The cost of rural water supply: A case study in South Africa

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Summary

This paper critically reviews the progress in the water sector in South Africa over the past 2 decades. Particular attention is paid to the institutional setting, and it is noted that no **single** agency is responsible for supplying water to unserviced communities, which has resulted not only in haphazard and unco-ordinated policy in the sector, but, more importantly, in a situation in which less than 53% of the rural population has access to adequate potable water supplies. Cost figures must continue to be regarded with a degree of scepticism as long as estimates are based on extrapolations from existing data rather than on detailed cost estimates for different regions and varying schemes and technologies. This paper provides an example of a detailed cost estimate for one particular project, and suggests that there are potentially considerable cost savings associated with small-scale schemes, which emphasise community participation and the use of community labour.

Introduction

In a draft policy on water supply and sanitation for developing communities, the Department of Water Affairs and Forestry (1991) has acknowledged that cost estimates for basic water supply provision "will continue to be a considerable task as long as information on water sector demand remains at its present low level". It is not surprising, therefore, that rural water supply cost estimates by the Development Bank of Southern Africa (DBSA) (see e.q. Hollingworth, 1990; Jackson, 1991) and the CSIR (see e.q. Pearson, 1991) have tended to rely on extrapolations from existing data, rather than on detailed empirical projections.

This paper begins with a brief history of water supply development in South Africa since the 1970s, focusing on the institutional constraints in the sector. This is followed by the core of the paper, in which a detailed cost analysis of a rural water project is provided. The project was initiated by the Rural Advice Centre (RAC), a non-government organisation working in the field of rural development. It is hoped that an assessment of the particular approach followed by the RAC (community participation, the use of local labour in construction, etc.) will contribute to a re-evaluation of the global estimates on which policy conclusions in the sector have been unduly influenced.

Institutional issues in the water sector

The emphasis in water supply development in a South African context has been on large-scale regional schemes, involving conventional engineering designs of dams and storage reservoirs which aim to supply water to a number of communities via long pipelines. Not only have such schemes been costly to implement and operate, but the long time-period required for construction has meant that regional systems have been unable to respond to immediate needs brought about by severe water shortages, such as the drought in the mid-1980s. As a result, most authorities have been forced to switch to emergency relief supplies, usually in the form of small borehole schemes (Pearson, 1991). As financial constraints worsen, regional plans have slowed and cost recovery has been introduced (at a low level) in many areas.

Moreover, the institutional setting in which water supply development has taken place is instructive as to why only 53% of the population living in rural areas of South Africa had access to adequate drinking water supplies at the end of the decade (Pearson, 1991). In real terms, the United Nations'International Drinking Water Supply and Sanitation Decade (IDWSSD) appears to have made very little impression in a South African context, "where no single agency at national level is charged with the responsibility of ensuring that all households are served with adequate water supply and sanitation" (Muller, 1991a). The Department of Water Affairs and Forestry, for example, which is responsible for controlling and encouraging effective water resource development, has no direct responsibility to supply potable water.

Sound policies and strategies for rural water supply development are meaningless in an institutional framework which is fragmented and unco-ordinated. Responsibility for water supply to communities "within" the Republic has been delegated to a variety of Government agencies at national, regional and local levels. At the national level, the Departments of Water Affairs, Planning and Provincial Affairs, National Health and Development Aid (now defunct) all have some responsibility for promoting service provision in rural areas; none, however, has a direct mandate to supply water to communities which remain unserved.

At the regional level, Water Boards are restricted in their operations by the requirements that their tariffs cover costs and that they supply local authorities rather than individual consumers (Muller, 1991). Both restrictions invariably result in the poorest communities missing out, perhaps with the exception of Umgeni Water in Natal, which has a substantial water and sanitation programme to rural and peri-urban areas. Regional Services Councils, structured on racial lines, have proved unsuccessful on legitimacy grounds. Many black local authorities have failed for the same reasons.

Furthermore, apartheid social engineering and the subsequent emergence of so-called national states and self-governing territories has placed the majority of South Africa's rural population outside the jurisdiction of the above-mentioned government departments. The water supply needs of these communities have thus become the responsibility of financially hamstrung, inept and often corrupt homeland governments. At local level, many tribal authorities lack legitimacy and/or the resources to provide services.

