WORKING PAPER 74

Possible Impacts of the Transformation of Water Infrastructure on Productive Water Uses

The Case of the Seokodibeng Village in South Africa

Marwan Ladki, Jetrick Seshoka, Nicolas Faysse, Hervé Lévite and Barbara van Koppen

International Water Management Institute

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Acronyms

AWARD	Association for Water and Rural Development
CSIR	Council for Scientific and Industrial Research
LPDAE	Limpopo Province Department of Agriculture and Environment
DWAF	Department of Water Affairs and Forestry
LSEC	Lebalelo Sub-Executive Committee
LWC	Lesetse Water Committee.
LWSS	Lebalelo Water Supply Scheme
LWUA	Lebalelo Water User Association
MCM	Million Cubic Meters
NDA	National Development Agency
SDPC	Seokodibeng Development Program Committee
SV	Southern part of the Seokodibeng Village
SWC	Sub-Water Committee
TLC	Transitional Local Council
WC	Water Committee
WUA	Water User Association
WV	Western part of the Seokodibeng Village

Summary

The study assesses the current water supply system and water uses in the Seokodibeng village in the former Lebowa homeland, in the Limpopo Province of South Africa. This village is part of a group of 96 villages that are to receive water from a pipeline built by neighboring mines in order to secure their development. The mines and the villages are members of the Lebalelo Water User Association. In 2003, this association was the only Water User Association in South Africa not based on farming activities. The initial question of this study concerns the future of productive uses of water at village and household levels once Seokodibeng's connection to the pipeline is achieved.

The review of past investments shows that the village was successful in attracting funds from many organizations to develop its water pumping and distribution infrastructure. However, investments for irrigation activities or domestic water uses have been made separately, without considering the possible multiple uses of an infrastructure. Because of internal problems and the lack of satisfying communication with other external organizations, a part of the village faces serious water shortages, while irrigation has been stopped in the different communal gardens. At the same time, homestead gardens irrigated from communal taps are flourishing in the part of the village unaffected by shortages.

The connection to the pipeline will bring about a change in tariffs, from a monthly fee per household to one based on volume consumption, but communal taps will probably still be used. The analysis of the economic productivity of the different small-scale activities (homestead garden, communal garden, brick fabrication, and livestock) shows that all these users should be able to bear the change in the tariff system, provided that the products can be sold.

The current problems faced by the village are not a lack of water resources or equipment, but rather a lack of internal organization within the village and the absence of an organization in charge of maintenance that is accountable to the village. Therefore, the important investment about to be made of connecting the village to the pipeline may be less urgent than an improvement of the institutional organization of water supply. The productivity of water used at household level and the link between the size of the gardens and the distance from the taps call for a more thorough investigation of the costs and benefits of installing household taps.

Introduction

Aim of the study

In 2001, a group of mining companies built a pipeline to secure access to water in the Steelpoort River basin and neighboring subbasins, situated in both the Limpopo and Mpumalanga provinces in South Africa. The Department of Water Affairs and Forestry (DWAF) accepted the building of the pipeline and the related temporary water licence on the condition that the 86 villages situated along the pipeline would be connected (the number of villages to be connected was later expanded to 96). Another requirement was that the mines and the villages would be part of the same Water User Association (WUA) that would operate and maintain the pipeline. This study aims to understand, through a case study of the village of Seokodibeng, the main changes in water usage and management that the future connection to the water pipeline is likely to trigger.

In order to understand the situation in 2003 and the possible changes stemming from the forthcoming connection, this research investigated three different issues: i) the historical development of water supply systems in the village, ii) the management of these systems and the related problems, and iii) the productivity of the different uses of water at village and household levels.

The current level of access to water varies tremendously among the villages that will eventually be connected to the pipeline, from the use of a nearby river to private connections in homes. Therefore, the findings with regard to the case study of Seokodibeng cannot be extended to the whole area without further research. It is, however, a very interesting example, with incidents of active community involvement in developing access to water and with many productive uses of water being noted at the household level.

The first section of this paper describes the association responsible for bringing together the mines and villages, called the Lebalelo Water User Association (LWUA). It also describes the reason for the LWUA's creation, its infrastructure, management, and the involvement of the villages. The second section discusses the Seokodibeng village, the different water-related projects and, finally, the problems experienced in water management. The last section focuses on the future involvement of the village in the LWUA, and, in order to do this, assesses the productivity of water for the different existing productive uses at household and village levels.

Methodology

The study took place from June to September 2003. The history of Seokodibeng's access to water, its water management and the map of the water-related infrastructure were obtained through individual interviews with members of the past and current Water Committees (WCs), and relevant individuals from the community (cf. table 1 in appendix 1).[1] Documents from previous water-related projects in the village were also reviewed. Moreover, an economic assessment was conducted for the productive uses of water (cf. last section of this report).

[1]Table 1 (in appendix 1) also indicates the reference code used to cite the source of information given hereafter. For example, LWUA1 refers to a member of the LWUA staff.

The Lebalelo Water User Association

The need to transfer water from the Olifants River

The growing demand for water

In the Steelpoort River basin, mining activity is constrained by water availability. First, due to the lack of storage capacity in the Steelpoort River, the mines often face water shortages for a period of 4 months a year. Second, since the mines have been expanding their activities (Lévite et al. 2003), in the 1990s, they were seeking more water licences—from 14 million cubic meters (MCM) a year in 1992 to 28 MCM in April 2000. In 2003, the mining industry was estimating that its needs would be around 50 MCM/year by 2012 (LWUA1). However, the DWAF does not grant new water licences in this basin, because of the already fragile balance between resources and uses (Lévite et al. 2003). Therefore, the mines approached the DWAF in 1999 to consider the possibility of building a pipeline that would transfer water from the nearby Olifants River to the Steelpoort River basin. However, for the same reasons mentioned above, the DWAF refused to grant more water licences from the Olifants River.

The Arabie small-scale farmer irrigation scheme is situated between the Flag-Boshielo (formerly Arabie) Dam and the junction between the Steelpoort and Olifants Rivers (figure 1). The scheme almost completely collapsed in the 1990s after the disestablishment of the previous parastatal agency (Kamara et al. 2002). Therefore, the DWAF proposed to temporarily transfer a 13 MCM/year water licence from Arabie's formal allocation of 18 MCM/year. Negotiation took place to specify the terms of the transfer between the mines, the DWAF and the Limpopo Province Department of Agriculture and Environment (LPDAE).[2] The latter represented the small-scale farmers in the negotiation.

It was initially agreed that the mines would rent these 13 MCM for a period of 5 years (2002 to 2007) for a sum of ZAR 7 million.[3] This amount was used to reconstruct parts of the canals within the Arabie Scheme (LWUA 2001). It represented around 3 percent of the total costs of the water transfer scheme. New dams are scheduled on the Olifants and Steelpoort Rivers so that both the mines and the Arabie Scheme will be able to get more water (appendix 2).

