explain how a 'photograph' was taken of the ground. By going higher and higher from the ground, more and more of the area could be 'seen' by the camera, until it was eventually high enough to take a 'photograph' of the entire catchment. It was explained that this camera (sensor) was mounted on a satellite, which is situated above the atmosphere. Thus the maps that we were looking at were not merely drawings from someone's head, but rather a 'photograph' of the catchment. Knowing that the map was some sort of photograph of the catchment, people were asked to try to interpret to colours of the map. Some answers were as follows:

- ③ The pink represents bare ground and hard places.
- ③ Blue represents water
- ③ Green represents the mountains.

By pursuing the link between mountains and greenness on the map, it came to be understood by the participants that green more accurately represents healthy vegetation and dense ground cover.

At this point, two things were pointed out. Firstly that all the grass was dry and brown outside (recall that this workshop took place in mid-winter), and yet there was so much green in the 'photograph'. It was explained that this had, in part, to do with the fact that the image was captured in February 1994, which was during a wet season. Secondly, the satellite "camera" does not represent colours on the ground the same way that our eyes see them. It shows even the brownish grass as a shade of green depending on how much moisture and chlorophyll there is in the plant. On the other hand, it shows areas with low moisture and sparse to no vegetation cover as pink. In other words, pink could represent dongas, overgrazed or degraded areas, settlements and towns, or newly cultivated or bare lands. Interestingly enough, the upper slopes of the catchment were green, graduating to predominantly pink in the valley and lower reaches. Some of the explanations for this phenomenon offered by the members were:

- ③ The graduation was caused by the shadows of the mountains.
- ③ There are forests in the mountains but not in the valleys.
- ③ There is more rain in the mountains than in the valleys.

One of the researchers pointed out that perhaps in addition to these explanations, the graduation from green to brown to pink correlates with the high population densities along the valley bottom, resulting in less healthy vegetation. She also pointed out that less vegetation allows greater erosion,

which means that soil is washed into the rivers. She suggested that it would be good to get the valley back to healthy green by looking after the environment.

Although we challenged the participants with a number of questions along these lines, they, in turn asked us numerous questions regarding the map, the colours of the image, and the state of the landscape. The discussion eventually had to be ended due to time-constraints.

6.6.4 Map Exercise (large scale map)

Each person was handed a large-scale satellite-based map that correlated to the village in which they live, to which the exercise sheet had been stapled. The Forum was divided into five groups and assigned a facilitator from the CRCG. Although much attention had been paid to familiarising the members of the Forum with the maps, people nevertheless required detailed and careful guidance before they understood the tasks involved in the mapping exercise.

The members were asked to take their set of three maps home, and conduct the exercises on the back page with their families, and to use their map to record any issues or problems that arose. The Forum was reminded to consider their local issues in terms of the whole catchment, which was why they had been given the set of three: the local scale map is situated within the map of the upper catchment, which in turn is situated in the map of the entire catchment.

Once the mapping had been completed, the purpose and route of the bus-trip or “catchment transect” was explained. Members were asked to plot their route and each stop on their maps as we worked our way up the catchment. This was so that they could understand how each village and its issues and opportunities fitted into the broader picture of the catchment.

6.6.5 Catchment Bus Trip

While in the busses, people regularly noticed and enthusiastically commented to one another about issues regarding the catchment and the river. It was observed by one of the members that dead wood was being washed up against the bridges, which would eventually result in them being washed away. Passing one of the citrus farms, the group discussed the fairness of the farmer pumping the water from the river into the dam and using it for his own purposes. Passing a cabbage field, one of the locals in that area pointed out that pesticides used on the cabbages washes into irrigation furrows and then back into the river.

Seven villages were visited. The representatives at each village were eager to share information about their community, while the rest of the Forum was interested to hear about that village. Many questions were asked, some of these highly insightful. Considering how late it was (the Forum was happy to delay lunch in order to visit more villages), people were surprisingly keen to take the time to listen to and share local information (see figure 6.3).



Figure 6.3: Sharing the story of the community at Fairbairn.

6.7 Results of mapping exercise and lab based GIS activities

32 maps and their associated exercise sheets were returned. Of the participants, 19 had used maps previously. However, on analysis of their exercises, only 12 (or 63%) of these people appeared to be able to interpret the maps to some degree. Interestingly, the same proportion (61%) of those who had not worked with maps appeared to interpret the map equally clearly. Since each community or village was labelled on the maps, none of the members (bar the one or two who are illiterate) struggled to locate their village. Interestingly the delineated village boundaries appear to coincide quite neatly with those of adjacent communities in many places.

Issues were varied, with unplanted fields/no access to fields and soil erosion and dongas being mapped most frequently. Some of the more frequently mapped positive aspects included forests where wood can be chopped, areas where grazing was available, planted fields and full dams. Some of the mapped activities included areas where they farm, areas where they hunt, areas where they live and places where they fetch water.

It would appear that most people struggled to map features precisely. One of the reasons behind this is that most features at the community scale are not defined on the low resolution satellite image. Few participants, based on their knowledge of their area, managed to extrapolate the position and extents of features from topography, roads and rivers.

Figure (6.4), being an exception, shows the accurate mapping of local knowledge onto the base-map. The position and extent of the Gonzana settlement has been delineated quite accurately (feature b) even though there are no explicit clues as to the position of the settlement on the image. Furthermore features (a) and (c) were correctly differentiated as unplanted lands and a playing field respectively.

In figure (6.5), the general area in which the community lives was correctly identified (even though it was not labelled). However, there were some clear misinterpretations. For example (b) has

been labelled as burned fields when this is in fact a scrubland hill-slope and (e) has been labelled a poorly managed field of oranges when it is actually a grassland area intersected by dongas. The majority of participants generalised or made errors in this fashion.

Figure (6.6) is at the other end of the mapping spectrum. This participant circled large areas, and often incorrectly identified them according to colour. For example the green features that have been labelled (a – green fields) and (b – orange fields), are actually forested areas, while the area (c) adjacent to this, labelled “building of houses next to fields” is an unpopulated north-facing slope. It appears that (b) and (e) were (incorrectly) labelled as eroded fields simply because of their pink colour. It is clear that this participant, together with many others, struggled to translate their knowledge of their local area onto the map. Often they simply tried to interpret the various colours, without conceptually linking this to what might be out there in reality.

The exercise sheets were translated into English. Mapped information was digitised into three shapefiles, namely community boundary polygons, issues points, and activities points. Note that since much of the information was mapped as points, or where delineation did take place it was highly generalised, often out of proportion, and sometimes inaccurate, it was decided to represent all mapped issues and activities as points within that delineation. Where the same issues were mapped in the same place by different villagers, only one of these was digitised. Written information associated with the mapped data was included in attribute tables. Since issues were expressed in so many different ways, similar issues were coded, yielding over 25 types in the upper catchment.

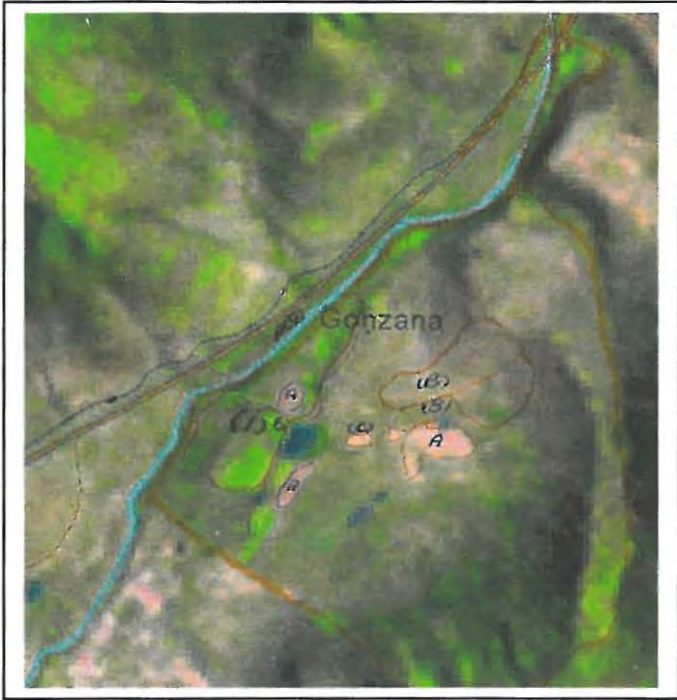


Figure 6.4: Gonzana: Accurately inferred and defined features.



Figure 6.5: Picardy: The community area and the settlement are correctly identified, although many of the features have been misinterpreted or misplaced.

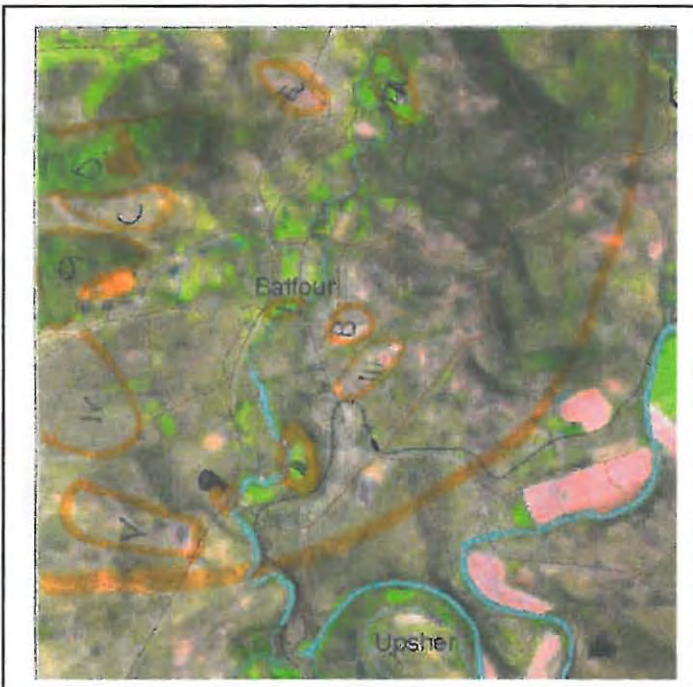


Figure 6.6: Balfour: This participant appears to have mis-interpreted the scale of features on the map. Descriptions attributed to delineations do not link up to features on the ground.

Figure (6.7) shows a map of the community boundaries. For each community, there are as many boundaries as there were community representatives on the Forum. Rather than trying to develop some sort of “average” or fuzzy boundary, the delineations for each community was left as a multiple set of lines. In terms of the scope and objective of this phase of the project, each delineation is assumed to be as valid as the other.

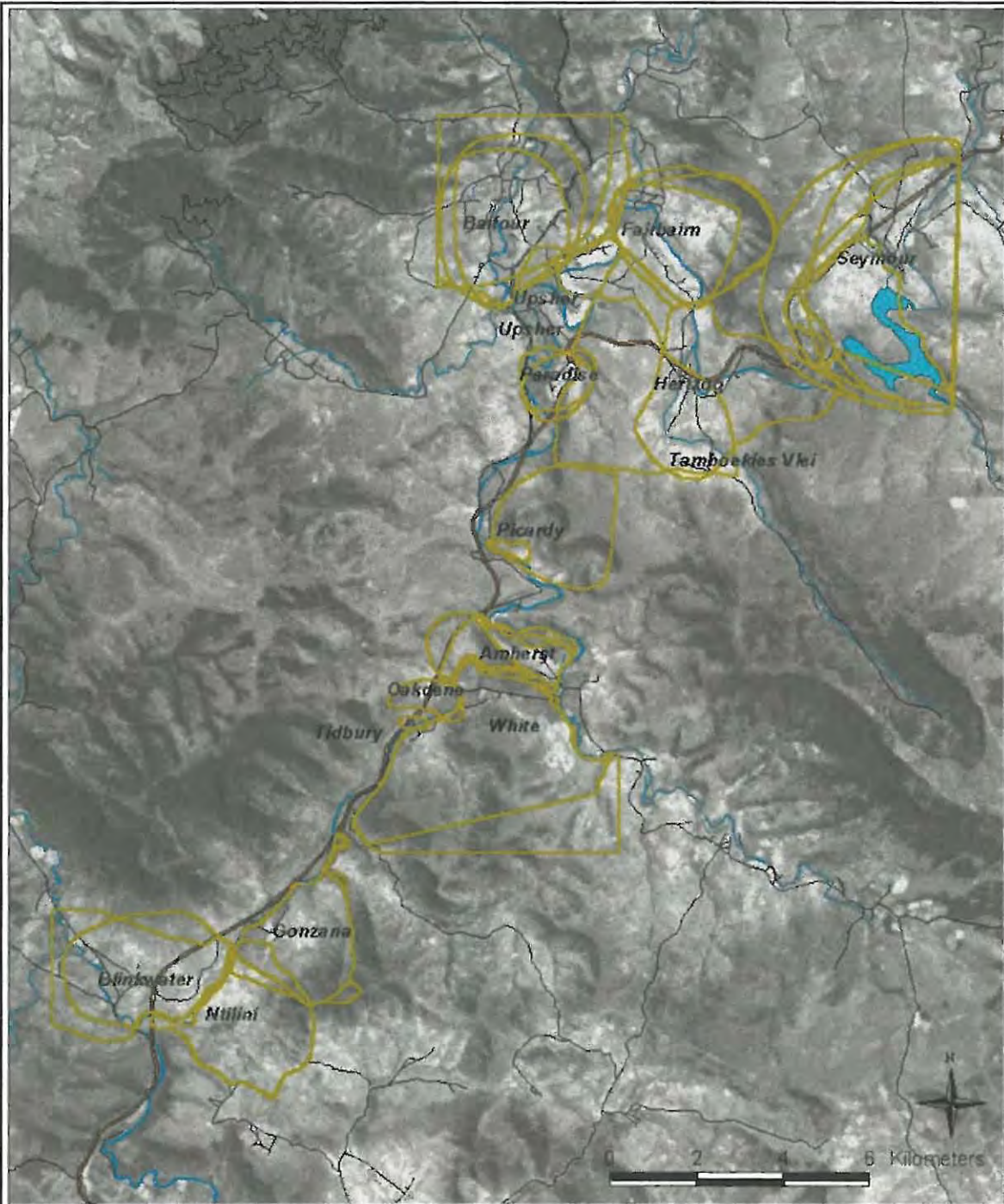


Figure 6.7: Map of community boundaries as defined by members of the Catchment Forum at the Map Skills workshop

UPPER KAT RIVER VALLEY
Issues identified by local community representatives

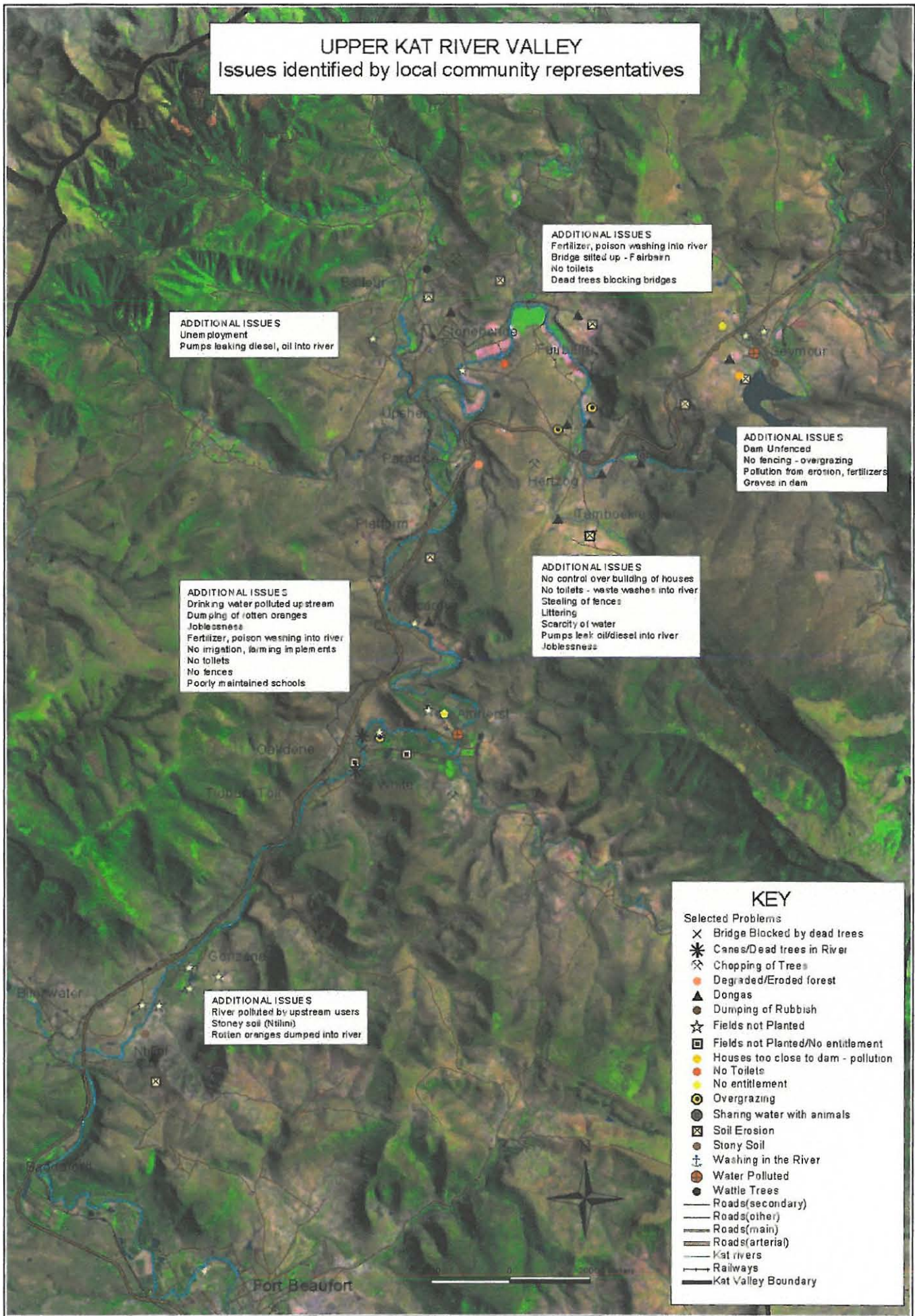


Figure 6.8: Issues mapped by KRV Catchment Forum members in July 2000

Figure (6.8) shows a layout of the mapped issues in the upper catchment. For the sake of simplified map representation, 18 of the most common issues were represented as icons on the map, while the more village-specific issues were represented in text boxes.

6.8 Reflections and discussion

6.8.1 Map-reading and mapping skills of the participants

During the map orientation exercise, it was clear that the participants grasped certain key mapping concepts. For example they were eventually able to successfully link the map to the surrounding landscape. However, most of the participants seemed to struggle to read the map – in other words to picture in their minds what an unseen landscape would look like based on information from a two dimensional abstraction of that landscape. Although they may have well developed mental maps of their community, translating these into geometrically correct spatial dimensions by overlaying them onto ‘birds-eye view’ images of their community seemed to be somewhat problematic. This may be largely due to the fact that most non-topographical features apart from roads and rivers were indistinguishable due to the low resolution of the satellite image. Furthermore the false colours of the image may have confused the participants, causing misinterpretation. However a few participants did manage to provide highly accurate interpretations and delineations. This points to towards a comparative lack of mapping skills among the participants at this workshop – despite our devoting some hours to helping them understand the maps, and our providing each group with a facilitator. In retrospect, it has been discovered that even some of the facilitators had gaps in their mapping skills at the time.

Some learning points from the workshop regarding our approach to the mapping capabilities of the participants are detailed below:

- ③ More time should have been devoted to assessing the skills of the group and developing their mapping skills¹⁴. Perhaps developing their spatial skills could have been done in more creative ways, for example by using three-dimensional models of the catchment, from which the idea of a two dimensional abstraction could have been developed.
- ③ Although the satellite image is technically the most sophisticated way of representing the catchment, it does provide a highly realistic ‘picture’ of the topography and, to a degree, the condition of the catchment. Close-up appraisals are limited by the 30m resolution of the image, although the false colours can be confusing and sometimes misleading. For future work, higher

¹⁴ How and when to facilitate the development of map skills among the Forum is a theme related to the principles of Action Learning. Should map skills be developed properly *before* the next map-based workshop, or should people’s engagements with maps and spatial concepts over a number of workshops be the mechanism through which map skills are developed?

resolution images in either black-and-white or true colour would probably be more effective. Unfortunately the next workshop would take place within eight days, which was not enough time for acquiring and preparing such images (aerial photographs for the catchment had not been obtained at the time).

- ③ The mapping ability of individuals within the Forum is certainly not uniform. This reinforces the idea that people should work in groups, where those with stronger mapping skills can help those with weaker skills.

6.8.2 *Sharing and development of catchment concepts*

There was clearly a high degree of interaction among the Forum members. They worked cooperatively in their groups during the mapping exercise, and during the bus trip were willing to share their concerns and ideas with each other. It would be difficult to assess the degree to which Forum members had developed a picture of the catchment and its condition. It would be even more difficult to know to what extent people had developed the idea of each village and its issues being interlinked by a spatial continuum. Mapping, let alone quantifying, the development of such abstract concepts at either the individual or group level would be quite a task in itself. Perhaps the seed for such ideas had been planted at this workshop. By the questions and answers that the participants presented during the workshop, some of them certainly attempted to engage with these concepts.

6.8.3 *Participatory GIS: generation of local data and potential to contribute to the development and running of a GIS*

Data of the local realities in the catchment were generated. However, the generation process was fraught with issues as has been detailed above. Furthermore, incorporating this information into the GIS required a degree of interpretation, processing, and standardisation. In so doing, much of the richness in the information has been done-away with. Furthermore, presenting this information back in a map format introduces bias from my part – the GIS technician, as well as from the limits inherent in the GIS. This invites a number of considerations which will be dealt with in the discussion chapter.

It was clear from this workshop that rural people in the catchment were in no position to play a part in the development and application of a stand-alone, multi-stakeholder GIS for catchment management. Apart from the lack of their capacity to do so at this stage, a GIS for catchment management was just not central to their immediate concerns at the time. Having a say in the running of GIS-based models and analyses using locally generated data was not immediate to where the Forum members were at, at that time.

6.9 Conclusion

Points of consideration coming from this workshop are:

- ③ An assessment of participants' levels of engagement with spatial concepts was achieved. There is scope for the further development of spatial skills among many participants. More creative ways could be used to develop these skills, such as using a three-dimensional model. Local appraisals were limited by the low resolution of the satellite image. The mapping ability of individuals is not uniform.
- ③ The group-work and discussions related to the maps, and the bus trip through the catchment, may have contributed to the development of an overall picture of the catchment and its condition.
- ③ Based on the results of this workshop, it was realised that the Forum members did not yet have the skills, nor a conception of, or immediate interest in, the catchment as a whole, to meaningfully participate in the development and application of a stand-alone, multi-stakeholder GIS for decision-support related to catchment management.

7 MAP-BASED ACTION PLANNING WORKSHOP

7.1 Purpose of the workshop

This workshop was the second phase in the establishment of the Catchment Forum. It lasted two days (20/21st July 2000), and was held at Fort-Fordyce – a forestry station on the western watershed of the catchment. At the previous workshop, Forum members had met each other, shared their issues and opportunities, and had developed some sort of feel for the catchment. This workshop would provide the opportunity to assess these needs and issues at the scale of the catchment and develop an action strategy. Some of the objectives of the workshop were as follows:

- ③ To provide the Forum with a sense of purpose as well as an action oriented focus for group development.
- ③ To develop a set of action plans for future implementation.
- ③ Through the action plans, to indicate a pro-activity and capacity that would cause funders and government departments to take the group seriously.

Since this was map-based action planning, the use of GIS was integral to the process.

7.2 Structure of, and preparation for, the workshop

The essential approach to the workshop was to develop action plans based on the logical framework developed by AACM International (1996). The logical framework works on the basis of defining a goal for the area in question, determining a set of outcomes that would be required in order to see that goal achieved, and then working out the inputs required for each outcome. This was adapted for the workshop to give the following procedure. A desired outcome would be determined for an area and then a set of actions necessary to achieve that outcome would be worked out. For each action, justifications, responsibilities, methods, resource requirements and evaluation criteria would be defined as set out in table (7.1) below.

Table 7.1: Structure of the worksheet on which actions for each desired outcome would be planned.

Outcome 1					
<i>Action</i>	<i>Who will do it?</i>	<i>Why will it be done</i>	<i>How will it be done</i>	<i>What resources are needed?</i>	<i>How will we know it's done?</i>
A1					
A2					
A3					

It was anticipated that the planning would be taken one step further by factoring cost-sharing into the actions. In other words, taking into account beneficiaries, implementers, and resource requirements, the optimal placement of that action or on-ground work in the landscape would be negotiated. By 'fiddling around' with the location of the action, the best balance between cost-sharing and environmental, social and economic outcomes could be achieved. Once the location of the action had been decided on, this would be recorded by tracing it onto a transparent sheet overlaid onto a map. The alignment of the transparent sheet to the map could be maintained for integration with other layers by means of control points. Each mapped action could be linked by an identifier to the relevant action on the outcomes worksheet.

7.3 Preparations related to the GIS research

Three sets of A3 maps of the catchment were produced and laminated: one of the catchment, one of the upper section of the catchment, and one of the lower section of the catchment. Once again these consisted of the satellite image as the background, onto which 1:50000 topographic layers and the catchment boundary had been overlaid. In addition, a number of A3 printouts of the issues mapped in the previous workshop were produced (see Figure 6.8) The GIS database was transferred to a laptop computer for use at the workshop: the GIS, projected onto a screen, would be both an aid in the demonstration of the action planning process, and a source of spatial and attribute information for the mapping process. The laptop did not have the processing power to handle a multi-layer satellite image, as a result of which only band three, in grey-scale was used as a background image. A second shortcoming caused by the lack of processing power was that three-dimensional models of the catchment could not be generated, displayed and manipulated in order to further develop spatial concepts and the idea of a catchment and catchment processes.

7.4 The workshop

The workshop was attended by the same 32 participants from earlier that month. In addition three commercial citrus farmers from the middle and lower Kat attended.

Following initial proceedings and a talk by a representative from the Department of Water Affairs and Forestry (DWAF), the purpose of the workshop was explained. This included the concept of a Logical Framework, the reasons for action planning and the methods involved. The mapping component of these ideas and methods were then further developed by myself in following manner:

Using the GIS, the picture of the catchment that the Forum had become familiar with in the previous workshop was projected onto the screen (although in this case the satellite image was in grey-scale). It was explained that when we experience a problem in a local community, we only see the picture of what is happening around us. But these problems are often a part of bigger problems

happening throughout the catchment. To manage the problem we have to understand what is happening to the catchment as a whole. This was where the GIS was useful, in that it could help to see not only local scale problems, but also the pattern of problems across the whole catchment.

It followed that part of understanding catchment scale problem involved each village sharing their local scale problems. One of the ways to do this was to map these problems for others to see – which explained the purpose of the previous workshop. Bringing the digitised and collated results of the previous workshop onto the screen, it was shown how the GIS could “pull” all these different problems together. Now people could see how the problems fitted together across the whole catchment, and with this better overview, could deal with them more effectively.