By the 1980s, a number of non-government organisations (NGOs) began to operate in the water sector. Recognising the importance of appropriate technology, these NGOs opted for small-scale schemes, preferring spring protection, groundwater extraction and local water systems (reticulation to a few communal

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taps) to the centralised schemes pursued by government agencies. Moreover, community participation - from initial planning, through construction to operations and maintenance - became central to village water supply development. Although current practice by government authorities remains focused on completing regional schemes started in earlier years, there has been sporadic co-operation with some of the NGOs in developing smaller schemes.

The Mafefe water project

Project background

Homeland government agencies have a clear mandate to provide water to the population living outside proclaimed towns. In Lebowa, the Department of Agriculture and Environment Affairs and the Department of Works are responsible for the provision and maintenance of water supply and sanitation systems (DBSA, 1989). Given the recent findings of the De Meyer Commission into irregularities in the Lebowa Government, Development Corporation and Agriculture Company - in which the homeland government is charged with large-scale fraud, nepotism, corruption and a general lack of competence (see e.q. The Star, 1992) - it is not surprising that at least 50 % of rural people, over 1.25 m., do not have access to adequate water supplies (Pearson, 1991).

The Mafefe Water Supply Scheme in Lebowa is a project of the RAC, a non-government organisation which aims to "support the development struggle of rural people through the provision of professional engineering, community organisation, financial advice and agricultural skills" (RAC, 1989a). The RAC's approach to rural development is based on the belief that the sustainability of infrastructure development is dependent on the creation of acceptable, accountable and accessible local organisational capacity. Thus, the empowerment of rural people - the process whereby marginalised communities equip themselves with the resources and the will to break out of their entrapment - is the major objective of the RAC.