DWAF willingness to set up a Water User Association

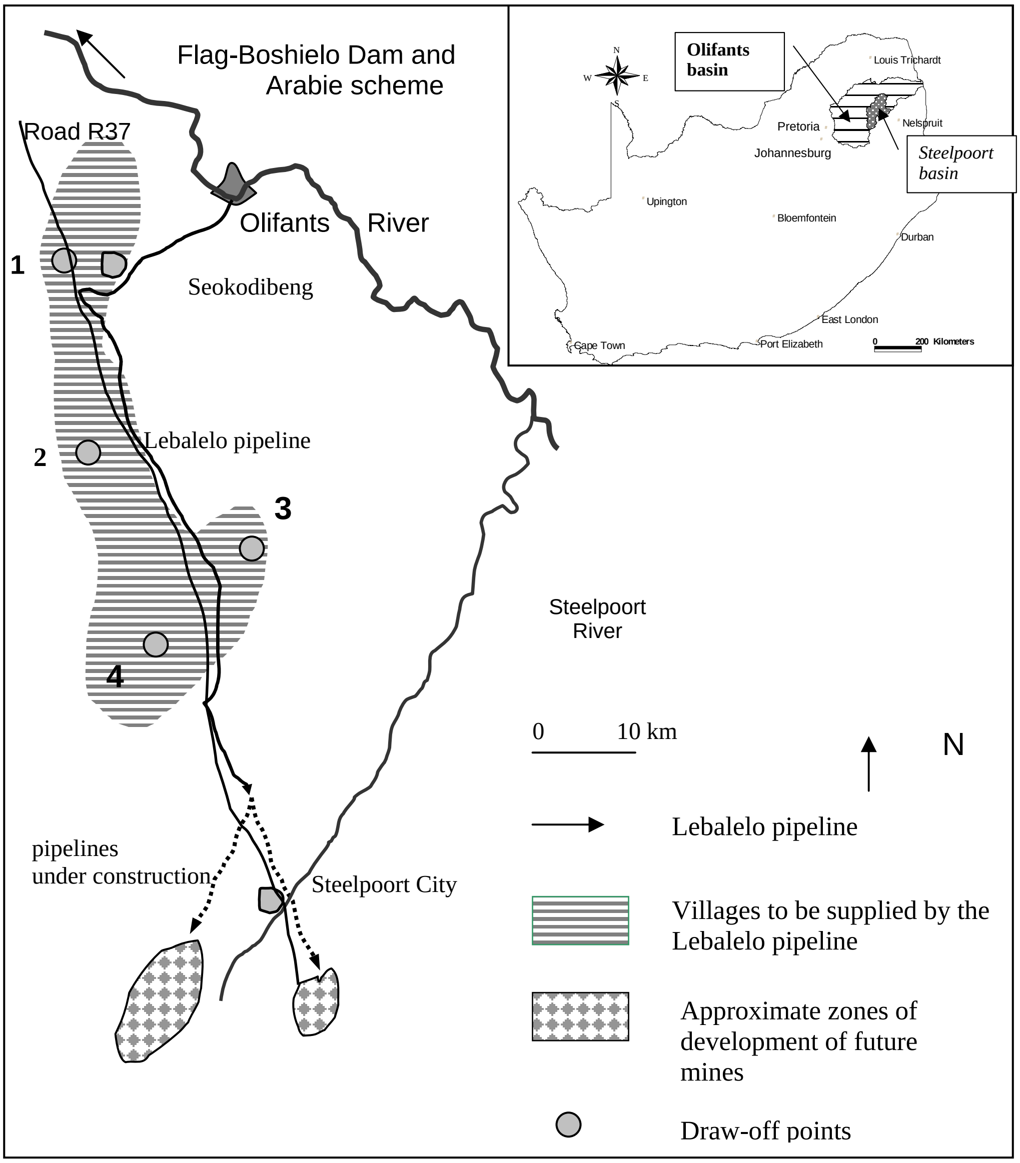
The South African National Water Act (Act 36 of 1998) created two new water management organizations: the WUA at the local level and the Catchment Management Agency at the broad catchment level. The Act also gives the possibility to the DWAF to request for membership in a WUA as a necessary condition to obtain a water licence. Even though in 2003 most of the large-scale WUAs came into existence from the transformation of farmer-dominated Irrigation Boards, any type of water user can a priori join a WUA.

The DWAF accepted the temporary transfer of licence from the Arabie Scheme to the Steelpoort River Basin on the conditions that i) a WUA would be created to manage the pipeline; ii) the water scheme would also supply the rural communities situated along the pipeline; and iii) these communities would be part of the WUA. Three reasons justify the connections: (a) in many places, the boreholes are not functioning because of a lack of maintenance; (b) in some places, there is not enough groundwater; and (c) even though the

[2] Until 2002, the Limpopo Province was called Northern Province.
[3] In November 2003, 1 South African Rand (ZAR) amounted approximately to US$0.12.

water provided by the LWUA may be more expensive than water obtained from boreholes, the pipeline will provide a better assurance of supply in periods of drought (LWUA1) and will ensure adequate operation and maintenance of the system.

Figure 1. Location of the Lebalelo Water User Association.



The Lebalelo WUA

The LWUA is responsible for the construction, operation and maintenance of the Lebalelo Water Supply Scheme (LWSS), which abstracts untreated water from the Olifants River and which is due to supply six mining ventures and 96 nearby villages of the Sekhukhuneland district in the Limpopo and Mpumalanga provinces. The constitution of the LWUA was signed by the mines in April and July 2001, and the association was approved by the Ministry of Water Affairs on 22 January 2002. The construction of the LWSS started in

April 2001, and the scheme started functioning in April 2002 (LWUA 2001). Appendix 2 describes the LWUA infrastructure.

Membership

According to the constitution of the LWUA, the members of the association are divided into two groups. The first group is called "industrial users" and is made up of the six mining companies which initially invested capital in the project in 2003. The second group, called "ordinary members", comprises all the non-mining users. In 2003, the DWAF was the only member in this category. According to the Water Service Act (1997), the DWAF should handover the responsibility of drinking water supply to the local government, i.e., the Local or District Municipality.[4] During this process, the DWAF should also transfer its share of capital in the LWUA to the local government. Table 1 provides the names of the LWUA members, their initial contributions and their voting powers within the LWUA.

Management of the association

The number of votes is proportional to the capital committed (table 1). The Anglo American Platinum Corporation (also called Amplats; hereinafter referred to as 'Anglo Platinum') was the main driver behind the design and implementation of the project. Indeed, Anglo Platinum's mines are expanding in the area, through six different projects. Because of an urgent need for water, Anglo Platinum agreed to pay all the initial costs, and be reimbursed afterwards by the other members (annexure 2 of the LWUA constitution, 2001).

Table 1. Water use entitlement, percentage of votes and capital invested for the members of the LWUA.

Members	Water Use entitlements		Voting rights (%)	Capital invested (%)
	$1,000m^3/d$	$1,000,000m^3/yr$		
Anglo Platinum	44	16.06	57.34	66.10
Trojan	13.8	5.04	17.99	17.63
ASA Metal	1.2	0.44	1.56	2.05
Samrec	0.6	0.22	0.78	0.19
Samancor	6	2.19	7.82	6.51
Mpumalanga and Northern Province Development Corporation	0.5	0.18	0.65	0.86
DWAF	10.6	3.87	13.85	6.66
Total	76.7	28	100	ZAR 230 million

Source: Annexure C of the LWUA constitution, 2001.

