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WATER AVAILABILITY, REQUIREMENTS, AND WATER-RELATED SOCIO-ECONOMIC ASPECTS OF THE KAT RIVER CATCHMENT

A SURVEY ON SECONDARY DATA

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Terminology and Acronyms

DWAF	Department of Water Affairs and Forestry
ELSU	Equivalent Large Stock Units
GIS	Geographical Information Systems
KRWUA	Kat River Water Users Association
LSU	Large Stock Units
MAR	Mean Annual Runoff
MAS	Multi Agent Systems
WMA	Water Management Area

List of Tables, Maps and Figures

1. INTRODUCTION.

This document focuses on water availability and requirements in the Kat River catchment, Eastern Cape, and provides a socio-economic picture of the catchment with particular reference to the households' access to: a) sources of water; b) sanitation facilities; c) energy for lighting and d) telephone. The report is based on secondary data obtained from the Statistics SA's Census database (1996 and 2001), and on the report "Fish to Tsitsikamma Water Management Area: Water Resources Situation Assessment" by the Department of Water Affairs and Forestry (DWAF) (2001).

The report is organised into four sections:

Section 1 is the introduction to the report.

Section 2 presents the Kat River catchment situation in terms of water availability and requirements. It is based on the DWAF (2001) report. The objective of this section is to focus on the water requirements of all the user sectors and the ability of the available water resources to supply these requirements. This information was collected on a catchment basis at the quaternary catchment level of resolution.

Section 3 is a preliminary step towards the socio-economic analysis of the Kat River catchment. Socio-economic data and data on water uses are crucial for the development of tools for facilitating a common understanding of water management amongst the stakeholders in the catchment. Statistics SA's 1996 and 2001 census data were utilised to produce a first, approximate picture of the catchment situation. Additionally this secondary data (Statistics SA) will enable the researchers involved in the preceding primary data collection to develop more focused research methods i.e. questionnaires, and identify those areas where data is still required.

Section 4 provides some conclusions and synthesis of the main findings, and indicates further areas of analysis.

2. WATER AVAILABILITY AND REQUIREMENTS IN THE KAT RIVER CATCHMENT

The Kat River catchment is situated in the Fish to Tsitsikamma Water Management Area (WMA), which covers an area of 97 023 km^2 and falls mostly in the Eastern Cape, with small portions falling in the Western and Northern Cape Regions. The mean annual precipitation in the WMA ranges from 150mm in the north-western interior, where the climate is semi-arid and the rainfall generally occurs from March to May, to more than 1 100mm along the coast in the south-west, where rainfall occurs throughout the year. The tertiary catchment of the Kat River lies in the eastern part of the Great Fish River Basin, and is made up of six quaternary catchments (as designated by DWAF): Q94A to F (see Map 2.1). The total catchment surface is 1 715 km^2 and the floor of the main valley is fertile and fairly wide. The mean annual precipitation ranges from 804mm in the mountains along it eastern edge (Q94A, B) to 480mm in the vicinity of the Great Fish River (Q94F).

Tables that follow refer only to the Kat River Catchment area (Q94).

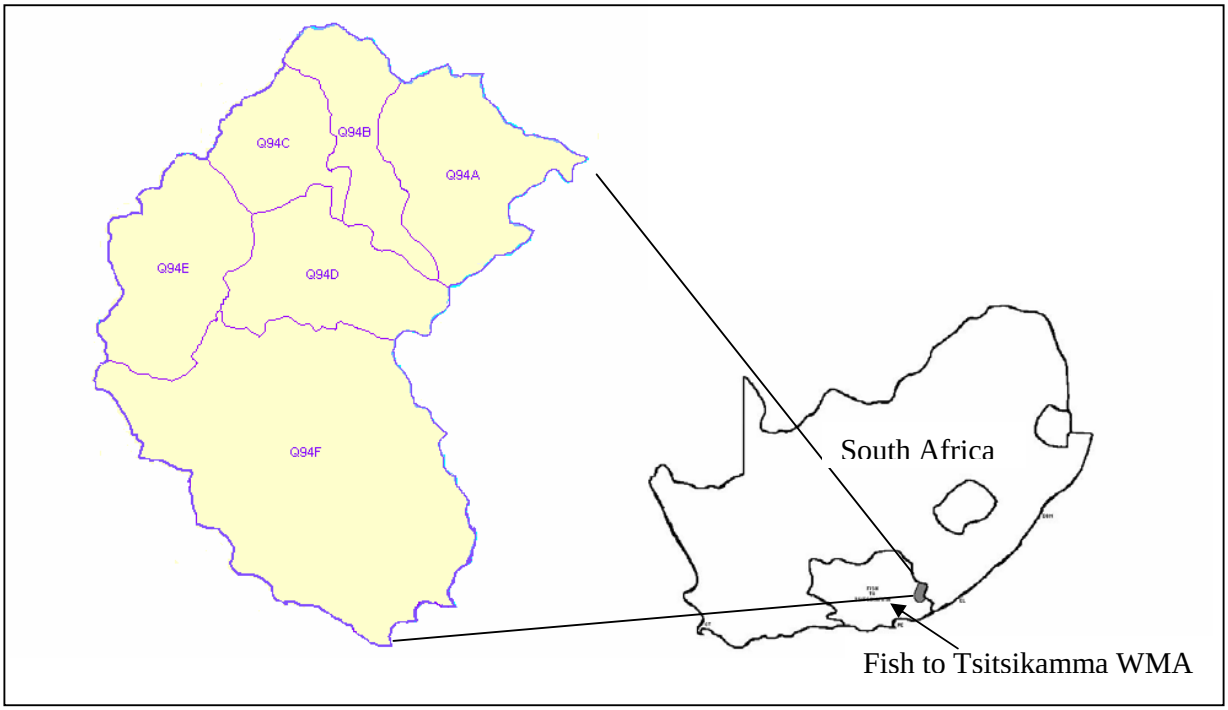


Figure. 2.1 - The Kat River catchment (Q94) and its quaternaries

2.1 Water requirements

Table 2.1.1 shows the land use in the Kat River catchment area.

Table 2.1.1 - Land use (Km^2)

Irrigation	Dry land crops	Afforestation	Indigenous forests	Alien vegetation	Nature reserves	Urban areas	Rough grazing and other	Total area
18.7	36	73.3	32.3	21.8	19.2	18.9	1494.8	1715
1.1%	*2.1%*	*4.3%*	*1.9%*	*1.3%*	*1.1%*	*1.1%*	*87.2%*	

Table 2.1.2 focuses on irrigation land, which, according to DWAF's (2001) report, is used predominantly for lucerne and citrus production; however, the dominant irrigation crop in the catchment is citrus.

Table 2.1.2 - Irrigated land use

Total irrigated area (km^2)	Land area irrigated in average years		
	Lucerne (km^2)	Citrus (km^2)	Total (km^2)
18.7	2.0	11.5	13.5

Irrigation in the Kat River catchment relies on water from local sources, the Kat River Dam and the river.

The total irrigated area in the Kat River catchment is 18.7 km^2. In average years, the total area of land under irrigation is 13.5 km^2 (Table 2.1.2). In determining the average irrigated area, it is assumed that 30% of the total scheduled area is irrigated each year, on average, and that this pattern applies throughout the catchment (DWAF, 2001). Small-scale farmers work about 7.4 km^2 (39.6%) of the 18.7 km^2, the remaining area is worked by larger commercial farming enterprises.

Table 2.1.3 shows the distribution of irrigated surfaces and irrigation water use between the quaternary catchment areas.

Table 2.1.3 - Irrigation surface and estimated average water use per quaternary

Quaternary Catchments	Max. area under high category crops[1]	Average land area irrigated conveyance losses for high category crops	Total average water use by irrigators
	(km^2)	(km^2)	Million m^3/a
Q94A	0.1	0.1	0.09
Q94B	0.0	0.0	0.00
Q94C	0.7	0.5	0.50
Q94D	8.7	6.3	6.62
Q94E	0.0	0.0	0.00
Q94F	9.2	6.6	7.04
Total	***18.7***	***13.5***	***14.25***

According to DWAF's (2001) report, irrigated land in the Kat River catchment is almost exclusively concentred into the quaternaries Q94F (49.4%) and Q94D (46.5%).

Total annual water uses for irrigation are calculated on the basis of coefficients by DWAF. An assumed field-edge-water requirement of 9 000 m^3/ha/a is applicable to the citrus in the Kat River catchment. The estimated irrigation return flows as percentage of field edge irrigation requirements is 5%.

90% of the total scheduled area in quaternaries Q94D and Q94F falls within the Kat River irrigation scheme, which was previously controlled by an Irrigation Board, but is now governed by the Kat River Water Users Association (KRWUA). The total scheduled area, in the irrigation scheme, was 1 600 ha (16 km^2), with a quota usage fixed at 10 900 m^3/ha/a. The allocation of water to the Kat River irrigation scheme was made under Article 56(3): "Scheduling and quotas from Government Water Schemes" of the Water Act of 1956. The total allocation of water to the irrigation scheme was therefore 17.5 million m^3/a[2].

[1] High category crops = Crops dependent of water for satisfactory production.

[2] The quota usage is the allocation of water for irrigation under Government Water Scheme. In Government Water Control Areas these allocations were calculated based on scheduled areas of irrigable land for each property to which water was allocated and a quota of a prescribed quantity of water per annum per hectare of land. The annual quantity of water allocated to each property was calculated as the scheduled area multiplied by the quota. The Kat River irrigation scheme receives water from Government Water Schemes.

Table 2.1.4. Shows that in 1995 the actual average annual water use in the controlled irrigation scheme was 11 million m^3/a instead of 17.5 million m^3/a.

Table 2.1.4 - Controlled irrigation scheme in the Kat River WMA in 1995

Scheduled area (ha)	Area irrigated in 1995		Produce	Supply source	Available water (million m^3/a)	Average annual use (million m^3/a)	Quaternary catchment no.
	Value from other data sources (ha)	Assumed (ha)					
1 600	1 030	1 150	Citrus	Kat River Dam	11.0	11.0	Q94D, Q94F

The combined annual urban and rural domestic requirements are 2.6 million m^3/a (Table 2.1.5).

Table 2.1.5 - Urban and rural domestic water requirements in 1995 at 1:50 assurance of supply (million m^3/a)

Urban requirements	Rural domestic water requirements	Combined urban and rural domestic requirements	Human Reserve
2.2	0.4	2.6	0.5

Urban and rural total water requirements per quaternary catchment are illustrated in Tables 2.1.6 and 2.1.7.

Table 2.1.6 - Urban water requirements per quaternary

	Total urban water use* (million m^3/a)	Increased runoff due to urban areas (million m^3/a)	Urban population	*Direct urban use (million m^3/a)*	*Indirect urban use (million m^3/a)*	Total return flows (million m^3/a)	*Total losses (million m^3/a)*
Q94A	**0.15**	0.00	2700	*0.08*	*0.03*	0.05	*0.04*
Q94B	**0.00**	0.00	0	*0.00*	*0.00*	0.00	*0.00*
Q94C	**0.00**	0.00	0	*0.00*	*0.00*	0.00	*0.00*
Q94D	**0.00**	0.00	0	*0.00*	*0.00*	0.00	*0.00*
Q94E	**0.00**	0.00	0	*0.00*	*0.00*	0.00	*0.00*
Q94F	**2.05**	0.13	23350	*0.90*	*0.63*	0.79	*0.52*
Total	**2.20**	0.13	26050	*0.98*	*0.66*	0.84	*0.56*

* Calculated as: Direct use + Indirect use + Total losses

Table 2.1.7 - Rural water requirements per quaternary

	Rural domestic water use (million m^3/a)	Livestock water use (million m^3/a)	**Total water use (million m^3/a)***	Rural population	Number of large stock units
Q94A	0.02	0.02	**0.04**	1950	592
Q94B	0.04	0.00	**0.04**	3472	0
Q94C	0.06	0.02	**0.07**	4447	830
Q94D	0.04	0.02	**0.07**	3464	595
Q94E	0.01	0.03	**0.04**	930	1522
Q94F	0.23	0.24	**0.47**	17180	5278
Total	**0.40**	0.30	**0.70**	31443	8817

* Calculated on the basis of 45 litres/LSU/day, where LSU = Large Stock Unit

Most of rural and urban domestic water requirements are estimated as originating from quaternary catchment Q94F.