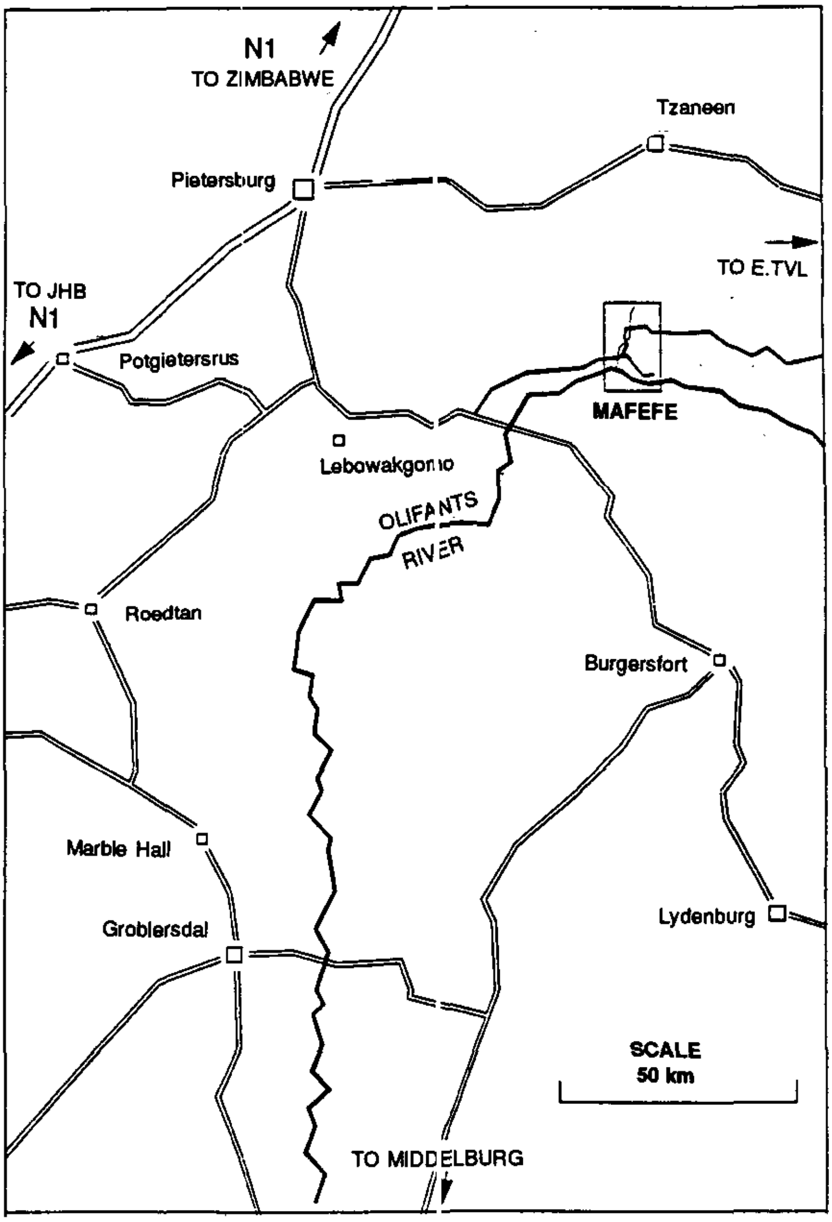

Figure 1
Regional location of the Mafefe district

Mafefe is a district of approximately 250 km^2, consisting of 27 villages, situated in a triangle created by the Strydpoort Mountains, the NE Drakensberg and the Olifants River (Figs. 1 and 2). Mafefe is 100 km SE of Pietersburg in the N. Transvaal, and 410 km from Johannesburg. A 1987 census, undertaken by the National Centre for Occupational Health (NCOH), indicated a total population of 11 082, 19% of whom were migrant labourers (Felix et al., 1988). The community depends mainly on remittances from migrant workers employed in the Pretoria-Witwatersrand industrial region for its economic support. Apart from agriculture (largely for domestic consumption), there have only been limited employment opportunities in teaching, shop-keeping and building construction since the closure of the asbestos mines in the district in the early 1970s. In addition, RAC assessments suggest that the agricultural resource base is minimal. The few farmers who manage to produce a surplus of vegetables complain of inadequate transport and market opportunities (RAC, 1992).

The RAC was introduced to the Mafefe community in May 1988 by Dr Marian Felix of the National Centre for Occupational Health (NCOH) which has been active in Mafefe since 1987 to assess the health hazards posed by environmental asbestos pollution. The mining of asbestos, which commenced in 1910 and continued until the early 1970s, has resulted in the deposit of numerous waste dumps in the district, creating a serious health risk for the local residents. An NCOH medical survey of asbestos-related diseases revealed a prevalence among 40% in a random

TABLE 6
COST COMPARISONS; RURAL WATER SUPPLY*

Reference	*Per capita* cost**			Ga Mampa *per capita* cost (1989 constant price terms)***	
	US$	Rand equivalent			
WHO, 1984	$32	R25	(1980 prices)	R 54	(1980 prices)
Africa - (Singh, 1990)	$40	R89	(1985 prices)	R 96	(1985 prices)
CSIR - (Pearson, 1991)	N/A	R18	(1990 prices)	R194	(1990 prices)
DBSA - (local schemes)	N/A	R100	(1990 prices)	R194	(1990 prices)
DBSA - (regional)	N/A	R600	(1990 prices)	R194	(1990 prices)

* It is acknowledged that these various rural water systems are not **directly** comparable in that details of design criteria and levels of technology are not available. Moreover, differences in calculation methods have hindered effective cost comparisons between countries. In a South African context, the lack of co-ordination in the water sector places substantial doubt on the reliability of available cost data. Nevertheless, such comparisons are useful in that they yield some indication, albeit imperfect, of the relative cost-effectiveness of the Ga Mampa water supply scheme.

** The *per capita* cost for each scheme is determined by converting the US dollar price into rands (where applicable), using Quarterly Bulletin of the SARB (1988) average $/R exchange rates for the year in question.

*** The construction cost of the Ga Mampa project of R173 *per capita* (at constant 1989 prices) is deflated (inflated for 1990 prices) to the relevant year, using Production Price Index data available from the Quarterly Bulletin of the SARB (1989, 1990, 1991). The deflated (inflated) figures are then compared to the *per capita* cost of the various water supply schemes referred to in Table 6.

funds are available. It must, however, be borne in mind that there is insufficient empirical evidence to support the validity of either the CSIR's or DBSA's figures.