Anglo Platinum leads the association. The quorum is fixed as 50 percent of the votes. Therefore, the vote of Anglo Platinum is a sufficient condition to reach the quorum, as the company owns 57.34 percent of the votes. The Chairperson and the Deputy Chairperson of the LWUA Management Committee "shall be elected by the members of the association

[4]Local government in South Africa consists three levels: province (e.g., Mpumalanga), district municipality and local municipality.

from among the members of the management committee and on the basis of a two-thirds majority vote," which means that they cannot be persons Anglo-Platinum would not vote for (LWUA 2001). Similarly, Anglo Platinum votes are necessary for any decision concerning the disestablishment of the association. Eighty percent of votes are needed for the approval of a Business Plan, as well as for some specific decisions.

Management Committee

The Management Committee of the LWUA is made up of five members: three industrials, one ordinary member and one representative for both provincial governments dealing with the LWUA (Limpopo and Mpumalanga). The Management Committee must be represented by members of both genders and must include black as well as white representatives (LWUA 2001). The office term is 2 years and one can only be re-elected once. The LWUA constitution accepts the possibility for the members to trade water licences among themselves.

Finances

The cost for the whole project (pump stations and reservoirs) was ZAR 230 million (cf. table 1). Each of the seven LWUA members paid a capital contribution in proportion to their water use entitlement as described in table 1. The price of water includes two types of costs. First, the fixed costs, called basic charges, are to be paid by each LWUA member, in order to recover the capital costs. They are proportional to the distance between the user's connection to the main pipeline and the water abstraction station on the Olifants River. The basic charges do not depend on the consumption. Second, the variable charges are set to recover costs such as electricity, operation, maintenance or repairs. They depend on the consumption and were around ZAR 2.5/m^3 in 2003 (LWUA1). As a consequence, the variable costs depend on both individual consumption and the total water consumption of all the users, since a general decrease in water consumption will lead to a relative increase in production cost per unit of water.

Involvement of the rural communities

Water supply to the communities

Initially, 86 villages were to be supplied by the LWUA. The area was later extended to encompass 96 villages. The DWAF contributed ZAR 14 million for the necessary infrastructure that would be able to supply the demarcated villages with 25 liters per capita per day. The LWUA also contributed ZAR 14 million for future additional demand from 25 to 65 liters per capita per day (LWUA 2001). Finally, the number of inhabitants—132,000 in 2003—was considered to remain stable in the future, with the hypothesis that departures to cities will compensate natural growth. However, the water dedicated to drinking water use was calculated for 165,000 inhabitants, in order to be able to later provide a supply to other villages neighbouring the zone. Given a demand of 65 liters per capita per day, this amounts to a rise in domestic water needs from 3.5 to 3.8 MCM/year (Rouzère 2001). Untreated water will be supplied to the communities through four draw-off points in the demarcated area (figures 1 and 6). Water will probably be distributed through communal standpipes, based on the Reconstruction and Development Program standards, i.e., each household should be at a maximum distance of 200 m from the nearest tap.

Depending on the sources of information, the total cost of building the schemes to provide water from the main pipeline to the communities varies from ZAR 175 million (BKS 2001) to ZAR 380 million (Rouzère 2002). In 2003, the first feasibility studies were made on the zone corresponding to draw-off point number four in order to supply an existing public hospital. By the end of 2003, there was still no village connected to the pipeline in the whole LWUA area.

The Water Service Act (1997) defines two organizations for the management of water supply and sanitation. The drinking water and sanitation networks are owned by a Water Service Authority, which is usually the District or the Local Municipality. The operation and maintenance is delegated to a Water Service Provider. The Water Service Authority has a formal water entitlement. The main part of the LWUA area of jurisdiction falls under the Greater Tubatse Local Municipality. The rest of the LWUA falls under the Fetakgomo Local Municipality. Both Local Municipalities are part of the Greater Sekhukhune District Municipality. The Greater Tubatse Local Municipality is due to become the Water Service Authority in its area of jurisdiction. However, the choice of a Water Service Provider had not been finalized by mid-2003. It could be, for instance, a private company, the LWUA, the Local Municipality itself, or even the Sekhukhune District Municipality for the entire area (according to a meeting with the Mayor of Fetakgomo, having the Sekhukhune District Municipality as a WSP for the entire area was being discussed). Both levels of municipalities have also to prepare a water supply development plan and an integrated development plan.

Representation of the communities within the LWUA

Since the DWAF was very sensitive with regard to the quality of the public participation process, the mines committed ZAR 200,000 to achieve this, under the guidance of the Naledi Development consultants. This public participation process lasted for 9 months and was completed in May 2001 (LWUA 2001). First, the 86 villages initially concerned were visited individually and the Ndunas (local representatives of the traditional chiefs) were met. Second, each village sent three representatives to meetings that were held at each of the four future draw-off points. During the workshops set up at these four draw-off points, representatives were elected—a permanent Lebalelo Sub-Executive Committee (LSEC), made up of 30 representatives of the villages and three representatives of the local government (Annexure B of the LWUA constitution, 2001). Finally, a meeting was held with all 13 local Tribal Authorities, who nominated a representative of the villages at the Management Committee of the LWUA.

The purpose of the LSEC is to provide feedback of the LWUA's activities to the communities. Members receive transport allowances from the LWUA. The first chairperson was elected in 2001 for no limitation in time and was still occupying this position in 2003. The representatives knew very little about each other and the one who was elected chairperson was the 'most known', since no one else volunteered (LSEC1, LSEC2). This lack of enthusiasm can be seen as a lack of involvement by the community representatives in the public participation process, or as a lack of in-depth participation building from the Lebalelo WUA.

There was no agreement with regard to the success of the public participation process. The community representatives felt that the workshops for capacity building did not take place as promised. Many villagers and members of the village Water Committees interviewed were not aware of the public participation process that had taken place. Meanwhile, the Lebalelo WUA staff considered that capacity building had been achieved and that the community representatives had misunderstood the meaning and the scope of the process. Moreover, according to the social consultant in charge of the public participation process, transport allowances—which are larger than the actual cost of transport—are of key importance with regard to the representatives' interest in participating.

The chairperson is already part of the social network linking the mines and the communities, since he is a staff member of Anglo Platinum and a member of the Labor and Management Task Team on one of the sites of the mine. Therefore, he is also in charge of providing feedback of the mines' activities to the members of the LSEC.

In 2003, 2 years after the public participation process, no village had still been connected to the pipeline. The extensive public participation process created high expectations among the villagers, who started getting impatient and damaging the mining equipment (LWUA1). The villagers reported that although many promises were made, they were not fulfilled Therefore, the LWUA was active in trying to push forward the development of the secondary pipes and treatment plans, which is, in fact, actually the responsibility of the DWAF and the Municipalities.

Seokodibeng Village

The area and the village are presented first. Then, the history of the development of the village's infrastructure is described, followed by a presentation and analysis of the rules that manage this infrastructure and its current functioning.

Description of the area

Seokodibeng is among the ten villages that fall under Ward 11 of the Fetakgomo Local Municipality. It is adjacent to the R37 that links Lydenburg and Burgersfort to Polokwane, and is about 50 km north-west of Burgersfort (figure 2). The area was part of the former Lebowa homeland. Seokodibeng is stretched out at the foot of the Tsidintsing and Lesetse Mountains, with a few houses at the foot of the Ledingwe Mountain (figures 2 and 3). The village consists of two well-separated geographical areas, namely, the southern part of the village (SV) and the western part (WV).