Table 2.1.7 shows the rural water requirements, including livestock water usage, which consists of those animals indicated in table 2.1.8.

The total return flow of 0.8 million m^3/a in Table 2.1.7 is due to the urban infrastructures such as pavements and roads. In rural areas no return flow is considered.

Table 2.1.8 - Livestock

Numbers of livestock					No. of ELSU[3]
Cattle	Horses and donkeys	Sheep	Goats	Pigs	
5 247	408	11 696	2 546	51	8 817

2.2 Water availability

The main supply source of water for irrigation and domestic use in the catchment is the Kat River Dam. The total capacity of the dam is 24.8 million m^3, with a total yield of 12.7 million m^3/a, of which 1.7 million m^3/a is for domestic supplies and 11.0 million m^3/a is for irrigation. The government water scheme allocates 2.7 million m^3/a to municipalities.

Water resources in the Kat River catchment, which include groundwater and surface water, are presented in the next three tables. Table 2.2.1 shows that surface water resources in 1995 made up the largest proportion of available water resources in the catchment. The 1:50 year assurance of supply utilised yield from surface water is 23.0 million m^3/a, whereas only 0.1 million m^3/a come from groundwater.

Table 2.2.1 - Water resources (million m^3/a)

Surface water resources			Sustainable groundwater exploitation potential not contributing to surface water base flow[4]		Total water resources	
Cumulative natural MAR*	1:50 year utilised yield in 1995	*1:50 year total potential yield*	Used in 1995	*Total potential*	1:50 year utilised yield in 1995	*1:50 year total yield potential*
70.0	23.0	*36.0*	0.1	*7.9*	23.1	*43.9*

* Mean Annual Runoff (MAR)

Groundwater is an important potential unexploited source of water (7.9 million m^3/a), which together with 36 million m^3/a of potential surface water yield, contributes to bring the 1:50 year total potential yield in the catchment to 43.9 million m^3/a.

Table 2.2.2 - Groundwater resources at 1:50 year assurance of supply (million m^3/a)

Utilisable groundwater exploitation potential	Groundwater use in 1995	Unused groundwater exploitation potential in 1995	Groundwater contribution to surface base flow	*Portion of groundwater exploitation potential not contributing to surface base flow*
16.6	0.1	16.5	8.7	*7.9*

Table 2.2.2 breaks down the groundwater resources components. 16.6 million m^3/a are estimated to be the total potential groundwater resources. 8, 7 million m^3/a of this amount contributes directly to surface base flow and only 0.1 million m^3/a are extracted independently. The remaining 7.9 million m^3/a are the total potential unexploited groundwater mentioned in table 2.2.1.

[3] Equivalent large stock units.
[4] Base flow is a portion of the total water resource that can either be abstracted as groundwater or surface water.

Table 2.2.3 - Surface water resources

Incremental catchment area (km^2)	Mean annual precipitation (mm/a)	Mean annual evaporation (mm/a)	Natural MAR	Incremental yield	
				Utilised in 1995 (million m^3/a)	*Total potential (million m^3/a)*
1 715	668	1 580	70.0	23.0	*36.0*

Table 2.2.3 indicates the geographical and hydrological parameters in the catchment (area, annual precipitation, evaporation, and runoff) used by DWAF to calculate the potential and actual yield.

2.3 Balance between water availability and requirements

Table 2.3.1 - Average water requirements in 1995 (million m^3/a)

Streamflow reduction activities		Water use		Water requirements						Eco-logical Reserve	Total
Affor-estation	Dry land sugar cane	Alien vegetation	River losses	Bulk	Irriga-tion	Rural	Urban	Hydro-power	Water transfers out of catchment		
2.8	0	2.5	0	0	14.3	0.7	2.2	0	0	7.1	29.6

Table 2.3.1 shows the average water requirements in the catchment, in connection with the requirements previously illustrated in the last section, and the Ecological Reserve, as defined by DWAF as 'the quantity and quality of water required in a basin to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource'.

These requirements are expressed under a scenario of 1:50 year assurance of supply in table 2.3.2. the Ecological Reserve amount indicated in this table is higher than the one reported by DWAF (2001) (1.3 million m^3/a) and was suggested by researchers at Rhodes University.

Table 2.3.2 - Average water requirements in 1995 at 1:50 year assurance (million m^3/a)

Streamflow reduction activities		Water use		Water requirements						Eco-logical Reserve	Total
Affor-estation	Dry land sugar cane	Alien vegetation	River losses	Bulk	Irriga-tion	Rural	Urban	Hydro-power	Water transfers out of catchment		
1.7	0	1.2	0	0	12.8	0.7	2.2	0	0	2.5	21.1

From table 2.3.2 it can be seen that the water requirements in the catchment originate exclusively from agricultural and related activities (livestock uses are included in rural domestic requirements) as well as from domestic uses. Mining and industrial processes are absent from the area and no water is used to produce electric power. There is no transfer of water out of the catchment.

Water requirements and availability at 1:50 year assurance of supply are compared in table 2.3.3. A positive balance of 2 million m^3/a results, meaning that, according to the estimated water requirements, there is no water stress in the catchment.

Table 2.3.3 - Water requirements and availability in 1995 (million m^3/a)

Available 1:50 year yield in 1995			Water transfers at 1:50 year assurance		Return flows at 1:50 year assurance		Water requirements at 1:50 year assurance	**Yield balance at 1:50 year assurance**
Surface water	Groundwater not contributing to surface water base flow	Total	Imports	Exports	Re-usable	To sea		
23.0	0.1	23.1	0	0	1.5	0	21.1	**+2.0**

Table 2.3.4 shows the cost of capturing and utilising the potential surface water development indicated in table 2.2.1. DWAF calculated the capital cost of increasing the catchment yield by 12.9 million m^3/a. This would be possible if the gross-storage capacity of the Kat River dam[5] was enhanced by 78.9 million m^3/a.

This increase would provide water for the future requirements of the towns of Seymour and Fort Beaufort and the increased needs of irrigators.

Table 2.3.4 - Capital cost of improved water availability (dam rising)

Tertiary	Maximum feasible storage capacity (million m^3/a)	Capacities of existing major dams (million m^3/a)	Hypothetical dam capacity (live)[6] (million m^3/a)	1 in 25 year sediment yield (million m^3/a)	Hypothetical dam capacity (gross) (million m^3/a)	Cost of hypothetical dams (R million)
Q94	95.0	24.8	70.2	8.7	78.9	302

The estimated cost of R302 million including VAT is calculated on the basis of a cost function derived for the purposes of DWAF projects in the WMAs. This function is equal to:

$$Total\ Capital\ Cost = 39.3 \times Gross\ hypothetical\ capacity^{0.467}$$

According to DWAF this is a very rough estimate, and the resulting cost estimates should be used cautiously.

2.4 Synthesis of water supply and requirements at the catchment level

Although the data used in this section dates back to 1995, it represents the most recent available secondary data on the subject. In terms of water requirements and availability in the Kat River catchment the DWAF (2001) report provides a good indication of the present situation as there has been little change in activities in the few years since the survey was conducted.

Water requirements in the Kat River catchment are predominantly for domestic and agricultural uses. There is no industrial sector, mining sector, or hydropower production in the area.

Urban users consume three times more water than rural users (the latter including also livestock requirements). Both rural and urban domestic water requirements are concentrated in the Q94F quaternary catchment, where the main centre of Fort Beaufort is situated.

[5] The hypothetical dam capacity (gross) is the sum of the live capacity and the 1:25 year sediment yield. The existing Kat River Dam has a live capacity of 24.8 million m^3/a, and with an increase of 70.2 million m^3/a gives a maximum feasible storage capacity of 95 million m^3/a, to which 8.7 million m^3/a must be added to consider the sediment yield.

[6] The additional storage capacity required to obtain the 1:50 year total potential maximum surface water yield (95 million m^3).

Irrigation, the main water consumer sector in the catchment, is concentrated in two quaternary catchments: Q94D and Q94F. This is where the previous irrigation board was situated.

Water resources for the year 1995 consist almost exclusively of surface water resources; ground water resources provided only 0.5% of the total water resources.

The balance between water requirements, inclusive of the Ecological Reserve, and water availability at the moment of the survey was positive by 2.0 million m^3/a, indicating a situation of non-stress at the catchment level. Nevertheless, emerging agriculture is increasing in the area and citrus producers require more and more water for their intensive orchards. Furthermore, domestic users, particularly rural ones, are presently underprovided with water. Most of the rural users and many urban ones do not have access to tap water and sanitation facilities (cf. following section). The provision of these basic services would increase dramatically the use of water and therefore water requirements for domestic purposes.

To face this estimated increase in the water demand, DWAF made the hypothesis of a potential surface water development quantified as an increase of 12.9 million m^3/a of the total catchment yield. This result would be possible if the gross-storage capacity of the Kat River dam was enhanced by 78.9 million m^3/a.

The capital cost of this exercise would correspond to R 302 million including VAT (cost referred to 1995). This cost can be considered as a benchmark to calculate water tariffs or economic instruments for water policy at the local level in order to recover the capital cost from water users, or to compare this project to other possible investments aimed at improving the living conditions in the catchment.

3. A SOCIO-ECONOMIC PICTURE OF THE KAT RIVER CATCHMENT WITH PARTICULAR REFERENCE TO THE HOUSEHOLDS' ACCESS TO SOURCES OF WATER, SANITATION FACILITIES, ENERGY FOR LIGHTING, AND TELEPHONE