Most significantly, the cost of the Ga Mampa scheme is substantially less than the DBSA estimate for regional water supply projects, based on **actual** policy in the South African water sector (The almost R10 billion required for rural water supply assumes investment in centralised piped schemes which, at the present rate of implementation, may take 20 to 30 years to complete. Based on current policies, the capital cost of rural water supply is approximately R600 *per capita* - Jackson, 1991).

Conclusion

The current institutional setting in the South African water sector is patently haphazard, and is likely to be restructured under a new political dispensation. Since it is usually those communities with the greatest needs which have the weakest institutions, it will be necessary to establish at a national level an appropriate forum to co-ordinate water sector activities so as to ensure that no communities fall through the institutional net. Regional and local authorities will similarly need to be replaced by institutions which enjoy the support of the communities they represent.

With respect to cost data, this paper has attempted to argue that it is reasonable to remain sceptical of the "alternative" available estimates of water supply project costs (Jackson, 1991; Pearson, 1991; etc.), until the organisations and agencies responsible for these figures begin to rely less on extrapolations from existing data and start to develop a set of detailed empirical analyses covering the geographically specific costs of supply and the level of service appropriate for each area. Jackson, for example, bases his calculations on the assumption that handpumps are the appropriate technology for **all** rural communities. Given that haul costs can be significant, particularly where the opportunity cost of villagers' time is high, then a handpump scheme may in fact involve higher costs than a piped system over the full lifetime of the project.

Despite its poor showing with respect to WHO estimates, it is interesting to note that the cost of the Mafefe water scheme is not significantly different from that of rural water supply projects in other sub-Saharan African countries. Moreover, although it would be premature to arrive at any definite conclusions, it appears that the emphasis by NGOs on small-scale, participatory schemes has the potential not only to deliver urgently needed drinking water at a faster rate, but would require a substantially smaller capital investment than one based on current policy in the sector. The net saving of such schemes could be substantial, particularly when one considers the fiscal impact on Government revenue of addressing other inequalities such as health care and education.

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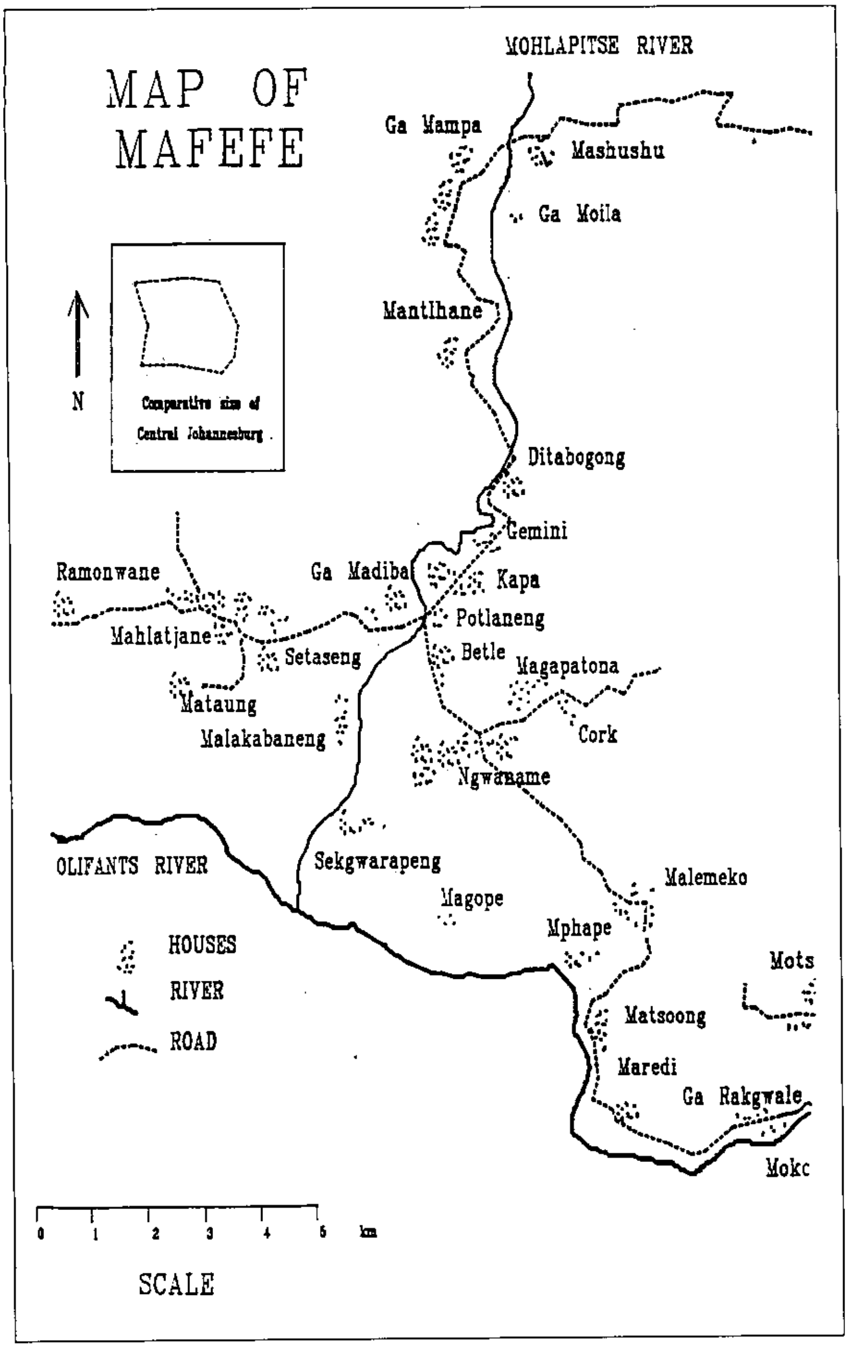