The Sekhukhune area falls within the summer rainfall region of South Africa. It has a mean annual precipitation of between 500 and 600 millimetres with a standard deviation of up to 30 percent from the mean. The mean annual temperature is 20 degrees Celsius and the mean annual evaporation is calculated to be around 1,700 millimetres (Geo Hydro Technologies Consulting 1994). Local people report an intermittent storm occurrence once in 3 years. In January 1990, November 1994 and January 2003, very strong storms occurred, with disastrous consequences for Seokodibeng. Buildings at the foot of the Lesetse Mountain were destroyed, such as the community hall and other communal infrastructure (FWC1).

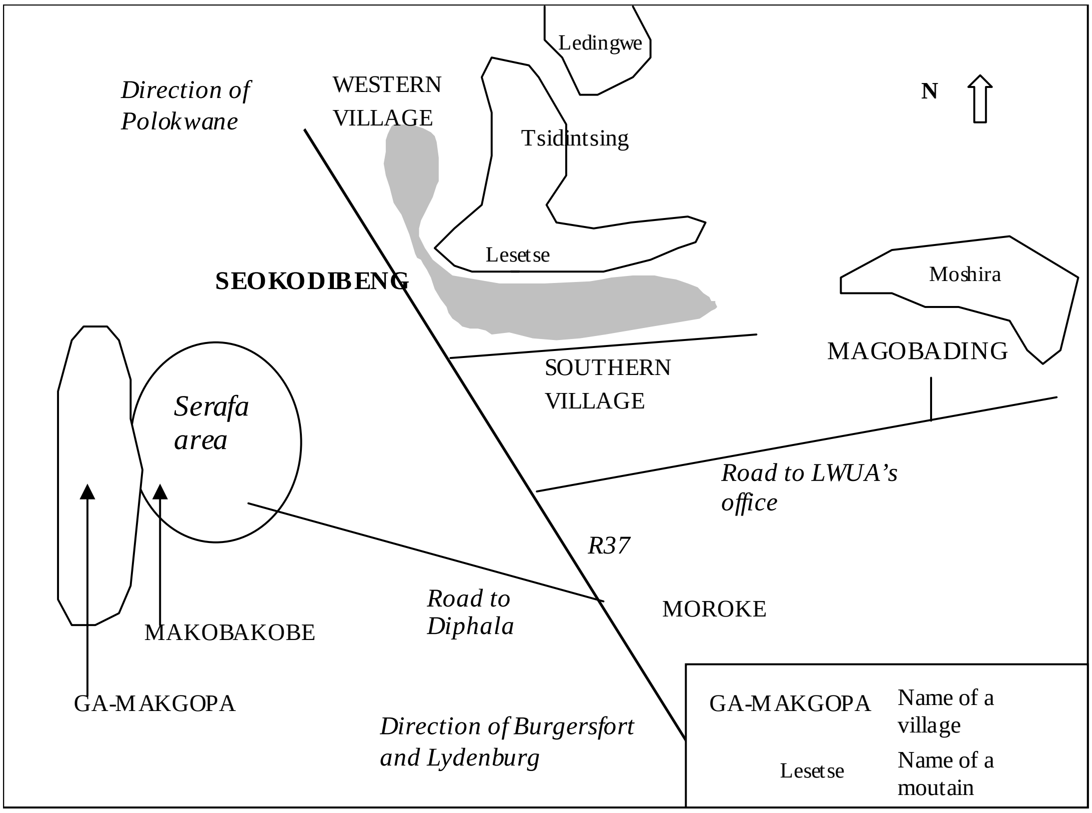
Land use and activities

The R37 tarred national road passes near the village. In the village itself, the gravel roads are in fair to bad condition. The village is not connected to a power line, and there are only two public phones. Seokodibeng has three schools—two primary schools and one secondary school—as well as six churches. There is also a community hall for committee meetings.

The only economic activities are three communal gardens of 2 hectares each, a communal poultry farm, two shops and two tuck-shops. Only the two tuck-shops were functioning in July 2003. The communal poultry farm and one of the communal gardens have never functioned. The other two communal gardens were irrigated only for a few years and both of them stopped functioning in 1999. Their closure led the villagers to increase the size of backyard vegetable and fruit-tree gardens.

These trees are common in many households, even in houses without private gardens like in the WV. Fruit-trees are grown mainly for the purpose of obtaining food, either for self-consumption or for sale in local markets. The most common fruits are paw-paw, banana, marula, and avocado. Trees are also grown for amenity (e.g., bougainvillea), shade and for protecting houses against strong winds, for example, Moogoma, Jacaranda and Marula trees. The mountain slopes provide grazing grounds for the community's cattle.

Figure 2. Scheme of Seokodibeng and the surrounding villages.



Vegetation and soil cover

The area is relatively dry, with short grass covering the high-lying areas and sparse bush covering the valleys. The soil cover is of a brown to red sandy type and is thickest in the valleys. It has a very high infiltration rate and a low holding capacity. Because of its sandy and loose nature, the soils are very susceptible to erosion (GHT Consulting 1994). The drought, overgrazing and other agricultural malpractices have affected the land. The mountain slopes are barren and the plains are scarred with erosion ditches. There is no vegetation left to retain rainwater, which flows rapidly down the mountain slope carrying away valuable topsoil and flooding the houses. Since the January 1990 floods, the villagers have moved away from the foot of the mountain and built their houses in the valley. This relocation was immensely difficult and expensive for a community with very scarce resources (CSIR 1993).

Description of Seokodibeng village

Socioeconomic facts[5]

Seokodibeng is a village of around 416 households—133 in the WV and 283 in the SV (own survey). With approximately 6 persons per household on average, the total population of Seokodibeng is estimated at around 2,500 persons.

The population is composed of approximately 65 percent of females. There is a general unemployment rate of 80 percent in the village, with 70 percent of men and 90 percent of women being unemployed. The employed women work either as teachers (around 10), maids in the urban areas, or workers in large farms. Among the 30 percent of employed men, 75 percent work in Johannesburg or Pretoria and the other 25 percent work in the area—15 percent work as civil servant (such as teachers, DWAF employees or local administrations) and 10 percent work in the nearby mines. According to LSEC1, the average monthly income is ZAR 1,200 for working persons and ZAR 200 for those unemployed. People working far away from the village in areas such as Johannesburg and Pretoria are still considered as inhabitants of Seokodibeng since they sometimes return with money for their families. This constitutes a great part of the money circulating within the village.

Only one percent of the inhabitants are not Sepedi. They are either Xhosas or Vendas, and came to live here mainly after getting married. The migrants who came to work in mines mainly live in villages in the vicinity of the mines, not in Seokodibeng.

History of Seokodibeng

The first settlers were people from Ga-Phasha, a nearby village, who sought to be closer to the Motse River and looked for more space for agriculture and livestock.[6] The land occupied by the Seokodibeng villagers was bought from a local chief, Sekhukhune, in 1948 (CSIR 1993). Therefore, Seokodibeng can be considered as an extension of Ga-Phasha and falls under Chief Phasha's authority. Later, tribal conflicts occurred in the Mafefe region, 20 km north from Seokodibeng, which compelled Chief Ntwampe and his tribe to leave. As a relative of Chief Phasha, Chief Ntwampe obtained lands in Moroke, a nearby village, and settled down there with his tribe. Another related tribe, the Mampas, also arrived from Mafefe and settled down in the area. Later, people from both the Ntwampe and Mampa tribes moved to settle in Seokodibeng.