Following this explanation, the idea of developing a future desired state was demonstrated using the GIS and the idea of the “picture of the catchment”. All the layers in the GIS view were removed until just the grey-scale satellite image remained. The GIS was now showing a basic picture of the catchment – one could see the mountains, places where there were forests, and places where there were big towns. It was pointed out, however, that this was incomplete. For example the rivers and roads could not be clearly seen. These were then added as new layers. To further add to the picture, the catchment boundary was added, and then all the communities. In this way it was explained that there are many phenomena and features in the catchment, and by adding each of these phenomena as spatial layers, a more and more detailed idea of what is happening in the catchment can be built. However, for the needs of catchment management, a description of the physical features in the catchment is not enough. Among many other gaps in the picture the conventional GIS does not show the issues and opportunities that are experienced in each village. By participating in the mapping exercise at the previous workshop (at this point the issues layer was added), the Forum was now contributing towards a more complete idea of the catchment, and in so doing, helping everyone understand what was happening.

It was further explained that one of the problems with this picture of the catchment was that it did not show how people wanted things changed. It did not show peoples desires for the future. It was explained that the object of this two day workshop, was to build this picture of the future desired state for the catchment. The need for reduced soil erosion, toilets and fenced-off fields (issues that had been mapped at the previous workshop) were used as examples (it was emphasised that these were examples and not necessarily what the communities should plan for). Layers were added for those communities that would have implemented these a year from then, five years from then, and ten years from then, until the catchment as a whole had dealt with the problem of soil erosion, toilets, and fields with fences.

After the GIS demonstration, the practicalities of undertaking the action planning were explained. For the rest of that day and the morning of the following day the action planning took place (Figure 7.1 and 7.2 and appendix 3). The Forum members divided into village groups based on the sub-

sections of the catchment in which they lived. For guidance, each group was allocated a researcher as well as one of the members of the Catchment Research Creative Group. Both days ended with a report-back from each group – including a set of short-term and long-term priorities on the last day.



Figures 7.1 and 7.2: Mapping issues and plans at the July 2000 Action Planning workshop

7.5 Collation of plans into the GIS, and analysis of work done

On return to Rhodes each sheet of transparent paper containing mapped action plans was aligned to the map on which it was based, and the relevant area digitally scanned (see for example, Figure 7.3) Figure 7.3 also shows an example of the planned outcomes that were linked to the mapped data. The scanned images were imported to the GIS, geo-referenced, and the mapped information was digitised on-screen. Each action was digitised as one theme, although at a later stage similar actions across the catchment were grouped into single themes. Once the actions had been digitised, they were linked to the information on the outcomes tables (appendix 3). A map of the action plans is presented in Figure (7.4.). Some of the more commonly planned actions related to water supply and sanitation; access to, and cultivation of (often fallow) lands; fencing, the control of soil erosion (particularly gulleys), the removal of alien vegetation, and the repair of bridges.

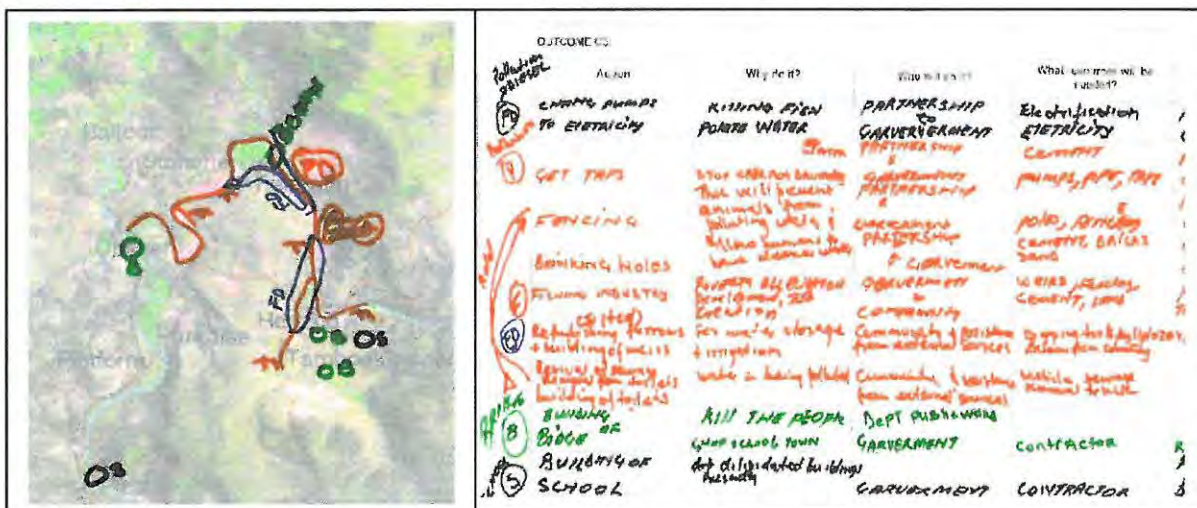


Figure 7.3: An example of mapped on-ground works or actions, and the associated outcomes table, created at the map-based Action Planning workshop in July 2000.

Once again the delineations by the participants were poorly linked to features on the ground. Consider figure (7.5) (Hertzog donga). Note how the delineated gulley is illogically placed. Interestingly the individuals who mapped these features have turned out to have some of the strongest mapping skills in the Forum. At a later date, when these delineations had been overlaid onto an aerial photograph at the scale of 1:2000, the error was independently recognised by these individuals, the gulley in question was identified, and the delineation corrected. This points again to the fact that the low resolution, and the small scale of the maps that they were working with, hampered effective mapping. It would also appear that many of the participants were misled by the colour-scheme of the satellite image: where areas were pink, they simply circled these as eroded areas.

The four groups representing the rural communities only mapped action plans for the areas in which they lived. From working with these groups and their data it was not apparent that any action planning took place explicitly at the catchment scale. In contrast, the group of three commercial farmers mapped areas along the *whole* of the lower Kat that could be developed, they mapped areas within Fort Beaufort where management of infrastructure threatening river health should take place, and they even mapped areas in the communities of the upper Kat where improved grazing management should take place.

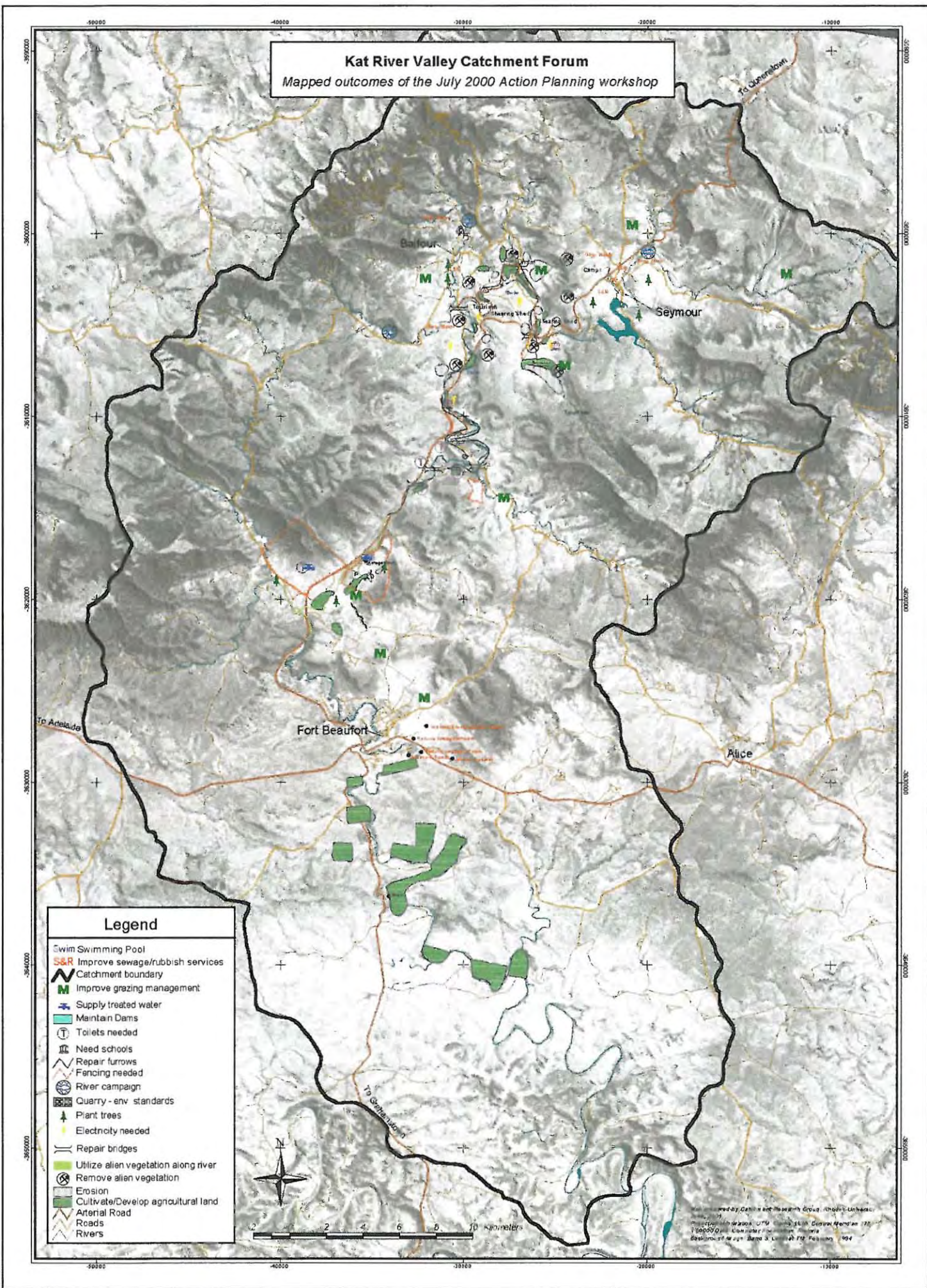


Figure 7.4: Map of planned outcomes from the July 2000 Action Planning workshop, which was presented to Forum participants in A3 format.



Figure 7.5: The green circle in the satellite image was delineated as an eroded area. Overlaying this delineation onto a corrected aerial photograph (corroborated by observations in the field) shows that most of the area is un-eroded. The actual placement of gulleys or eroded areas is shown in red on the aerial photograph.

7.6 Reflections and discussion

7.6.1 Mapping skills and spatial concepts

One of the clearer lessons coming from the workshop regarding participatory mapping and the development of mapping skills and spatial concepts, is that the use of the low-resolution satellite image alone is simply not enough. As a better starting point for developing spatial concepts, people should literally be able to *see* their landscape from a birds-eye view. Providing people with a relatively abstract representation of their landscape and then expecting them to infer the exact position of features is just too challenging. In my experience, many university-level Geography students struggle with mapping – despite the use of higher resolution images and being *in* that landscape. In future activities with the Forum, therefore, mapping should take place with aerial photographs. If mapping should occur at the catchment scale and required the use of the satellite image, then this should be done in combination with aerial photographs.

7.6.2 The concepts of catchment

An interesting point is the difference in perspective between the group of three commercial farmers and the groups of community representatives. Recall that the farmers saw problems at the scale of the catchment while the community representatives only dealt with problems and opportunities immediate to their surroundings. Perhaps one of the reasons for this difference is that the farmers in the lower Kat are at the receiving end of activities further up. Reduced water quality and quantity as a result of untreated effluent and soil erosion affect them directly. As a result, the

solution to their immediate problems lies in solving the problems that occur throughout the catchment.

The challenge for effective catchment management is in getting the local communities to see problems occurring elsewhere in the Kat as *their* problems – to develop a perspective of the catchment as a whole, and to see the solutions as being developed at the level of the whole. As was shown in the “Picture of the catchment” talk, GIS can be a useful aide in developing spatial as well as integrated catchment concepts. However, it is felt that there is far more scope for the using GIS in this way. For example we could have gone on a ‘tour’ down the river, panning from birds-eye view to birds-eye view, each representative giving the story of their village, but at the same time, all the representatives being able to see how that village and its story fits in with the rest in a spatial sense. In other words by moving along the continuum bit by bit, analysing each bit as a group, an understanding of the whole can be developed.

7.6.3 *Sharing, integrated planning and the potential role of GIS*

The above consideration brings into question the separation of the workshop into groups for action planning. The Catchment Forum came together as a group in order to realise opportunities that do not exist at the individual community level. Much of this potential for action at the catchment level may have been lost by dividing the group back into the sub-sections of their catchment. Indeed, as was pointed out, none of the rural community groups performed any action planning beyond the limits of the villages in question. Fault lies with our assumption at the time that the Forum would automatically think at the catchment level, even if they were divided into sub-groups. Indeed we only provided the groups with catchment scale maps, since we assumed that they would plan at this scale. The overall result was imprecise mapping of local scale actions that were not coordinated or integrated with actions planned elsewhere in the catchment by other villages.

A second consequence of dividing the Forum into groups, and our evident lack of attention to developing an understanding of the importance of *catchment*, was that the group did not come near to cost-sharing. Recall that one the intentions of mapping in action-planning was to facilitate cost sharing:

Once draft plans are ready identify who the beneficiaries are for the different actions and negotiate who will provide the resources needed for implementation of actions. Identify how beneficiaries change as actions are located in different parts of the landscape. Fiddle with location until a balance is reached between cost-sharing and catchment management outcomes (environmental, social and economic) (CRG research associate, 2000, pers comm).

Perhaps a solution to this, as well as a way of exploiting the momentum that had been developed at this workshop, would have been to hold a second workshop soon after. At this workshop, the actions plans, now digitised into GIS format, could be presented back to the Forum. The actions

could have been prioritised at the *catchment* scale as well as integrated at this scale. Furthermore, the actions plans could have been developed to the next level of detail (notice that only skeleton plans were developed at the Action Planning workshop), which could have included negotiations around the optimised location or distribution of actions in the catchment in terms of costs and benefits experienced by each village. Much potential lies with the use of GIS in facilitating the catchment-scale planning and analysis. For example, zooming into areas under discussion, and then zooming out to consider that area in terms of the catchment could easily have been achieved. In other words the GIS could have facilitated analysis at multiple scales, and the integration of each scale and area of consideration into the whole.

There are a number of disadvantages to conducting a planning workshop of this sort as a large group. Two will be discussed here. One of the immediate disadvantages of operating as a large group is the danger of the workshop being dominated by the stronger players – the more confident, the more articulate and those with the most capacity to participate. The outcome is a set of negotiated plans for the catchment that do not necessarily take the interests of all its representatives into account. The second disadvantage is that negotiations can become drawn-out and possibly conflictual as numerous individual, village-based and sectoral interests have to be played-off against one another or drawn into a consensus. Arrival at group consensus is the ideal. Rogers *et al* (2000) argue that developing a group vision and determining common needs are essential prerequisites to the achievement of consensus. This reiterates the importance of devoting time to the analysis of common (or catchment) needs, and the development of a catchment vision, before group catchment planning can take place. As has been shown by a number of authors, GIS can play a central role in such analysis and vision building (for example Bosworth (1998), Kim (1998) and Al Kodmonay (2000))

Despite the above difficulties, the advantages to group action planning are clear: harmonised and coordinated action plans; plans that take into account the system as a whole, benefits to the whole (even though this may mean that some receive more direct benefits than others), and, most importantly the development of a group who work together, and who have a set of plans (ideally) that is owned by all and that is supported by all. Perhaps it is naïve to argue that such complex interaction and ambitious results can be achieved so soon in the development of the group capacity. On the other hand group interest, and momentum in such capacity building processes is best maintained if it is focussed around some sort of action. Perhaps the best solution to this dilemma would be to focus on one of the more common action plans, and tackle just this one component of catchment management as a group. This is essentially what would take place in the next workshop.

7.7 Conclusions

In this workshop, on-screen GIS was used to facilitate the explanation of the concept of future desired state. Furthermore, maps were used to facilitate planning for actions or on-ground works, while GIS was used to synthesise the mapped information into an integrated format.

A number of learning points can be drawn from reflections on this workshop:

- ξ That participants should not be expected to infer the exact position and dimensions of features from abstract, low resolution two-dimensional images. Rather, high resolution images that give an exact picture of the landscape should be used – for example, aerial photographs.
- ξ That far more attention could be devoted to developing mapping, spatial and catchment skills and concepts before *catchment* scale planning can take place.
- ξ That there is much scope for the interactive use of GIS as an aide in explaining and demonstrating these concepts.
- ξ That negotiated solutions and plans of action should be developed and integrated by the Forum as a *group*, and *for the catchment*, to be most effective.
- ξ And that GIS can contribute to facilitating vision-building, analysis of common needs, and the resolution of conflict for the above planning and negotiation.

8 LANDCARE FUNDING PROPOSAL WORKSHOP

8.1 Introduction

At the workshop of 20/21 July 2000, the representatives of the majority of communities had developed Action Plans for the control of soil erosion and gulleying. The National Landcare Program (NLP) was identified by the CRG as a possible source of funding for the implementation of these plans in the upper catchment. The goal of the NLP is to “develop and implement integrated approaches to natural resource management in South Africa, which are efficient, sustainable, equitable and consistent with the principles of ecologically sustainable development” (NLP, 2000, p.1). The NLP supplies funding in the form of both Small Community Grants, aimed at individual communities, and Focussed Investments, which operate at a catchment scale. The NLP aim for Focussed Investments is holistic environmental management and social and economic development through the facilitation of “a locally led conservation approach, on a watershed basis, where people work together for effective land stewardship” (NLP, 1999, p.5). This approach is in line with the principles of the Catchment Forum, and it therefore formed a highly worthwhile endeavour around which the Forum could work and develop.

In August 2000 the CRG and members of the CF arranged a meeting with a local official from the NDA. This meeting set the process in motion for the development of an NLP Focussed Investments project proposal which would be pulled together at a CF workshop on the 13th of September 2000.

As part of the build-up to this workshop a group of CF members was taken on a field trip to the Adelaide Agricultural Research Station to learn about principles and methods of land-rehabilitation. Thereafter, in early September, members of the CRCG went out to the catchment to deliver invitations/starter documents to all the CF members. These included an introduction to the NLP, the reason for the proposal, sets of questions for each community to think about, as well as a GIS print-out of the areas in the catchment mapped by the CF which needed erosion control (figure 8.1). Other activities that took place prior to the workshop included meetings and correspondence with various NDA officials, as well as with staff from the University of Fort Hare with the view to a partnership for the project.

8.2 GIS preparations

As was pointed out in Chapter 6, local-scale maps based on the satellite image did not provide the resolution at which precise mapping could take place. This was particularly the case when it came to mapping individual gulleys.

At the Landcare workshop the 1975 orthophoto maps (which had 5m contours) and the more up-to-date GIS maps based on 1985 and 1996 aerial photographs were used by the Forum representatives to identify and map the gulleys and associated catchments that most affected their community.

GIS preparation included the rectification and geo-referencing of scanned aerial photographs of each village (see Chapter 6), and the printing of 17 maps of each community based on these images. The maps included the eroded areas that had been mapped on the satellite images at the previous workshop, cadastral boundaries with farm names or numbers, as well as planar coordinate grid references (For an example see Figure 8.2). The GIS database on the laptop was updated, although as it turned out, the GIS was not used on the day.

8.3 Workshop aims

The aims of the workshop were as follows:

1. To inform the CF about the NLP, and to further develop ideas and principles around which community-based erosion control and rangeland management could take place;
2. To compile data, generated by the community representatives, pertaining to the necessary details required in the application form. This included the mapping of target areas in which rangeland management and erosion control would take place. Based on the mapping, the size of the areas and their perimeters could be calculated in order that a costing could be calculated.
3. To enable the Forum representatives to come to a consensus regarding the nature of the proposed project, as well as such issues as erosion and rangeland management plans, management structures, financial matters and the project title.
4. As a group, to come up with answers that any of the members of the Forum might have regarding the NLP and the proposed project.

8.4 The workshop proceedings

After an introduction that included an account of the background to the workshop and a summary of its purpose and objectives, a Catchment Forum member gave a report back on the Adelaide field trip. This was followed by a drama given by the CRCG. The drama showed the changes in the Xhosa life-style and settlement circumstances, the resultant importance of adapting the ways in which the environment is used, and the way that the NLP could assist in bringing these changes about. A lecture was then given on soil conservation and the management of degraded areas.



Figure 8.2: An example of the maps produced for the Landcare mapping process.

In the mapping process, the Forum members attempted to identify the gulleys and eroded areas that affected each of their communities and then to delineate these gulleys. Thereafter, the members attempted to define and map the catchment area of these gulleys. The reasoning behind the mapping of the catchment areas was that gulleys cannot be seen as separate from the surrounding landscape: they are the product of wider factors and processes in the landscape, and should be treated accordingly. Once this was explained, and the mapping procedures demonstrated, the Forum was grouped into villages, each village was given maps of their area, and with the assistance of the researchers and facilitators, they proceeded with the mapping process (Figures 8.3. & 8.4).

After lunch the Forum discussed project considerations relating to aim (3) of the previous section. The workshop ended with the CF giving the CRG the unanimous mandate to complete the application process.

The application was finalised and submitted in October 2000. It was highly recommended at the East Cape provincial level, but turned down at the national level. The Eastern Cape Department of Agriculture has resubmitted the proposal for reconsideration for 2002.

8.5 GIS results and analysis

On return to Rhodes the maps on which the delineations took place were digitally scanned, the images were georeferenced, and the delineations digitised on screen in much the same way as for the mapped action plans. During the workshop many of the Forum members had struggled with the mapping. This is clearly evident in the mapped results. Of the 15 villages for which mapping was done, only eight correctly identified, and produced logical delineations of gulleys (for example Figure 8.5). Some of the remaining seven groups mapped areas *along* the contour (Figure 8.6) or down ridges or spurs (Figure 8.7); or tree lines and paths were incorrectly identified and mapped as gulleys.



Figures 8.3. & 8.4: Village representatives identifying and mapping gulleys that most affect their communities.

Subsequent questioning or site visits (as will be documented in Chapter 9) showed that some of these mapped gulleys did not exist at all (for examples Figure 8.8). Furthermore, gulleys that were clearly visible in the aerial photograph were missed or ignored. Where gulleys were correctly delineated, this was often as a result of direct assistance from one of the researchers.

Of the eight useful delineations, the contributing catchments that were mapped took the form of narrow zones or rough polygons from which the water flowing into the gulley originates. None of the maps contained accurate delineations of the *complete* catchment from which water flows into the gulley. As a consequence of this, GIS procedures were used to define the catchment for each gulley. This was achieved with the use of the 50m by 50m digital terrain model and the ArcView 'Basin' extension developed by the Engineering Decision Support section of DWAF. The program operates on the basis of the operator designating a "pour point", above which a catchment is then defined. This is achieved by the sequential inclusion of adjacent squares of greater or equal elevation into the set of "contributing cells", until no more appropriate squares can be found. Due to the grid resolution, only roughly defined catchments were developed. These were suitable, however, for determining estimated costings for inclusion in the budget of the proposal. A map of the community identified gulleys and their GIS defined catchments was included as part of the proposal submitted to the NLP (Figure 8.9).



Figure 8.5: Delineated gulleys with contributing catchments – Landcare workshop – September 2000.



Figure 8.6: The lengths of the gulleys that were drawn are along the contours (as indicated by arrows)



Figure 8.7: These delineated gulleys and areas of contributing flow (indicated by arrows), are placed down the line of a ridge. The remaining gulleys represent the areas defined at the mapping workshop.



Figure 8.8: The gully delineated in this map was found to be non-existent at a subsequent visit to the community.

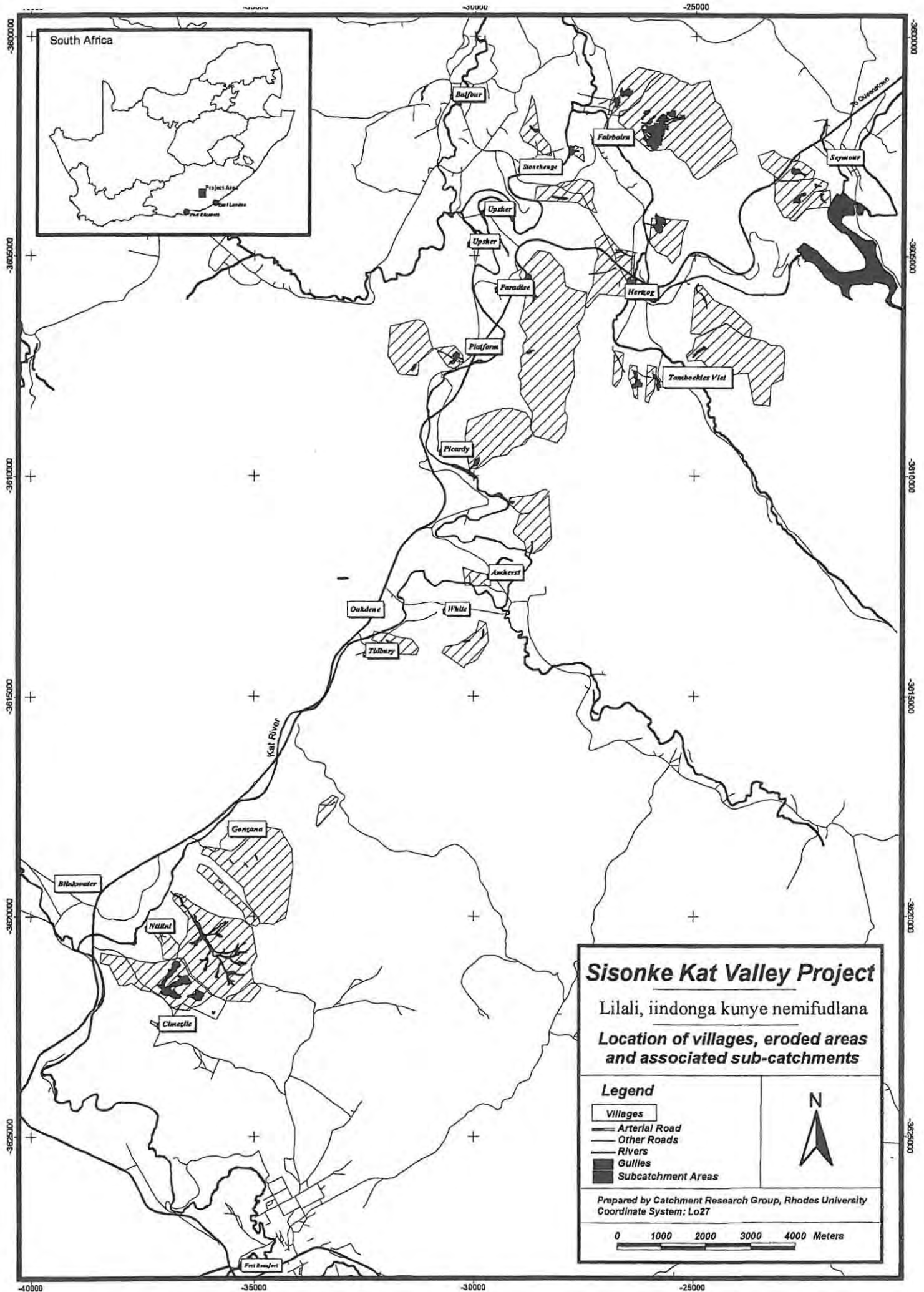


Figure 8.9: The map of community identified gulleys and their catchments that was included in the Landcare proposal

8.7 Reflections and discussion

8.7.1 *Mapping skills and spatial concepts*

Relative to the previous workshops, a focus on mapping or the development of spatial concepts was secondary to the development and completion of the project proposal. There are however a number of considerations arising from this workshop.