3.1 Introduction

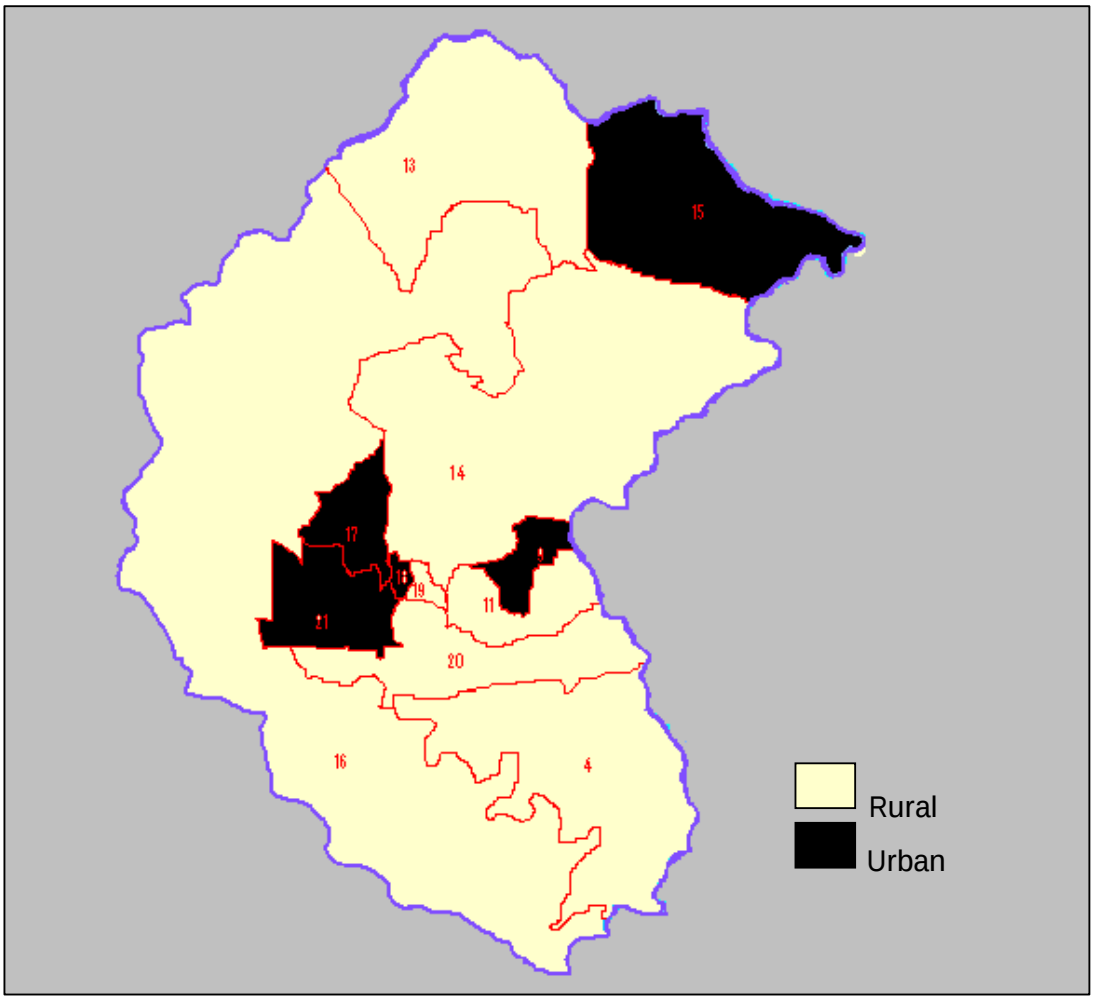
This section is structured in four parts: after a description of the methodology for data collection and processing (3.2), an illustration of the main results is provided (3.3) and a final paragraph synthesises the outcomes and provides some suggestions for future research.

3.2 Data collection and processing

The figures contained in this report come from the Statistics SA (2004) Census databases. Both the Census data of 1996 and 2001 were used. Since data from the Census refers to administrative territorial units, namely wards and municipalities, the main problem consisted of making this data correspond to the catchment's population. The relation between data from Statistics SA and the population in the catchment was found by overlapping maps of the catchment (obtained from the Map Shop web site of DWAF) with those available from the South Africa Explorer software (Jhagoroo et al. 2000). The latter indicate the administrative units (wards and municipalities) to which Census data corresponds. This procedure allowed for an estimated extraction, from the Census data, of only those households falling within the catchment borders.

As indicated in section 2, the Kat River catchment is a tertiary catchment within the Great Fish River's primary catchment, and falls within the Fish to Tsitskamma WMA, in the Eastern Cape Province. The catchment covers an area of approximately 1 700 Km^2 and lies fully within the Nkonkobe municipality. The municipality is divided up into twenty-one wards, of which the Kat River catchment only consists of twelve (Map 3.2.1). Of these twelve wards, some lie completely in the catchment and others only partially. To estimate the population living within the catchment, the following procedure was followed:

1. Villages and urban centres in each ward were identified using SA Explorer.
2. Then, by overlapping SA Explorer maps and DWAF catchment maps only the towns or villages per ward that lay inside the catchment boundaries were included.
3. Finally, for each ward the proportion (%) of the centres within the catchment borders was calculated and the hypothesis that all centres were of the same size was made. This percentage was then multiplied by the population of each ward as indicated in the Statistics SA dataset.



Map 3.2.1 - The Kat river basin: Rural and Urban wards

Two main groups (strata), namely rural and urban households, were identified to better analyse the population in the catchment. The method used to identify urban and rural wards:

1. Was to look at specific data and identify indicators in the secondary data set.
2. Indicators included: occupation, the source of water and the access to sanitation facilities households had.
3. The hypothesis was made that urban areas were those with the lowest number of farmers, the highest percentage of private tap and water inside dwelling or inside yard, as well as the highest percentage of flush toilets and flush septic toilets.

According to this typology, wards 9, 15, 17, 18 and 21 were considered “urban”, whilst wards 4, 11, 13, 14, 16, 19 and 20 were classified as “rural”. Urban wards correspond to the area surrounding Fort Beaufort, the main urban centre of the catchment, and the area of Seymour, in the northeast.

The following section shows some results obtained by applying descriptive statistics to the Statistics SA Census data prepared and categorised as illustrated above. These data sets enable the exploration of some of the important socio-economic aspects of the catchment’s population, such as the household income, the level of employment, the productive branches, and the level of education attained by the household’s head. Then, information on the water source, sanitation facilities and sources of energy to the households is provided. Since there is data available from the 1996 and 2001 Census, an indication of the temporal trends in the selected variables was possible.

3.3 Results

3.3.1 Demographic dynamics

Total population in the catchment decreases during the period between 1996 and 2001. It changes from 55 777 to 49 530 (Figure 3.3.1.1). This negative trend can be due to a combination of factors such as migration out of the catchment, due to the low level of employment opportunities, the HIV/AIDS incidence, etc. A discussion on these factors is provided later in this section. Meanwhile the number of households increases from 10 502 to 12 310. This logically results in a decrease of the households' average size (from 5.3 to 4.1 units). Africans, followed by Coloured and White, form the far largest population group (Figure 3.3.1.1).

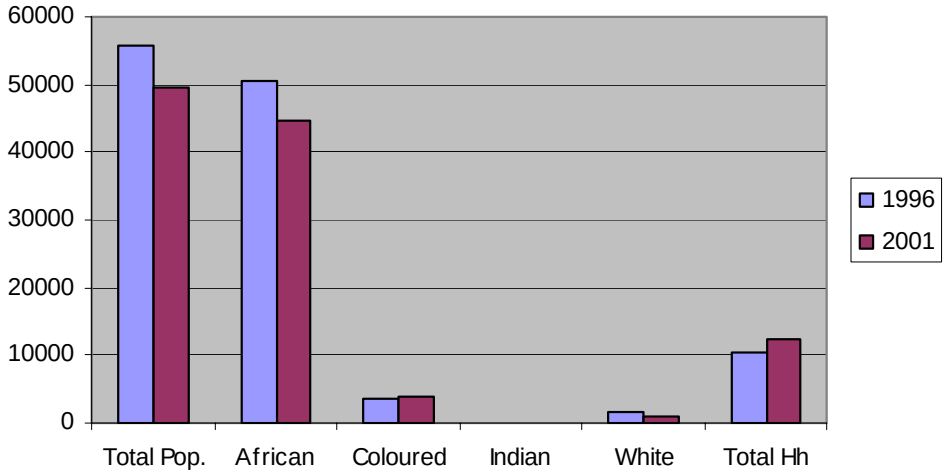


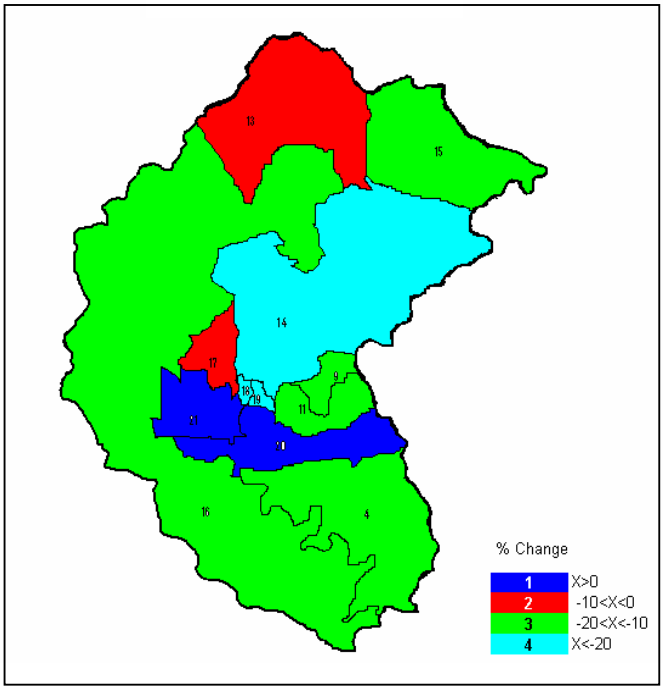
Figure 3.3.1.1 - Population in the Kat river catchment

In 2001, according to the described methodology of stratification, 7 073 households (57.5%) live in rural areas and 5 328 (42.5%) live in urban areas.

In order to describe better the demographic dynamics that took place in the catchment over the period covered by the two Censuses, the following maps were constructed. These maps illustrate the various changes in indicators both spatially and temporally, within the spatial demarcation of the wards within the catchment.

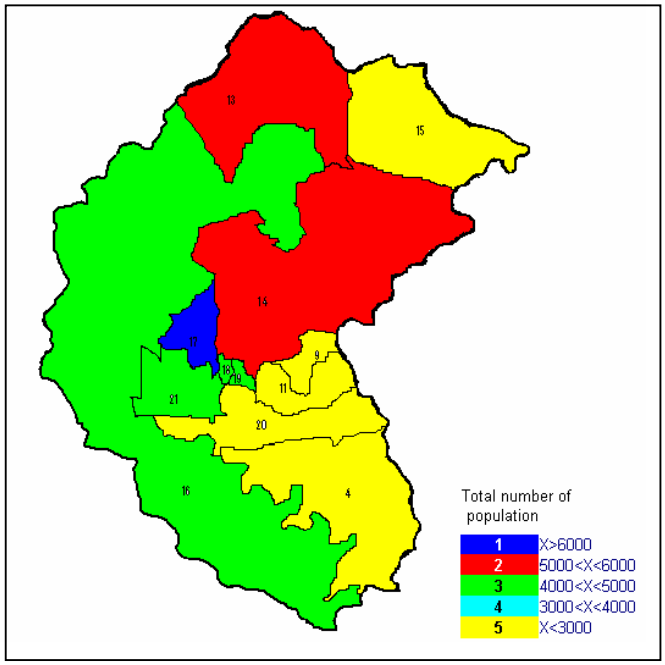
The change in the total population of each ward between 1996 and 2001 is shown in Map 3.3.1.1.

The only areas in the catchment that show an increase in total population are wards 20 and 21. Ward 21 is identified as an urban ward and the positive change here could be explained by better employment opportunities compared with the rest of the catchment. Ward 20 is a rural ward, but characterized by intensive citrus production, which also provides work opportunities. Wards with negative changes in the population are the majority. Rural areas have on average negative population trends.



Map 3.3.1.1 - % change in total population (1996-2001)

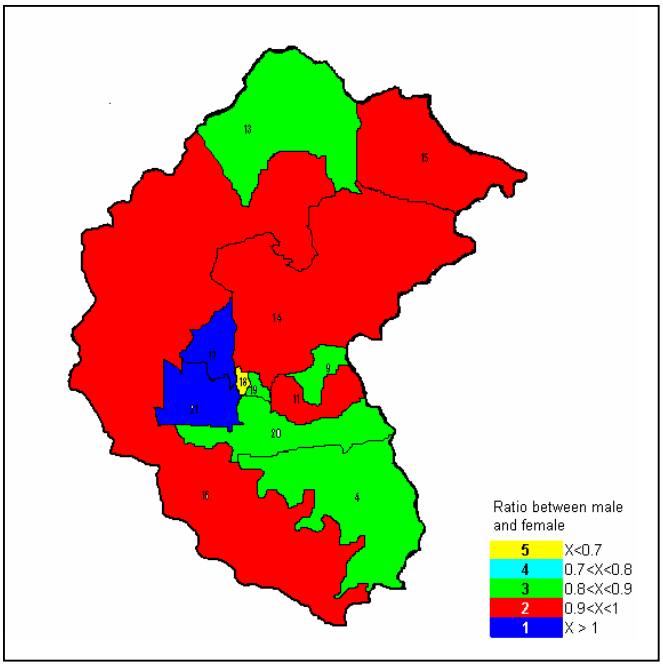
The distribution of population in the catchment in 2001 is shown in the following map (3.3.1.2).