Figure 2

The 27 villages comprising Mafefe district in Lebowa

sample of 612 adults (Felix et al., 1989). Although the ingestion of asbestos-contaminated water will not cause asbestosis, tests in Mafefe have shown that clothes washed in the rivers that flow through the district contain a very high concentration of respirable asbestos fibres. The inhalation of such fibres is likely to contribute to the spread of respiratory disease.

The water sources for the majority of Mafefe inhabitants are the Mohlaphitse and Olifants Rivers. In addition to the presence of asbestos fibres, both rivers are contaminated with bilharzia. NCOH tests of urine and stool samples from schoolchildren in different areas of Mafefe indicated that 78% were positive for either *Schistosomiasis* (bilharzia) *mansoni* (stool) or *Schistosomiasis haemotobium* (urine). Twenty-nine % of adults were infected with *S. mansoni* and 2% with *S. haemotobium*. Chronic infections of the former can lead to liver fibrosis and splenomegaly, and of the latter to haematuria and a higher incidence of cancer of the bladder (Felix et al., 1988).

Given this background, the objective of the water intervention was to provide safe primary and secondary water supplies to all the people of Mafefe, paying particular attention to the removal of asbestos and harmful bacteria from the water. Project design therefore included the establishment and protection of adequate sources, the treatment of water (where necessary) to acceptable standards, the reticulation of water to all 27 villages and village reticulation. All supply lines are designed for a 40 year period, based on an expected annual population increase of 3%. Given RAC's emphasis on community organisation, the project also involved the establishment and training of committees to ensure that community members were included as primary decision-makers in all aspects of design, construction and maintenance.

The 27 villages of Mafefe were divided into 7 zones for design and costing purposes. The water scheme in Zone 1, the Ga Mampa subregion, has recently been completed. The zone consists of 4 villages; namely Ga Mampa, Mashushu, Manthlane and Ditabogong. Prior to the intervention, people from this subregion collected water from an old irrigation canal, fed by the Mohlaphitse River, or from the river itself.

Given the expenditures involved in treating the river water and pumping it to a high level storage reservoir, it was decided to use an alternative source, the Dibenge Spring, situated in the mountains 2.1 km from Ga Mampa village. The spring flow was measured twice during the dry season of 1989 and was found to yield between 3.3 and 5 $\ell \cdot s^{-1}$. According to local residents, the spring has never been known to dry up. Tests of the bacterial quality of the water indicated that the spring was relatively uncontaminated and would therefore not require treatment (RAC, 1989b).

The spring pipeline, which has been protected, carries water to a balancing reservoir where it is distributed to village storage reservoirs (ferrocement tanks) via the main supply line. Village mains then supply the communal standpipes. The maximum cartage distance from a standpipe to any household is approximately 250 m. The system has also been designed to allow for direct household connections, although this has not yet been implemented. The scheme in Zone 1 involved the construction of 7 ferrocement tanks and 18 standpipes, and the laying of approximately 10 km of pipeline. The scheme provides the entire population of 1 647 (1992) with potable water.