One of the criticisms in the previous chapter had been that the low resolution satellite image inhibited the interpretation and definition of local features. In this workshop, maps based on aerial photographs overcame this problem: features could be viewed directly – as opposed to their position and dimensions being inferred. In particular, eroded areas are clearly visible and easy to define. Furthermore, if eroded areas had developed since 1985 (for some of the maps), based on participants' knowledge of the landscape, these could easily be worked out. However, based on the results of the mapping exercise, it is quite clear that most of the workshop participants struggled to 'see' the landscape of their village in the aerial photographs. Many people struggled to see gulleys or ridges on the map, or to differentiate up-slope from down-slope.

It would appear that many of the members of the Forum struggled to link their mental maps of their community area to a birds-eye view image. Moreover based on the misplaced gulleys and catchments it seems equally clear that many people struggled to read a three-dimensional landscape from a two-dimensional image.

8.7.2 *Group planning for the catchment*

This was the first time that the Forum worked together for a cause which was manifest at the catchment scale. Indeed the group spirit was not simply limited to input to the proposal: there was also the perception that an effort that involved all the communities in the area had real benefits. For example it was widely agreed among the Forum that fencing would not be stolen (as it usually is in this region) because it would be jointly owned, while benefits would be accrued by all the villages. On the other hand it was recognised that funds and on-ground works would not be evenly distributed among the community. It was evident that this would be a difficult issue when it came to implementation. It is possible that the GIS could have contributed to resolving this problem in particular, where the GIS-based, catchment scale, cost-sharing negotiations, as envisaged in the previous chapter, would come into play.

From the point of view of catchment scale appraisal, one of the criticisms of this workshop is that, once again, the group was divided up into its component villages to undertake the mapping. This means that each person would build a clearer idea of what is happening in their local area, but would have no idea of how the problem of soil erosion is manifest at the catchment scale. Although all the information would be presented back as a composite map at a later stage, each person does

not *own* the process of building this catchment scale picture. Where the GIS could be useful is enabling mapping which involves panning from a projected scene of one community to the next, and where the *group as a whole* participates in (or at least observes) the gulley and catchment identification and mapping for each community.

The down-side of group mapping of the catchment is that it would be more time consuming – developing a proposal could be considered more important than subtly attempting to enhance the group understanding of the catchment. However, it can be argued that the greatest learning can take place when it relates to real issues. A workshop like this provides the best opportunity for a catchment scale appraisal because there is a valid reason for conducting it – people will remain interested in that they have a stake in the process. Therefore the greater investment in time is countered by the fact that each person could be further enabled to see, think, and eventually plan and negotiate, in the context of multi-stakeholder catchment management.

8.8 Conclusions

Some of the conclusions from this workshop are:

- ξ That many of the participants do indeed have difficulty in interpreting maps and conducting mapping – even when this involves the use of aerial photographs in which features are clearly visible.
- ξ That a workshop that focuses on a particular issue can provide the perfect opportunity for conducting appraisals and mapping as a whole group; GIS can play a useful role in such a process; and the extra time invested in such a process can yield benefits in terms of effective learning and a sound product.

9 PHASE 2: AN ASSESSMENT OF FIVE ENGAGEMENTS

The aim of this thesis has been to explore the potentials of GIS to facilitate the empowerment of Catchment Forums to better participate in catchment and local environmental management. The first three chapters have described workshops in which the Kat Valley Forum participants were introduced to, and challenged with, GIS and mapping concepts and procedures. To what extent had this GIS and mapping empowered the Forum? Had the Forum been further enabled to see their catchment spatially and to understand their environment in terms of this catchment? To what extent had the GIS promoted sharing about local and catchment scale problems and ideas among the Forum? This chapter describes five subsequent engagements between the CRG and the Catchment Forum in which GIS or maps have been used. Although these engagements have themselves contributed to the achievement of the research aims, they have also provided evidence based on which the development of the Forum with respect to the GIS process can be assessed.

The engagements will be dealt with in chronological order, beginning with a Water Quality workshop held in Fairbairn, followed by a three-day interview and feedback process held in June, then three sets of workshops that took place in the latter half of 2001.

9.1 Pollution mapping for a Water Quality workshop

In December 2000 a workshop focussing on water quality in the Kat River was held in Fairbairn. The workshop was both a feedback and a data gathering process for a CRG Masters research project on water quality in the Kat. Participants at this workshop included Catchment Forum representatives and other community members from Seymour, Tamboekiesvlei, Hertzog, Fairbairn, Stonehenge, Balfour and Upsher. Part of the workshop included the mapping of pollution sources and their effects along the length of the river. For this, A3 printouts of the aerial photograph maps, overlaid with cadastral boundaries and farm names and numbers, were prepared for each village.

Procedures related to the mapping of pollution began with a walk down to the river. Here, possible sources of pollution were identified. On return to the workshop venue, a list of these sources was written down and put up for display. Each village was given a map of their community, asked to identify sources from their village, and then map these. This was achieved by placing a bright orange sticker over the pollution site, and then writing the pollution type on the sticker.

Once this had been done, each map was placed along a line of blue card (representing the river), according to the sequence of villages down the river (Figures 9.1 – 9.3). Each village then presented the results of their mapping back to the rest of the group.



Figure 9.1: Participants indicate perceived water quality along a card model of the Kat river at a water quality workshop held at Fairbairn in December 2000



Figure 9.2 and 9.3: Village maps on which sources of pollution have been marked are placed in sequence along the card model of the river.

The representation of the river by the sequence of blue card provided a useful spatial framework for the workshop. In particular by placing the map of each village in sequence along this model, it reinforced the conceptualisation of the river as a common thread linking all the communities, as well as the concept of up-stream and down-stream effects and relationships. The use of bright orange stickers to mark sources of pollution, by their sheer visibility, facilitated the sharing of village specific pollution issues with the rest of the group: they served as an aid to the speaker for that village, and helped the audience visualise what was being spoken about. Such sharing is essential if an overall picture of the river condition is to be developed.

An additional possible advantage of the use of the orange stickers is that it may have been easier for participants to mark the general locality of a pollution source, rather than having to define its exact outline or situation; in other words, participants new to this did not have to go into any sophisticated mapping. As such, this exercise provided, on the one hand, a general impression of what was going on in the upper catchment in terms of pollution. On the other hand, the use of the stickers did not allow for the explicit delineation of features. In addition, the stickers provided a vague indication of the location of point sources (such as a dip-tank), particularly considering that the maps represented high-resolution images at the scale of 1:10000 to 1:20000. As a result, the community that I worked with in this exercise (Hertzog and Tamboekiesvlei), became frustrated and eventually started working with different coloured pens, giving exact indications of point sources, and delineating other sources (such as the exact fields on which fertilizer and pesticide was being used) in a precise manner (Figure 9.4). This group, particularly the Catchment Forum members, proved highly adept at orientation with respect to the map, at recognising features and their extents, at recognising cadastral boundaries and farm numbers, and at locating points on the map where they knew sources of pollution to be.

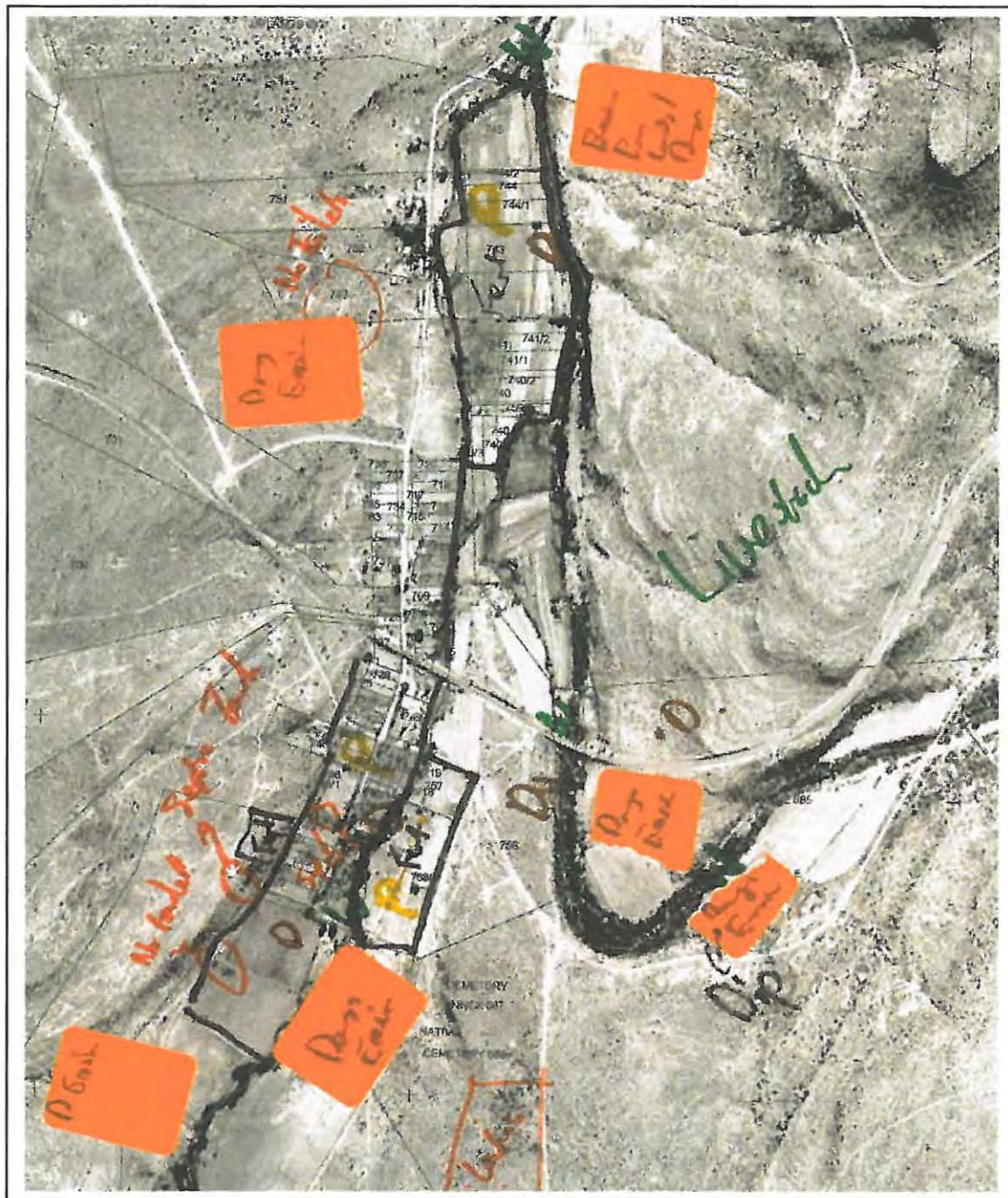


Figure 9.4: The participants of Hertzog found that the use of stickers did not allow for the precise mapping of pollution sources. They resorted to using coloured pens, with which they undertook detailed mapping. P. represents fields in which pesticides have been used, Fert. represents fields with inorganic fertilizer, D. indicates points along the river where there are diesel pumps, and W indicates weirs. Notice that the type of sanitation for individual homesteads has been mapped.

Towards the end of the workshop, a map of the collated outcomes of the Action Planning workshop for the upper section of the Kat Valley was presented back to the participants. Copies of the maps were handed out to each participant, while a package of outcomes tables was handed to each village.

While presenting these back, the purpose of the Action Planning workshop was reiterated. It was pointed out that in this (Water Quality) workshop, the outcomes of the Action Planning workshop would be refined in terms of water quality. The group then revisited the outcomes, developed new sets of priorities, additional outcomes or refined outcomes as they saw fit. As it turned out, they were satisfied with the original set of outcomes, although they decided that it was important that they engage DWAF on the issue of water quality. It was agreed that the Catchment Forum, representing all the villages in that part of the upper Kat, would provide a powerful and focussed lobby group to do this. One of the Forum Members, with the help of the CRG, would notify the department and invite them to a meeting with the Forum and villages.

9.1.1 Summary, assessment and learning points:

- ③ The use of stickers on aerial photograph maps can simplify mapping, making it more accessible to people new to such concepts, while promoting the sharing of this information with the larger group.
- ③ Placing each map into a spatial framework (in this case the river) can help to give an overall picture of conditions and their linkages along the river.
- ③ The Catchment Forum members from Hertzog and Fairbairn in particular showed a sophistication in their mapping abilities, which is in sharp contrast to what they produced in the three previous mapping workshops.
- ③ This workshop provided an opportunity for the outcomes of the Action Planning workshop to be presented back to the community. In turn, the outcomes provided a context within which actions regarding water quality issues were considered.

9.2 Feedback sessions and discussions with the Forum members, within villages, regarding the GIS and mapping process

By June 2001 the Catchment Forum had become a well-established group with a reasonably strong identity and a certain level of group maturity. It was decided to conduct a three day visit to the catchment, in which feedback, review and reflection could take place, with particular emphasis on the GIS process. Visits would be made to individual communities in which a meeting would take place with the Catchment Forum representatives in that area. Three of us would conduct the trip: myself, a translator from the CRCG, and an overseas observer. Aspects of the visit would include:

- ③ Presenting back packs of maps and associated information that had been generated by the members of the Forum over the past year. One of the principles of PRA is local ownership of the process. Participation is more about sharing than the extraction of information by some outsider. Until then, mapped and written information had been taken away to be collated into the GIS. This collated information had been presented back on-screen, or in hard-copy format in a rather disjointed manner. Until now, Forum members did not own the full set of information that had been

generated.

- ③ Providing each community with a large-scale map of their locality to be used by the whole community. If not for planning, it could be used for reference purposes by the community, or simply as an object of interest.
- ③ Discussing in detail the maps and the GIS process with the individuals in order to assess their grasp of the maps and spatial concepts, and to understand their perceptions of the GIS process.
- ③ Obtaining feedback about the Catchment Forum process.
- ③ Answering questions that participants might have about the GIS process or about the Catchment Forum process in general.

A3 versions of both the catchment scale outcomes map (see Figure 7.4) and local scale (corrected aerial photograph) maps were created, printed and laminated. The digitised outcomes were also included on the local scale map (although the gulleys from the Landcare workshop replaced those delineated at the Action Planning workshop), together with cadastral boundaries and farm names and numbers. Due to the expense of the maps, each communities would only receive one or two A3 maps (depending on the size of the community and number of representatives). Water-washable pens would be supplied, should people want to draw on the maps. 45 Booklets containing associated information and other maps were created (see appendix 3).

Of the seventeen villages to which the maps and booklets were delivered, we managed to arrange meetings in ten. Between one and four people were present at the meetings, depending on the size of the village and who was available at the time. A dictophone was used, which meant that the conversations could be transcribed later while freeing us up in our interaction with the participants. All of the meetings involved a session in which we gave an explanation of why we were there and what we hoped to achieve, as well as an explanation of each map and document that we were giving to them (see figure 9.5). Apart from this no set structure was followed. The course of the meetings tended to be spontaneous, or, from our side, were often responsive to where each group was at in terms of thinking about the maps and the Forum process. Some of the groups or individuals offered little of their own accord, as a consequence of which the meeting would end up more or less as a questions and answers session. Other groups – for example the members from Hertzog, had a lot to say, and sometimes all that was required from us was a question here and there to stimulate the next discussion. At Tidbury Toll, the meeting ended up as a gathering of community elders (Figure 9.6). Here, more than anything else, we listened to the rich story of the community history and present-day issues. At Oakdene, where the only participant was both illiterate and had been passive in Catchment Forum workshops, we focussed on the basics of understanding the local scale map of her community.

Despite the differences in these meetings and differences in our approaches, a number of questions and ideas were common to most. These will be discussed in five sections:

- The synthesis of the Action Plans at the catchment scale;
- The relationship between the outside GIS operator and the owners of the information;
- The development of spatial concepts and mapping skills;
- Perceptions about the GIS process;
- Potentials for the use of local community maps, and:



Figure 9.5: A feedback session with the Catchment Forum participants at Amherst



Figure 9.6: Working out the position of a donga at Tidbury Toll

9.2.1 Analysis of Feedback sessions

9.2.1.1 The synthesis of the action plans at the catchment scale

During our explanation of the catchment-scale map, we described how the different mapped Action Plans had been synthesised by the GIS into a single set. This synthesis meant that people could now develop an understanding of how all the different issues and plans in the catchment fitted together. Attendant to this was the idea of “*Bunye, Ngamandle*”: together there is strength – by everybody knowing what all the communities had in common, issues and plans could be dealt with in cooperation, and as a unified group that would be taken seriously by outsiders.

All the participants agreed with the importance of this idea. For example the Tidbury Toll elders said: “We would like to work with other villages to cooperate with them – whatever problem, maybe we can deal with it with the help of other villages.”

Many of the groups also agreed that the mapping process had helped them to develop a picture of the catchment as a whole. The Hertzog participants felt quite strongly about this. Quotes coming from this session put it quite well:

...Because now we know about Ntilini problems, Balfour problems, Seymour problems. You can see Hertzog problems, and Fairbairn problems in one map. (Previously) we see only one place. (But) we are all together now, we see every places, what is happening there, what is happening there (referring to the map), sometimes we talk about water there, we know water of Balfour is wrong, and water of Tamboekiesvlei is fine water, other is too sour or too strong.

And:

...Like this map, you see, it shows us all the places that are bad, and what is happening. Otherwise, if we didn't have this map, we wouldn't know what those other places are like.

9.2.1.2 The relationship between the outside GIS operator and the owners of the information

The maps and plans created by the Forum members had been taken away, converted to a digital format, and then presented back in the form of computerized lines and symbols. In this process, there is the danger that meanings could have been subtly changed and biases introduced. One of the questions was whether people were satisfied with the way in which the outcomes had been presented back in digital map format, and whether they had a problem with an outsider having so much latitude with *their* information.

All the participants were satisfied with the digital representations of their mapping and my use of symbols to depict common themes. One of the quotes in this regard is as follows:

From what we've marked from Fort Fordyce (Action Planning workshop), when I look at the map, it represents exactly what we marked – they are the problems that we have put down, so I'm very happy (Balfour participant).

Another issue was whether people could understand the way in which I had represented their information - for example the types of symbols, colours and lines that had been used and then linked to the legend on the map. Although a few of them still struggled with the satellite image (even though it was now in grey-scale to reduce the confusion that could be caused by the image colouration), most appeared to understand the actual mapped action plans. One of the participants pointed out that they understood the map of synthesised action plans because they had worked with the initial information in the first place.

A concern on my part was the fact that I was an outsider to the catchment, and yet I was running the GIS for the catchment, taking the data that was created by them and handling it on their behalf. None of the participants had a problem with this. Many of them saw the situation as a necessary partnership between themselves and outside experts. For example:

We don't have any problem with somebody from outside. What we need is to work with such people so that we can get some experience from outside (Balfour participant).

This view was framed in an interesting way by a participant from Ntilini:

N: We don't have a choice in the matter. Even if we didn't want you to work with it, how would we do this (ourselves)? So we don't have a problem. You are the one that knows this stuff. And you are interested in Ntilini's information.

Al: And what about the fact that every time things get put onto maps, it goes again – it goes back to Rhodes?

N: No, this isn't a problem. Whenever things that have been marked, you take it, and that actually tells us that you are interested. And more than that, it does actually come back.

9.2.1.3 The development of spatial concepts and mapping skills

By direct questions, or by listening to clues in what people said, an attempt was made to get an idea of how spatial concepts and mapping skills had developed. Apart from the person at Oakdene who was clear about the fact that she did not understand the maps at all, most people felt that they had come a long way in developing their understanding of the maps in the past year. For example:

It was difficult at the beginning – I didn't understand it immediately, and especially these ones (the satellite image). I've dealt with maps before, but not these kinds of maps. So as we attended workshops, and with your help explaining to us how to read these maps. So as the time goes, I did actually understand (Balfour participant).

And:

I've never understood maps before – I've only been able to understand these maps since we started with the workshop (Amherst participant).

And:

... No, I didn't catch quite fast (at) first, but now I know (Seymour participant).

As will be shown later, this and a number of other participants have shown in later workshops that they have developed an in-depth understanding of the maps that we have been working with. This understanding has even extended to an ability to read the topography of the landscape off the map:

...Because you see even that mountain up top there, that one there, you see, you can see it now (pointing to it), you know that it's flat up on top, even though you may never have had a chance to go up there. Of course we've been there. But you can see (from the map) that it's properly flat (Hertzog participant).

It should be noted however, that some of the participants, even though they had said that they

understood the maps, struggled at first to interpret the photographic map of their community during these meetings.

9.2.1.4 Perceptions about the GIS process

We asked for feedback about the GIS process. For example whether there had been times when people felt that we had gone on too fast, or had not listened to what they needed. No one had any complaint about the process (they were quite clear that they would tell us if there were), apart from a participant at Tidbury Toll, who said:

I found it very difficult ... I had to ask other people to help me. The problem is that I don't have any one else to come to the workshop with me – there are no young people to come with me. There was one guy, but he left.

This indicates that perhaps we should have looked for weaker participants in the mapping processes and provided them with special attention or linked them up with a stronger participant.

In answer to questions regarding new directions for the GIS process, some of the participants (particularly from Balfour and Hertzog) said that they would like much bigger maps, or lots of smaller ones, so that they could use these to present what they had done back to their communities. The Seymour participant said that the mapped information should be used to develop tourism.

9.2.1.5 Potential uses of the local community map

Although some participants agreed that the maps that we had given them could be used for local community planning, they were not sure about what type of planning they would do. Although many of them said that they *could* use the maps for planning, it was evident that this did not mean that they *would* use them for this. The only group that appeared to be enthusiastic about using the map were the Hertzog participants. For example:

Al: Do you see yourselves using these maps in future? Maybe not for Forum things but for other things? Is it worthwhile leaving these maps with you?

N: They are very handy, especially there is one that I was looking at – I think it's this one – if you look at this one, it clearly gives you the picture of Hertzog, whatever we need, we refer to this map. Numbers (farm numbers) and all, it's straightforward.

Al: So have you found these farm names and numbers quite useful to you as well?

N: Definitely. For instance the National Committee of Land, they've asked me to give the numbers for all HACOP fields. But when looking at this map, I could easily give that. I could easily pick up all those numbers that they want (Hertzog).

9.2.2 *Working with the maps*

At many of the meetings we would all study the map of their community. These sessions were fascinating and produced some interesting results. Since they took place in the actual community, we were “placed in the map” in a sense, and could point to all the features around us.

At three of the meetings discussions took place around the placement of dongas.

In Seymour all the dongas had been correctly delineated, but new ones were pointed out. These were marked on the map. At Hertzog, the members discovered that they had marked the dongas incorrectly:

...Although I don't know how we made this mistake... (referring to the Hertzog scale map). The dongas were put on the map in the wrong place – they're here, not there. There are no dongas where we put them – it's a bit of a mistake.

We proceeded to work out where all the dongas actually were, and then mapped them in detail.

At Tidbury Toll the participant first showed as where all the dongas were, explaining from which valley all the water came, and then where the dongas were in relation to other features such as fence lines and rows of sisal. We then worked out and marked on the map the exact placement of these dongas. It turned out that there was no donga in the place that had been marked at the Landcare workshop.

At Amherst we discussed some inconsistencies in the mapping that had taken place. They had marked a region of a steep woody hillslope as “fields not planted because there is no access to fallow fields”. We worked out that the group had got confused in linking the delineation of this to the outcomes table. Rather than designating this as a field to plant, they felt that it was an overgrazed area, and they wanted to fence it off so that the grass could be allowed to grow.

The fact that the aerial photographs were taken in 1985 and 1996 meant that they proved to be interesting historical documents. Using these maps, we could work out how things had changed over the last 15 years. For example in Amherst, where they had marked dongas where dams were visible

on the aerial photograph, it turned out that the dams had burst subsequent to the photograph being taken. This group also became fascinated in how their village had changed. In 1985, only a few houses were visible. Today there are perhaps 50. This was because at the time the area had only recently been converted from a privately owned white farm to one that was state owned. Associated with this was a change to communal ownership of that part of the property.

At Hertzog, the participants felt that although no new dongas had developed, the existing ones had intensified, while the community had grown:

A1: ...Are there new things that aren't represented, because it's such an old map? For example, I can see that where this path is here, you've got it marked as a donga. Has that appeared there since 1985?

C: I don't think so. They were not as strong as they are now, so things have changed slightly. Otherwise the other things that have changed are houses. There are houses there, and they are not there on the map. For example here at 699 (the farm). Otherwise that's it – this fence was here in 1985. I don't see anything else that has changed.

In the process of studying the community maps as a group at these meetings the participants reached a new level understanding of their map. They started to see greater detail in the map than simply where the river was or where the roads were. At Ntilini and at Amherst the participants were at first hesitant about where things were or what things were, but as things progressed they became more and more confident about what they were talking about, working out exactly which was their house, where furrows were, which field was which, where “that dam over there” was (pointing) on the map. Perhaps most importantly, for the first time people showed a real excitement about their map.

In the light of the above, the discussion with the participant at Oakdene deserves particular mention. As has been indicated, there is one participant for Oakdene, who is an illiterate grandmother. She had participated little in the workshops, and could not understand the maps at all. During the mapping workshops, participants from other villages had helped her out. During our meeting with her (see Figure 9.7) we had been trying to find on the map the features that she had been talking about – in particular a set of fallow fields. We went outside for her to point out to us this field and some dongas. All the time we had been trying to get her to work out where these features were on the map, but she remained confused. One of the problems was that in 1985 her house had not yet been built, and therefore was not visible on the map. It was apparent, however, that there was some sort of building that had been close by at the time, which no longer existed (Figure 9.8). The woman had lived in this village since she was a child, so we asked her whether she remembered such a building. After a bit of discussion, she remembered a shed, and showed us the foundations. When we showed her the shed on the map, everything suddenly made sense to her. She

was clearly excited, especially by the fact that she was looking at her village as it was 15 years ago.

At a later stage in our discussion, she said:

My interest is that I was surprised to see this area – the things that used to be in this area. I see it in this map. That has raised my interest, so that I could tell my children what was here. ... If I could get this map, I would use it, I would even frame it!

To me this was a special experience; to watch someone make a conceptual breakthrough and suddenly “see” their landscape in the map and get really excited about it.

A second meeting that was of special significance was at Tidbury Toll. Recall that this participant invited all the village elders to join us. As a result, the meeting ended up more as a detailed discussion about their village. In the process a rich picture of the village was presented in terms of historical factors determining their present circumstances, issues behind issues and conflicts with outsiders over land-tenure. An example of an issue behind the mapped data is the story of their bridge. At the Action Planning Workshop, the bridge at Tidbury Toll had been marked and linked to a record saying that it is low and therefore impassable during high flow, and as a consequence its height should be raised. In talking to the elders we discovered that the bridge (in fact a low causeway) is under water on numerous occasions, and that this is a serious inconvenience. If people want to leave the village (for example to go to school) they have to walk for a number of kilometres through the bush to a bridge lower down the river. Furthermore, if someone is sick, there is no way that an ambulance or taxi can reach them. The issue of the bridge had in fact caused a conflict within the community. One elder (who is also the member of the Catchment Forum) wanted to move the entire village to the other side of the river, while the others were far more reluctant to do this. This person has subsequently built a home across the river and lives there apart from his community. Later that day I reflected on the meeting:

It’s amazing how, as the “GIS technician”, I’ve worked with the data of the community - the information that they have provided – but just working with it does not mean that I’ve fully understood it. Today at Tidbury Toll, I actually only understood and got a feeling for the depth of the information by talking to a whole lot of the community at the meeting. And actually being *in* the environment and discussing it with them, rather than them handing it to me. So now I’ve got a deeper appreciation for the dynamics of the information that they have supplied, I understand the more social side of the information. I understand the things that can’t be depicted in terms of GIS, or even in terms of paper.