Map 3.3.1.2 – Distribution of total population in the Kat River catchment (2001)

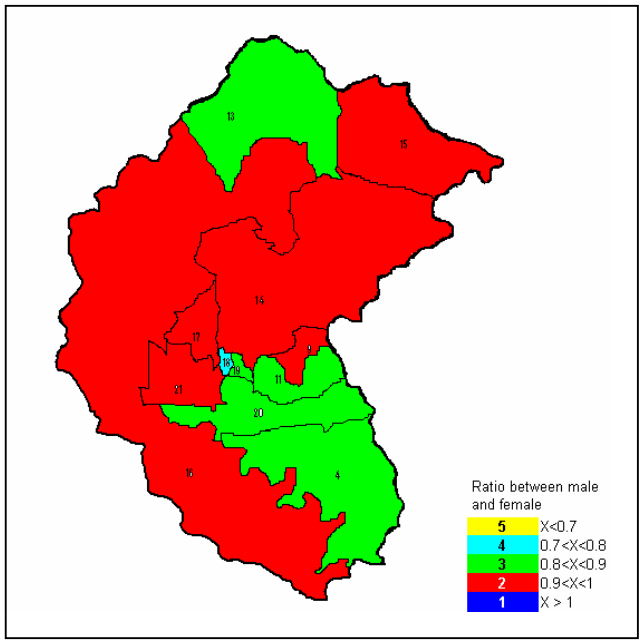
Ward 17 is the most populated ward; Fort Beaufort is situated within this ward. Conversely, the least populated areas in the catchment correspond to the wards located in the north-east and in the south-east parts of the valley.

The following two maps look at the gender ratio[7] per ward in 1996 and 2001.



Map 3.3.1.3 - Gender ratio in the Kat River catchment (1996)

In 1996 only ward 17 and 21 had a ratio higher than 1 (more males than females) (Map 3.3.1.3). Both of them are urban wards according to our typology. In 2001 no ward was characterised by a gender ratio >1. Urban wards, in general, show a decrease of the gender ratio, whilst in rural wards it remains generally stable (Map 3.3.1.4). This fact could be explained by the migration of the male population of working age from rural to urban areas of the catchment until 1996, and then to other areas outside the catchment because of lack of job opportunity. Other causes, such as HIV/AIDS, might be at the origin of this trend, particularly in rural areas.

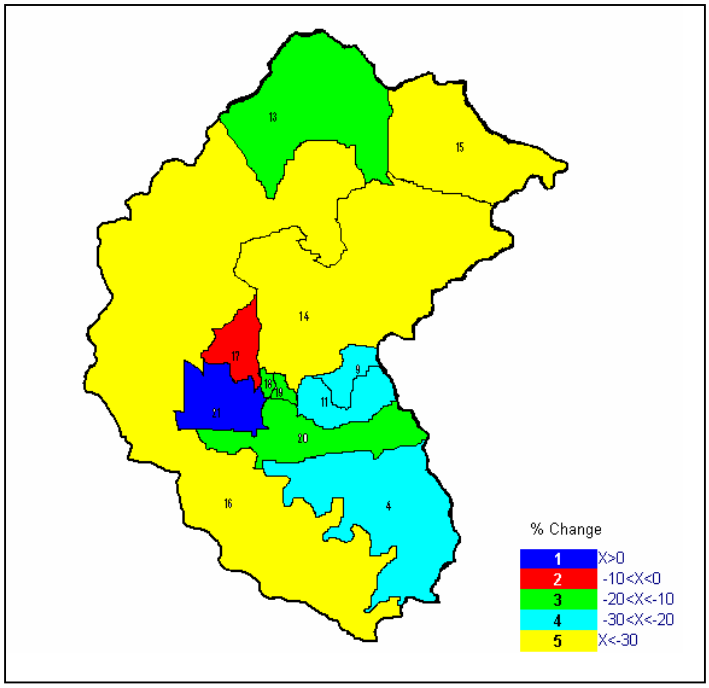


Map 3.3.1.4 - Gender ratio in the Kat River catchment (2001)

[7] Gender ratio = number of resident males/number of resident females.

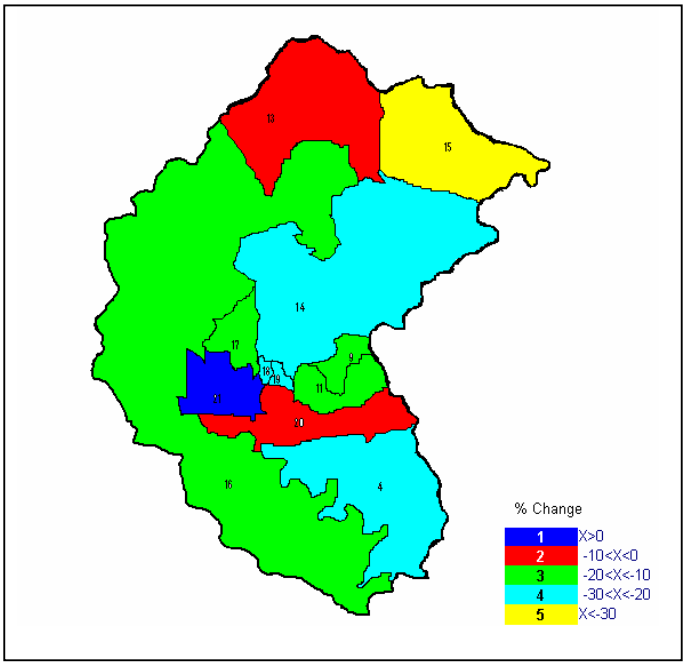
To investigate this phenomenon in more detail, the following maps illustrate the dynamics of the different age groups in the wards of the catchment, during the period 1996-2001.

The age group including 0-4 year old children increases or stays stable during the period only in some urban wards (21 and 17) (Map 3.3.1.5), whilst it shows a decrease higher than 30% in wards where the total population decreases (wards 14, 15, and 16).

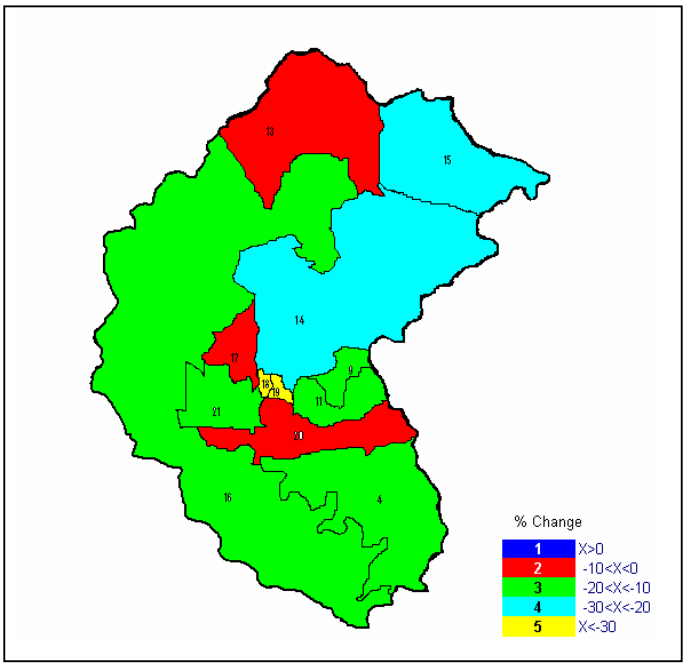


Map 3.3.1.5 - % change in the group of age 0 – 4 (1996-2001)

Similar trends, but less negative, characterise the age group of 5-14 year olds (Map 3.3.1.6).

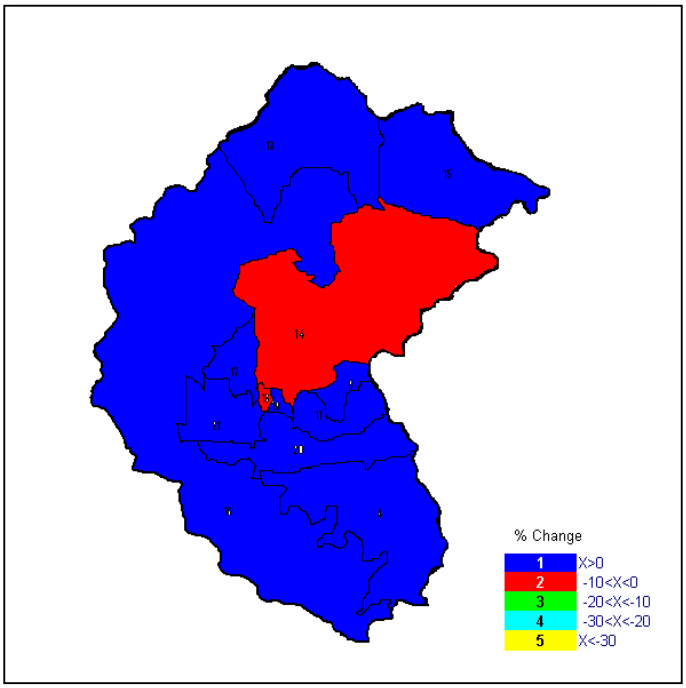


Map 3.3.1.6 - % change in the group of age 5 -14 (1996-2001)



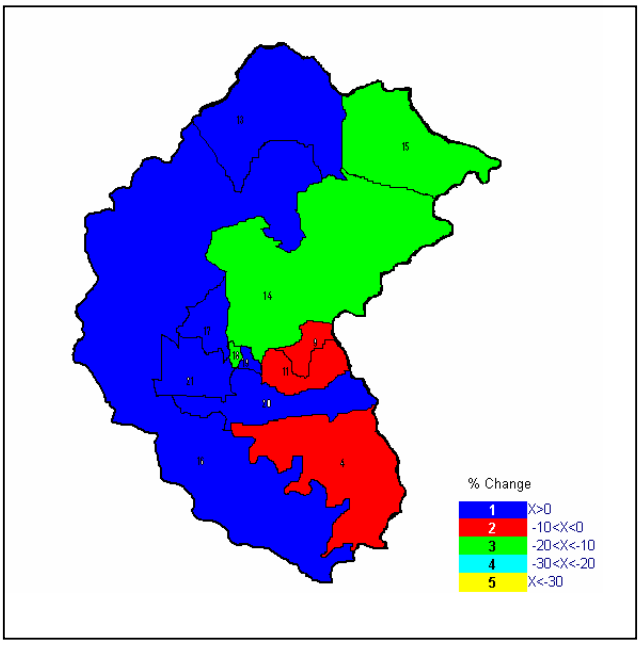
Map 3.3.1.7 - % change in the group of age 15 - 34 (1996-2001)

Map 3.3.1.7 shows that the age group of 15 to 34 is the only one for which all wards show a reduction over the observed period. This fact might be the consequence of the combined effects of HIV/AIDS and migration to other catchments.