Project costs (cost figures are based on 1989 prices)

Ga Mampa is the largest village in Zone 1 (75% of the total Zone 1 population - see Table 1) and was the first to receive piped water. Construction was completed by March 1991. This case study will focus on project costs and benefits only with respect to Ga Mampa village, since final cost data for the other villages in the subregion are not available.

Material costs

The costs of the original preliminary bill of quantities were inflated in that they did not take into account the substantial discounts (often up to 40%) available from suppliers. The costing has subsequently been reworked, and given that most pipes are of the same diameter, is based on an average pipe cost (including transport) of R6,90/m. Table 2 summarises the material costs for Ga Mampa village, which includes 4.1 km of pipeline, a break-pressure tank, 2 cattle troughs, 2 ferrocement tanks and 12 standpipes.

TABLE 1
VILLAGE POPULATION - GA MAMPA SUBREGION
(Felix et al., 1988)

Village	Population - 1987	Population - 1992*
Ga Mampa	1 064	1 234
Mashushu	114	132
Manthlane	154	179
Ditabogong	89	103
Total	**1 421**	**1 647**

* The 1992 figures were calculated on the assumption of a 3% per annum growth in population.

TABLE 2
ACTUAL MATERIAL COSTS (1989)

Item description	Unit	Quantity	Rate	Amount
1. Ferrocement tank (reservoir)				
Sand	m^3	3.67	20.00	73.40
Cement	pockets	33	10.00	330.00
Chicken mesh	m^2	47.11	5.00	235.55
Wire	m	75.30	1.50	112.95
Outlet/inlet	number	2	60.00	120.00
			Total	**871.90**
2. Reticulation				
2.1 Spring pipeline				
50 mm dia., HDPE	m	1 600	6.90	11 040.00
Break-pressure tank*	number	1	300.00	300.00
Cattle troughs**	number	2	150.00	300.00
			Subtotal	**11 640.00**
2.2 Main pipeline - Ga Mampa				
Reservoirs	number	2	871.90	1 743.80
50 to 75 mm dia., HDPE	m	2 500	6.90	17 250.00
			Subtotal	**18 993.80**
2.3 Standpipes (includes soakaway and surroundings)				
Communal standpipes	number	12	282.50	3 390.00
			Subtotal	**3 390.00**
3. Summary				
Spring pipeline				11 640.00
Main pipeline				18 993.80
Standpipes				3 390.00
			Total	**34 023.80**

* Including labour. A breakdown of the labour content of the cost of a break-pressure tank was not available from RAC files.

** Including labour. As with the break-pressure tanks, RAC did not separate out the labour content of the cost of cattle troughs. The cattle troughs were included in order to keep animals away from the spring.

Labour costs

The Mafefe Water Committee decided that the community would provide all the unskilled labour for the project. The Water Committee provided a Water Team to assist with technical details, but the residents of Ga Mampa were responsible for the digging of trenches and laying of pipes in their village. Initially, a base rate of R7.50 per day for community labour was agreed upon. Although it was subsequently decided that community labour should be voluntary and unpaid, this original base rate has been used to calculate the labour component of the project costs. (It should be borne in mind that this rate is high relative to the prevailing casual daily wage rates and the opportunity cost of this labour (Sender, 1993). However, the choice of a different wage rate would not have made an appreciable difference to the estimate of total project costs, since, as shown in Table 3, unskilled labour costs only amounted to about 6% of total costs).

Administration support costs, travel and fees

It was necessary to divide the project into 4 separate time periods, since community organisation (CO) and construction work did not occur simultaneously. (As mentioned above, the RAC is not only concerned with the technical aspects of projects. As a result of the emphasis on "community organisation" or "community-based development", the salaries and travel time of community field workers - usually social workers or social scientists - constitute a significant component of **total** administration support costs, travel and fees). In addition, the death of the Chief delayed construction work between May and October 1990. RAC's field register suggests that June 1989 and February 1990 are the appropriate starting times for calculating the costs to the project of the community social worker and field engineer respectively.