Figure 9.7: A participant from Oakdene and a member of the CRCG.

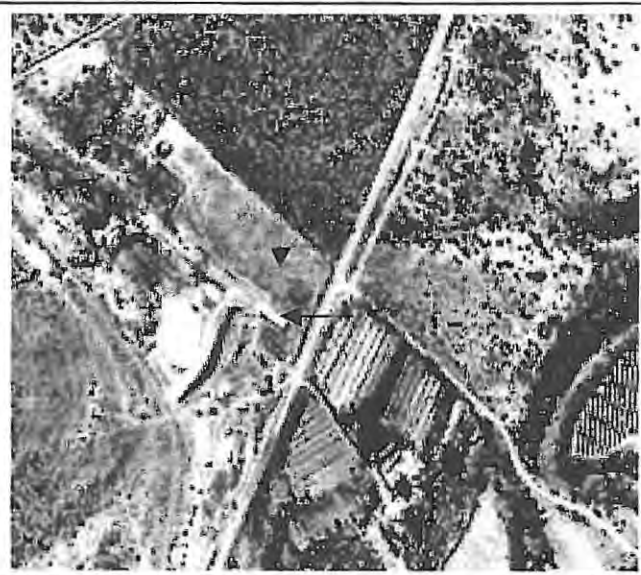


Figure 9.8: Corrected 1985 aerial photograph view of the community of Oakdene. The position of the present day house of the Oakdene participant is shown by the vertical arrow. The shed that existed in 1985 is shown by the horizontal arrow.

There are three learning points here:

- There is a rich context to the spatial information that is mapped by the community representatives.
- This brings into question the role of the outsider. What are the dangers of their working with this data while being oblivious to its context? Furthermore it highlights the importance evaluating a process with community members.
- In terms of GIS and participatory mapping as a PRA method, mapping should not be conducted in isolation from other PRA methods. Furthermore there are definite advantages to conducting mapping while *in* the community, in a smaller, more personal context.

9.2.3 Summary, Learning Points and Analysis

- Members of the Forum recognise the empowering potential of a group knowledge of common issues and plans in the catchment. Furthermore, many members felt that the mapping process had helped them to develop an overall picture of the catchment.
- Members of the Forum were satisfied with the GIS synthesis and representation of their action plans. They see an outsider working with their data not as an intrusion but a necessary partnership involving their local knowledge and outside expertise and resources.
- Most of the participants felt that they had come a long way in developing their understanding of maps in the past year.
- Of all the communities, only the Hertzog participants foresaw a particular future use for their map.
- The part of the meetings when people's interest was most engaged was when we were working with

the maps of their communities. It is felt that in exploring these maps with the community members in an in-depth manner, *in* those communities¹⁵, and interpreting the historical significance of spatial phenomena, participants reached new levels of understanding of, and enthusiasm for, the maps.

- ③ There is a rich context to the spatial information that is mapped by the community representatives. Practitioners should be sensitive to this context, and should attempt to include it in their work. This could mean visits to individual communities to hear their full story. Ultimately the spatial dimension should form only a part of a multi-faceted community or catchment appraisal.

9.3 The use of a Catchment Map at the CF Vision workshop

By September 2001, issues began to develop among the Catchment Forum regarding structures, roles and responsibility. This related in particular to a Forum management committee that had been elected in May that year. At the same time it was evident that the Forum as a whole was beginning to lack a sense of purpose – until then, none of the plans had translated into actions, while at the same time there still remained a sense of reliance on the CRG. As a consequence, a Catchment Forum workshop was held in Balfour in order to revisit the vision and aims of the Forum, and to try to develop ways in which the Forum could become more self-sufficient.

As part of developing the vision, the Forum went through a process of reviewing its identity. This included using an A0 colour satellite map of the catchment that had been created for the Forum. With reference to the map, the Forum was reminded how each person came from a village that was part of a whole: the catchment, and that the Forum existed to represent this whole. By looking after the interests of the whole, they were, in effect, looking after the interests of each village. To emphasise this, a representative from each of the villages came up to the map, placed themselves in this “whole” using a sticker with the name of the community, and gave a brief talk about their locality (Figure 9.9 and 9.10). After this, the Forum was randomly broken into groups who each told a part of the history of the Forum. Thereafter, each group told how it saw the Forum functioning in future. These group views were synthesised, and, by negotiation among *all* the Forum members, a provisional vision was created. This is:

To be an independent, sustainable group with a commitment to the fair and healthy use of the catchment by: (1) Being the voice of the stakeholder communities in the Kat River Valley and the connection between the communities and other bodies; and (2) by promoting sharing among the Catchment Forum and the communities.

(Note that this is not the final vision: it is in a constant process of development)

¹⁵ The idea that learning takes place best in context is one of the underlying principles of Active Learning.



Figure 9.9 and 9.10: The use of the A1 colour satellite map of the catchment at the Vision Workshop, September 2001

9.3.1 Summary

The use of a large map of the Kat River valley promoted the contextualisation of the vision development process in terms of the catchment.

9.4 The use of maps for the Kat River Reserve Workshops

One of the projects being conducted by the CRG is a capacity-building process with the communities of the Kat Valley with the eventual determination of the Ecological Reserve in mind. Between August and November Reserve workshops were held in each village. Each workshop involved maps and mapping, in which the aerial photographs, as well as an A0 printout of the colour satellite map of the catchment were used. One of the purposes of the mapping was to record, along the river, past resources and present threats, in order to develop an idea of how the condition of the river has changed (Figure 9.11).

Members of the Catchment Forum were present at all of these workshops and played a central role in the mapping. A recording of the workshop at Seymour provides an interesting story in the context of the GIS process and the empowerment of the members of the Catchment Forum. What is of particular interest is the fact that the mapping section of the workshop was facilitated by a member of the Catchment Forum.



Figure 9.11: Working out past resources and present condition of the water resources at the Seymour Reserve workshop.

The Forum member began by giving a detailed explanation of the A0 satellite image to the rest of the participants. He explained where Seymour was and then pointed out all the villages down the Kat River until Fort Beaufort. He then explained the concept of a satellite image and the fact that this one was taken in 1994. He explained the graduation of colours, and what each colour might indicate. He pointed out all the roads, showing where they went to, he pointed out the railway line, and he pointed out the length of the Kat River and some of its tributaries. He also pointed out the catchment boundary, explaining that everything within the boundary was part of the Kat River Valley, and everything outside of it was not.

After explaining the satellite image, he facilitated the work with the aerial photograph. All the participants sat in a circle, and he went from one person to the next, helping them to understand the map. In the process he explained what an aerial photograph is, how it is made, and how the Seymour one relates to a particular place in the satellite image. In explaining this, he went as far as linking up the pink areas on the satellite image to degraded and eroded areas in the photograph. He then assisted the participants in defining problem areas in the map.

It was quite clear that this participant was highly competent and confident in working with the maps. In contrast, in our June discussion with him he had said that he had not understood the maps at first.

A second point of interest was the level of involvement of the community participants. Once they came to grips with the map of their community, they sustained an animated interest in it for the next half hour. Some of them interpreted the map to great levels of detail, for example working out which road was which, where a particular set of trees was, where the new buildings were and where the sewerage works was. This interest extended their using the map, on their own initiative, to work out

what the river looked like in the past as compared to the present, during a river transect¹⁶.

9.4.1 Summary and learning points

- ③ The Catchment Forum representatives played a central role in the mapping component of the Ecological Reserve workshops which were held in each community. These workshops demonstrated that, in comparison to their performance at earlier workshops, some of the Forum participants had developed a clear understanding of the catchment-scale and local-scale maps.
- ③ The maps of the local community are of immediate interest to villagers; for some it provides a novel perspective on their local environment. This reinforces the idea that local maps, rather than catchment maps, should be the starting point in the development of a spatial perspective of the catchment.

9.5 The use of Maps and GIS in an Action Projects workshop

At the Vision workshop of September 2001 it was realised how important it was for actions to be central to the Forum development process. Many of the skeleton plans developed at the Action Planning workshop in July 2000 were reasonably simple, such as cleaning out irrigation furrows or negotiating with a farmer to access fallow lands. These ideas could easily be translated into more detailed plans and then actions at little cost to the Forum members or community. The CRG together with the CF members initiated action project planning in each village. This involved deciding on one of the action plans that had been developed in the Action Planning workshop, and then going through cycles of information finding, selection of alternatives, developing plans, and evaluation¹⁷, until a level had been reached where effective implementation could take place. The first cycle of planning took place in each village with the help of the CRG facilitators. The second cycle took place at a workshop held at Hobbiton-on-Hogsback on the 28th-30th of November 2001.

On the first day each set of village participants was assigned randomly to five different groups. For example Fairbairn, Platform and Amherst formed one group. These groups sat together and, with a facilitator, helped each other develop their plans. In this way valuable cross-fertilization took place between the villages. For example the participants from Gonzana, who wanted to start small-scale farming, were helped invaluablely in terms of ideas and NGO contacts by the Hertzog participants, who were already involved in such an undertaking.

All the groups were handed laminated aerial photograph maps of their villages. These were not the focus of the project planning, but were nevertheless available should they be necessary. The use of these by the Ntilini participants provides an interesting example of how the maps facilitated sharing and group discussion. The participant had explained that their village needed to access some fields but could not get there because a donga was in the way. Participants from other villages could

¹⁶ This is a further illustration of the use of the maps as historical documents.

¹⁷ Based on the Action Learning framework.

not understand why people could not simply go round the donga. Only until a map had been referred to, could people picture what she was talking about and understand the extent of the problem: the donga stretched for over a kilometre up a steep valley to the east, while the river prevented people from going around the western side (figure 9.12). Only with the help of the map could solutions be suggested, since they related directly to the topography of the areas. For example it was suggested that the water above the desired crossing point be diverted by a furrow along the contour to an outlet in the south, and then the donga be filled to form a bridge. Based on the map it was decided, however, that this would not be possible because of the placement of the village on the one hand, and the extensive area (and therefore potentially large volume of water) that was drained by the donga, on the other. Eventually it was decided that a causeway across the donga would be the most effective solution.



Figure 9.12: An aerial view of the village of Ntilini (indicated by the circle) and the donga that is preventing access to a field (the field is indicated by the arrow in the north-west of the image). The Kat river is to the west of the village, while the donga extends from where it flows into the river close to the arrow, south-eastwards to the bottom of the picture.

At the end of the project planning, on the evening of the 28th and the morning of the 29th, each village presented its plan back to the Forum. In this way the Forum as a whole developed a picture of what all the villages down the river had planned, while at the same time, other Forum participants shared with that village suggestions and critical considerations regarding their plan to great effect. Using the GIS, the corrected and referenced aerial photographs were projected on to a screen to

facilitate the sharing, should any reference to the GIS be necessary. Use of the GIS indeed took place, as will be documented in the following paragraphs.

The Seymour villagers needed fences: one along the Kat Dam to prevent children from drowning in the dam and cattle from disturbing and polluting the edge of the dam; and another along the arterial road that passed by the village. Referring to the image on the screen, the presenter pointed out exactly where these fences would be, and how far they would stretch.

The Hertzog participants wanted to refurbish an irrigation furrow for their fields. On the screen, the presenter showed exactly where these furrows were, where the building of a weir would be required, and where the outlet of the furrow was (figure 9.13).

Fairbairn wanted to rehabilitate a particular set of dongas that was silting up one of their bridges. However, since the presenter did not refer to the map, some of the Forum members asked to be shown exactly which dongas he was talking about. This particular presenter (who, surprisingly, is one of the facilitators), admitted that he could not understand the map of his village. As a result, with the help of other participants, and orienting ourselves to particular roads, the river and the bridge, we worked out exactly which dongas were being referred to.

The Stonehenge presenter briefly explained on the screen where his village was and which length of the river he was talking about before explaining their project.

The Amherst participant showed on the screen a furrow that they were planning to fix. This would enable the villagers to start gardening, as well as provide them with easier access to water.

The participants from Cimezile used the projected image of their community throughout their presentation. Similar to Ntilini, this community has problems accessing fields as a result of dongas. The presenter pointed out their village, and then showed in detail why they could not access their fields, pointing out where the fields were in relation to the dongas and roads. In addition he pointed out a newly built bridge and, showing the extent of the dongas above that bridge, explained how erosion and deposition was so active that the bridge would be useless in a few years. A second participant from Ntilini then got up and explained other erosion problems in the village, in particular a donga that was threatening their school. While she was doing this, the first participant was standing at the projected image pointing out what she was talking about (Figure 9.14).



Figure 9.13: A Hertzog participant explaining plans for the refurbishment of a furrow.



Figure 9.14: A participant from Cimezile pointing out features on the GIS image while a second participant explains related problems.

In addition to the size of the projected layers in relation to maps, the use of the GIS and screen projection proved useful in a number of ways. In particular, we could pan around without being limited by a map boundary. For example the furrow that the community of Amherst intends to fix originates at a weir on the river at Picardy. Since we were using GIS, we were able to "navigate" up the river to bring this weir into view. Had we simply used the hardcopy map of Amherst, only half the length of the furrow would have been shown. A second advantage of using a "live" GIS is that one can zoom in to a particular area in question. For example at Fairbairn we could show the particular set of dongas in question. In contrast a hard-copy map is effectively limited to a scale small enough to incorporate the whole of that community. Essentially, the GIS allowed a dynamic presentation of the spatial dimension of the communities in the Kat, facilitating more effective sharing among the Catchment Forum.

Although it had been stated up front that participants did not *have* to use the GIS images (they were only there should people want to refer to them), they became a focus around which the presentation process took place. Even when people did not refer to the screen at all, the image of the village was nevertheless in view and, while the participant was talking, many of the Forum members were looking at the village in question, apparently linking what was being said to what was in view. As the GIS operator, I often influenced this by independently zooming in to the areas in question: by the participant's description of their plan, I knew which area was being discussed (in working with the maps and the communities for over a year and a half, I have developed a useful knowledge of the area). For example as the Paradise participant spoke about a project to clean up jointed cactus, I zoomed in to that part of the community area affected by this weed – in this case the participant had

described to me where the jointed cactus was in a prior conversation.

The above describes my use, as the GIS operator, of the knowledge that I have gained of the area as a participant in the Forum process. This knowledge was used, in fact, to correct one of the participants in terms of where she thought some fields were on the image. The community of White had developed plans to access fallow land and use this for small-scale agriculture. The participant presented the project, but then admitted that she could not understand the map of her community. I was asked to come up and explain where their houses were situated (note that this was a 1985 map and their houses had not been built then). Starting from the arterial road as a reference point, I worked my way along the gravel road to their community, pointing out features as we went (such as the bridge, the loading shed for oranges and the old farm house), until we got to the site where the community has since been established. Once I had pointed out the area of their houses, she indicated a general area to the south and said that this was the land that they wanted to plant. This was however a steep-sloped bushy area, and many of the Forum pointed this out. Having been to White many times, and having spoken to other Forum members from this community, I knew which field she was talking about, and so showed this to her on the map. For an outsider “facilitator” to play such an active role could be seen as “taking back the stick”, and going against the principles of participatory practice. Recall, however, that an important principle of participation is that the facilitator should use their own best judgement (Chambers, 1994b). In this instance, apart from giving the rest of the Forum an idea of where the field was, a focus was provided around which the participant could be helped to translate her local knowledge into a spatial perspective. As we experienced with the Oakdene participant in July 2001, picturing just one feature spatially can be the key to the rest of the map. Furthermore in helping the participant to see her community spatially, a conceptual tool is being handed over which will allow her to conduct her own map-based appraisal of her community. The above incident is an expression of the partnership between the outside GIS operator and the local participants. The idea of partnership will be discussed further in the next chapter.

Five of the presenters were open about the fact that they could not understand the map of their community. If we consider the presenters to be a sample of the Forum, then at least two thirds of the members were still unable to read the aerial photograph maps of their community. This is interesting considering that the Forum had been working with maps with the help of facilitators for almost a year and a half. Even more surprising was that one of the facilitators, who has had far more intensive skills development with, and exposure to, the maps and the GIS, was still unable to understand them.

9.5.1 Summary and learning point.

At this workshop, much focus was placed on sharing. This sharing was promoted by the GIS and GIS maps in the following ways:

- ③ For two groups the village maps facilitated the explanation of issues and the development of plans,

in that they helped the group as a whole to visualise the situation.

- ③ The GIS projected on to a screen provided a useful aide for many participants when they presented their plans to the rest of the Forum. Many presenters explained their plans around the image, in so doing allowing the rest of the Forum to visualise what the presenter was talking about.

Additional points of considerations are:

- ③ That the GIS projected on to a screen provided a far more dynamic means of presenting the spatial dimensions of the communities than could have been achieved with hardcopy maps and;
- ③ While some participants showed a sophisticated ability to read the maps, a proportion of the Forum were unable to read the aerial photograph maps of their community.

For the first time since the initial workshop in July 2000, sharing among the Forum had taken place at the catchment scale: the group as a whole now had a picture in their minds, not only of the plans for their village, but also the plans for all the other villages in their catchment. It is felt that this has contributed to the development of an overall picture of the catchment among Forum participants. The GIS was instrumental in this sharing. It is regrettable that such GIS based sharing had not taken place sooner in the Catchment Forum process.

9.6 Conclusion

This chapter has detailed five engagements between the Catchment Forum and the CRG. In three of these, *detailed* mapping and appraisal at the local scale took place *in* that local community (namely, at the Water Quality Workshop, the Feedback and Discussion meetings and the Ecological Reserve workshops). It is felt that through these focussed appraisals great advancements in abilities to “see” the landscape from a birds-eye perspective took place among individual Forum members. The learning point in terms of introducing GIS and mapping among local community participants has been that it is important to start slowly, locally, in focussed groups, and with the undivided attention of a facilitator who is able to interpret the maps.

With regard to the development of the Forum as a group, the GIS and maps promoted the conception and the development of the identity of the Forum in terms of the catchment at the Vision workshop, while sharing among the Forum was facilitated by the GIS at the Action Projects workshop.

The five engagements have thrown light on the extent to which the Forum has developed, through the GIS process, in terms of mapping and spatial concepts. In the description of the Water Quality workshop, the feedback and discussions meetings, the Ecological Reserve Workshops and the Action Project Workshops it was noted that participants had demonstrated sophisticated abilities to interpret and work with the maps. Furthermore many participants felt that the GIS process had helped them to develop an overall picture of the catchment. However, it was noted at the Feedback and Discussion meetings and the Action Projects workshop that some participants were lacking in

the ability to interpret even the local scale maps.

The engagements have provided learning points regarding the role of the GIS practitioner. The GIS practitioner should be aware of other forms of community information when working with the locally generated spatial information. Essentially, the spatial dimension should only form a part of a multi-faceted appraisal. The relationship between the GIS practitioner and the Forum is seen by some participants as a partnership; the practitioner works with the technical component of the GIS while the participants, through the platform provided by the GIS, conduct appraisal and planning processes.

10 DISCUSSION

In this thesis, each engagement with the Catchment Forum has been described and discussed or reflected on in chronological sequence. The reason for this is that each engagement has represented an Action Research cycle, and has therefore provided the context for subsequent engagements. In this chapter the various themes that have emerged from separate discussions will be integrated into an overarching consideration of the GIS and mapping research project.

In Chapter 4 the philosophical and methodological context of the research was covered. This included the fact that:

- ③It is situated in a critical paradigm, in which there is an interplay between theory and practice as the research process plays itself out;
- ③One of the contexts for this interplay is Action Research, which involves cycles of understanding, planning, action and reflection;
- ③As a result of this both the research questions and objectives become clearer and the practice becomes more effective, as the research progresses, and;
- ③There *should* be outcomes both in terms of adding to a body of knowledge, as well as in terms of some sort of action outcomes, or a form of emancipation.

The research cycles have been presented in the preceding chapters. This chapter considers the research outcomes as well as the lessons, coming from the research process, that can contribute to thinking and practice around GIS for Participation and catchment management. Throughout this discussion, outcomes in terms of the empowerment of the Forum will be referred to, although these will also be listed in the concluding chapter. The chapter will end with an assessment of the research process. However, since the entire research process has taken place in the context of a broader people-development framework, this should first be considered in order to contextualise the discussions.

10.1 The Catchment Forum journey as the axis around which other processes took place

The Kat River Valley Project, and the associated work of the CRG over the past year and a half, has focussed largely on the development of the Catchment Forum in order to enable them to effectively participate in catchment management, and to enable them to initiate actions that deal with some of the negative circumstances under which their communities live at present. It follows that the tools and methods involved in each engagement with the Forum on the part of the CRG has been in the context of the Forum journey, and the effectiveness of these methods and tools can only be considered in terms of their constructive contribution to the Catchment Forum process. Good

workmen do not blame their tools. Or conversely, the effectiveness of various methods and tools for the development of the Forum depends on the way in which they were used. For example were they used at the right time in the Catchment Forum journey? Were they used in the right way? Were they complementary to the Catchment Forum agenda, or were they imposed by researchers wanting to test and develop their particular tool or method?

What is being argued here is that there should be a needs-based application of the tools and concepts in engagements with the Forum. For example, as the need for appraisal changed to a need for action and implementation, so PRA methods such as transects and mental mapping fell away, to be replaced with Action Learning oriented methods (although PRA principles were retained) such as action planning and project development. If researchers had been stuck in any one methodology, responsiveness and relevance would have fallen away, with the danger of the growth of the Forum being stunted. Thus all the tools, methods and concepts should form a menu of approaches, to be selected when needed, in various combinations, for the building of the Catchment Forum capacity.

Figure 10.1 gives an idea of the relationship of some of the tools and their associated conceptual frameworks to the Catchment Forum journey. The diagram shows that the development of the Forum has been the central process to which all the other processes (for example PRA, GIS and Action Learning) have been ancillary. Although these ancillary processes have driven the development of the Forum, the nature of these processes have in turn been determined by the changing needs, abilities and outputs of the Forum as it has developed. Although one cycle is shown between the Forum process and each conceptual framework and associated tools, in effect numerous cycles took place. For example with the GIS for Participation, 12 engagements (to varying degrees of interaction) between the Forum and the GIS framework took place (each engagement representing a cycle of understanding, planning, action, and reflection). Thus the GIS for Participation went through a process of development over time in concert with the Forum development process and the development in thinking about, and use of, the other frameworks. Unfortunately, due to the limits of a two-dimensional page, this simultaneous process of development is not illustrated in the overall set of interactions in the Forum development. A sense of the GIS process over time as it relates to the Catchment Forum journey is shown in Figure 10.2.

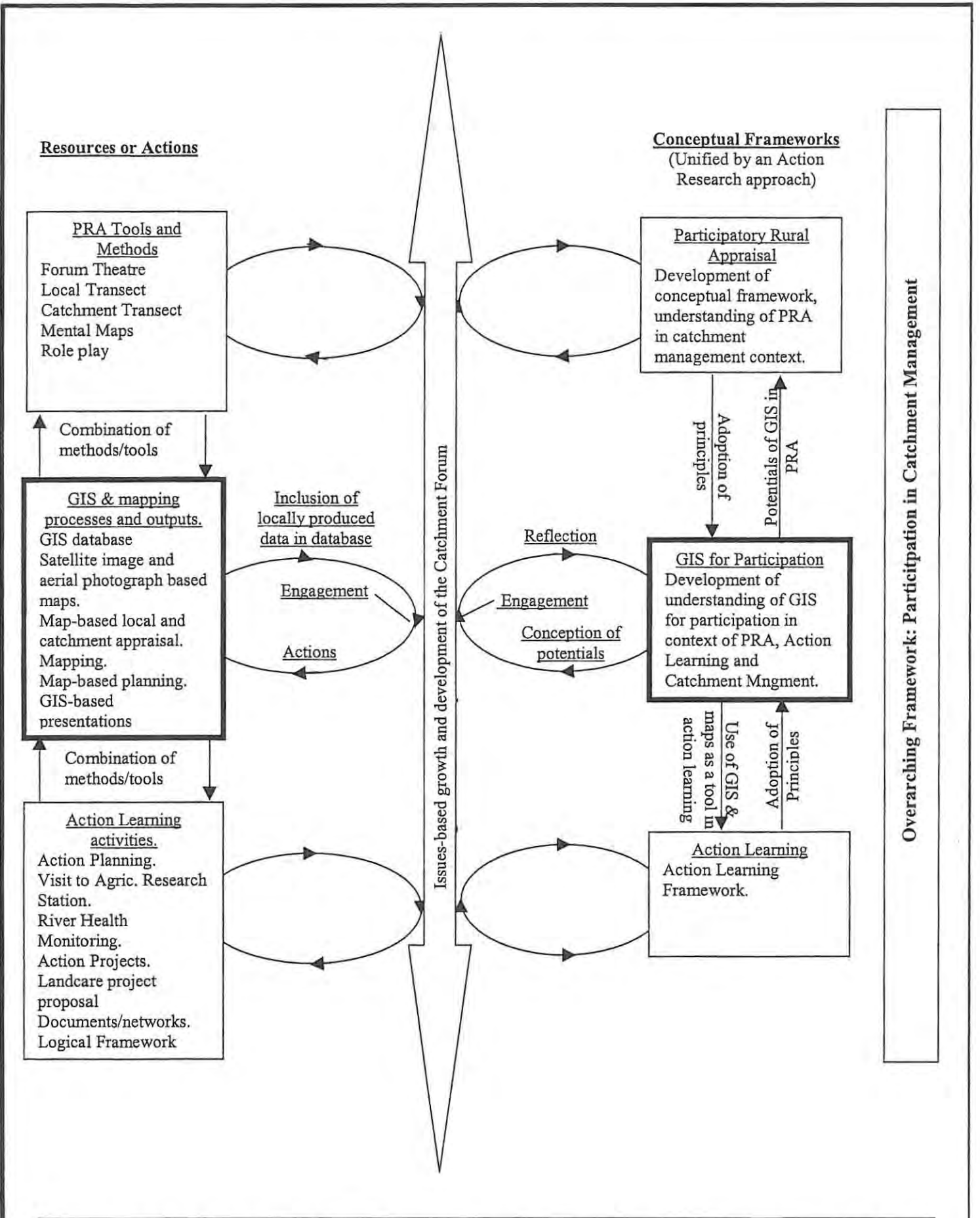


Figure 10.1. A diagram of the interrelations between the Catchment Forum development journey and the GIS for Participation, and participatory catchment management frameworks, approaches and methods. Note that the GIS research process is represented by the text boxes in bold and their cyclical interactions with the Forum. The other components of the diagram are dealt with in the introductory chapters.

Notice in figure 10.1 that this thesis is about the components “GIS for Participation” and “GIS and mapping outputs”, and some of their relationships to the other dimensions of the overall picture. Mapping out the full spectrum of dimensions and interrelations of the catchment management people-development framework that relate to the GIS process would be an exceedingly difficult task, leading to a large volume of text. Consequently, only the most pertinent themes, lessons and outputs from the process will be discussed here in response to the overall aims and objectives of the project. These will be discussed in three sections. The first section will deal with the role that the GIS and Mapping played in the conceptual development of the Forum participants in order to enable them to better participate in catchment management. The second section considers the platforms for empowerment that GIS provides. In particular, platforms for sharing and communicating, and conceptual and skills platforms for more sophisticated engagements. The third sections considers lessons learned about the role of the GIS practitioner in people-development processes, and the appropriateness of GIS as a tool in such a development process for rural people.