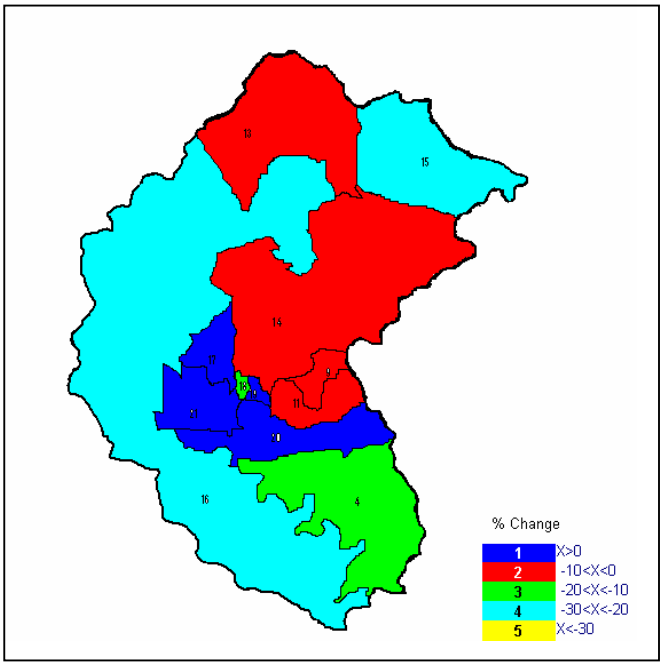
Map 3.3.1.8 - % change in the group of age 35 - 64 (1996-2001)

The age group of 35 to 64 year olds increases in almost wards of the catchment, with the exception of wards 14 and 18 (Map 3.3.1.8).

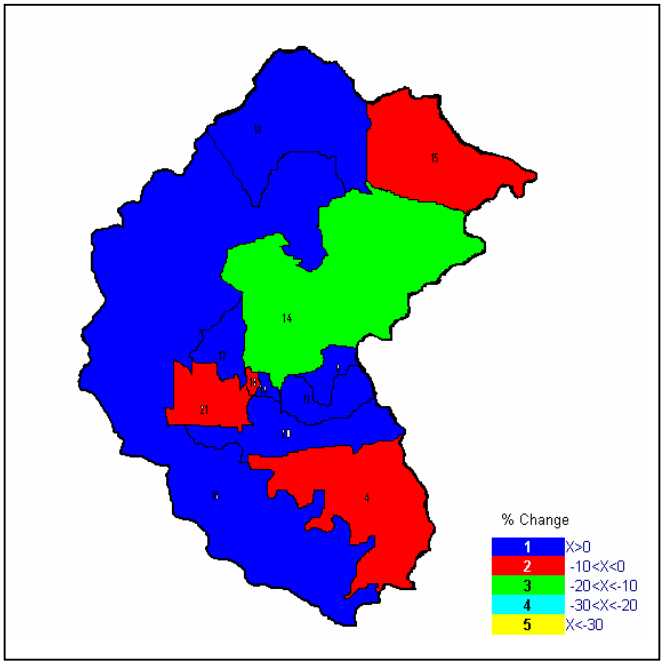


Map 3.3.1.9 - % change in the group of age over 65 (1996-2001)

Older people (over 65) increase or stabilise in most wards (Map 3.3.1.9), but the following two maps show that the trends are different for male and female populations. While in fact females over 65 show the same trends as in Map 3.3.1.9 (Map 3.3.1.11), males over 65 increase only in urban areas around Fort Beaufort and in ward 20, where intensive citrus plantations occur (Map 3.3.1.10).



Map 3.3.1.10- % change in the group of age over 65: males (1996-2001)



Map 3.3.1.11- % change in the group of age over 65: females (1996-2001)

Interpreting the population decrease in the catchment during the period of 1996-2001 in the light of the shown trends, it can be observed that:

1. A lower birth rate (or a higher mortality during the first four years of life), particularly in rural areas, takes place;
2. A serious reduction of young people (of the age group 15-34) characterizes the catchment both in rural and urban areas;
3. Older people increase or stabilize over the studied period, but women are more numerous than men, particularly in rural areas.

Concluding, statistics on groups of age seem to confirm the HIV/AIDS impact on younger generations, whereas the gender ratio would confirm migration trends to urban areas and outside the catchment, looking for job opportunities lacking in the Kat River catchment.

3.3.2 Occupation, education and income

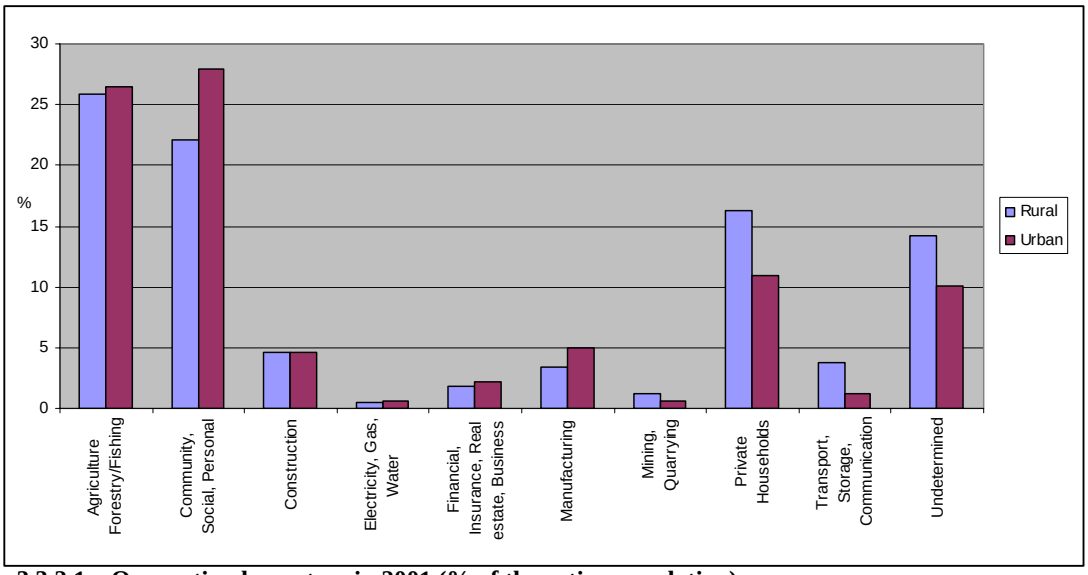


Figure 3.3.2.1 – Occupation by sectors in 2001 (% of the active population)

The unemployment rate in the catchment passes from 81.9% in 1996 to 83.3% in 2001. In rural areas it stabilises at a very high level (85%) during the period, whereas in urban areas it increases from 77% to 81%.

The active population is mainly involved in the provision of public and social services (about 40% and 30% in urban and rural areas respectively), whereas 25% of formally employed in rural areas work in the agriculture/forestry sector, and a relatively large group of employment is considered "undetermined". 10% of the active population in both rural and urban areas are employed as housekeepers. Wholesale and retail trade reaches 13% in the urban areas (10% in rural areas). Industry and the mining sectors are marginal in the catchment and the other categories of occupation account for less than 5% each (Figure 3.3.2.1).

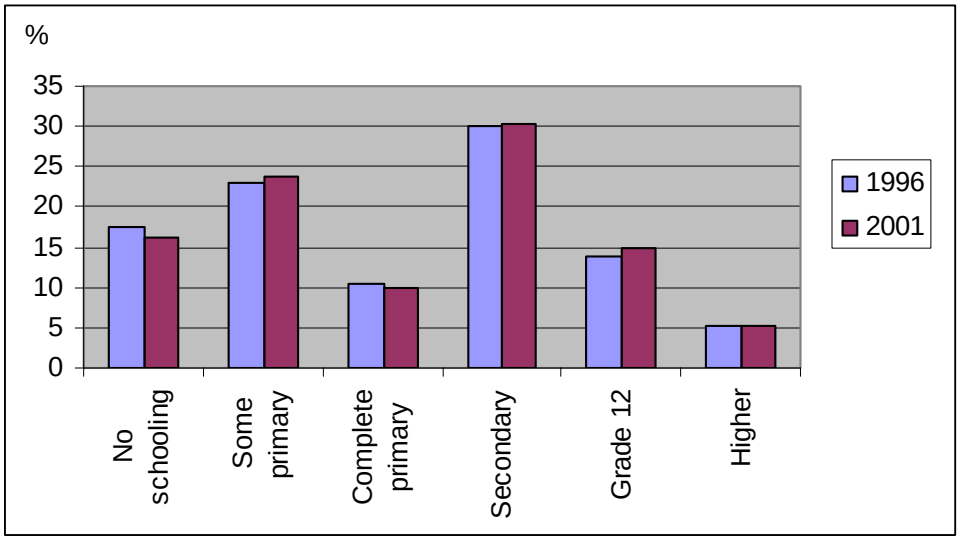


Figure 3.3.2.2 – Level of education in the catchment (% of population > 20 years old)

The level of education in the catchment does not improve remarkably during the 1996-2001 period (Figure 3.3.2.2). A slight reduction of total illiteracy is observable, as well as a slight increase in the percentage of people having some primary education, Grade 12 or higher diplomas.

Efforts to improve the basic level of education seem to take place particularly in rural areas, where the rate of illiteracy passed from 19.2% in 1996 to 17.2% in 2001.

An average annual income of R21 470 per household (R447/month/capita) was calculated for the whole catchment in 2001. In rural areas annual income decreases to R14 957/household (R328/month/capita), whereas in urban areas it reaches R30 264/household (R670/month/capita).

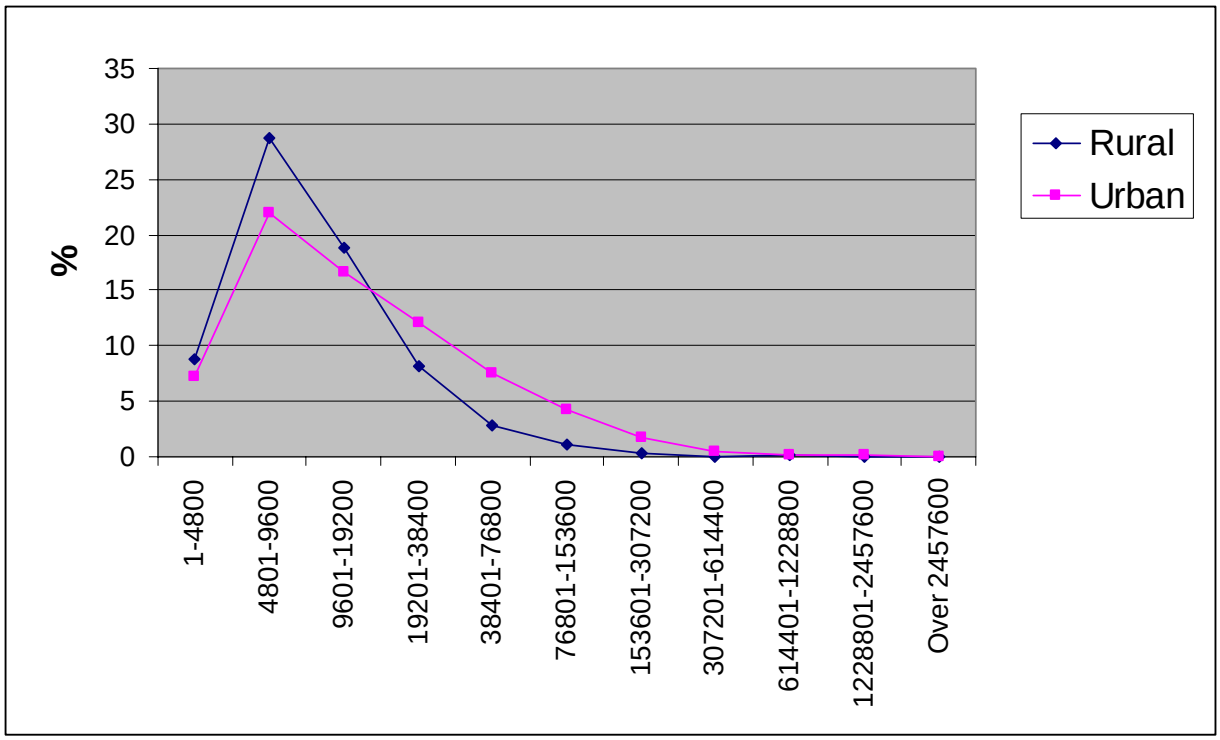


Figure 3.3.2.3 – Household's annual income distribution –2001 (R/year)

In terms of income distribution, in 2001 31.1% of households in the rural areas and 27.7% in urban wards declare to have "no income". The remaining households are distributed as in Figure 3.3.2.3. The large majority of the Kat households live with less than R19 200/year (corresponding to less than R400/month/capita). In rural areas more than 70% of the households dispose of less than R9 600/year. In urban areas the income distribution shows a slightly better situation: the share of population disposing of an annual income per household between R19 201 and R307 200 is higher than in rural areas. The percentage of households disposing of more than R307 200/year is marginal in both rural and urban areas.