In 1984, a fight occurred between two clans of Phasha, one following Chief Phasha, and one rebelling against him. Chief Mampa supported the 'rebels'. None of the clans were really successful. This war of clans still had consequences in 2003 with regard to social relations in Seokodibeng. On the one side, villagers from the WV were seen as supporting Chief Phasha since most of the people who worked in the Chief's office came from the WV. Moreover, the WV hosted Chief Phasha's Nduna (local representative). On the other side, people from the SV were considered as supporting the rebels by the people from the WV, because they were part of the rebel group of Phashas or because they were Mampas. Some villagers did not take part in this tribal conflict since they came from other areas (such as the Ntwampe). In 1988, a 'reconciliation process' started under the impulsion of the first Water

[5]The source for this section is FWC2, except when specified.
[6]The sources for this section are FWC1 and FWC2, except when specified.

Committee (WC), whose mandate was defined as including the two parts of the village. This first WC was determined to bring water to the village and knew success would not be achieved without unity. Villagers from both the SV and the WV started understanding that they had to be united if they wanted to improve their access to water. Although there were still some problems between the two sides, these problems were not apparent to the external donors (FWC1).

The third 'wave of immigration' took place from 1991 until 1994, when people came to Seokodibeng to benefit from transportation facilities enabled by the nearby R37. Finally, the fourth migration wave started in 1995 with the implementation of the water supply communal network (and later the sanitation program), and is still continuing. People from various areas such as Mafefe, Malokela, or Ga-Nkwana, come to Seokodibeng for its existing access to water, and are ready to pay for it.

Institutions related to water management

The community is managed by committees for each type of issue, for example, the water committee, the sanitation committee, the communal garden committees, the civic committee, etc. These committees also work together on certain common issues. The main ones are the water committee and the Seokodibeng Development Program Committee. The civic committee, though socially important, is not an 'operational' committee. Its members organize meetings with inhabitants to discuss all kinds of issues concerning the village. They do not take decisions. It is considered as a social place of discussion and exchanges. Problems are directly faced by the relevant 'operational' committee. However, in case the solution to a problem has to be adopted by the entire community, the decision is collectively taken during a public meeting organized within the civic committee. For these reasons, only the main 'operational' committees are described hereafter.

Seokodibeng Development Program Committee

The Seokodibeng Development Program Committee (SDPC) was created in 1996 to organize applications to donors to fund water supply projects in Seokodibeng. Once a project is implemented through the SDPC, its management is transferred to a specific committee. The first tasks of the SDPC were the implementation of the third irrigated communal garden I3, the extension of the communal garden I1 (see figure 3), and the communal poultry project.

The Water Committee

The Water Committee (WC) is composed of nine members elected every 5 years. The first WC was created in December 1988 to tackle the situation that arose due to problems of accessing water. The WC deals with all kinds of water issues, and is allowed to take a decision for the community if more than five villagers attend the meeting (FWC2). In term of hierarchy, it heads the other committees (such as the communal garden committees or the sanitation committee) jointly with the SPDC. According to FWC2, the community pays special attention to gender representation within the WC, where a minimum of two to three males is wished. This policy was implemented since in 2003 there were three males in the WC.

Tribal authorities

The village is under the chieftaincy of Phasha, who stays in a nearby village, Ga-Phasha. The people from the other tribal authorities (namely Ntwampe and Mampa) still consider themselves as falling under their original chief and as a result some villagers believe that the village belongs to all three chiefs. However, any development done in the village has to be approved by the Phasha Tribal Authority. The chief has to be informed when a project impacts on land use. Nevertheless, chiefs are now only remotely involved by the community in development projects, because villagers believe that they misused funds in the past (FWC2).

Administrative authorities

When community members want to discuss a water issue with the government, they first need to talk to the chairperson of the Water Portfolio at the Ward 11 committee level. Depending on the importance of the issue, the chairperson can raise it to the ward councillor. The matter can then eventually be raised at the municipality level and, finally, to the DWAF. Before 1995, Seokodibeng fell under the former Lebowa government's authority. Then, from 1995 up to 2000, Seokodibeng belonged to the Transitional Local Council (TLC) of Moroke.[7] Seokodibeng now falls under the Fetakgomo Local Municipality.

The DWAF

The local DWAF office is in Moroke. The main responsibility of this office is to operate, maintain and repair the existing water supply schemes of 52 villages, composing the Dilokong area, which is the Moroke DWAF office's area of responsibility. Before September 1997, the local DWAF offices were also in charge of supplying free diesel for the operation of water pumping infrastructure. These offices gave up this responsibility around 1998.