To provide a context for these sections, and as a summary of the chapters in which workshops and meetings were held with the Forum, Figure 10.2 shows one element of the Catchment Forum process. This is a timeline of the points of engagement between the CRG and the Catchment Forum, the outputs of these engagements in terms of the development of the Forum, and the inputs, by the Forum, to the next workshop, based on the capacities developed at previous workshops.

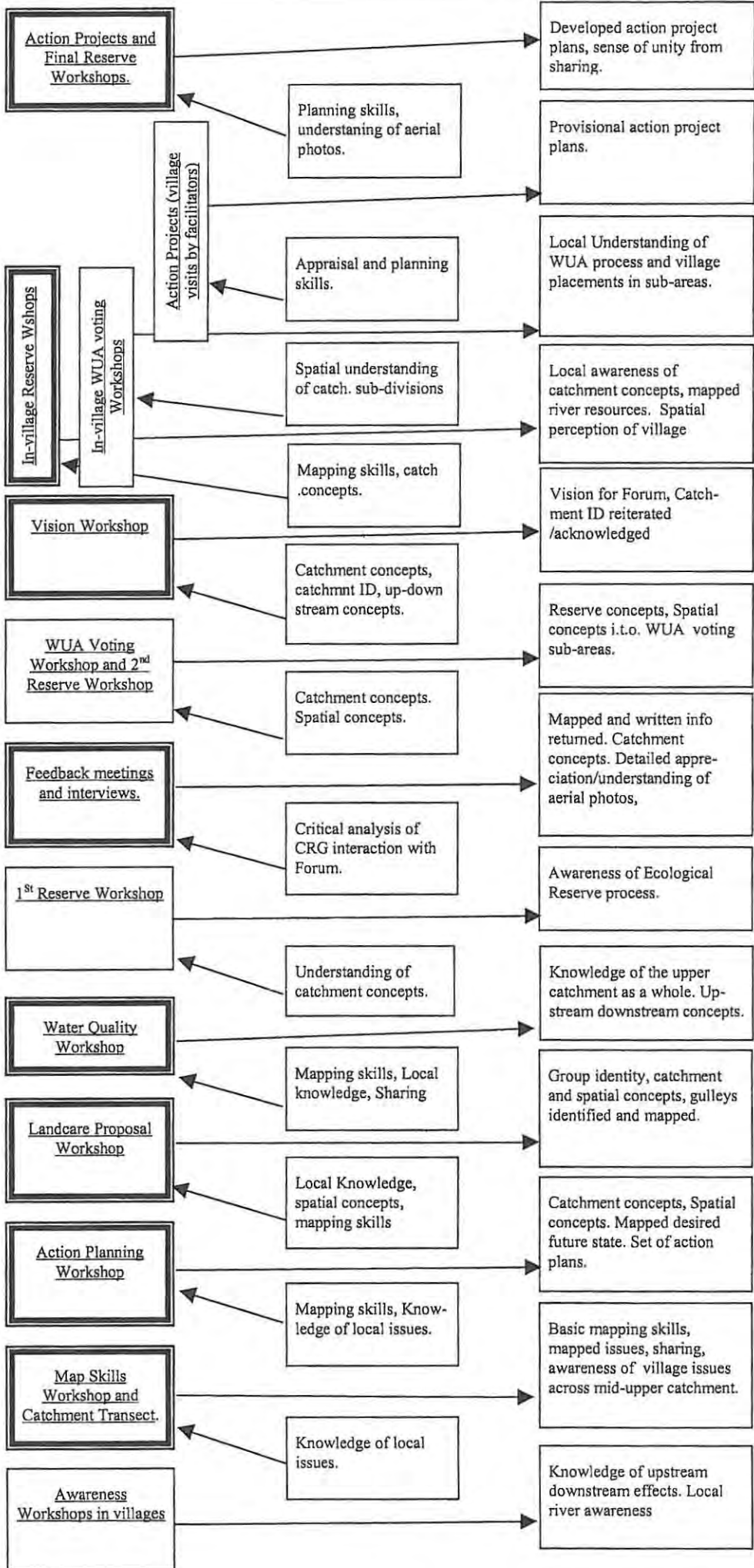
November 2001

September 2001

July 2001

December 2000

July 2000



Simultaneous GIS research process, with inputs to and outputs from each engagement – each input informed by previous engagements

Figure 10.2. A time-line of engagements with the CF, with associated inputs and outputs.

10.2 GIS and the development of the Catchment Forum: the development of mapping skills and spatial concepts for participation in catchment management

As was argued in the introductory chapter, one of the challenges in the development of the Catchment Forum has been to mobilise people to think in terms of the catchment – especially since the Forum is defined by this concept in the first place. Recall that the first objective of the research was:

To explore the potential for GIS to facilitate the development of mapping skills, an understanding of the Kat River catchment, and an understanding of catchment concepts in general, among the Catchment Forum.

Essential to thinking about a catchment is the concept of space as a surface (see Rowntree *et al*, 2000). In terms of ICM, the catchment surface¹⁸ represents the continuum, or spatial framework, within which processes in the catchment are integrated. Therefore to be able to understand many of the concepts in ICM, and to participate in ICM, some sort of knowledge of this spatial framework – the catchment as a space – is necessary. Indeed, for the Catchment Forum to achieve its potential, to see the catchment space, to see the whole, and to see how the components of the whole fit together, is most important. I reflected on this after the Action Planning workshop in July 2000:

Knowing spatial patterns within a whole can be so important. They give information about linkages between so many processes. Understanding a process at a broader scale provides knowledge of how it affects entities at the local scale. Therefore in order to deal with a local scale issue with any effect at all, one often *has* to deal with the problem as a whole. Knowing how different opportunities fit together and are arranged spatially in a catchment, villages can come together to optimise their use of a resource, or to exploit an opportunity that arises out of cooperation, out of sharing or from exploiting economies of scale. By the same token some threats can be mitigated or dealt with far more effectively if they are seen as a whole, and dealt with at the scale of that whole.

The unique potential of the Catchment Forum lies in the fact that it is a group of representatives from different parts of the whole, who together have the interests of the whole at heart, and who, through working together for that whole, are better enabled to facilitate the solution of local community problems.

It follows that one of the objectives of the research has been to use the GIS and maps to help people to picture, in terms of this two- and three-dimensional surface space, their local environment, the environment that is constituted by the villages of the upper Kat and, ultimately the catchment environment as a whole. In other words, it was to use the GIS and maps to see both their local and

¹⁸ The word surface is used here to describe the two- and three-dimensional space of the catchment. This includes both the concept of “above” or “below” (in terms of the elevation of the surface), as well as the concept of the surface being the layer of earth through which groundwater flows.

their catchment environment in terms of a whole. The value of the GIS and maps (as a *picture* of the environment) in helping people to see this whole was articulated by Burt (2001, p. 14):

Being able to see the bigger picture of our environment immediately opens our eyes to a different set of possibilities. We begin to see the links between our homestead and the river, the river and the mountains.

Once people start understanding their space, and start *thinking* in terms of this space, they are one step closer to thinking in terms of catchment and catchment management.

Have the Catchment Forum been enabled by the GIS and mapping process to see their environment, and in particular their catchment, spatially? One clue to the extent to which this has been achieved would be to consider participants' development in their ability to read and interpret the maps. Evidence of this development in ability will be discussed here with respect to the workshops and other engagements that took place from July 2000 to November 2001.

At the first and second workshops of July 2000, it was noted that although people appeared to be able to link the more obvious point and line features in the map such as roads, rivers, villages and dams to their equivalent in reality, the ability to see and interpret continuous data, or to interpret or infer additional information from the map, remained limited¹⁹. On reflection it was argued that participants had possibly been challenged initially with too big a picture (the catchment and sub-catchment scale), and too much of an abstraction from reality (the satellite image is poor in resolution and detail and therefore required more extensive interpretation at the local scale). It was resolved, therefore, that in future engagements with the Forum, members would be challenged with a smaller conceptual jump: they would work with maps based on aerial photographs. These would provide an almost exact picture of their reality from a birds-eye perspective, and the participants would only have to look at and think about their immediate community environment. As it turned out at the following workshop (the Landcare Proposal Workshop), many participants struggled to interpret even this representation of their reality. From this it was concluded that people do not necessarily have a natural capacity to interpret, *in detail*, their landscape from a birds-eye perspective at the first instance. However, despite this apparent lack of initial success, and bar certain other factors that came in to play at a later stage²⁰, this workshop and the use of aerial photograph maps appeared to have been the key to the subsequent development of the map-reading capacity of the Forum members. At the Water Quality workshop, the Hertzog representatives of the Forum took the lead in conducting comparatively detailed mapping, in which an ability to link their local knowledge of the landscape to the map representation was evidently advanced. This same

¹⁹ However, people could at least understand the maps to a certain level of detail. They could see up-stream and downstream along the network (because of their prior development of network concepts), and the spatial organisation of their villages with respect to this network. This in itself is empowering.

²⁰ Namely our meetings with forum participants in their villages, which involved in-depth appraisals of their local community maps in a small and personal context.

group later saw and corrected mistakes in the mapping from previous workshops, and one participant even demonstrated the ability to determine the topography of a landscape from the maps. In the Ecological Reserve workshops, the Catchment Forum representative in each village took the lead when it came to the mapping component, as observed by Burt (2001, pers com):

... The Catchment Forum members are far more engaged in that (map) exercise than anyone else, they obviously see the greater importance of doing it, and the importance of the map. And people are fascinated - I mean they are fascinated by looking at them. And what is nice is that the Catchment Forum representatives usually take over that exercise and start explaining to them what is what and things like that. I suppose it is the sort of thing that comes out in itself.

Furthermore, at least one representative (from the Seymour Reserve workshop) showed a highly developed ability not only to interpret both the local map and the satellite image, but also to place the local map in the catchment scale map and link their common features. At the Action Projects workshop, the majority of participants showed a clear understanding of, and confidence in working with, the aerial photographs of their communities. Based on the above evidence, it can be concluded that there has been a general development in the ability of the Forum as a whole to work with local scale maps, if not the catchment scale maps.

In addition to these observations regarding the development of map skills, during the feedback meetings in June 2001 many of the participants themselves have felt that they have come a long way in their ability to understand the maps. For some this includes the developed ability to understand the catchment scale satellite image based maps.

It was stated earlier in this section that it was possible that one of the reasons behind participants' struggles with mapping was that the satellite image was too challenging. However, this certainly does not mean that the satellite image based maps have not influenced participants' conception of the catchment at all. The participants have been exposed to, and dealt with the satellite image on numerous occasions. A3 versions, and later an A0 printout, of these maps have been present at almost every CRG engagement with the Catchment Forum. Indeed at the Vision workshop, and at all the Voting²¹ and Reserve Workshops they were used to introduce and contextualise some of the workshop activities. Furthermore, the satellite image has formed the background to the GIS-synthesised Issues maps and Action Planning workshop Outcomes maps, which have been distributed to every village. Finally, the satellite image of the catchment formed the context for the GIS displays at the Action Planning and Action Project Planning workshops.

²¹ See figure 11.2.

Although there is little evidence that the majority²² of participants have developed a *detailed* understanding of the satellite image-based maps, they certainly have *some* understanding – otherwise they would not have been able to conduct any mapping at all.

Perhaps the greatest contribution of these maps, together with other printouts such as the soil-erosion maps and the WUA voting maps, as a part of the overall GIS process, has been that they have facilitated greater spatial awareness of the catchment. For example the participants clearly know the placement of their villages within the catchment, as was evident at the Vision workshop, in which representatives went up to the A0 map and placed a label over the site of their village. Furthermore the map has facilitated an awareness of catchment identity in terms of what constitutes the catchment. For example participants know that their villages, as well as Fort Beaufort, and the farms south of Fort Beaufort along the road to Grahamstown are *in* the catchment, whereas the towns of Alice and Adelaide are *outside* the catchment. In addition to knowing that these towns, communities and farms are in the catchment, they know how they fit together with respect to each other, with respect to landuse, and with respect to the river, as was evident in a role-play regarding the Ecological Reserve at the Hogsback workshop (This role-play will be covered later in this chapter). In addition, and with respect to the satellite image in particular, among some of the participants there is an apparent awareness of the link between the environmental condition as indicated on the image, and that which can be observed in the landscape: in talking about an area in which there is extensive erosion, or a high density of houses, Forum members have been observed to have related these to the “pink” areas in the satellite image.

There remain, however, a proportion of participants who appear to have a minimal understanding of either the satellite based maps or the local scale aerial photograph based maps. This is despite the fact that some of these participants have gone through the maps with the personal attention of either myself or one of the more knowledgeable facilitators. This indicates that some participants have natural capacities to understand maps, while the same concepts come to others less easily²³. Indeed, within the group of facilitators, there is marked differentiation in abilities to read maps – ranging from one facilitator who has a detailed understanding of all the maps, to another who cannot interpret the map of his own community. This is despite the fact that they received equal attention in their skills development prior to workshops.

²² There is a minority of participant who appear to have a well developed understanding of the satellite images. Some of these stated clearly during the interviews in July 2001 that they could interpret the maps comfortably.

²³ Although, rather than “capacity”, the issue may be “reasons for accessing the maps”. Perhaps some people see no use in trying to interpret the maps. For others, the maps may be significant in that they are a record of the past (the idea of the maps as historical documents), or a record of the land that a person owns (or wants to own) (the importance, for some, of farm/erf boundaries and numbers on the maps).

In Chapter 7 it was noted that the processing power of the laptop computer that was used in the field was, unfortunately, not sufficient. This implied that a 3-Dimensional computer model of the catchment could not be used with the Forum. A physical model of the Ntshongweni Catchment was used to great effect among participants of the Ntshongweni Catchment Management Forum in Natal (Auerbach, 1997). Furthermore a Participatory 3-Dimensional Modelling technique (using GIS and physical models) has been used in the Philippines as part of Participation, Learning and Action processes (Rambaldi and Callosa, 2000). A three dimensional representation of a landscape is less abstract than a two dimensional representation. The use of 3-D modelling may have been an important stepping-stone in the development of participants' conception of the catchment as a whole. The use of 3-D GIS modelling in the context of GIS for Participation has much potential, and warrants further investigation.

10.2.1 Conclusion

This section has dealt with the first research objective, which relates to the potential for GIS to facilitate the development of mapping skills, an understanding of the Kat River Catchment, and a developed understanding of river catchment concepts.

Based on the evidence in this section, the majority of participants have further developed their mapping skills and understanding of the catchment. Although it was noted in the introductory chapter that GIS could facilitate an understanding of spatially extensive systems (Jones, 1997), it would be difficult to quantify the extent to which the development of mapping skills, and an awareness of the catchment through the GIS, has facilitated the development of catchment concepts, or of processes and linkages in the catchment. This is apart from the fact that during the feedback meeting and interviews, many of the participants expressed the view that the maps had helped them develop a picture of the catchment as a whole.

After a reasonably lengthy process of capacity building for participation in multi-stakeholder catchment management (which has included a variety of methods), in the whole some people have certainly developed understanding, skills and grasp of issues to an advanced degree, while a few remain lacking in these qualities. To an extent, this is to be expected. While some are advanced in terms of spatial concepts and the ability to see the bigger picture (including the catchment as a whole), others have qualities such as initiative, enthusiasm, integrity or leadership. The outcome is that there is a diversity of capacities and qualities which makes for a Forum that, as a unit, represents a group with the maturity and potential to carry into effect their vision for themselves and for the catchment.

10.3 GIS and maps as platforms

10.3.1 *Platforms for sharing and communicating*

The second objective of the research was:

To explore the potential for GIS to facilitate constructive communication and sharing among the Catchment Forum, and between the Catchment Forum and other stakeholders.

Part of the vision that the Catchment Forum has for itself is that it should promote sharing for both its members and the communities that they represent. Much sharing has taken place over the past year and a half. Perhaps the value of sharing was embraced and lived out most explicitly at the Action Projects workshop at Hogsback in November 2001. Here, the Forum members shared their problems, their suggestions, their experiences, their intentions and their success stories in an unprecedented way. Throughout the research process there have been opportunities for GIS to promote sharing in this way. In some cases these opportunities have been followed through with success, in other cases, further light has been thrown onto the potential role of that GIS can play in this area. The GIS can be seen as having provided various types of platforms for sharing. These will be discussed in the next three sections.

10.3.1.1 **The maps of synthesised issues and outcomes as platforms for sharing**

By means of the GIS, the diverse information that was mapped for local villages at the workshops of July 2000 was synthesised onto catchment scale maps. Through these maps, Forum members were not only presented back with what they had mapped, but also with what all the other members had mapped. This meant that, at a glance, each participant could see what all the issues, plans and concerns were in any of the villages. Moreover, by participants having mapped these issues with reference to a geometrically correct background, information could be represented such as where issues or planned actions were in relation to a village in question, how extensive an issue was (such as the extent of soil erosion), how each issue or plan related to other issues or plans, how they related to other features such as the rivers, how they related to other villages, and how they related to the catchment as a whole.

The recording of issues and plans on the maps has added a new dimension to verbal sharing. For example following the 12th July 2000 bus transect through the catchment, the subsequent production of the map of the village issues reinforced the sharing that took place in each village, serving as a reminder of the experience in that village on the day. The map also linked the individual village stories into the bigger picture of the catchment.

By recording issues, needs and plans on a map, a platform for sharing with outsiders is also provided: by looking at a map, an outsider can immediately get a picture of the needs in a local village, or of the overall needs in the catchment. In this sense there is the strong potential for GIS

and mapping to be a link between local communities and government or outside agencies²⁴. Although having said that maps of local information could promote sharing with outsiders, it should be noted that these should form a component of a more complete process of sharing. A map or GIS cannot represent a complete picture of social and biophysical conditions. The consideration of spatially related information in isolation of other sources of information will result in an incomplete picture and the formation of incorrect assumptions.

10.3.1.2 GIS and maps as a medium for communication and discussion

One of the challenges in communicating ideas, especially with respect to catchment management, is in conveying to other listeners the picture that is held in one's mind. Simply using words to convey ideas can be limiting, or can result in misinterpretation on the part of the listener. In participatory practice, and especially in PRA, visual methods are strongly promoted as mediums, or platforms, for discussion and sharing (Chambers, 1992; Mukherjee, 1993; Chambers, 1994b). Visual methods provide, in a sense, a shared image of what is in the speaker's mind, or they allow the speaker to convey abstract concepts, which, for many people, can be difficult to describe by verbal means (Pretty *et al.*, 1995). Examples of these visual methods or media include models, diagrams, images and maps.

The value of maps, or spatial representation of information, as a means of facilitating sharing has been demonstrated on numerous occasions throughout the Forum process. For example in the Action Planning workshop, the maps facilitated group development of plans. At the same workshop, the use of on-screen GIS helped in the explanation of the concept of future desired state and the importance of considering the local in terms of the whole. At the Water Quality workshop maps facilitated sharing among the different villages around pollution sources. During the feedback and interviews in June 2001, the maps formed the basis for numerous discussions between myself and Forum and other community members about the villages. In the Ecological Reserve workshops in each village, the maps formed the platform for discussions about changes in river condition in terms of resources. But the occasion where the most considerable sharing took place with the aide of GIS and maps was at the Action Projects workshop in November 2001. For some groups, maps were the basis on which problems were explained and alternative solutions worked out and argued at new levels of detail. For most people the GIS projected onto a screen formed the focus around which projects were presented back to the Forum, questions were asked, and suggestions made. As noted in the previous chapter,

²⁴ It is often the case that "grassroots" and outsiders talk at cross-purposes. At what point do DWAF engineers and local communities engage? There is scope for the map to be one of the common languages through which both stakeholders "speak". This is especially the case with the Catchment Forum since many of them have been enabled to do so. This will be discussed further as part of a consideration about appropriate technology.

even when the presenter did not refer to the screen at all, most of the audience was studying the image as if trying to picture, in the landscape, the project that the participant was talking about.

10.3.1.3 GIS and mapping as a platform for consensus building

The Catchment Forum represents a grouping of people with a common interest: the catchment. As has been mentioned previously, such a grouping of people, with the health of the catchment as a *whole* at heart, opens up a number of opportunities for action that could not necessarily be realised by people representing, and thinking and operating at, a more local scale. However, a counterpoint to the advantages to such a grouping is the fact that diversities of needs, interests and perspectives have to be taken into account, adding complexity to group functioning. The first step in developing consensus among diversities of stakeholders is to identify common needs: common needs form the foundation on which a group can operate harmoniously (Rogers *et al*, 2000).

The GIS synthesis of locally mapped information has provided a useful means of identifying common needs in the catchment. For example the outcomes map of the July 2000 Action Planning workshop (Figure 7.4) shows that a desire or need (for different reasons) common to all stakeholders in the Forum is the cultivation of fallow or previously undeveloped land. Common needs among the communities of the catchment north of Fort Beaufort include soil erosion control, the control of alien vegetation, repaired bridges, the need for treated water and toilets.

The identification of erosion control as a common need in the catchment led to the development of the Landcare Focussed Investments proposal. As discussed in Chapter 8, it was at this workshop that, for the first time, the Forum worked together with outcomes in mind that related to the catchment scale, as opposed to the local village scale. It was coincidental that one of the project funding requirements was that implementation and cooperation should take place on a watershed, or catchment, basis.

Identifying common needs is the first step to reaching group consensus in terms of purpose and action. As was argued in Chapters 7 and 8, much potential lies with the use of GIS as platform for *group* negotiation and development of plans which are optimised at the catchment scale. In particular, GIS could form a platform around which negotiations for cost sharing in the implementation of on-ground works could take place in order to maximise efficiency and accrual of benefits across the catchment.

10.3.1.4 Conclusion

The preceding four sections have dealt with the second research objective, which relates to the potential of GIS to facilitate sharing. In these sections it has been shown that GIS *has* facilitated sharing. This has been achieved through providing a synthesis of separately mapped issues and plans and through providing a medium for communication and discussion. Furthermore, the GIS has provided a means of identifying common needs for consensus building. Finally it has been noted that

the GIS has much potential for the facilitation of multi-stakeholder negotiations.

10.3.2 The building of conceptual and skills platforms through GIS and mapping

The remainder of this chapter does not deal directly with the research objectives. However, numerous outcomes have emerged from the research process, which relate to the overall research aim. This section details outcomes in terms of the development of the Forum capacity. The remaining sections are discussions, based on lessons from the research experience, which deal with aspects of the GIS and Society and PPGIS debate, and with conceptions about GIS and participation.

The development path of the Catchment Forum has involved the building of products, skills or conceptual foundations based on which participants have been enabled to become involved in more advanced activities, or based on which more advanced concepts can be developed. In other words the GIS has provided a series of platforms in the Catchment Forum journey. At the November 2001 workshop it was reflected that the GIS and mapping was once new (in that it was a challenge to the Forum in its own right), and yet now it plays a supporting role to the challenges of the Action Project planning. In turn, the skills developed by the Forum participants in the Action Project planning will contribute to subsequent action involving a new level of sophistication. In other words one concept or skill becomes the platform on which the next is built (Burt and McMaster, 2001).

There are a number of examples where the GIS formed a platform for later engagements. The Map Awareness and Mapping Skills workshop of July 2000 formed the platform for the map-based Action Planning later that month. The mapped and digitised action plans provided a starting point for the mapping of erosion at the Landcare workshop, and for the development of Action Projects in October and November 2001. And the use of maps based on aerial photographs at the Landcare workshop, even though participants appeared to struggle here, formed the platform for the successful use of the same maps at the Water Quality workshop, the Reserve Workshops, and the Action Projects workshop.

The above are product or skills related platforms. It is felt that the development of a spatial awareness of the catchment, as well as the concept of a holistic approach to dealing with problems in the catchment, has also provided a platform for more sophisticated actions. For example the development of a vision at the 2001 Vision Workshop required, as a foundation, such thinking. A second example is the final Reserve Workshop in November 2001, where an understanding of the concept of upstream-downstream effects, as well as a spatial (surface) understanding of the different landuses in the catchment as they relate to the river and the Kat dam, enabled some participants to successfully enter into a role-play around negotiations for the determination of River Management classes. At one point, the participants in the role-play argued strongly for a management class that would ensure adequate flow in the lower reaches of the river where it flows through a reserve. In negotiating for a sequence of classes down the river, the Forum members demonstrated thinking that went beyond the needs of their immediate community. Rather, a conception of the river and the

catchment as a whole was demonstrated.

In Chapter 7 it was noted that the individual capacity of participants, as well as the level of group maturity at the time, precluded them from entering into sophisticated negotiations surrounding cost sharing at a catchment scale should this be required. It is felt that, since that time, the development of the Forum in terms of spatial and other concepts and required skills has reached the level where the group members can hold their own in, and contribute constructively to, such negotiations.

10.4 GIS for Participation and the role of the outsider, and considerations surrounding appropriate technology

Much has been learned about the role of the outside GIS practitioner in capacity building processes. What will be discussed in the next sections relates to both the GIS and Society and PPGIS debate, and to the principles of PRA and Action Learning.

Recall that Miller (1995, p. 100) calls for "...GIS practitioners and theorists (who) should not be merely technical functionaries, but cognizant, socially aware actors." Some of the issues that these practitioners should focus on are the limits inherent to GIS structure because of Boolean logic on which it is based, the biases inherent in data that is used, and the power of the practitioner in working with and presenting data. These issues will form themes throughout the next few sections. But perhaps in terms of GIS for Participation, the theme that comes through most strongly is the responsibility of the GIS practitioner to integrate the GIS into a broader people-development framework.

10.4.1.1 Presenting locally mapped information through GIS

In working with the data generated by the community representatives, certain difficulties have been experienced in incorporating the local data into the GIS. One of the difficulties relates to the standardisation of diverse meanings. For example, in GIS database management it is useful to store common features as part of a single layer. However, when thirty-two people map similar issues in thirty-two different ways, to preserve the meaning of each would require the storage of each person's variation as a unique data file. This can be problematic in database management. Suppose that each participant maps at least five different issues. This means that a GIS synthesis of the mapped data will contain a minimum of 160 layers or themes. The management, use and presentation of this number of themes would be cumbersome and decidedly time consuming. However by choosing the alternative, which would be to merge similar data into single themes, and the attribute information into single categories (as has been done in this research project), there is the danger that the richness of diverse information will be lost, or that the meaning attributable to that mapped piece of information will be subtly altered. A case in point is the information from the Action Planning workshop that has been grouped under the theme "cultivate/develop agricultural

land" (Figure 7.4). Although this theme represents on the map a single meaning, there were as many different issues behind, and intentions in, mapping this "future state" as there were groups. Some wanted simply to improve existing utilisation of fields, some wanted to start small subsistence gardens, some had issues regarding ownership of or access to fields, while the farmers of the lower Kat had the economic interest of the Kat at heart, in which comparatively large injections of capital would be required for intensive citrus farming.