3.3.3 Water sources

The major source of water for the households of the catchment in 2001 is the communal tap (39%) followed by private tap within the dwelling or in an outside yard (37%). River or stream water still represents the only source for 15% of the households, other sources (9%) include borehole, spring, and rain tank (Figure 3.3.3.1).

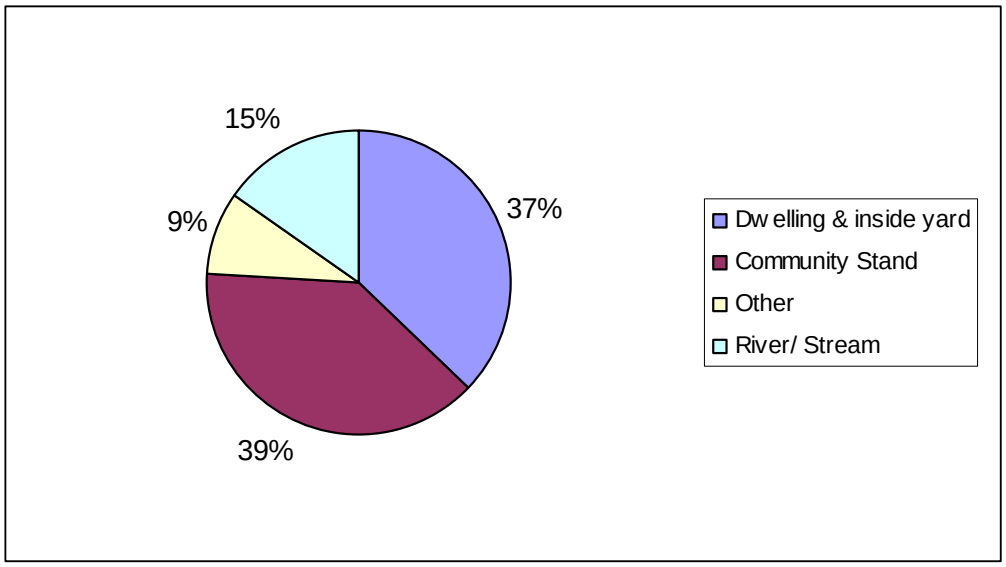


Figure 3.3.3.1 – Sources of domestic water in the Kat (2001)

Figure 3.3.3.2 shows the main trends in terms of water sources in the catchment (1996-2001). Improvements are observable in the provision of both private and collective tap water, whereas the number of households obliged to fetch water from the river or a stream decreases (from 25 to 15%). Vending water also reduces to 0 while it represented 2.5% of the domestic water sources in the catchment.

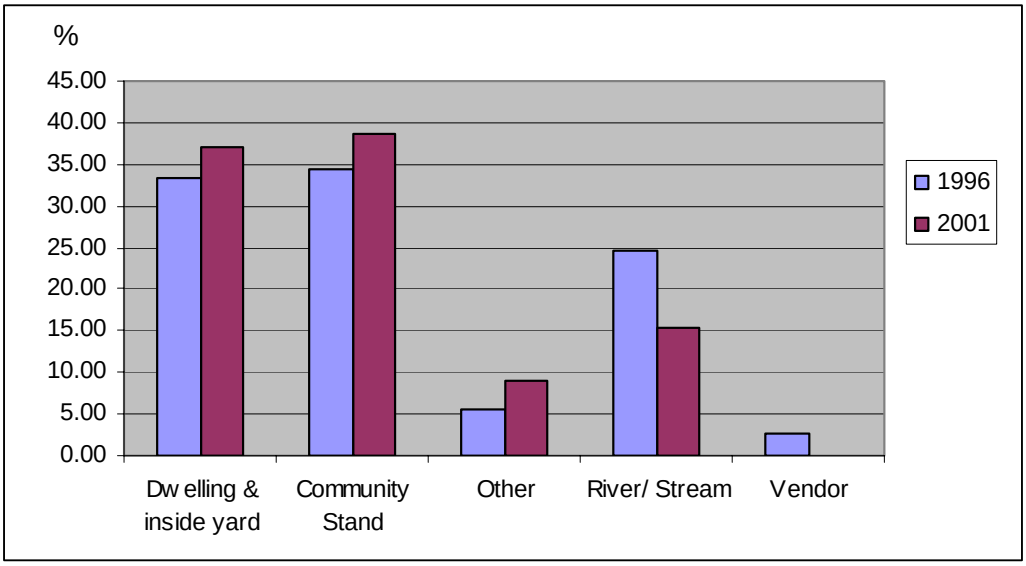


Figure 3.3.3.2 – Domestic water sources trends in the Kat (1996-2001)

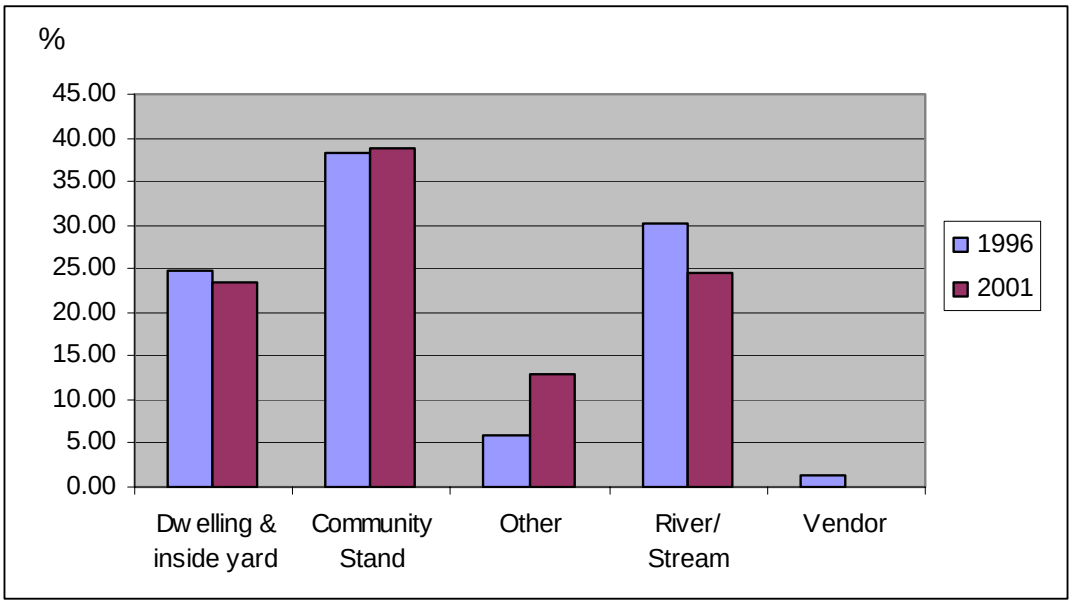


Figure 3.3.3.3 – Domestic water sources trends in the Kat (1996-2001) – Rural areas

The distribution of domestic water sources is strikingly different in rural and urban areas. Figures 3.3.3.3 and 3.3.3.4 show that while in rural areas still a relevant percentage of households fetch water directly from rivers and streams or buy water from water vendors; in urban areas almost 100% of the households have access to tap water (55% within dwelling or inside the yard).

Efforts for improving access to tap water in the urban areas are observable during the period 1996 to 2001, while in rural areas some improvements come from other sources, including boreholes and rain tanks.

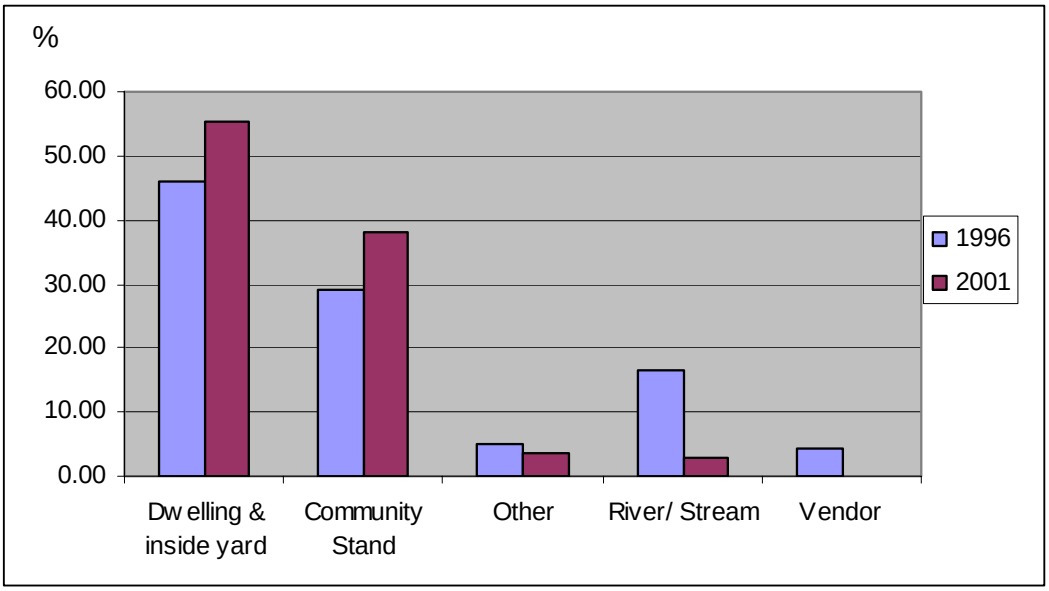


Figure 3.3.3.4 – Domestic water sources trends in the Kat (1996-2001) – Urban areas

3.3.4 Sanitation

15% of the households in the catchment have no access to sanitation facilities. Most families have a pit latrine (40%) or a bucket latrine (22%). Only 16% of the households dispose of a flush toilet (septic or not) (figure 3.3.4.1).