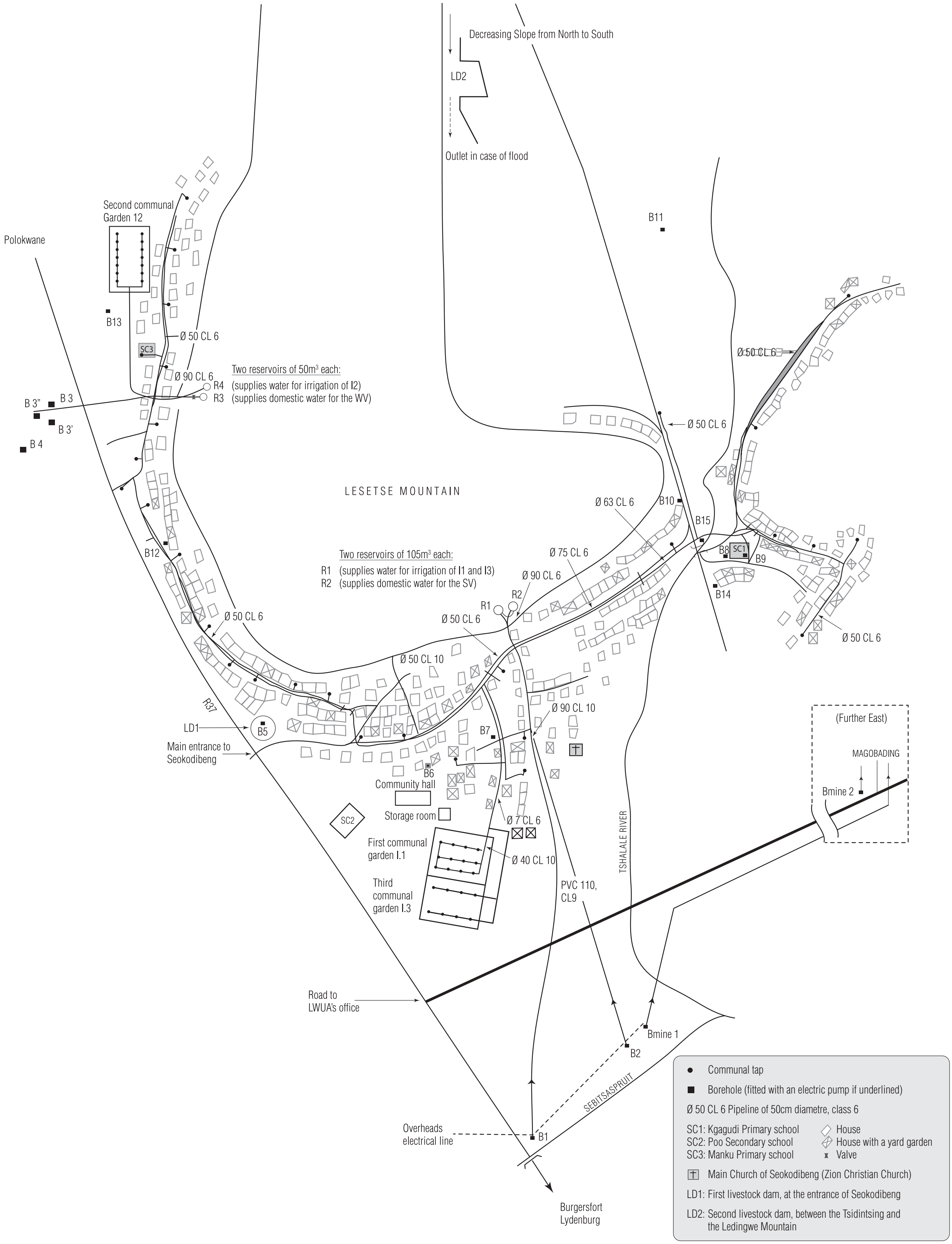
Water supply equipment in 2003

The water supply equipment of Seokodibeng consisted of the following in 2003. The village has 18 boreholes. Three boreholes are provided with electric pumps: B1, B2 and B3ter. Out of these pumps, only B1 was working in July 2003. Eleven were equipped with hand pumps, which are no longer functioning (B4 to B13 and B16). Finally, there are four unfitted boreholes—B3, B3bis, B14 and B15.

Second, there are four reservoirs. Two reservoirs of 105 m^3 each are situated in the SV, on the southern flank of the Lesetse Mountain (R1 and R2, see figure 3). Both of them are in a good state, however only R1 was being used in July 2003. Two reservoirs of 50 m^3 each are situated in the WV, on the western flank of the Lesetse Mountain (R3 and R4). Both of them are in a good state, but neither of them is used. A water supply network gets water from these reservoirs and supplies 34 communal taps (two taps in the WV are broken), and other taps within the communal gardens and the poultry farm. Third, there are three irrigated communal gardens with irrigation infrastructure such as hosepipes and sprinklers. Finally, two livestock dams have been built and are in a good state (LD1 and LD2).

[7]The Transitional Local Councils were temporary local governments before the set up of the Municipalities.

Figure 3. The water supply network of Seokodibeng village.



Seokodibeng's water infrastructure history: When success triggers unity

Drinking water schemes

At the end of the 1940s, the first settlers came from Ga-Phasha to Seokodibeng partly for improving their access to water by living closer to the Motse River. Streams and pools were the only access to water before a hand-pump (referred to as B4 on figure 3), followed by another one in 1954 (B8), was installed. Thirty years later, a state of emergency came into being due to the increase of the population and poor access to water (FWC1). In order to address the situation, the community requested for and obtained a borehole from the Transvaal Provincial Administration and a second-hand hand-pump from the Lebowa government (B1). The installation of these three hand- pumps can be seen as the first phase in Seokodibeng's water supply development program, characterized by isolated investments without continuity, in order to address a situation of crisis with regard to the access of water.

From 1988 to 1993, the community entered the second phase of its water supply development process, still characterized by a situation of emergency but with a will to ensure continuity in the implementation of schemes. This phase started in 1988 with the creation of the WC, the first official structure of Seokodibeng in charge of water affairs. The WC started seeking funds from the inhabitants in 1989 for implementing hand-pumps. From 1990 to 1993, six pumps were set up, with four different donors (the community also participated financially, cf. table 2). The community also started to rely on sources other than the government to improve their living conditions. Cooperation between the community and nongovernmental donors was initiated in such fields as communal gardens, livestock watering dams, sanitation, etc. The third phase started in 1993 with the financing of the feasibility study of a communal network. This network was implemented in 1995 and supplied water through 34 taps spread throughout the whole village. These taps provided the villagers with adequate water pressure, minimum waiting time to obtain the water, good quality water and a sufficient quantity of water for domestic uses. From 1990 to 1995, ten different donors funded and sometimes also implemented eleven water supply schemes (table 2).

The WC also launched a process of reconciliation and unification in 1988. Despite these efforts, however, quarrels between people from the SV and the WV remained (box 1). The successful improvement of the WV's and the SV's access to water was finally a major factor in the reconciliation and unification of the village. Indeed, the entire community showed an uncommon involvement during the third phase of their water access development program according to FWC1. Many villagers became involved, either by providing labor or by being active in the committees (such as the sanitation committee, the communal gardens committees, etc.). Villagers from the whole community attended the different workshops. When the money committed by the donors for labor payment was delayed for several weeks, the people kept on working, being conscious of the fact that they were first of all collectively working for improving their living conditions through access to water.

Table 2. Water supply developments in Seokodibeng.

Year of implementation	Source of funds	Project budget	Brief description of the project
unknown	unknown	unknown	Drill B4 and fit it with a handpump
1954	unknown	unknown	Drill B8 and fit it with an animal pump
1986	Transvaal and former Lebowa government	unknown	Borehole from the Transvaal Provincial Administration B1 and a wheel handpump from the Former Lebowa government
1992	Lebowa government and Department of Agriculture	unknown	Drill B9 in Kgagudi school and fit it with a handpump
Jun-92	Community of Seokodibeng	ZAR 50 per household asked and ZAR 17,500 obtained	Drill and fit with hand pumps B7 and B13
1992	Community of Seokodibeng	ZAR 15 per household	Drill B11. However, not enough money was available to set up a handpump
1993	American Embassy	ZAR 33,800	Drill and fit B5, B10, B12 with handpumps
			Fit B11 with a hand pump
Sep-1993	DWAF of Moroke Transvaal Provincial Administration and the Community of Seokodibeng		Scheme 1: Fit B1 with a diesel pump and connect it to 3 tanks of $10m^3$ each linked to six taps
		unknown for DWAF	Scheme 2: Drill and fit B3 with a diesel pump. Equip it with 1 tank and 1 tap
		ZAR 50 per household	Drill B6 and fit it with a hand pump
			Drill B14, unfitted
			Scheme 3: hire and train two members of the community to be Seokodibeng's diesel pump operators
1993	South African Brewery	ZAR 15,000	Fund the CSIR feasibility study for a communal water supply network made in 1993
1993	Anglo-American and De Beer Foundation	ZAR 15,600	Fund the GHT consulting geo-hydrological study on Seokodibeng, achieved in January 1994
1994	Edgars Edgardale Foundation	ZAR 2,000	Capacity building training for the water committee members
1994	Independent Development Trust	ZAR 100,000	Fund the labor (digging trenches, setting installations, etc.) for the future communal network.
1995	Mvula Trust	ZAR 237,820	Reticulation of stand pipes, two reservoirs (R1 and R3), 34 communal taps, extra labor payment and extra training in capacity building
1999	Seokodibeng and the DWAF of Moroke TLC	ZAR 60/house-hold asked. ZAR 6,633 required and paid	Electrification of B1 and B3bis

Box 1. Quarrels in the 1990s between the West and South parts of Seokodibeng.

Villagers from the SV were complaining about the WC Chairperson's decision to improve WV's access to water through the implementation of the first hand-pump in the WV, B13On the other hand, villagers from the WV did not trust a committee, which was initially mainly composed of people from the SV. In 1992, some of them were reluctant to give money for hand-pumps. Others refused as they thought that either their money would be stolen or that the project would fail. Therefore, it took 3 years to collect ZAR 50 per household for improving a situation that was seen as urgent by the villagers.