Monthly expenditure since the project's inception is made up as in Table 4. Total administration support costs, travel and fees are therefore

TABLE 3
UNSKILLED LABOUR COSTS

1. Piping	Length of piping	4 100 m
	Labour cost per metre	R2.50
	Subtotal	**R10 250.00**
2. Reservoirs	Work days/reservoir	42
	Labour cost/reservoir	42*7.5 = R315
	Number of reservoirs	2
	Subtotal	**R630.00**
3. Standpipes	Work days/standpipe	9
	Labour cost/standpipe	9*7.5=R67.50
	Number of standpipes	12
	Subtotal	**R810.00**
	Total	**R11 690.00**

* Given the local conditions of the terrain and the experience/skills of the community work teams, it has been found that, on average, a community labourer can dig, lay and refill 3 m of trench per day. The labour cost per metre is therefore calculated by dividing the metres dug per day (3 m) by the base pay rate (R7.50). In other words, the labour cost per metre is R7.50/3 = R2.50.

TABLE 4
ADMINISTRATION SUPPORT COSTS, TRAVEL AND FEES (IN R)

Cost categories	06/89-01/90	02/90-04/90	05/90-10/90	11/90-03/91
Engineering costs	**00 000**	**6 112**	**00 000*** **	**7 810**
Salaries:				
Senior engineer (1/8)	00 000	498	00 000	498
Field engineer	00 000	813**	00 000	2 400 ****
Student technician	00 000	2 500	00 000	00 000
T4 technician	00 000	00 000	00 000	2 500
Travel	00 000	1 745	00 000	1 702
Design fees @ 10 % of salaries and travel	00 000	556	00 000	710
CO costs	**3 150**	**2 943**	**3 070**	**2 968**
Salaries:				
Senior CO staff (1/3)	1 000	1 000	1 000	1 000
CO field worker	1 050	1 050	1 050	1 050
Travel (CO)*	1 100	893	1 020	918
Admin support @ 20% of CO and eng. costs	**630**	**1 811**	**614**	**2 156**
Monthly total	**3 780**	**10 866**	**3 684**	**12 934**

* The travel costs in each period are determined by multiplying the number of trips per period by the return distance to Mafefe (850 km), and multiplying this amount by a per kilometre vehicle cost based on Automobile Association of South Africa figures. This value is then divided by the number of months/period to determine an 'average' monthly travel cost. The rate appropriate for the community field worker's car and engineer's panel van was 45 and 77 c·km^{-1} respectively in 1989.

** During this period, the field engineer spent only a quarter of his time on the Mafefe project.

*** As mentioned above, the Chief of Mafefe passed away in April 1990 and the community observed a traditional mourning period of 4 months. As a result, although community organisation continued, construction was delayed for almost 6 months.

**** A new field engineer began to work in Ga Mampa from January 1991. Rather than breaking the period 11/90 to 03/91 into 2 separate periods, the cost of the engineer has been calculated by multiplying his salary (R4 000) by 3 months (January to March 1991) and dividing by 5 months to determine a monthly average [i.e. (4 000 * 3)/5 = 2 400].

(R3 780 * 8 months) + (R10 866 * 3 months) + (R3 684 * 6 months) + (R12 934 * 5 months) = **R149 612** (or R68 862 and R80 750 for engineering and field costs respectively).

Summary of costs

1. Material costs	34 023	18%
2. Unskilled labour costs	11 690	6%
3a. Travel, fees and admin costs (eng.)	68 862	35%
3b. Travel, fees and admin costs (CO)	80 750	41%
Total project costs (at 1989 prices)	**195 325**	**100%**

Given a 1989 population of 1 129, the capital cost of the Ga Mampa village component of the Mafefe water supply scheme is R173 *per capita*. It must, however, be borne in mind that the above estimate of the total project cost of the Ga Mampa scheme has been inflated, for several reasons. Firstly, the protected Spring, the spring pipeline and the balancing reservoir serve **not only** Ga Mampa village but 3 other villages with a combined 1992 population of 414. Therefore, part of the material, labour, travel and supervision costs are not specific to Ga Mampa village but rather to the Ga Mampa subregion as a whole. Secondly, "community organisation", the cost of which includes the salaries of the field workers, travel and administrative support, takes place **throughout** the 27 villages of the Mafefe region and its costs cannot therefore be attributed to Ga Mampa village alone. Both these factors may be considered to reduce the per capita cost of the Ga Mampa water system, and in particular the latter, since "community organisation" contributes 41% of total project costs.