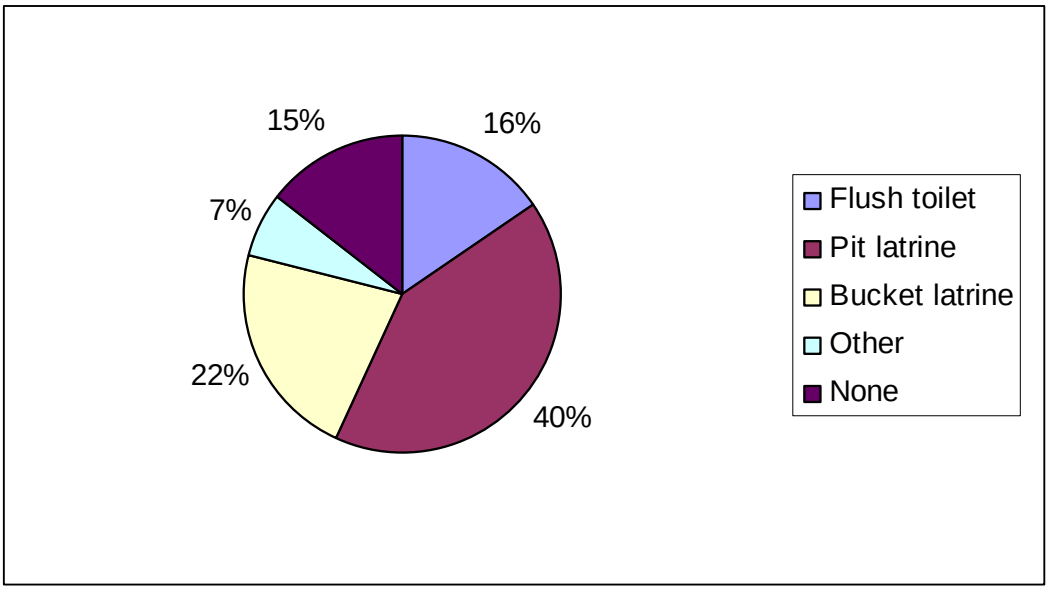


Figure 3.3.4.1 – Sanitation facilities in the Kat (2001)

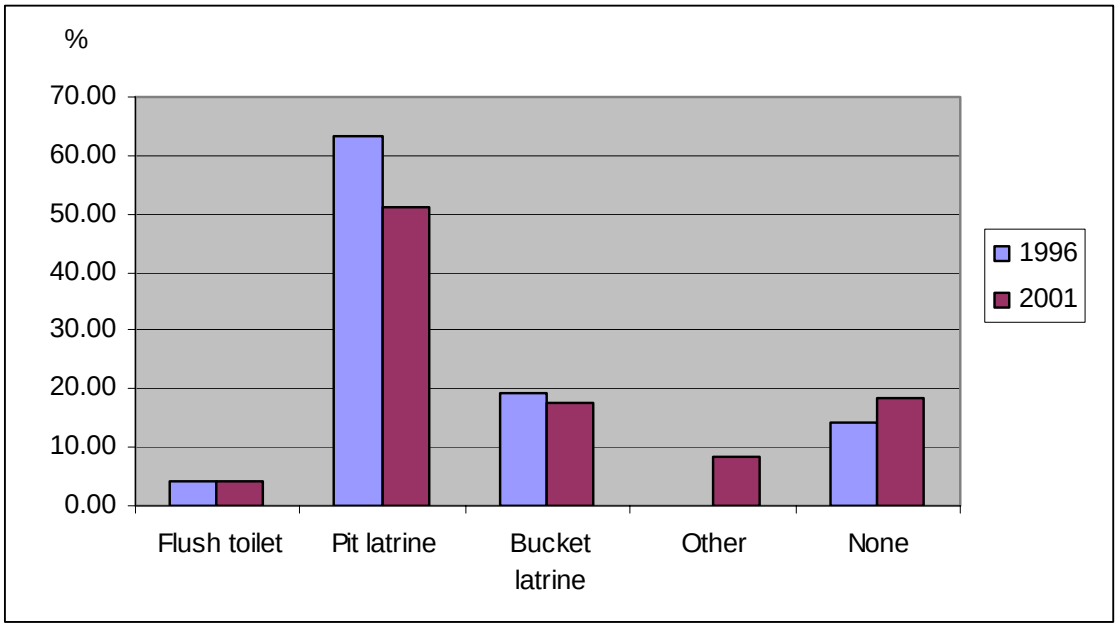


Figure 3.3.4.2 – Trends in sanitation facilities in the Kat (1996-2001) – Rural areas

Figures 3.3.4.2 and 3.3.4.3 illustrate the distribution of sanitation facilities in the Kat river rural and urban areas. The most frequent facility in rural areas is pit latrine, while in urban areas flush toilets, pit latrines, and bucket latrines represent 30 % each. The most relevant fact to observe is the increase of the number of households not making use of any sanitation facility in both rural (20% in 2001) and urban areas (less than 10% in 2001). Percentage of households with flush toilets increased in urban areas (from 20 to 30%) and stabilised in rural wards (less than 5%).

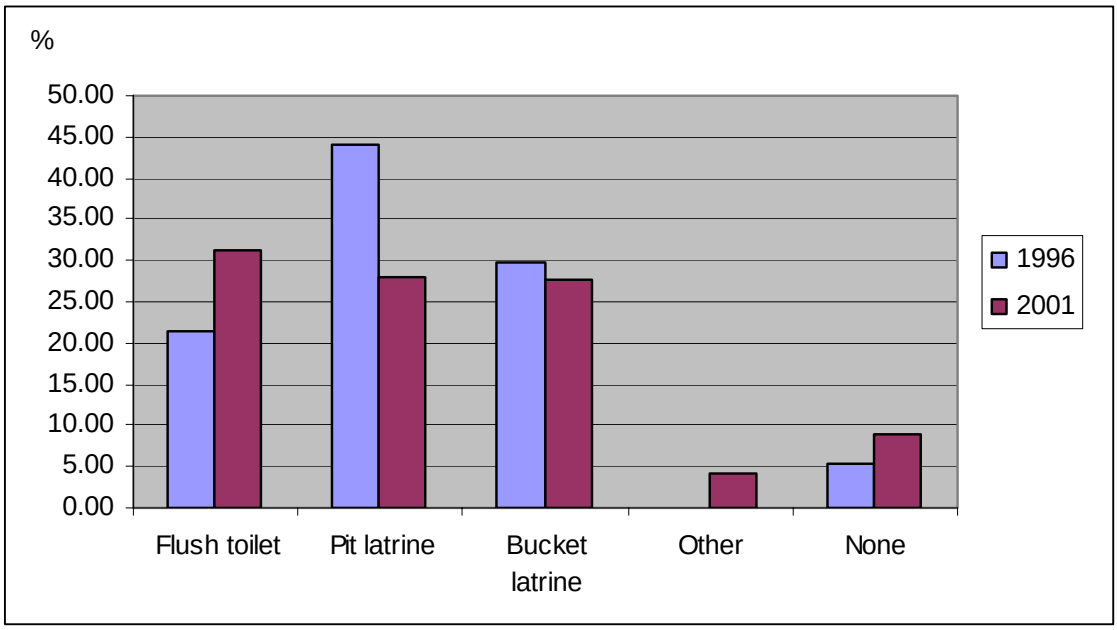


Figure 3.3.4.3 – Trends in sanitation facilities in the Kat (1996-2001) – Urban areas

3.3.5 Energy for lighting

An important effort towards electrification was made in the catchment during the period 1996-2001. Electric power for lighting was available for more than 60% of the Kat households in 2001 (about 30% in 1996). Electricity clearly substitutes paraffin, which was the main source of energy for lighting for the 65% of households in 1996 (30% in 2001) (Figure 3.3.5.1).

Surprisingly enough, in 2001 56% of the urban households use electric energy for lighting compared with 65% in rural areas. Candles still play a certain role in urban areas (10% of households) while in rural areas they are used only by 3% of the households.

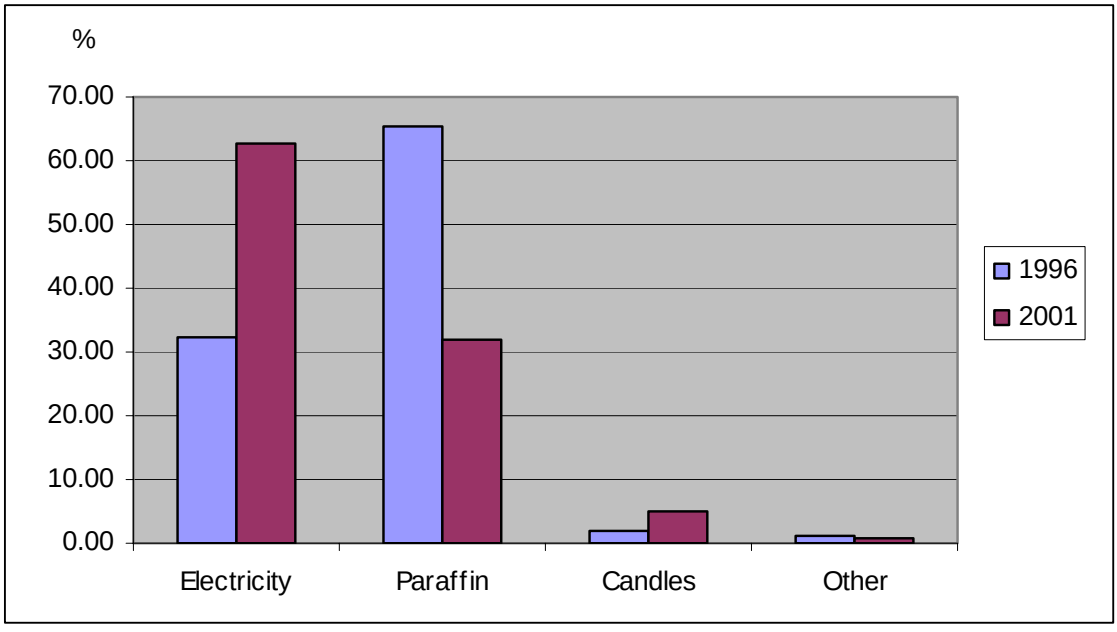


Figure 3.3.5.1 – Trends in the availability of energy for lighting in the Kat (1996-2001)

3.3.6 Telephone

The improvement in communication facilities, particularly in rural areas, is among the most distinctive socio-economic trends in the catchment. In 2001 only 4% of households declared to have no access to a telephone (27% in 1996) (Figure 3.3.6.1). In 2001 Public telephone is still the dominant way to communicate (45%), but 25 % of households have a private telephone within the dwelling (11% only cell phone and 6% both cell phone and telephone) while in 1996 only 13.6% of the total population had a telephone at home. The advent of new technology (mobile telephones) at a reasonable cost represented here a boost in the improvement of the local communication facilities. 18% of the households have access to the neighbour's telephone. "Other" includes households having access to a private telephone other than the neighbours' ones.

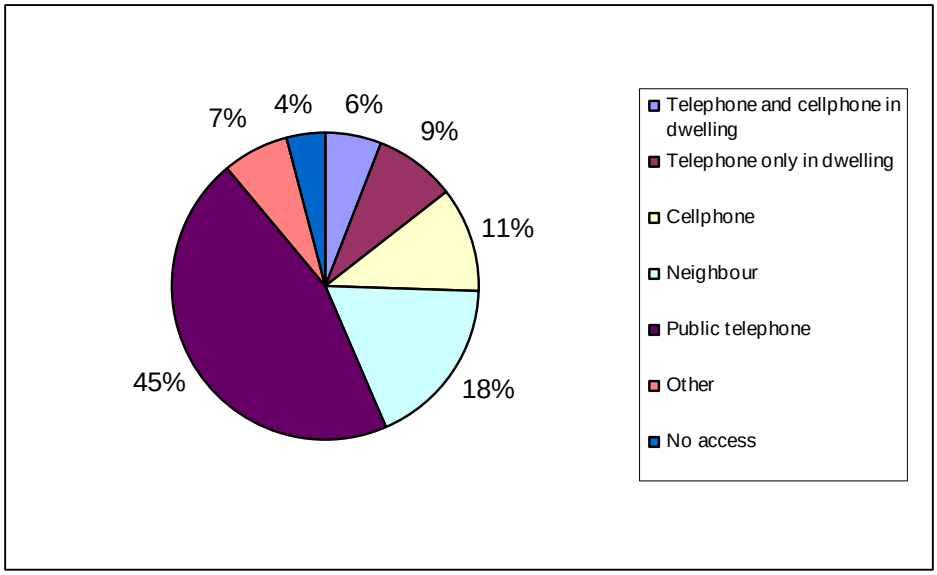


Figure 3.3.6.1 – Telephone facilities in the Kat (2001)

Figures 3.3.6.2 and 3.3.6.3 indicates clearly the different diffusion patterns of communication technologies in rural and urban areas during the period 1996-2001.