From the feedback and interview meetings in June 2001, it is apparent that the participants were satisfied with the way their information had been converted, to an extent standardised, and synthesised into a single map. Nevertheless, in terms of the GIS and Society debate an important lesson has been learned. Rundstrom (1995) warns that the "standardised" GIS representation of reality may marginalise other diverse ways of knowing and representing the world. The above issues surrounding the translation of locally mapped information to digital format requires a sensitive balancing act on the part of the practitioner, as well as honesty about meanings that may have been subtly changed in order to ensure that the richness of information within and between communities is not lost. In the next section, the complementarities between GIS and other representations of community information will be discussed.

10.4.1.2 Limits to the inclusion of social data in GIS and the role of the practitioner

Many authors including Harris *et al* (1995), Miller (1995), Sheppard (1995) and Weiner *et al* (1995) see a major constraint in the more equitable use of GIS in society in that its structure limits its ability to deal with qualitative information. This concern is certainly valid. It is important, however, to differentiate between the *limits* of the tool, and the inequitable *use* of the tool (Taylor and Johnston, 1995). Although the limits of GIS may exacerbate the inequitable use of the tool, the solution is not necessarily to focus only on the shortcomings of the GIS. What is needed, and what is generally being aspired towards, is a simple change in attitude towards, and use of, GIS by decision-makers. In GIS for Participation it should not necessarily be a problem if GIS cannot incorporate most social information into its structure: there are other tools by means of which social data can be accounted for and social situations reflected. As is corroborated by Barndt (1998), what counts is that GIS should form a part of a more complete participatory process; GIS on its own is unlikely to embody a process of people-development or empowerment. Just like all tools in participatory practice, GIS should form part of a menu of methods and solutions that are ancillary to a much broader, holistic participatory, capacity building, or people-development framework.

With respect to the above, some of the lessons learned in terms of the development of the Catchment Forum have highlighted the crucial role of the GIS operator. Perhaps most importantly, far more than simply being a technician running a PPGIS, the person operating the GIS should take on the full responsibilities of being a *participatory* practitioner. What has come to be realised in the course of this research, as was argued at the beginning of this chapter, is that what has counted more

than anything else has been the development of the Catchment Forum. Any other processes, tools or methods have been in the context of this development process, and have effectively been accessory to that process. It follows that the agenda for developing the GIS process or method for participation, or a database of locally generated information, should not have subverted the process of empowering the participants in the first place. The lesson is that running a GIS for Participation cannot take place in isolation of the people-development framework to which it contributes. With respect to the practitioner, this requires a cognizance of, and sensitivity to, the issues and circumstances surrounding the people-development process, so that GIS related methods are brought in at the right time and in the right way so as to maximise its contribution to the empowerment process.

10.4.1.3 The principles of participation

Using the GIS in “the right way” in the context of a participatory process implies applying the principles of participation. In terms of the Catchment Forum process, this has involved PRA principles in particular. With respect to the GIS process in the Kat the PRA principles that have come into play to the greatest extent include “listening and learning, and learning through participation”, “self-critical awareness and responsibility”, and “facilitation and sharing” (Chambers, 1992; Mukherjee, 1993). These will be discussed in the next sections.

10.4.1.3.1 Listening and learning.

At the feedback and interview meeting at Tidbury Toll, the importance of being aware of issues surrounding what was mapped was driven home for me as the GIS operator – to the extent that I realised the importance of actually conducting the mapping, *together* with that community, *in* that community. In other words it was realised how crucial it was, as the GIS operator, to “listen and learn”, and by mapping *with* the participants, to “learn through participation”.

10.4.1.3.2 Facilitation and ownership.

Facilitation involves promoting investigation, analysis and learning *by* the local people, with minimum influence by the outsider, so that outcomes are *owned* by that community (Chambers 1992; Mukherjee, 1993). One of the important principles in the Catchment Forum development process has been not to unnecessarily lecture to the Forum – not to tell them what *their* catchment looks like, what the fundamental catchment processes are, or what catchment management principles are. Rather, the object has been, *through* their working with maps, the synthesised product, and interacting with the GIS, to have conducted their own investigation into, and learning about, their local and catchment environment. As was written by Oscar Wilde, “nothing that is worth knowing can be taught” (1890, p. 349). It is based on this thinking that Action Learning has come into play to such an extent in the Catchment Forum process. As the GIS operator within this process, the idea has not been simply to use the GIS at will, but rather to use it in a way that maximises the

empowerment of the Forum; namely by using it as a tool or medium to facilitate learning by the participants. It is in this arena that critical awareness comes into play: if the GIS is going to be used to maximise learning, it must be used in a fashion that is appropriate to the capacities and needs of the group.

As can be gathered, the use of GIS to facilitate learning, as detailed above, in turn facilitates participant ownership of their own capacity building. There are two other aspects to ownership surrounding the GIS and mapping process for the Catchment Forum. These are ownership of the mapped product, and ownership of the actual GIS process.

In conventional participatory mapping, the product (be this a model on the ground, a mental map on a wall, or delineations and writing on paper) would be left with the community. It was their appraisal process, for their own empowerment, and therefore their product. One of the difficulties of synthesising individually mapped local information into a catchment scale product, however, is that the maps produced by the participants have to be taken away to be digitised. To offset this, as the GIS operator I have endeavoured to return the synthesised product to participants as effectively as possible. This has included presenting back the digital product on-screen; returning numerous black-and-white photocopied versions of the action plans together with their outcomes tables, and the results of the Landcare erosion mapping; returning Laminated A3 colour printouts of the action plans at both a local scale and catchment scale; as well as a booklet of maps and linked information as compilation of the most important mapped information generated by the Forum. This arrangement appears to have been satisfactory with the Catchment Forum. In the feedback meetings of June, the participants did not mind the fact that their mapped information was being taken away, especially since it was being returned to them at a later stage.

Returning the mapped product to the participants can be seen as reinforcing their ownership of not only their learning process and the mapping process, but also of the initiative they have taken. These have been *their* action plans – the participants have owned the planning process, they own the written and mapped plans, and consequently they should feel a sense of ownership of any resultant on-ground works, should these take place. Indeed owning the initiative in many cases implies taking the initiative. Such initiative was demonstrated by the Seymour participants of the Forum, who took complete ownership of, and followed through with, a catchment management related action that had been planned at the Action Planning workshop²⁵.

²⁵ At the Action Planning workshop (June 2000) the Seymour participants had planned a river clean-up campaign in their village. In November 2001 (subsequent to the in-village Reserve Workshop) these participants carried through with the plan. The campaign was remarkable successful: 500 community members participated, a partnership was forged with the municipality, food was provided by sponsors, local dignitaries attended, and many presentations and speeches were made. Organisation of the campaign was conducted completely independently from the CRG; members of the CRG, and other members of the Forum, were simply

In addition to the value of returning the product to the participants to reinforce ownership, it is evident that such a gesture is important to the communities in that it shows that the outsider has a long term interest in the group, and values their input. This was reflected by Julia Kolanoski (2001), a researcher from Germany who spent a number of months observing the CRG activities in the Kat River Valley:

... As it seemed, to some people this information is certainly very valuable. But my impression was that most importantly, especially to those not reading the maps, were not the maps themselves, (but) rather the fact that Alistair returned to their village, brought back their information, showed continuing interest for their problems and needs. This seems to be very important because there were complaints about a lot of people coming to their villages with big promises to help and bring about change, but that they never came back and never anything happened.

The final dimension to ownership, GIS for empowerment and the role of the GIS operator as it will be dealt with here, is the ownership of GIS process. It was argued above that a GIS for empowerment should facilitate ownership of the learning process by the participants. In some ways this counters the traditional expert-local (or indigenous) relationship, in which expert knowledge is considered to be superior to local knowledge. With regards to PRA, Chambers (1994a, p. 1438) argues for a turn-around in attitude on the part of the outside expert:

For local people confidently and capably to express their own knowledge, to conduct their own analysis, and to assert their own priorities, outsiders have to step of their pedestals, sit down, "hand over the stick", and listen and learn.

In the development of the Catchment Forum an important consideration has been the degree to which ownership of the GIS process should be extended to participants. Since the process exists, more than anything else, to build their capacity, it is important to seek input and feedback from the participants about the nature of the process, and in particular their perceptions about the role of the GIS operator²⁶. Ms Kolanoski (2001) wrote that:

It was a very positive experience for me to (see them) actually go and ask for feedback. To offer the people the opportunity to comment on and criticise the maps, the mapping process, the workshops, the way that Alistair and the team have worked with them so far... . One thing is, that this way of communication and valuation of people's perception, bring all involved people on a more equal ground, moving away from a scientist expert who knows things best... .

However, apart from providing feedback on the GIS process and the role of the operator, there is a limit to the extent to which the participants can own the GIS process. There is a technical side to GIS which means that the tool cannot simply be handed over in its entirety to the participants to

invited to attend the campaign as guests. Furthermore, much of the organisation was conducted at the members' own expense.

²⁶ Although local participants cannot be expected to contribute to the more technical issues involved in the GIS process, there certainly is scope for them to comment on areas that affect them directly. This includes, especially, the way that the outsiders interact with the forum.

conduct their own appraisal and learning at this stage of their skills development. What the GIS practitioner *can* hand over is a means of learning. In this context, the “stick” is the *learning process*, for which the GIS has been a resource, and not necessarily the GIS itself. Again, this highlights the crucial role of the GIS operator as being the participatory practitioner, or in this case, the facilitator of learning. Knowing how much of, and in what form, the GIS and mapping process should be handed over, requires critical awareness and judgement on the part of the practitioner.

Having said that GIS as a technology can only be partially handed over to the community representatives, access to the technology, even if to limited extent, appears to be highly valued, as observed by Burt (2001):

Although knowledge of maps was gained, I feel that the main success of this project is the access to power that was handed over in the form of GIS maps. No matter what meeting is called in the catchment, Catchment Forum representatives come to the meeting with their maps. It has become a symbol of acceptance into a world that has hidden behind the supposed inaccessible tools of the expert scientist

Rather than seeing their limited access to the GIS process as inequitable or a form of marginalisation, the participants see this simply as the necessary condition of a local knowledge - expert knowledge partnership. Indeed they see this partnership as an opportunity, and if this opportunity is a means of empowerment (especially in terms of participation in structures beyond their local community) they will embrace this. The word partnership, however, implies trust. There is trust on the part of the participants that the GIS practitioner will remain committed, has their interests at heart, will not misrepresent them, and will not misuse their information. On the part of the GIS practitioner, there is the responsibility to uphold this trust.

10.4.2 GIS for Participation as it relates to appropriate technology

The discussion above incorporates thinking around appropriate technology. This will be dealt with explicitly here.

It can be argued that GIS as a tool for rural appraisal is inappropriate to the capacities of rural people and that more effective appraisal can take place by doing the traditional PRA mapping using sticks and stones and seeds on the ground. This raises the question: why should rural people not be challenged? By working *within* the capacities of people, practitioners are making negative assumptions about people’s capacity to grow.

Indeed, as mentioned above, the challenge of GIS was welcomed: it was seen as a means of access to power in one form or another. In terms of catchment management, it has been the handing over of power to engage with the technologies and the language of the water sector. If it is empowering, it is appropriate. What counts, however, is *how* the technology is handed over. This again illustrates how inseparable responsible participatory practice is from the operation of a GIS for Participation. In the case of the Catchment Forum, the handover has taken the form of a careful

partnership, the nature of which evolved along with the developing capacity of the Forum, until more and more of the tool could be handed over. On the part of the CRG, this has implied a long-term commitment. What would be inappropriate would have been to hand over the GIS as a quick fix. An ambition has been to eventually hand over the tool to the Forum in its entirety. Based on the support of the Catchment Forum, a project proposal was submitted in November 2001 to the South African Foundation for Education, Science and Technology (FEST) for the transfer, in 2002, of the GIS to an office in the catchment, to be run (after appropriate training) by the Forum members, with support from Rhodes University. Unfortunately funding has been withheld, pending further availability on the part of FEST.

It was mentioned above that handing over the technology is a way of handing over power. This includes handing to people the power to deal with their own circumstances. No longer should the tool be used by remote decision-makers to determine the rural people's fate. The consequences of the means of decision-making not having been handed over in the Kat River Valley was insightfully assessed by Kolanoski (2001, P. 1):

.... I perceived some of the people being really reluctant to put any effort into the land in order to make a better living out of it. Looking at the land lying fallow and listening to the people, gave me a strong impression of resignation among the villagers and that there is a little trust in themselves as being able to bring any long lasting change in their lives about by themselves. A reason for this may certainly be the ever changing political circumstances and the extremely high insecurity of access and rights to land, lack of political power..., *but also being exposed to (i.e. being subject to) decisions being made by outsiders* on land redistribution, distribution of financial resources, betterment schemes etc - all having a very strong impact on their living (own italics).

By slowly handing over the GIS, a platform has been (and possibly still is being) built. Based on this platform, local people are challenged to take their circumstances into their own hands.

It may be argued that the use of GIS itself was not necessary for empowerment. Abbot *et al* (1998) point out that participatory mapping (or in their case participatory resource mapping) without the use of GIS can be equally effective, but without the complications attendant to a complex technology. This argument may be true for local appraisals where PRA has been applied traditionally. But the counter argument is that the Catchment Forum process has not involved PRA in its traditional local sense. This has been an appraisal and empowerment process in the context of a catchment, at a scale which goes far beyond the local, but which has nevertheless been based on the principles and methods of PRA. For this type of appraisal and empowerment, GIS has certainly been useful.

The greater part of the case study was a form of PRA style participatory mapping for sharing, analysis and planning at the local scale, where the use of GIS was not necessarily essential. Where GIS *was* essential, however, was in its ability to manage and integrate the information generated at the local scale to allow the scaling up of this sharing, analysis and planning to the level of the catchment

(McMaster *et al* 2001, p. 4).

In addition there are numerous other instances where GIS has facilitated more effective participatory mapping or sharing. For example maps customised to the dimensions of the catchment, and which incorporate a unique combination of spatial data, have been generated by means of the GIS. Through the GIS, georeferenced aerial photographs that are more up to date, and that are at a more appropriate scale (in terms of local maps) than currently available orthophoto maps, have been created. At sessions in which a spatial representation of the landscape or catchment has facilitated sharing, the interactive use of on-screen GIS has promoted a type of sharing that could not be achieved with hardcopy maps. Lastly, the GIS has allowed locally mapped information to be represented in a “standardised” format which can be easily accessed by outside decision-makers, and in so doing may facilitate appropriate consideration of needs and issues by the decision-makers, or may attract partnerships for further action.

10.5 Reflection on the overall research process

This section considers the research process in terms of its limits and strengths, its nature with respect to the principles of Action Research, and the changes that have resulted.

10.5.1 Constraints and Weaknesses:

- ③ The high costs of technology have limited the acquisition of high-resolution digital satellite imagery, up-to-date digital orthophotographs, and a laptop computer with the processing power to work with 3-dimensional models.
- ③ An overarching set of guiding questions may have contributed to more comprehensive reflections.
- ③ The workshop participants were not given the opportunity to formally give feedback after *each* workshop. Although there was not time during workshops for feedback or reflection, participants may have been invited to give feedback or reflections informally.
- ③ In many cases, particularly in the earlier stages of the research, formal reflection with workshop facilitators did not take place.
- ③ The developed mapping skills of the facilitators were not sufficiently evaluated. The fact that some facilitators remained weak in terms of spatial thinking was only discovered towards the end of the research process.
- ③ Assumptions were made about the capacities of Forum participants to engage with spatial concepts. As a result not enough attention was paid to the initial development of mapping skills before map based planning took place. However, it was argued in earlier chapters that the greatest learning takes place around action. Through the *process*, spatial concepts *have* eventually developed.

10.5.2 Opportunities and strengths:

- ③ The effectiveness of the research process was enhanced by the fact that it took place within existing structures. At the outset of the research the groundwork for the establishment of the Forum had been achieved through the work of the Kat Valley Project.
- ③ The study took place in a context that was conducive for Action Research; much of the overall Forum capacity building took place in an Action Research framework. In addition, much of my thinking around the GIS research process was influenced and guided by other members of the CRG who work within the context of Critical Research.
- ③ Much cost sharing took place between the GIS research and other research endeavours related to the Kat River Valley and the Catchment Forum. For example there was complementarity between the GIS research and: the Kat River Valley Project; a PhD study of community-based erosion control; a Masters level study of water quality in the Kat; and research regarding community participation in the determination of the Ecological Reserve for the river.

It is important to consider whether this project has applied Action Research and the principles of Critical Science. Recall that Action Research is a continuous cycle of planning, action and review of the action, where there are both action outcomes, and outcomes in terms of research (McTaggart, 1997; Cherry, 1999; Dick, 2000a). Influenced by the above opportunities, the research has constituted an interactive and parallel process of learning and development in thinking, and responsive evolution of practice, in terms of GIS for Participation. This has led to developed knowledge, and to change in terms of capacity and skills for both the Catchment Forum members, and myself, the researcher.

10.5.3 Learning through participation

In Chapter 3 it was noted that "...the process of doing research and the learning of the research participants are what most closely relate to change and development. Critical science is about change and development" (Janse van Rensburg, as quoted in Burt, 1999, p.107).

An important change has related to research philosophy. Through learning based on the research experience, I replaced a positivist approach with a critical approach, in which Action Research was applied. As such, my approach changed to become congruent with the research context.

It has been stated that the GIS for Participation has taken the form of a partnership. A partnership is a two-way process. In my role as researcher and practitioner, I have been a learner. I have grown immeasurably from the experience provided by the Catchment Forum and the process that they have been central to. Many of the insights gained from the process are reflected in this thesis. Apart from developed insights into participation, GIS and catchment management, I have been empowered by a deeper understanding of the challenges and the potentials that face South Africans in the context of

rural environments.

10.6 Conclusion

This chapter has drawn together some of the common themes that have emerged from the eight research cycles that have been documented in this thesis. In particular, the extent to which the research aim has been achieved in terms of the development of spatial concepts, and in terms of sharing, among the Forum, has been considered.

It has been argued that through the GIS process, the majority of Catchment Forum members have developed (to varying extents) map related skills and the ability to consider their local environment, and the catchment *as a whole*, from a spatial perspective. For some participants, these skills and conceptions have reached sophisticated levels. Furthermore it is argued that these skills, together with participants' understanding of the catchment from a spatial perspective, provide a conceptual platform for effective participation in water resources management activities such as the determination of management classes for the Ecological Reserve, or in negotiations related to multi-stakeholder Catchment Management (should these take place).

The GIS has facilitated sharing among the Catchment Forum. In so doing, it has contributed to the development of the identity of the Forum and to an enhanced awareness of threats and opportunities in the catchment, while it has further enabled the Forum to approach problems effectively (through a sharing of ideas and solutions).

The research process has yielded lessons regarding the GIS and Society and PPGIS debates. The difficulties of representing locally generated spatial information in GIS format have been highlighted. It is also argued that if GIS is to be used for capacity building, then it should form a part of an overarching people development process. Hence the use of the term "GIS for Participation", as opposed to "Participatory GIS". As a result of such an approach, the limits to the inclusion of some forms of data in GIS are balanced by the opportunities provided by the menu of other methods available in the *broader* capacity building or empowerment process. What is crucial, however, is that if the GIS is to be used effectively as a tool within a people development process, the GIS operator should work according to the principles of participation. Essentially, the GIS operator should become a participatory practitioner.

Although GIS is a sophisticated technology, its use among the Catchment Forum has represented a handing over of power in order that decision-making processes and initiatives are owned locally. In addition, the technology has allowed the scaling up of local appraisals and planning to the level of the catchment. Appraisal and planning at the catchment scale would not necessarily have been possible if more traditional PRA methods had been used.

The final section in this chapter has provided an assessment of the research process. The opportunities and constraints that have influenced the research process have been listed.

11 CONCLUSION.

This chapter will provide a picture of the overarching GIS research cycle (Figure 1.3). It will include the initial approach to the research, the research “actions” taken, and the overall reflections on that research.

11.1 A review of the context, aims and objectives

The GIS and Society debate considers the impact, on society, of the use of GIS. A central argument in the debate is that GIS, as it has traditionally been used, entrenches unequal relations of power (especially in relation to capitalism and the State). Public Participation GIS is an outgrowth of the GIS and Society debate. PPGIS has generally focussed on facilitating stakeholder access to GIS processes in order to allow participation in decision-making. Some practitioners have proposed, however, that rather than “participatory GIS”, emphasis should be placed on the use of GIS as a tool within participatory processes – “GIS for Participatory Research” (Abbot *et al*, 1998)

This thesis has documented a research process that has explored the potential contribution of GIS to the Kat River Valley Catchment Forum capacity building process.

The National Water Act of South Africa recognizes the need for grassroots participation in water management (Republic of South Africa, 1998). The mechanism through which DWAF envisages such participation is the formation of catchment forums (DWAF, 1999). However, catchment forums cannot be expected to participate in water management unless their members have the capacity to do so. It follows that the Kat River Valley Catchment Forum capacity building process has aimed to enable members to participate in, and own, catchment and local environmental management initiatives. Consequently the aim of the GIS research has been:

To explore the potential of GIS to facilitate the empowerment of catchment forums to better participate in catchment and local environmental management.

Catchment Management involves the sustainable use of water resources through the integrated management of social and environmental systems (Gorgens *et al*, 1997). In other words, catchments should be managed holistically. This means that for participants to engage in catchment management, they must be able to conceive of the catchment as a whole. Since many social and environmental processes form a continuum across the surface of the catchment, a conception of the catchment as a two- and three-dimensional space, and knowledge of the character of this space, is necessary for such holistic thinking. Since GIS is a tool for the capture, management, manipulation, analysis and display of spatial information (World Bank, 1993), there is the potential for GIS to contribute to the development in sophistication of spatial thinking, with respect to catchment management, among Forum participants. An exploration of this potential has formed one of the objectives of the research. As a formal statement:

To explore the potential for GIS to facilitate the development of mapping skills, an understanding of the Kat River catchment, and an understanding of catchment concepts in general, among the Catchment Forum.

Participatory catchment management implies the need to share and communicate. The second objective of the research has been:

To explore the potential for GIS to facilitate constructive communication and sharing among the Catchment Forum, and between the Catchment Forum and other stakeholders.

The “GIS for Participation” research process.

The above explorations have taken place in the context of Action Research, situated in the Critical paradigm. Action Research consists of cycles of action and reflection, where the actions should inform understanding, and enhanced understanding should assist action, while some sort of social outcome *should* take place (McTaggart, 1997; Cherry, 1999; Dick, 2000a). In this research, eight cycles, or engagements, taking the form of workshops and meetings, have taken place. Through these engagements, Forum participants:

- ③ Were introduced to mapping concepts;
- ③ Have mapped village scale issues and opportunities, action plans, erosion gulleys that most affect villages, potential sources of pollution affecting their river, and past and present resources as indicators of changes in river condition;
- ③ Have been presented back with the spatial information that they had generated, synthesized and displayed by means of GIS, either on-screen or in hardcopy format;
- ③ Have, in small groups, together with myself and a facilitator, conducted in-depth appraisals of aerial photograph based maps of their community, in that community;
- ③ With a map of the catchment as a context, developed a vision for themselves and for the catchment;
- ③ Used maps in group work to explain local village situations, and to develop alternative solutions, and;
- ③ With a GIS display as a medium, effectively presented to the rest of the Forum, plans for Action Projects in their villages.

Each engagement has led to a deeper understanding of how GIS can contribute to empowerment processes in general, and to the empowerment of catchment forums in particular. Some of the

engagements have yielded lessons regarding the capacities of Forum participants to engage with spatial concepts, and consequently, have informed the appropriate use of GIS for such capacity building. Most of the lessons from each engagement have informed the approaches to subsequent engagements. Some of the engagements have simply provided evidence for reflection on the issues and opportunities created by GIS in capacity building. Finally, most engagements have provided evidence of the development in sophistication of the Forum with respect to mapping and spatial conceptions of the catchment. The major points of consideration in the sequence of development of the GIS process, and the Forum with respect to this process, is summarized below.

1st Engagement: This workshop provided an assessment of the mapping and map interpretation skills of the participants. Apart from obvious features like roads and the river, participants generally appeared to struggle to read the maps – particularly the satellite image. On reflection, it was recognised that the low resolution satellite image may have been too challenging. It was resolved that aerial photograph maps should be used as soon as possible.

2nd Engagement: By force of circumstance, satellite images, rather than aerial photographs, were used for mapping in this workshop. Once again, participants had difficulty interpreting some aspects of the maps. The results of the mapping showed that the village participants (despite a catchment transect at the previous workshop) tended to think locally rather than in terms of catchment: participants confined action planning for catchment management to their immediate village environment. In contrast, commercial farmers from the lower sections of the catchment conducted action planning at a catchment scale. At this and the previous workshop the Forum had divided into its constituent village groups to conduct appraisal and mapping. On reflection it was realised that it is important for the Forum to conduct appraisal, planning, and mapping *as a group*, if they are to develop a feel for, and an understanding of, the catchment as a whole. The potential for GIS to facilitate such group work was noted.

3rd Engagement: This workshop involved mapping with aerial photograph-based maps. However, it was found that many of the participants still struggled to relate their local landscapes to the “birds-eye view” representation of the reality, despite the fact that features were clearly visible in the map. At this and the previous two workshops, an apparent heterogeneity in mapping skills was noted.

4th At this workshop, Forum participants from Hertzog conducted mapping on the aerial photographs in a sophisticated manner. This may have been attributable to the mapping exercise using aerial photographs at the previous workshop.

5th Engagement: This engagement consisted of a series of in-village feedback meetings. These meetings provided a means of assessing participants' perceptions about the GIS and mapping

process, and the development in their mapping skills so far. In addition, detailed appraisals of the local-scale maps took place. In some cases, participants demonstrated advanced abilities to interpret the maps. In other cases it is felt that breakthroughs were made in terms of interest in maps, and abilities to read maps. In reflection, the importance of in-depth appraisals of local community maps, in those communities, with the personal attention of facilitators skilled in mapping, as a prerequisite to mapping involving greater levels of abstraction (for example, using satellite images at the catchment scale), was realised. Furthermore, based on one particular meeting it was reflected that GIS representations of locally mapped information should be considered in combination with community issues represented by other means.

6th Engagement: This workshop demonstrated the usefulness of a map of the catchment as a means of providing a catchment context to the development of a vision for the Forum.

7th Engagement: These in-village workshops provided further evidence of developments in mapping ability, and the conception of the catchment from a spatial perspective, among Forum participants.

8th Engagement: This workshop provided the final set of evidence regarding the developed abilities of the majority of the Forum to interpret maps, and to consider the catchment as a whole from a spatial perspective. In particular, in a role-play around the determination of Ecological Reserve Management Classes, participants showed a concern for the health of the catchment as a whole. It was also noted, however, that some participants had comparatively poorly developed map reading skills. At this workshop, the usefulness of GIS and maps in facilitating the sharing of plans, ideas and solutions among the Forum was demonstrated. For the first time, through the GIS, the Forum as a whole went through the process of considering all the villages in the upper catchment. It is argued that this contributed to the further development of an overall picture of the catchment for Forum participants.

11.2 Outcomes

Recall that in Critical Science the process of knowledge creation should be emancipatory. Outcomes in terms of empowerment, lessons regarding practice, and contributions to a body of knowledge, will be detailed.

11.2.1 Outcomes in terms of the development of the Forum

Outcomes related to the empowerment of the Forum have been described, both implicitly and explicitly, in the preceding chapters. They will be summarized here.