However, once B13 was implemented in the WV, all the villagers who had not paid asked the WC to take part in the financing, in order to use this nearby water point. The WC charged them twice the initial fee, i.e., ZAR 100 per household, in order to sanction their lack of confidence in the community's projects. According to the then WC Chairperson, this decision to stand firm in front of the clans' complaints and to give penalties for villagers not fully involved in community projects was one of the factors that led the entire community to consider their WC as strong and trustworthy.

Water for food

From 1994 to 2003, three irrigated communal gardens were implemented in Seokodibeng in order to improve food security. The first one (I1) is a 2-ha garden implemented in 1994 by 59 women from the whole village. Later, in 1997, another group of 59 women from the WV only, implemented another 2-ha communal garden in the WV (I2). These two communal gardens were funded by the Claude Harris Leon Foundation (table 3). However, the community was growing at a fast pace and not everybody obtained a plot in the communal gardens. As a consequence, a last group of 61 women, all from the SV, asked the LPDAE and later the National Development Agency (NDA) for a new communal garden, I3, which is an extension of I1. I3 is a bit larger than 2 ha. In all the communal gardens, each farmer has the same 340 square meter plot size.

Table 3. Communal irrigated garden schemes in Seokodibeng.

Year of implementation	Source of funds	Project budget	Brief description of the project
First scheme: Communal garden I1, for the SV and the WV.			
1994	Claude Harris Leon Foundation	ZAR 65,000	Implementation of I1: building of one reservoir (R2), and pipes to bring water from B1 to R2, and from R2 to I1
Sep.1994	British Embassy	Unknown	Building of a storage room for equipment, 4 toilets, 16 garden hosepipes of 60 m each, and 16 sprinklers for I1
Second scheme: Communal garden I2, for the WV only			
1997	Claude Harris Leon Foundation	ZAR 209,589	Implementation of I2: building of one reservoir (R4), the pipes to feed it from B3 and garden infrastructures for I2
Third scheme: Communal garden I3, for the SV only			
1999 and 2003	LPDAE and the NDA	Unknown for LPDAE ZAR 195,200 for the NDA	Improvement of I1. Implementation of I3: drilling B2 and equipping it with an electric pump; pipelines and taps installation

Livestock watering and erosion control

Livestock access to water is an old matter of concern for Seokodibeng breeders. As the grazing fields recede further and further from the homesteads and as there are no perennial streams and springs near the village, there are only three ways to get water for the cattle:

1. By getting water from the Motse River, about 15 km from Seokodibeng
2. By walking 12 to 14 km every day to fetch water from near the Ledingwe Mountain in the North or the Makgake Mountains in the South
3. From a livestock dam (LD1), located at the west entrance of Seokodibeng

The LD1 diameter is around 40 meters, with a maximal depth of a meter. It was dug to get soil at the time of the building of the R37. Because it was not initially meant to be a dam, the ground was not compacted and the infiltration rate is high.

Livestock watering was a problem until the early 1990s. In order to tackle this problem, the water committee sent an application to Energos (Engen Petroleum) in 1993 for funding the building of an erosion control and livestock watering dam. They also sent an application to the Department of Public Works to obtain machines and operators for the technical labor. The dam was eventually built in 1994 (LD2). It is a 20,000 square meter dam, built in an area where livestock used to graze. The dam is roughly a square of 100 m with a height of 2 m. It is situated 3.2 km north of Seokodibeng. Its ground has been compacted to minimize water infiltration, which explains why LD2 still has water when LD1 dries up. The dam is filled by rainwater and prevents erosion in the valley in case of floods. An exit canal prevents water from damaging the dam when it is full.

Sanitation

Traditionally, most of the villagers did not have access to proper sanitation facilities. The initiative to make a sanitation scheme did not come directly from the community. The Mvula Trust—a NGO that closely collaborates with the DWAF—visited the village in August 1994 to inspect the water supply scheme and encouraged the WC to send an application to them, requesting for proper sanitation facilities. As a consequence, a Sanitation Committee was created in 1995 as a satellite of the WC, with its specific members and on the same nine-member basis as the WC. An application to Mvula was done afterwards. The Mvula Trust agreed to fund a sanitation project in 1996, and in 2001, 204 private pit-latrines were built throughout the village.

Poultry

In 2000, the Limpopo Province Department of Agriculture and Environment (LPDAE) and the Moroke TLC built a poultry house. This poultry project aimed at developing economic activities in the village and also at supplying the farmers with free fertilizer through chicken manure. The poultry project consists of two houses capable of housing 1,000 chickens each and has been scheduled for intensive management with two kinds of chickens: broilers for meat and pullets for eggs. Engineers of the LPDAE advised the community to rear these kinds of chickens because the latter would be easy to sell on the local market. However, the poultry project has not yet started since the houses have still not been connected to water and electricity.

Table 4 compiles information with regard to these last three activities.

Table 4. Livestock watering, sanitation and poultry developments in Seokodibeng.

Year of implementation	Source of funds	Project budget	Brief description of the project
Livestock watering			
1994	Energos (Engen Petroleum)	ZAR 52,000	Funded the building of a dam for livestock watering
1994	Department of Public Works	Unknown	Assisted the community for the livestock dam construction by bringing 2 trucks, 2 bulldozers, and 1 compactor
Sanitation			
From 1996 to 2001	Mvula Trust	ZAR 120,000	Construction of 204 pit-latrines
Poultry			
2000	The DoA and the Moroke TLC	Unknown	Building of a poultry farm with 2 buildings, with 1000 chicken capacity each and a fence
Application made in 2003. Still waiting for the response	Anglo-American and De Beer Foundation	Unknown	Supply the poultry farm with electricity

The key role of the Water Committee in water-related projects development

The village managed to attract substantial external funds, and is known in the area for its successes. Table 5 summarizes the large investments that the village attracted—a total of more than ZAR 1 million given by 14 donors to a village of only 400 households. The tribal authorities from Ga-Phasha and Ga-Mampa and some village representatives such as those from Ga-Mashishi came to learn from the Seokodibeng WC how and from whom to get funds (FWC2).

The set of water-related projects also shows the complete distinction between investments for domestic water and investments for productive water uses. This division stems originally from a separation in responsibilities of the funding organizations, with none of them formally responsible for the productive use of water at household level (cf. Moriarty and Butterworth 2003).

The activities of the first WC appeared to be instrumental in the success of the initiatives in the 1990s. During its first term, from 1988 to 1993, the WC used to meet with the community each Sunday to report back the progress on their different applications with the donors. Then, from 1993, once the WC obtained the feasibility study for a communal network, their main task was to apply for its funding to potential donors. Later, the WC reduced the frequency of the meetings to once a month, until the communal network was implemented in 1995. After that, the WC called for meetings only once in 2 months to discuss maintenance issues (FWC1). According to the then chairperson, there were three main factors of success.

1. The leader of the community did not grow up within the community so nobody could reproach him for belonging to one or another clan of Phasha. He was trusted and this enabled him to treat the clan member’s complaints with a high level of fairness. His education enabled him to interact with potential donors.
2. The WC had a will to remain united, because they all knew that if they disagreed with one another, they would fail.