In rural areas households not having access to a telephone pass from 35% to 5%. Private telephones, particularly cell phones, but also public telephones contribute to the impressive improvement of communication facilities in rural areas of the catchment.

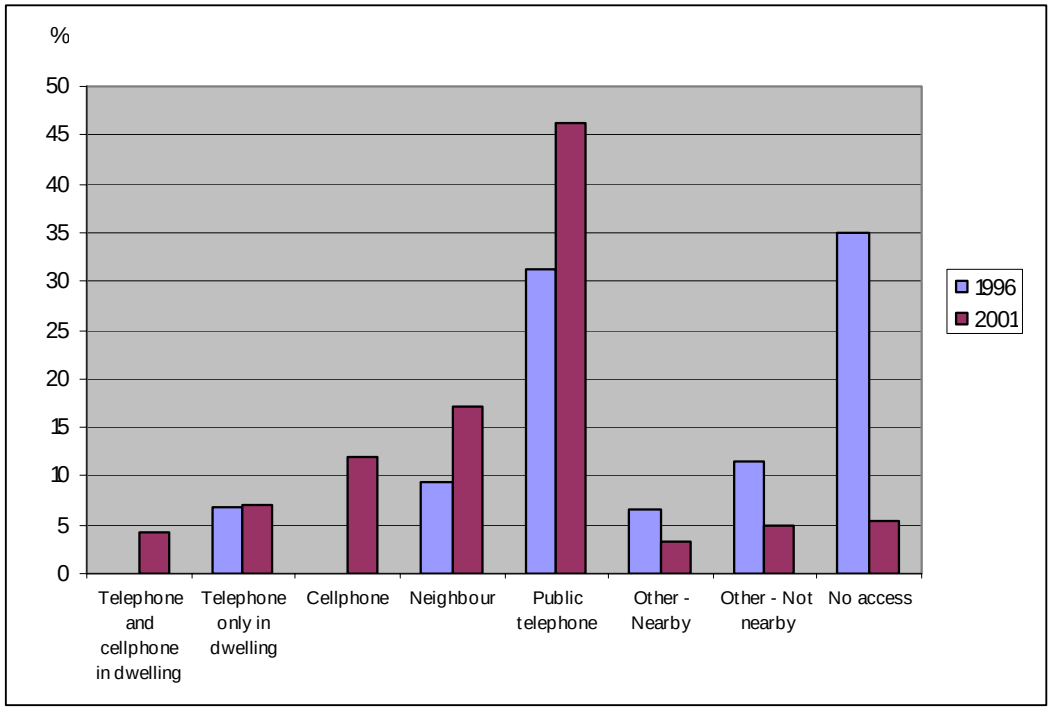


Figure 3.3.6.2 – Trends in telephone facilities in the Kat (1996-2001) – Rural areas

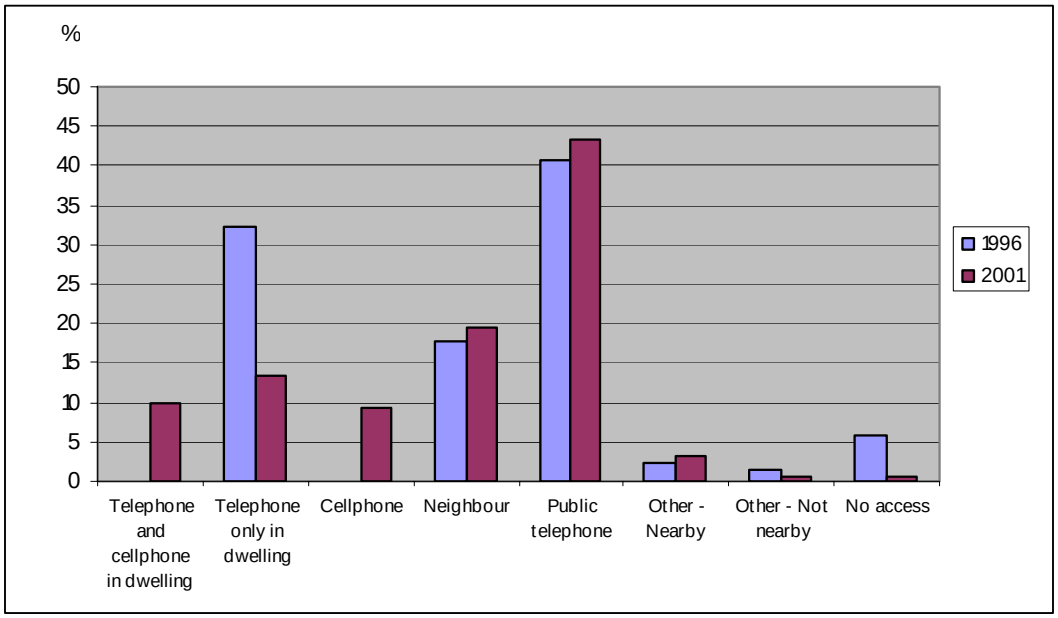


Figure 3.3.6.3 – Trends in telephone facilities in the Kat (1996-2001) – Urban areas

In urban areas almost no household declared in 2001 to have no access to a telephone (5% in 1996). It is interesting to note that the share of households having access to a telephone within the dwelling does not change during the period (about 32%), but the cell phone now complements or even substitutes the traditional telephone. Public telephone is still the major communication facility even in urban areas (more than 42% of households).

3.4 Synthesis of the socio-economic survey

The analysis conducted on the secondary data provided by Statistics SA (Census 1996 and 2001) allowed for the development of an initial socio-economic picture of the Kat river catchment. The catchment is constituted by a mainly rural population; where as about 40% of the total population is classified "urban" and live in small centres - mainly around the town of Fort Beaufort. The remaining population (almost 60%) lives in rural areas, which are identifiable by a lower income and a poorer provision of basic services i.e. water, education, sanitation facilities, etc.

Africans represent more than 90% of the total population living in the catchment.

A negative trend affects population in the catchment (-11% during the period 1996-2001). This trend is due to the combined effects of migration towards areas where work is more available and HIV/AIDS. The rate of unemployment in the Kat river catchment reaches 81.9% in 1996, and has worsened by 2001 (83.3%). Industry is marginal and there is no mining sector in the area. Consequently, agriculture and commercial forestry represent the main source of income for the local population.

Income is low, particularly in rural areas, where 31.1% of households declared to have no source of income at all (27.7% in urban zones). An average rural household composed of 4 members lives with R1 311/month, while in urban areas the average income for a household of the same size reaches R2 681/month. This, compared with national statistics, according to which the average individual income amongst the employed aged 15-65 years is R4 123/month in 2001, provides a clear image of the poor economic conditions of the households living in the catchment.

Illiteracy level is still high, particularly in rural areas, where in 2001 more that 18% of the population over 20 years old had received no education at all.

Efforts by the government to improve and provide basic services, to uplift the level of welfare and livelihoods in the catchment are evident.

In addition to the mentioned education efforts, provision of water, electricity, telephones and sanitation facilities improved during the period 1996-2001. Particularly in the field of water provision and sanitation services, though, the situation is still critical. Furthermore, improvements in urban areas are much more perceivable than in rural areas. 25% of the households living in rural areas have no access to a source of water other than rivers and streams, and 15% of the whole population in the catchment have no sanitation facilities. In addition to that, the large majority of households in rural areas declaring to make use of a sanitation facility have access only to pit latrines, and a large share of the urban population make use only of pit and bucket latrines.

It is evident that the investments to provide water distribution and sanitation networks, particularly in rural areas, are much more important than those needed for electrification and communication services. Nevertheless, in view of the present situation, it may be foreseen that public efforts will be addressed to water related fields in the future. This will have an impact on both water uses and water availability in the catchment, especially for the domestic uses. As domestic uses are likely to increase due to a better water provision and sanitation facilities, a rough competition between domestic and productive uses of the resource, mainly for irrigation purposes, can be expected. In addition to that, emerging farmers in the central and northern part of the catchment are expected to compete for the use of water with large-scale commercial farmers producing citrus in the central and southern parts of the catchment.
These dynamics could be a potential source of conflict between the different water users, in the near future. These conflicts could be avoided through better management of the resource at the local

level. In addition to supply management, which could be brought about through an improvement of the available water yield (cf. section 1), water demand management might be put in place through the adoption of economic and regulatory measures.

Participation and negotiation by all local users during the phases of design and implementation of these measures are crucial. They can be facilitated through the improvement of the information provided to all parties, and the availability of tools such as simulation models that help local users to discuss the scenarios. This then can lead to the adoption of improved strategies for the management of the common resource.

4. CONCLUSIONS AND WAY FORWARD.

This document provides a first picture of the water availability and requirements in the Kat River catchment, and illustrates some socio-economic trends over the period 1996-2001.

Resuming the main findings, it appears clearly that the present water balance in the catchment is positive, and therefore there is no water stress and no conflict for the use of the available water (yield). Nevertheless, this result refers to a situation where most households, particularly in rural areas of the catchment, do not have access to basic water and sanitation services. Furthermore, emerging agriculture, mainly smallholders, is expanding in the area. The provision of better water services to local households and the development of smallholding agriculture are the main socio-economic trends that may contribute in the near future to local scarcity and consequent conflicts for the use of water.

Increased water availability (supply management) or control (or limitation) on water demand may be ways to avoid these conflicts. Water demand management can be put in place either through command-and-control tools, such as a system of compulsory water licensing, or through the adoption of economic tools such as water tariffs and taxes. If economic tools are envisaged in the Kat catchment, they should be modulated to the poor economic conditions, and consequently the small willingness/capacity to pay, of most local households.

More in general, water management strategies should be negotiated and discussed among local stakeholders (the local Water User Association) in order to achieve a common understanding of the situation and a shared vision of the actions to be implemented at the catchment level for the common wellbeing.

Simulation models may help to accompany local stakeholders in the process of discussion and negotiation regarding water management strategies to be adopted at the catchment level.

The data and information collected in the present document are a first step towards the development of such models. Nevertheless, for the purpose of the project and particularly for the development of simulation models representing various scenarios of water allocations, further surveys are required in the following fields:

- Productive sectors: identification of the productive uses of water in the catchment, quantity used, production functions, water-connected costs and revenues, etc.
- Domestic users: in addition to the information contained in this report, a primary data survey will be needed to quantify: the amount of water used in rural and urban areas, their present cost (if applicable), water fetching practices (if a tap is not available in the dwelling), etc.
- Water available, hydrological and geographic data (GIS): data on the yield (according to DWAF terminology), the reserve, and the hydrological and geographic characteristics of the catchment will be needed for modelling purposes.

Of particular importance is the spatial information, since this can be included in certain methods of modelling such as the Multi Agent Systems (MAS) envisaged for use in the Kat River. MAS can provide a spatial representation of socio-economic and ecological dynamics in a determined context, such as the Kat River catchment. Scenarios produced by MAS are easily discussable by local stakeholders since they can refer to dynamic maps. This characteristic makes MAS a powerful simulation tool to be used in contexts of negotiation support and discussion facilitation.

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