- ③ The GIS was used to synthesise locally mapped data into a single set at the catchment scale for presentation back to the Forum, and for presentation to outsiders. This has allowed sharing and appraisal at the catchment scale. Furthermore the synthesis has facilitated the identification of common needs, which has promoted a unity of purpose, and in one case, resulted in group action (namely the development of the Landcare Proposal).
- ③ On screen-GIS and maps, as aides in communicating concepts, situations, ideas and solutions, have proved to be a valuable means of sharing among representatives from different villages.
- ③ Through the above two means of sharing, GIS has promoted greater visualisation and awareness of catchment-wide issues and opportunities.
- ③ The GIS process took the form of a partnership between the local community representatives and the outside GIS operator. This partnership provided the framework through which the participants could access the decision-making tool. It has also provided the opportunity for the researcher to understand the the needs of the communities with respect to natural resources management, which has in turn allowed for more responsive research practice and a developed understanding of the use of GIS in participatory processes (see section 10.5).
- ③ Through accessing the decision-making tool the Forum members have been handed the power to assess, and make decisions about, their own circumstances. This is as opposed to technocratic management styles where outsiders disempower locals by making decisions for them. Handing over access to the GIS process has further contributed to Forum participants' ownership of appraisal processes, data generation processes, and planning processes. Ownership of appraisal and planning can lead to ownership of the initiative.
- ③ The GIS and Society debate argues that traditional GIS based planning often relies on information that does not relate to the realities of the local people being affected by the planning (Sheppard 1995). Through the GIS for Participation process, planning information has been generated that is relevant to the needs and priorities of the catchment communities, and that is understood by the Forum members.
- ③ This information exists in GIS format and has been disseminated to stakeholders in the catchment. Furthermore it can be disseminated to government departments and to other agencies, or it can be integrated into the GIS database of the Catchment Management Agency for the region, should this be established. As such, there is an opportunity for the GIS to form one of the interfaces between the grassroots communities and government agencies. Essentially, this information can serve to "put the communities needs and plans on the map". In so doing partnerships for further (and appropriate) action in the catchment can be attracted.
- ③ Evidence suggests that the majority of the Forum have further developed their ability to interpret and work with maps – some to sophisticated levels. Mapping skills and associated spatial concepts have provided the platform for participants to engage with other catchment and environmental

management related activities or concepts. Furthermore, considering the landscape from a spatial perspective opens up possibilities for new ways of understanding the environment. In particular it is felt that a spatial conception of the catchment has reinforced Forum participants' understanding of up-stream down-stream effects along the river. For some this extends to an understanding of the relationship between the catchment and the river. For example the relationship between diffuse sources of pollution and river condition.

- ③ Evidence suggests that through the GIS process, many Forum members have developed a picture of the catchment as a whole. The sense of "catchment" provides the Forum with a unifying identity and purpose. Knowing how problems fit together at the catchment scale enables participants to better understand and deal with local scale problems.
- ③ GIS can be considered to be one of the common languages of planners. A developed knowledge of spatial concepts provides Forum participants with a means of engaging in this language. Furthermore a conception of the catchment, and an understanding of how local problems fit into this whole, will better enable Forum members to plan and negotiate with other stakeholders (both from within and from outside the catchment) for optimal catchment management.

11.2.2 Lessons regarding the practice of GIS for Participation

An important lesson in terms of procedure has been learned, through the research, about the development of mapping skills and spatial concepts among rural people. Namely that it is important to start off with the least abstract representation of people's realities before progressing onto more challenging representations and concepts. In the GIS process, it was found that the greatest breakthrough in people's abilities to consider their landscape from a birds-eye perspective took place when they studied aerial photographs of their local communities *in* those communities. This meant that they could link up the features that they could see around them to the features visible in the map. This appeared to be the key to understanding the maps among many participants.

It is regrettable that, due to technological constraints, a 3-Dimensional computer model of the catchment could not be used with the Forum. This may have been an important stepping-stone in the development of participants' thinking about spatial concepts and understanding of the catchment as a whole. It is felt that the use of 3-D GIS modelling in the context of GIS for Participation has much potential, and warrants further research.

11.2.3 Lessons learned with respect to an understanding of GIS and Society, PRA, and the potential of GIS for Participation

As stated at the start of this chapter, the GIS and Society debate considers how GIS may affect society. This thesis has dealt with the role that GIS can play in empowering social groups to participate in decision-making and action. Hence the phrase "GIS for Participation". In particular,

the focus has been on members of a Catchment Forum in rural South Africa. The lessons that have been learned with regards to GIS for Participation will be summarized below.

The strength of GIS as a tool in participatory processes is that it facilitates sharing, appraisal, thinking and planning beyond the local scale. The study has shown in particular that GIS can be useful as a tool in the process of enabling local people to participate in catchment management.

If GIS is to be used as a means of empowerment, it should form part of a menu of methods in an overarching people-development process. The limits of GIS as a tool for empowerment in certain areas are made up for by the strengths of other methods in the capacity building process. "GIS in itself does not cause participation, or change, or development, but ... it can certainly promote it in the context of a broader, people-oriented development framework" (McMaster et al, 2001, p.4). However, if GIS is to be used effectively it must be carefully integrated into the overall capacity building framework. This requires the GIS operator to take on the role of a participatory practitioner.

If GIS is to be "handed over" to rural communities as a tool for empowerment, it should be done incrementally in the context of a learning process, and in the framework of a careful partnership between the practitioner and the community or group.

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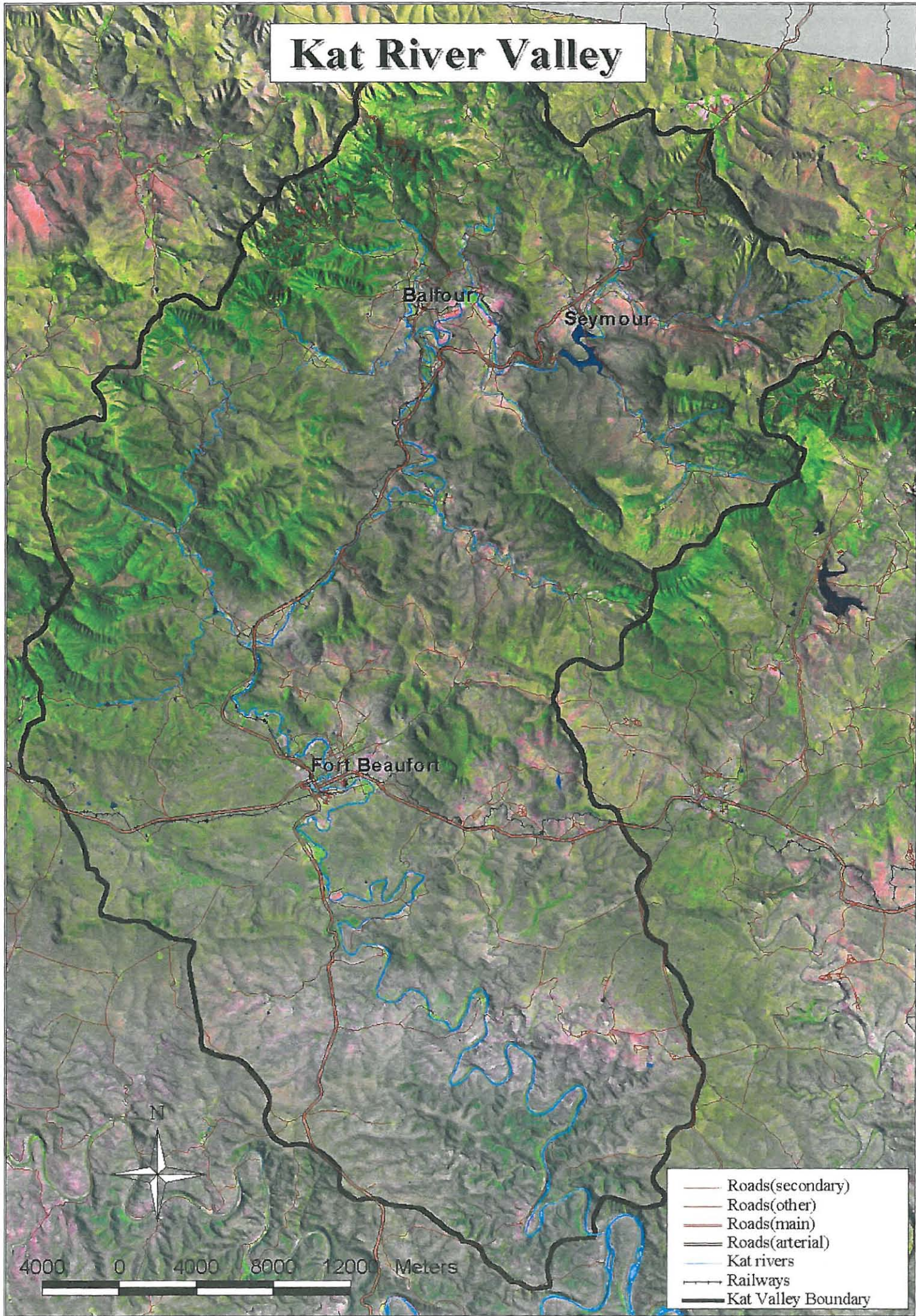
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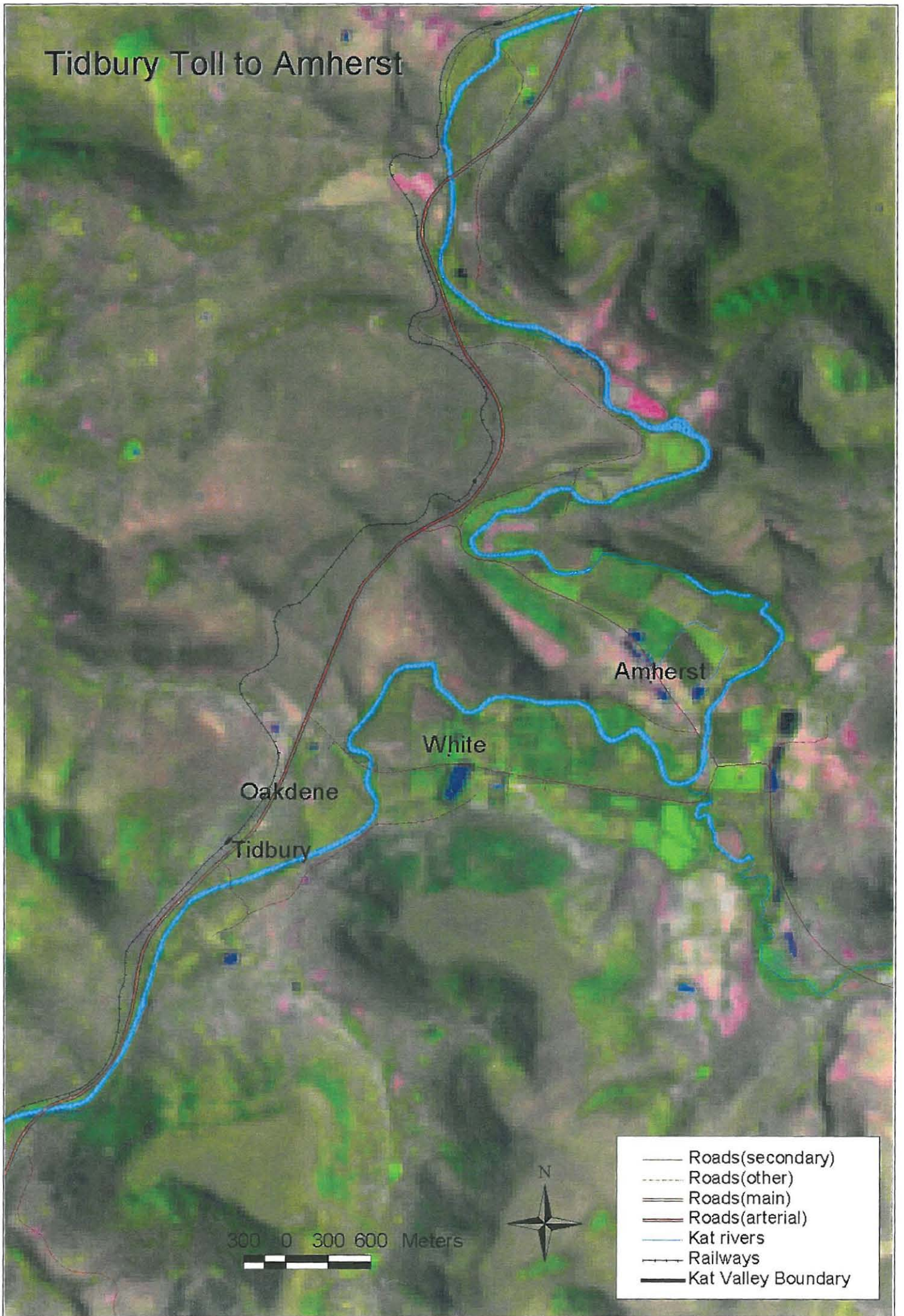
Appendix 1

One of three sets of maps, and associated tasks for completion at home, handed out at the 12th July Map Skills workshop (English translation).

Kat River Valley



Tidbury Toll to Amherst



Appendix 2

Tasks for the participants at the 12th July Map Skills workshop (English translation).

YOUR MAPS OF THE KAT RIVER VALLEY

① Record your name and address

--

② Have you worked with maps before?

① Yes	
② No	

③ Locate your community on the map

④ Draw your community boundary on the map

⑤ Write down the good and bad environmental issues in your community

i
ii
iii
iv.
v.

⑥ Locate the good and bad environmental issues in your community on the map

⑦ Write down the activities that occur in your community

i
ii
iii
iv.
v.

⑧ Locate the activities that occur in your community on the map

⑨ Trace the effects of your communities activities on down-stream residents

Appendix 3

Booklet of outcomes from the Action Planning workshop held in July 2000, together with other maps, that was handed out during the visits to the catchment representatives in June 2000. This booklet was accompanied by laminated A3 maps of the outcomes (See figure 7.4), and an A3 aerial photo map of the relevant community.

Kat River Valley Catchment Forum

*Outcomes of the Action Planning workshop
Ford Fordyce
July 2000*

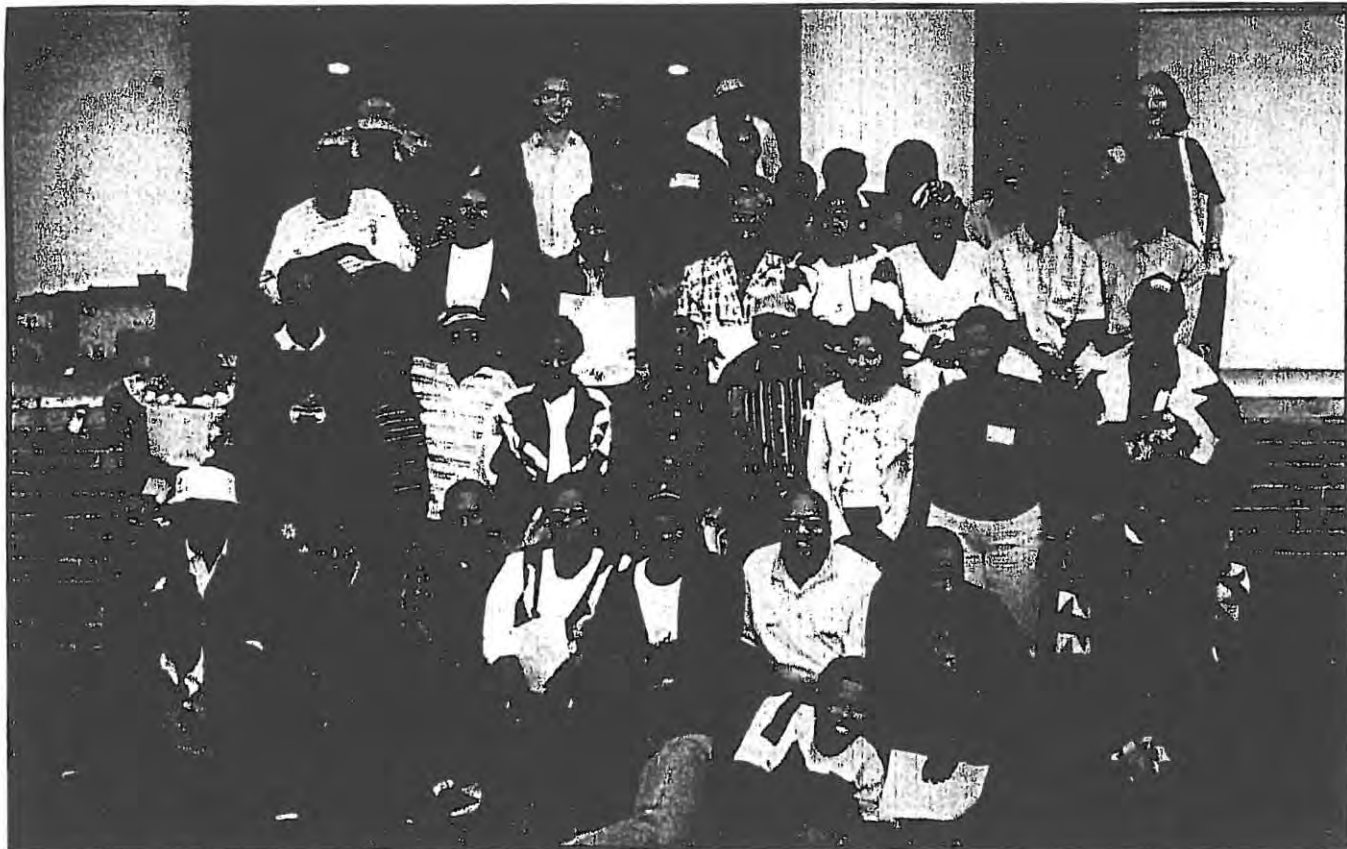
and

*Maps showing other information generated by members of the
Forum*

*Iziphumo ze-Workshop Yesicwangcingo Sezinto Ekufuneka
Zenziwe
eFort Fordyce
NgoJulayi 2000*

Nolunye ulwazi oluze namalungu eCatchment Forum





Abathathi-nxaxheba kwi-workshop ibise-Mpofu Training Centre, 03 May 2001

Intshayelelo

Eli phepha lithetha ngeziphumo ze-workshop eyayise-Fort Fordyce ngo-Julayi 2000 ye-Catchment Forum yase-Kat River, eyayisenza isicwangciso sezinto ekufuneka zenziwe yile-Forum. Le -workshop yesi Sasicwangciso sezinto ezizakwenziwa yaba yinkqubo yentsuku ezimbini apho kwakuchazwa izinto ezixhalabisa abahlali ezinxulumene nempilo kunye nendawo yaseKat, kwaza kwacetywa izinto ekufuneka zenziwe ukuze kulungiswe lo miba ixhalabisayo. Kumba ngamnye, kwabekwa iziphumo zoko kunqwenelekayo, kunye nenkcukacha ezicetyweyo, zathi zondlatwa. Isiphumo ngasinye esinqwenelekayo ekufuneka kwesetyenzwe into ngaso sihambelana nendawo nganye ekule ngingqi. Indawo okanye umzobo ngamnye ohambiselana noko kubhaliweyo phantsi ngabahlali kuye kwabekwa nalapha kwimephu. Oku kwenziwa ngompho ezininzi ezibandakanya indawo yaseMantla kunye nasezantsi yaseKat. Ezi mephu zihambiselana nefoto yamanani ye-Landsat TM.

Ukuqinisekisa ucwangciso oluyimpumelelo ngokwale ngingqi, amalungu eforum athi ahlula-hlulwa angamaqela elali. Oku ke, kwathetha ukuba ukuphela kwe-workshop yonke inkcukacha eyathi yabekwa kwimephu yathi yakhutshelwa kwimephu enkulu. Ngokusebenzisa I-GIS yonke inkcukacha yathi yafakwa kwikhompyutha ukuze izokwazi ukufakwa kwimephu enye ezakubandakanya yonke indawo. Le yimephu ekwiphapha elingu(A3) enizakuyinikwa kunye neli phepha. Iziphumo ezinqwenelekayo zibonakala ngenibala emnyama namhlophe yemifanekiso yesatellite.

Kwimephu nganye yendawo, ngasemva kukho imephu yelali yakho. Oku kwenzelwe ukuba imiba /ingxaki enaniyibekile kunye neziphumo ezizinqwenelekayo nibe nokuzibona. Le mephu ninganakho ukuyisebenzisa xa nifuna ukucebela enye into kwixa elizayo, ukuba kuya kuba yimfuneko oko, okanye yenzelwe ukuba abantu babe nokuyibona ukuba ime njani na ilali yabo kunye nezinto eziyingqongileyo. Into zokubhala ezisulckayo ziyakukhutshwa ukwenzela ukuba umntu ufuna ukuzoba apha emephini abe nokukwazi ukwenza oko. Ezi mephu zisebenzise ifoto ezithathwe esibhakabhakeni, oku thetha ukuthi kulula umntu ukuba abone ilali yakhe. Qaphela ukuba ezinye zezinto ezizizobileyo enithi zingxaki elalini yakho azihambelani ngqo nemefanekiso elapha kule foto ithathwe esibhakabhakeni. Oku kungenxa yokuba ezi zingxaki nceda ukuzilungisa zathi zaboniswa ngokwalendawo yenu, apho imifanekiso kunzima kakhulu ukuyibona. Ungabona ukuba ezinye zezi foto zindala zezango(1985). Oku kuthetha ukuba ubona ilali yakho ngendlela eyayijongekeka ngayo ngonyaka ka-1985, okanye 1986, kuxhomekeka kulo mephu ikuwe. Eminye imifanekiso yezinto ezilapha emiphini kusenokwenzeka ukuba yatshintsha ukususela ngoko ngenxa yokuhamba kwamaxesha.

Kwesi skeyile selali kukho imifanekiso yendonga(gulleys). Ezi ndonga zabokaliswa ngamalungu ecatchment forum aweyekwi-workshop eyenza isicela senxaso-mali kuLandcare seproject yokulawula ukhukuliseko lomhlaba. Ngokubonakalisa ezindonga, ezo lali zichaphazelckayo zingabonakala kule ndawo. Oku kwanceda kakhulu ekucbeni nasekujongeni izimali ngokweproject. Ezi ndonga zabanakaliswa kwimephu yeskeyile selali eyancediswa zifoto zasibhakabhakeni. Oku kwavumela inkcukacha ezithe vetshe ezabanakaliswa emiphini kunezo zazibanakaliswe kwi-workshop yesicwangciso sezinto ekufuneka zenziwe.

Noko imephu eziliqela ziyakuthi zinikezelwe kwilali nganye. Oku kuthetha ukuba ilali nganye iza kuyazi into efuna ukwenziwa zezinye ilali apha eKat. Oku kuthetha ukuba kwixa ngalinye iforum idibana kunye kwi-workshop, kukho ukuqondana okukhulu kwimfuneko ezifanayo kwakunye noko bakucebileyo kufanayo ukuze kuphathwe okanye kulawulwe le ndawo kakuhle iphela.

Ukuba kukho inkcukacha emephini okanye iziphumo ezinqwenelekayo ebezicetyiwe apha kwimephu ezingachananga okanye ezingaqondakaliyo, nceda qhagamishelana nalo:

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Introduction

This set of documents represents the outcomes of the Kat River Valley Catchment Forum Action Planning workshop held at Fort Fordyce in July 2000. The Action Planning workshop involved a two day process of identifying issues of concern related to the health of the catchment and its communities, and then planning actions or on-ground works to deal with these issues. For each issue, a set of desired outcomes, together with planning details, was tabulated. Each desired outcome or on-ground work in these tables is with reference to a particular place on the ground. The area or place or feature that relates to each record on the table, where applicable has been mapped. This was done with the use of a number of maps covering either the upper section of the catchment, or the lower section of the catchment. These maps were based on a Landsat TM digital image.

To ensure effective planning at the local scale, the forum was divided into four according to groupings of villages. This meant that at the end of the workshop, all the mapped information was distributed over a large number of maps. With the use of GIS the information was computerized so that it could all be put together on one map for the whole catchment. This is the large (A3) map that has been supplied together with this document. The background for these outcomes is a black-and-white version of the satellite image.

At the back of each catchment map, is a map of the area of your village. This is so that the issues and outcomes that were mapped for that village can be seen. This map is also for use as an aid to planning in future, should this be necessary, or simply so that people can see the spatial layout of their village and surroundings. Washable pens have been handed out with the maps if people need to draw on the map. These maps use aerial photographs as backgrounds, which means that the details of the village are more easily seen. Notice that some of the mapped action plans do not exactly match up with features on the aerial photograph. This is because the action planning outcomes were mapped at the catchment scale, where the features of the villages are hard to see. You can also see that some of these aerial photographs are out of date. This means that you are seeing what your village looked like in 1985, or in 1996, depending on the map. A number of features may have changed since then.

On the village scale maps are delineations for dongas (gulleys). These dongas were mapped by members of the catchment forum at a workshop for the development of a Landcare soil management project proposal. By mapping these dongas, an inventory of those that most affect the villages could be created for the catchment. This facilitated effective project planning and budgeting. These dongas were delineated on village scale maps which had aerial photographs as backgrounds. This allowed more detailed mapping than that of the action planning workshop.


At least one set of maps will be given to each village. This means that each village can know what action plans the other villages in the catchment have made. This means that each time the forum comes together for a workshop, there is a greater understanding of the common needs and plans for the management of the catchment as a whole.

If there is information on the map or the outcomes tables that is incorrect or which is not understood, please contact:


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Outcomes: Seymour and Balfour

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
	Soil Erosion	Planting of trees or grass for roots to hold the soil	More land to farm on; Better water quality by reduced sedimentation	Community CMF as advisors/ catalysts	Information	Once the area has been recovered trees can be planted
		(Seymour) Using Gabions (i.e. nets and stones) filling the areas with soil and then planting	To ensure higher fertility of soil - i.e. to reduce loss of nutrients	Community: (labour, knowledge) Outsiders: (knowledge, funding)	Stones, Cement Humans (involves many) - 2m height	Clean water Prevent erosion Below Seymour there will be improved conditions (i.e. water quality, less disease) Reduced sediment Reduced reeds below Seymour i.e. Currently reeds at Upsher No more soil erosion Graves will be protected.
		Walls at Seymour Dam to prevent water continuing erosion or to redirect the water	Eroded soil into rivers Potentially could carry diseases and be harmful to animals	Community - Catchment Forum will motivate	Concrete furrow - Cement Stones for 350 - 400m	
	Tree planting	Indigenous trees need to be planted in areas where working for water project has cleared	To reduce soil erosion Livestock corridors Medicinal needs	Outsiders provide knowledge about invasives vs indigenous (Working for Water) Community plants CMF advising the process from planning, planting, upkeep	Transport to collect trees Making contact with the people (phone) Produce own seedlings Knowledge of trees Seymour plant near houses	Indigenous trees improves climatic conditions and biodiversity Windbreaks for houses

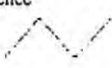
Outcomes: Seymour and Balfour.