Operation and maintenance costs

Recently, the Mafefe Water Committee and the RAC agreed to introduce a community project cost (CPC) scheme whereby Water Committee office bearers and Water Team members are compensated for time spent on water project activities (The CPC scheme is currently financed by the Independent Development Trust (IDT) but it is envisaged that the community will take responsibility for these costs once construction is completed). The former co-ordinate the project and the latter supervise construction in each village and are also responsible for system maintenance. **Monthly** CPC scheme and repair material costs for Ga Mampa village are given in Table 5 (at constant 1992 prices):

TABLE 5
MONTHLY CPC SCHEME AND MATERIAL COSTS FOR GA MAMPO VILLAGE

11% of the cost of 3 office bearers @ R150/month*	R 49.50
11% of the cost of 10 water team members @ R200/month	R220.00
Repair materials per month	R330.00
	R599.50

* Since the population in Ga Mampa village is approximately 11% of the **total** population of Mafefe, it is reasonable to assume that Ga Mampa residents should be responsible for 11% of office bearer and water team wages.

Since these costs are likely to continue even after construction is completed, they can be regarded as operation and maintenance costs. Given a 1992 Ga Mampa population of 1 234, and assuming an average 7 persons per household, a monthly household contribution of R3.40 (i.e. R599.50/176) would cover operation and maintenance costs for the Ga Mampa water scheme (Data on *per capita* costs for operation and maintenance are not readily available and comparisons are therefore difficult to make. The CSIR (see e.q. Pearson 1991), however, estimates a cost of R10/household per annum for operation and maintenance of a basic spring protection scheme).

The cost of "community participation"

It can be seen that the RAC's emphasis on the creation of local organisational capacity accounts for a considerable proportion (41%) of total project costs. This focus on "empowerment" and "capacity building" renders it difficult to compare the cost of an RAC scheme to that of a commercial engineering firm in the short term. In financial accounting terms, "community-controlled" projects are likely to be less cost-effective in the short-run. The crucial issue is to determine whether the stress on a so-called community-controlled process is cost-effective in an economic sense with respect to project sustainability. Given that only one of seven zones has been completed and that the project is only three-and-a half years old, it is probably still too early to ascertain whether the investment in "institutional capacity building" has been justified. On the other hand, high costs cannot indefinitely be explained away by this type of expenditure. So-called community-controlled processes must be able to yield significantly better results, i.e. in terms of maintenance quality, if they are to cost up to 40% more than conventional methods.

Cost comparisons of rural water supply

Table 6 compares the *per capita* cost of the Ga Mampa project with estimates of several rural water supply schemes cited in the literature. As indicated by the table, the Ga Mampa cost is more than double, in rand terms (R54 as compared to R25), the median construction cost of US $32 per capita for rural water supply, as determined by the World Health Organisation (WHO, 1984) review of national baseline data for the International Water Decade. With respect to Singh's (1990) estimates of water supply costs in Africa, the Ga Mampa scheme is slightly more expensive (R96 as compared to R89 *per capita*) than the median *per capita* cost of a communal standpipe system in Sub-Saharan Africa.

The Ga Mampa figure is considerably more than the CSIR's estimate (R18 *per capita* or R120 per household), which is based on a simple spring protection system to a village of 250 homes and an approximate population of 1 500 to 2 000 people. It is assumed that the system supplies a daily minimum of 20 *l* *per capita*, and that the average household consists of 7 people (Pearson, 1991). Moreover, it is higher than Jackson's (1991) estimates for the DBSA (R100 *per capita*) for basic village standpipe systems. Jackson's rural service proposals are quite closely in line with World Bank policy recommendations in that they involve a move towards the implementation of "appropriate" technology and the support of community-based projects, which are designed to lead to smaller, more cost-effective initiatives with communities more directly involved in operation and maintenance. The approach therefore favours a reliance on handpumps over regional piped schemes. In addition, the upgrading of existing water sources, like spring or well protection, plays an important bridging gap until