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?	
	Erosion	Research	Need research in areas where there seems no explanation for continued erosion (Seymour and Balfour)	Improved land management for livestock and humans For communities to get a better understanding of water process (i.e. insects in the river)	Monde CMF to provide support and advice	Communication with the communities Scientific skills	Balfour and Seymour house planning could be informed by research.
	Balfour	Quarry joint ownership for income Demand joint ownership of works	Income Guaranteed environmental standards	CMF will have to enter into negotiations with such bodies by going to meetings Outside support - i.e. environmentalists	Labour - human time Administration costs Funding for outside support	Better improved environment Better community involvement in business	
S&R	Seymour	Linkage of old septic tanks requires rebuilding	Spread of diseases - reduce insects Smell Drinking quality of water	CM to raise the issue TLC private owners	Materials - labour negotiations - knowledge	Better hygiene Better health Nice environment	
S&R	Balfour	Town expanding - increased pressure on pit latrines - require a sewage system	No space to build long- drops Cannot cope with population - therefore higher diseases because of overflow and contamination of underground water	Community - job opportunity Balfour TRC Amatola District Council and other TRC contacts	Pipes - materials Human capacity negotiations	Upgrading of standard of living Diseases decrease	


Outcomes: Seymour and Balfour.

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
S&R		Rubbish dump –Need to find a good location for refuse	Guaranteed water quality Decrease in diseases. Need a system that is able to manage the pressure of people	Need to find funders	Pre-study of needs. Land surveying.	Outbreaks of water-borne diseases decrease Safer for children (falling into holes) Illegal abortions will decrease.
S&R	Balfour : Piped water (from previous govt.): Infrastructure is unreliable and often breaks, leaving people with no water	Improved system that takes into account the needs of the people – i.e. water pipes to deliver the quality; Lay the foundations for pipes away from roads; Need pressure in pipes to get to households up the slope; Drainage of water to improve seepage (drainage prevents insects) Appropriate taps to prevent linkage i.e. press taps.	Access good water; Supply to everybody; Prevent water wastage – i.e. broken pipes, taps.	TRC – (have enough contacts) – i.e. Amatola district council need to find funder.	Pipes (wide enough) Labour from community; Passing skills onto local people so that they can do it; Appropriate taps (press); Survey; Pre-study of community needs; Need constant communication between contractor and community to ensure performance and quality of service; Who are funders?	Water provision and taps to everyone at the required standards.
	River water	To establish a river clean-up campaign	Water is healthy and clean	CMF with the help of the community	Material Catering Volunteers Funding	Improved, purified water


Outcomes: Seymour and Balfour.

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
Fence 	Fencing	Fencing of camps and river - to have economic development through livestock	For better grazing land for our livestock and to prevent livestock from road accidents	CMF with livestock committee	Negotiations Knowledge of camps for communities and to know lease agreement Have information from agricultural office about the land we think to use; Business plan so that we may have income in lands from livestock	Reduction of accidents in roads; No more local grazing; Have better livestock and income from what we have to fundraise
S&R	Seymour Need dumping site (communal); Needs to be dug.	Better service: People pay for service - The site must be dealt with properly to prevent the litter going into the dam.	Clean water; Better, cleaner, safer environment.	To deal with litter site??? TLC		
		People need to recycle plastic and candles	Money; Clean environment; Use plastic for multi purpose; Household savings	CMF responsible for environment motivate; Talks to community; Community members to teach others	Community support; Education and awareness; Knowledge; Market for selling: Market information. Proposal that combines environmental education (i.e. the need for river health) with personal safety.	No more plastic, tins; Clean and healthy Reduced livestock deaths

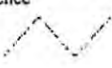
Outcomes: Seymour and Balfour:

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
		Establish a river clean up campaign				
Dirty Water	Seymour/Balfour Dirty water	Seymour: Lack of piped water - especially those communities far from the river; Communicate concern of dirty water to TLC Seymour Buxton: To get representatives on the CMF so will come part of the solution	Clean Water; No representative person here on CMF therefore need to communicate with these people who live above.	TLC will be informed by the CMF Fort Beaufort as Sseymour TLC has no communication but will first inform TLC Seymour and then access advice; Sit down and negotiate	Find out vision of NGO's, TRC, TLC, Government; Propose writing/ phoning funders; Copying letter to others	Near-by water Clean Communicate with above villages
	Organisation	Need information of funders - continue planning and organising a way forward; continue getting brochures; Make contact with people; Make letter heads; A space to put all the information.	Need money, skills, knowledge for development	CMF Make meeting to share information	Phones; Fax; Office; Cell phone numbers??? Transport; Stamp (CMF).	By having funding; Organisation among the Forum; Good communication among ourselves.



Outcomes: Seymour and Balfour.

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
S&R		Rubbish dump—Need to find a good location for refuse	Guaranteed water quality Decrease in diseases. Need a system that is able to manage the pressure of people	Need to find funders	Pre-study of needs. Land surveying.	Outbreaks of water-borne diseases decrease Safer for children (falling into holes) Illegal abortions will decrease.
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	River water	To establish a river clean-up campaign	Water is healthy and clean	CMF with the help of the community	Material Catering Volunteers Funding	Improved, purified water


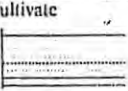
Outcomes: Seymour and Balfour.

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
Fence 	Fencing	Fencing of camps and river - to have economic development through livestock	For better grazing land for our livestock and to prevent livestock from road accidents	CMF with livestock committee	Negotiations Knowledge of camps for communities and to know lease agreement Have information from agricultural office about the land we think to use; Business plan so that we may have income in lands from livestock	Reduction of accidents in roads; No more local grazing; Have better livestock and income from what we have to fundraise
S&R	Seymour Need dumping site (communal); Needs to be dug.	Better service: People pay for service - The site must be dealt with properly to prevent the litter going into the dam.	Clean water; Better, cleaner, safer environment.	To deal with litter site??? TLC		
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Outcomes: Tamboekiesvlei, Hertzog, Fairbairn, Stonehenge, Upsher, Platform, Paradise, Picardy.

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
School 	School	Building of school	Present buildings are dilapidated	Government	Contractor	Presence of new building Supervision by community and progress report to forum
	Clinics	Building of clinics	Improve health	Government	Contractor	Report-back to forum
Swim		Building of swimming pools	Prevent kids from drowning Less water pollution	Government and external funders	Contractor	Supervision by community CMF
Electricity 		Electricity	For lighting	Eskom	Eskom Contractor	Supervision by community CMF
Shearing		Shearing shed	Shear our sheep	Government	Contractor	Supervision by community CMF
		Sports field	Leads to less crime	Government	Contractor	Supervision by community CMF




Outcomes: Tamboekiesvlei, Hertzog, Fairbairn, Stonehenge, Upsher, Platform, Paradise, Picardy.

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
Erosion	Erosion	Tree planting Dam Building	Stop Water	Government	Bulldozer People Tractor	Report back to catchment forum.
		Stone Gabion		People	Netting wire Stones	
		Fencing	Stop cattle from disturbing soil	People	Fencing Poles	
	Stray animals	Cattle Gate	To stop cattle from getting onto the road	Department of public works	Poles Gate Fencing Gate Cement	Report back to catchment forum.
Alien veg 	Alien Trees	Remove Make charcoal	Absorbs more water	Labour Community	Chainsaws Axes	Report back from catchment forum
		Remove Jointed Cactus (Fassteck)	poisonous	Community	Herbicide	
Cultivate 	Land	Re-cultivate	Poverty Allevation Development	Community Project and Government.	Fencing Poles Tractor Plough Irrigation	Report-back from catchment forum
Tourism	Tourism	Places of interest: Ntsikane's Grave Fort Armstrong Revive railway line	Economic Development Job-creation	Government	Contractor	Report-back to catchment form


Outcomes: Tamboekiesvlei, Hertzog, Fairbairn, Stonehenge, Upsher, Platform, Paradise, Picardy.

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
Diesel	Diesel Pollution	Change pumps to electricity	Killing fish Polluting water	Partnership with government	Electrification	Report back to catchment forum
Pollution	Pollution	Get taps	Drinking water unpolluted by cattle	Partnership with government	Cement Pipes Taps Pumps	Report back to catchment forum
		Fencing	Prevents animals from polluting water	Partnership with government	Poles Fencing	Report back to catchment forum
		Drinking holes	Allows humans to have cleaner water	Partnership with government	Cement Bricks Sand	Report back to catchment forum
		Revival of sewage Building of toilets	Water is being polluted	Community and assistance from external sources	Mobile sewage removal trucks	Report back to catchment forum
		Fishing industry	Poverty Alleviation Development Job Creation	Government and community	Weirs Fencing Cement Sand	Report back to catchment forum
Refurb_furrows		Refurbishing of silted furrows and building of weirs	Water storage and irrigation	Community and assistance from external sources	Digging tools Bulldozer Labour from community	Report back to catchment forum
Bridges 	Bridge	Building of bridges	Kill the people. Cannot get to shops, school town	Department of Public Works and Government	Contractor	Have a new bridge Report back to catchment forum

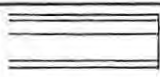
Outcomes: Amherst, White, Oakdene, Tidbury's Toll

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
	Debris blocking channel and bridge	Clean out the river channel (remove dead trees and cancs)	Blocked channel causes very high flow	Community in collaboration with Water User Association	Saws Sledges Tractor to pull logs Chain	Channel will be cleared
		Unblock bridge	Present situation dangerous; Bridge impassable during high flow	Community and department of public works	Saws Sledges Tractor to pull logs Chain	Bridge will be less dangerous and is passable
		Raise height of bridge	Present situation dangerous; Bridge impassable during high flow	Community and department of public works	A means of communication to DPW	Bridge will be less dangerous and is passable
	Toilets	Increase number of toilets	Effluent in community - washes into river.	Community - motivated by catchment forum	Zinc Planks Nails Bolts	Every family has access to toilets
	Fields not planted (no access to fallow fields)	Make community committee to negotiate with farmers	Want to plant fields	Catchment forum will drive the formation of the committee		Access to fields gained
	Pollution - Pesticides; Negligent use of chemicals	Meet with farmers; Send memo to farmers	Pollution and danger of pesticides/negligent use	Catchment forum members and Upper Kat Citrus Growers	Contacts Transport Venue Administrative resources	Farmers start becoming more accountable, less negligent



Outcomes: Amherst, White, Oakdene, Tidbury's Toll

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
	Access to water for irrigation; Furrows/canals to Amherst and White	Approach WUA to discuss water use; Fix furrows that leak water	Need water to water garden and to drink; Burst furrows flood houses	Paid members of the Amherst and White communities; Citrus farmers; Catchment Forum representatives will approach Water User Association and will meet with funders; Committee will be set up to maintain furrows	A means of contacting WUA; Cement Concrete Sand Tractor Trailer	Furrow works and community has better access to water





Outcomes: Blinkwater, Ntilini, Gonzana

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
	Sustainable agricultural development	Working with Chief Maqoma at Gonzana to resolve land tenure issues	Make currently vacant land useable - available for use	PDA, Dept of Land Affairs, WUA/DWAF	Time for chasing decision makers	People have secure land tenure
		Provide tools and tractor services to people with rights/access to vacant lands	Make use of currently vacant lands	PDA, Emerging Farmer funds and WUA Kat River Development Programme Katco	Access to tractors for ploughing; Irrigation equipment (pump, pipes, sprinklers) Seedlings.	Land is used
		Training Programme for emerging farmers	To equip farmers for sustainable irrigation	PDA, Bisho extension service, Katco WUA	Training courses Trainers Mpopu Training Centre or similar	Courses provided; Farming practices reflect best practice.
		Establish demonstration farm plots in Gonzana, Ntilini and Blinkwater	To equip farmers for sustainable irrigation	PDA, Bisho extension service, Katco WUA	Lands for demonstration farm, Fencing, Tools Plants and Equipment Labour	Demonstration farms established
	Riparian Zone Management	Remove logs and debris from river all along Kat and Blinkwater Rivers	Improve and clean river (logs trap water) Improve water quality	CMF with support from WUA	Chains Tractor Chainsaw to remove logs from river	Logs are removed from river
		Remove alien trees from river banks/riparian zone near Gonzana and Ntilini	Safety issues (trees are too dense near the river); and Water use and conservation issue	CMF with support from DWAF (Working for Water) and WUA	Working for Water programme funds	Trees along river are thinned or removed



Outcomes: Blinkwater, Ntilini, Gonzana, Tidbury's Toll, Oakdene, White, Amherst

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
	Erosion (Dongas)	Build retaining walls in two of the dongas at Ntilini Attempt to grass them over	Dongas are dangerous to people and animals They undermine houses Want grass	The community members (men and women) to be employed Will appoint a management committee	Tractor to carry stones Money for employment Soil and stones, Netting wire Advice for the design of the wall	It will have reached the stage where the funders can be shown a successful job
	Donga in the road	Fix the road	Difficult for cars to pass; Dangerous	Department of Public Works	Information and a means to communicate with DPW	When the road is fixed
	Fencing	Build fences	To fence off trees Don't want cows in the river; Don't want cows to leave territory Don't want cows on the road Better management with respect to ground-cover and erosion	Paid members of the community Community management committee (who will also oversee maintenance)	Poles Wire Wire strainers Pliers Wire netting Tractor and trailer Spades, picks and crowbars	Fence is made
	Tree Planting	Planting of trees (Galboom/ American Aloe)	To reduce soil being washed away	Community Forum will oversee	Saplings Fencing Watering of trees	Reduction of soil being washed away

Outcomes: Blinkwater, Ntlini, Gonzana

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
	Water Quality (Improved)	Conduct survey of nutrient and effluent transfers to river from pit latrines and groundwater seepage	Determine human health risks	Rhodes University (Soviti) as service to Catchment Forum and WUA	Money for transport, sample collection, analysis and reporting to CMF and WUA	Analysis results and report presented to WUA and CMF
		Identify alternative latrine systems for villages - e.g: composting toilets	Reduce risk of nutrient, faecal coliforms and diseases in river from effluent	Rhodes University (Soviti) as service to Catchment Forum and WUA	Money for study	Study report produced; CMF and WUA informed
		Install more sustainable latrines in Gonzana and Blinkwater	Reduce risk of nutrient, faecal coliforms and diseases in river from effluent	TLC with support from WSSA and funds from DWAF/ community affairs	Money for installation; Training in Maintenance; Maintenance	Sustainable latrines installed and maintained
		Plant high water use trees near pit latrines to use nutrients and water	Create local groundwater sink to reduce the risk of groundwater contamination	CMF and local communities	Trees (Pepper-corn?) Fencing wire Ongoing Maintenance	Trees growing and established
	Domestic Water Supply is safe and secure	Supply treated water to Gonzana and Blinkwater Communities	Currently water is taken directly from the river - polluted, dead animals, cattle drinking	TLC with support from WSSA and funds from DWAF under water services law	Engineering design Pipes and tanks Labour Maintenance training Maintenance	Community taps installed, maintained and used
		Repair and maintain stock water dams away from river at Gonzana	So that cattle do not have to drink from river	CMF with funds and equipment from PDA	Tractor Labour Fencing Gates	Dams/ stock water points used Less pollution in river

Outcomes: Blinkwater, Ntlini, Gonzana

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
		Fence river area to exclude livestock	Stop cattle drinking direct from river - stop pollution of river from grazing animals	CMF with funds from DWAF, TLC, WUA, PDA	6 strand barbed wire 10km length for Gonzana, Ntlini, Blinkwater Labour	Fence erected and maintained Livestock excluded from river.
		Construct storage tank at Gonzana, Pump and pipes from river and Blinkwater, and community taps	Reduce time needed to collect water	TLC with support from WSSA and funds from DWAF or aid donors and NGOs (Mvula Trust).	Tank for storage of water for 25 houses, Pump, 1km pipe to Gonzana R85 000 from Amatola Water	Tank constructed, Community taps installed, maintained and used
	Provide multipurpose wood-lots for soil conservation, shelter and fuelwood.	Plant multipurpose trees for fuelwood, shelter and soil conservation in Blinkwater and Gonzana	Trees - quick symbol for CMF action; Tangible and quick change.	CMF with support from PDA Landcare Programme and WUA (on soil conservation areas).	Seedlings Labour After-planting care Protection from grazing	Trees planted and cared for.
		Plant trees for shelter from strong winds in Gonzana and Blinkwater	Shelter from wind	CMF and home owners with support from DWAF and SAPPI/ MONDI	Seedlings Labour After-planting care Protection from grazing	Trees planted and cared for.
		Use trees (allics) thinned from river for fuelwood and timber	Use resources for local economic development	CMF and community with support from DWAF	Saws Safety training Vehicle for cut timber Labour	Trees thinned or removed along river

Outcomes: Lower Kat

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
	Development of Sustainable Irrigation Industry	Development of land suitable for irrigation subject to the availability of water	Economic Development	Land-owners – all land privately held	Water allocation from WUA, Cash etc for development.	
		Construct 12m weir at the Tower Site	Store water for irrigation	WUA with financial support from beneficiaries	Engineering and Environmental Impact Studies (some already done), construction and maintenance.	Weir constructed and operational.
		Develop weir operating criteria to preserve environmental flows.	Preserve environmental flows during low-flow periods.	WUA with support from technical specialists such as Rhodes University	Hydrology, ecology and engineering skills, money for studies and reports (DWAF).	Criteria prepared and applied in operating weir.
	Improve water quality	Stop sewerage effluent flowing into river at abattoir site.	Reduce sewerage effluent from entering river from broken pipe.	WSSA with financial support from TLC/DWAF.	Repair sewerage pipe, connect to CES. Engineering studies, resources from DWAF.	Sewerage discharges stop. Faecal coliform not measured below Fort Beaufort in water tests.
		Use sedimentation ponds to strip out nutrients from treatment works discharge (Fort Beaufort).	Strip nutrients from treatment works.	WSSA with financial support from TLC/DWAF.	Engineering designs, funds for construction, WSSA resources for maintenance and operation.	Ponds constructed and operational.
		Improve environmental health standards in Tini's Township – effluent stops going into river. Septic tanks or CES.	Reduce Tini's surface drainage entering the river.	TLC, CMF, WUA.	Engineering designs for CES, Septic Tanks, Money for works (DWAF, TLC).	Tini's effluent no longer enters river.

Outcomes: Lower Kat

Symbol	Outcomes/ Comment/ Threat	Action	Why do it?	Who will do it?	What resources will be needed	How will we know it's done?
		Landfill needs to be monitored	To prevent possible contamination of the surface water body	TLC & WUA, CMF	Monitoring kits, data records, MIS, money for collecting data, test kits.	Data sets exist. land-fill management is sustainable.
		Monitoring water quality coming into F.B. treatment works.	Reducing risk to human and animal health	TLC & WSSA/CMF, CMF to do monitoring.	Sample collection (Kate doing it already). Detailed analysis. Test kits.	Data sets (Periodical).
		Manage dam releases to flush salt below <u>all</u> irrigated areas.	Remove salt (especially just above FB), but in a way that doesn't shift problem to lower Kat.	WUA and contractor managing Seymour Dam.	Finances for water releases.	Water quality testing.
	Water use efficiency.	Review WUE of different supply systems (direct extraction vs furrows).	Increase water use efficiency for all irrigators.	Landowners, WUA	Change extraction techniques.	
		Remove aliens along riparian zone.	Reduce water use by exotic vegetation.	Communities, WUA, CMF.	Working for water/DWAF	
M	Soil erosion control (Soil Conservation)	Secure land tenure for ex ULIMICOR farmers.	Provide title so that land management and finance is sustainable.	E.C dept Land Affairs, PDA, NDA, KatCo (Mark Fry).	Time to lobby govt.	Farmers will have title to land.
		Change grazing management strategies to increase value of small stock.	Reduce overgrazing and impacts of soil erosion.	PDA/WUA	Extension Materials, Demonstration Farms.	Increased livestock productivity, reduced soil erosion.
		Extend best practice grazing management to small-stock owners.	Reduce overgrazing and impacts of soil erosion.	PDA/WUA	Extension Materials, Demonstration Farms.	Increased livestock productivity, reduced soil erosion.

Overleaf:

Map of the issues affecting each town or village.
These were identified by members of the forum at Ntilini, 12 July
2000

ephuh yemiba yendalo esingqongileyo echaphazela idolophu okanye
ilali nganye. Ezi zachazwa ngamalungu eforum eNtilini ngomhla
we-12 kuJulayi 2000.

UPPER KAT RIVER VALLEY
 Issues identified by local community representatives

ADDITIONAL ISSUES
 Unemployment
 Pumps leaking diesel, oil into river

ADDITIONAL ISSUES
 Fertilizer, poison washing into river
 Bridge silted up - Fairbairn
 No toilets
 Dead trees blocking bridges

ADDITIONAL ISSUES
 Dam Unfenced
 No fencing - overgrazing
 Pollution from erosion, fertilizers
 Graves in dam

ADDITIONAL ISSUE
 Drinking water polluted upstream
 Dumping of rotten oranges
 Joblessness
 Fertilizer, poison washing into river
 No irrigation, farming in plain
 No toilets
 No fences
 Poorly maintained schools

ADDITIONAL ISSUES
 No control over building of houses
 No toilets - waste washes into river
 Stealing of fences
 Littering
 Scarcity of water
 Pumps leak oil/diesel into river
 Joblessness

ADDITIONAL ISSUES
 River polluted by upstream users
 Stony soil (Ntlini)
 Rotten oranges dumped into river

KEY

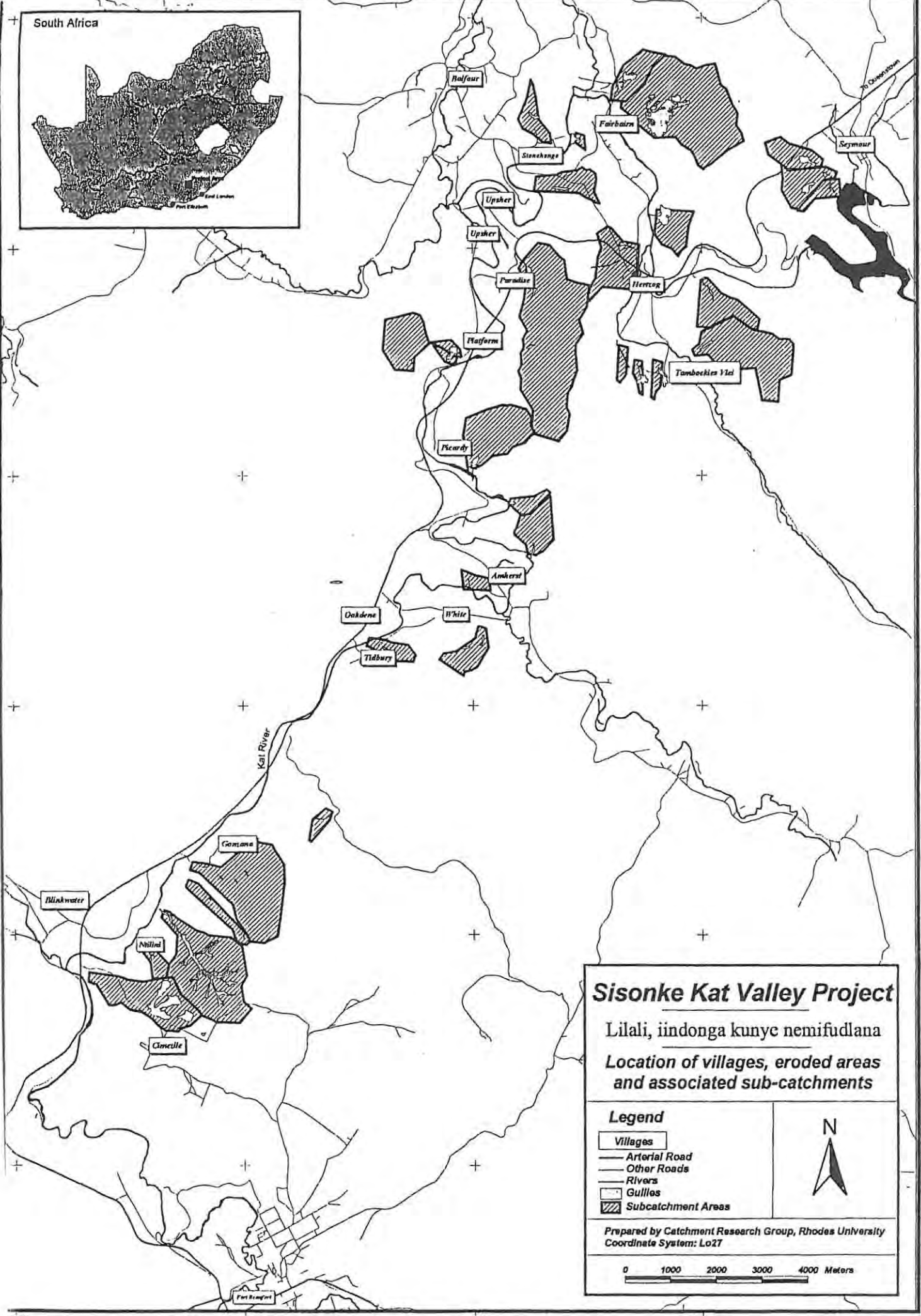
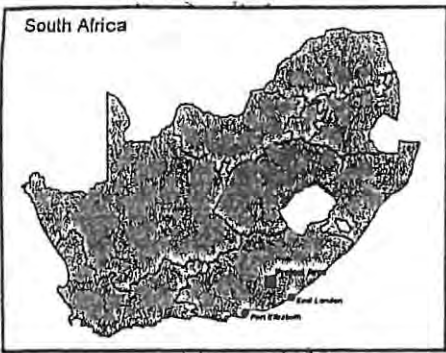
- Selected Problems**
- ✕ Bridge Blocked by dead trees
 - * Cane/Dead trees in River
 - ✂ Chopping of Trees
 - ⊙ Degraded/Eroded forest
 - ▲ Dongas
 - Dumping of Rubbish
 - ☆ Fields not Planted
 - Fields not Planted/No entitlement
 - ⊙ Houses too close to dam - pollution
 - No Toilets
 - No entitlement
 - ⊙ Overgrazing
 - Sharing water with animals
 - ⊙ Soil Erosion
 - Stony Soil
 - ⊙ Washing in the River
 - Water Polluted
 - Wattle Trees
 - Roads(secondary)
 - Roads(other)
 - Roads(main)
 - Roads(arterial)
 - Kat rivers
 - Railways
 - Kat Valley Boundary

Overleaf:

Map of dongas affecting communities of the upper Kat River Valley. The dongas were delineated by members of the Catchment Forum, Ntilini, September 2000.

Imephu yeendonga ezibonakaliswe ngamalungu eCatchment Forum kwi workshop ye Landcare ebiseNtilini ngoSeptember ka 2000

South Africa



Sisonke Kat Valley Project

Lilali, iindonga kunye nemifudlana
Location of villages, eroded areas
and associated sub-catchments

Legend

- Villages
- Arterial Road
- Other Roads
- Rivers
- Gullies
- Subcatchment Areas



Prepared by Catchment Research Group, Rhodes University
Coordinate System: Lo27



3520000
3605000
3510213
3615000
3520000
3525000

17000 16000 15000 14000

Overleaf

Map of Water User Association Voting areas.

Imephu ebonakalisa iingingqi zokuvota ze Water User
Association.

Kat River Valley Water User Association
Voting areas/lingingqi zokuvota

Upper Kat

Middle Kat

Lower Kat

Mpofu Game Reserve

Double Drift Game Reserve

Sam Krog Game Reserve

Mpofu - Fort Beaufort TRC Boundary

Victoria East - Mpofu TRC Boundary

Ward Bound./ VO Bound.

Cadastral/ VO/ Ward Bound.
 North boundary of farm Bryensfont



Legend

- Voting Boundaries
- Roads(main)
- Roads(arterial)
- Kat rivers