3. External organizations such as the CSIR encouraged the WC's own motivation.

In the then chairperson's opinion, an important reason for the WC failure was success itself, i.e., the abundance of funds. Once the money arrived in 1994 from the Independent Development Trust, Leon Foundation and Mvula Trust, and though it was clearly targeted for specific actions, the WC started arguing among themselves on how to spend the money. This was the only real factor of division within the WC from 1988 to 1998.

Table 5. Summary of donors' investment in Seokodibeng.

Type of donors	Donors	Capital committed
NGOs	Independent Development Trust	ZAR 100,000
	Mvula Trust	ZAR 357,820
	Claude Harris Leon Foundation	ZAR 274,590
Private foundations	South African Brewery	ZAR 15,000
	Anglo American and De Beer Foundation	ZAR 15,600
	Edgard Edgardale Foundation	ZAR 2,000
	Engen Petroleum (Energos)	ZAR 52,000
International donors	American Embassy	ZAR 33,800
	British Embassy	ZAR 40,600
Governmental donors	National Development Agency	ZAR 195,200
	Department of Agriculture	unknown
	DWAF	unknown
	Department of Public Works	unknown
Seokodibeng community	ZAR 175 per household asked	estimated to be greater than ZAR 60,000
Total	14 donors on 12 schemes	greater than ZAR 1,146,610

Conflicts in infrastructure operation and management: When failure triggers individual disengagement

The first two parts of this section present the main technical and institutional problems the community faced concerning the water supply. The last two parts focus on the management of the different schemes in a general way, and mainly address the consequences of the existing technical and institutional problems in the management itself.

A general lack of communication in the case of borehole B3bis[8]

The DWAF set up a diesel pump in borehole B3 in September 1993. B3 was functioning without any technical problems, and was supplying a tank and a tap located nearby. In 1994, a company tested the availability of groundwater in B3. However, when the borehole's tube was pulled out, it broke the pipe inside the borehole. The WC refused to pay the company for the work. The WC paid ZAR 16,000 from its own funds and without asking the community, to another company for drilling a new borehole (B3bis).

The borehole B3bis also broke down in 1999 and the DWAF did not intervene until 2003 because of problems with contractors. However, because of the lack of communication, the WC thought that the DWAF had decided that B1 was enough for the whole village (see details in box 2). The users from the west part of the village, faced with a water-shortage, thought that it was only a problem of pump breakdown and that neither the DWAF nor the WC cared about their situation. They, therefore, created their own committee, the Lesetse Water Committee (LWC), and bought a pump. They came to know later that the whole borehole had collapsed. This situation highlights a serious lack of communication between the DWAF and the village on the one hand, and between the WC and the villagers on the other.

The DWAF drilled another borehole (B3ter) only in August 2003. By August 2003, the DWAF was still waiting for a final test of groundwater availability in order to fit a pump in B3ter. Once the test is completed, they will use the electric pump bought by the LWC, and will pay for its connection to the electric line. The borehole will then be fully considered as WV property (LWC1). The electricity bill will be paid by the LWC, as agreed with Eskom. The LWC also plans to implement a valve at the place where the water enters the network from the reservoir R3 (see figure 3) to be able to disjoin their network with that of the SV. Their intention is to be able to close the valve in case B1 has a problem, since the general slope decreases from the WV to the SV.

Box 2. The breakdown of borehole B3bis.

In 1994, B3bis was drilled, fitted with the same diesel pump and started to run. B3bis worked without any problems from 1994 to 1999. In 1997, with the set-up of Leon foundation's communal garden scheme (I2), the use of the tank and the tap was stopped and B3bis was fitted with a pipeline outlet for supplying the WV for both domestic use (filling R3, see figure 3) and irrigation use (for I2 by filling R4). I2 started working in 1997 and B3bis did not face any problems until 1999.

In 1999, the diesel pump of B3bis broke down and the borehole collapsed. According to the DWAF (DWAF1 and DWAF2), B3bis collapsed as a result of over-pumping by the community. The community was not following the instructions for the operation of the borehole and the vibrations of the diesel pump made the borehole collapse. According to FWC1, the pump was indeed functioning continually for the villagers to get water from the reservoirs at any time and in sufficient quantity. Hence, another borehole needed to be drilled, which would take much more time (advertising, selecting a contractor, etc.). It explains why the DWAF did not quickly repair the breakdown (DWAF1 and DWAF2). At that time, Seokodibeng had two operators (one for B1 and one for B3) hired and paid by the DWAF since the implementation of the

[8] The source for this section is FWC1, except when specified.

Box 2. C*ontinued*

TLC scheme in 1993. While waiting for the re-drilling of the borehole, the DWAF decided to send Seokodibeng's operator for B3bis to the nearby village of Ga-Phasha, where he would use his skills to help this needy village.

However, it seems that the DWAF did not clearly explain this situation to the WC, which saw it in a totally different way. According to FWC1, the WC thought the DWAF considered B1 as sufficient for supplying the whole village, and thus wanted to save some money in maintenance and repairs by giving up B3bis. The WC also thought that the DWAF wanted to shift its operator mainly because having two operators for one village was a luxury when villages such as Ga-Phasha did not have any. Communication was lacking to such an extent that the WC was not aware that B3bis would be re-drilled, even one week before the drilling started. Later in 1999, the DWAF switched B1 and B3bis from diesel to electricity (table 3). The community paid Eskom, the national electricity production and distribution company, for the electric connections of B1 and B3bis. Although the DWAF was supposed to buy and fit the two boreholes with electric pumps, they only bought one pump, which was fitted in B1B3bis was not equipped since the DWAF had noticed earlier in 1999 that it had collapsed, and therefore that they had to first re-drill it. Hence in 1999, while B1 was ready to work with electricity, the electricity line was connected only to B3bis and a new borehole was still to be drilled. The persistent lack of communication induced the WC to think that the DWAF did not have the funds to buy the pump (FWC1) whereas the DWAF, in fact, had problems with their contractors

Because of this breakdown in communication, villagers from the WV have been experiencing difficulties in getting water since the breakdown of B3bis in 1999. From 1999 to 2003, the WC had only limited information about what was going on with B3bis and was giving only a limited feedback to villagers from the WV. At the same time, villagers from the WV felt that neither the DWAF nor the WC was taking their problems with access to water into consideration (LWC1). As a response to this lack of consideration, they decided not to attend the WC meetings and also to stop paying the ZAR 10 per household per month fees for water. On the other hand, the WC accused the WV villagers of not being involved in water issues because they did not go to the meetings, and of taking advantage of the water shortage in order to avoid paying the water-fees (LSEC1). This issue has in part revived the tribal quarrel between the SV and the WV. Nevertheless, both sides agree that there is a great problem of communication (LSEC1, LWC1 and FWC1). According to SDPC1, it is possible that the WC did not want to give villagers from the WV feedback because their lack of information would have been seen as a sign of failure and incompetence.

The lack of communication between the DWAF and the WC, the rising lack of understanding between the WC and villagers from the WV, and the 4 years of water shortage, led villagers from the WV to attempt to self-manage their access to water. A water committee of seven members was created under the name of Lesetse Water Committee (LWC) and in 2003, started collecting money to buy an electric pump for B3bis that could be connected with the existing electric connection (LWC1). A fee of ZAR 100 per household was requested for (and obtained in great part according to LWC1) buying the electric pump. The LWC bought the electric pump in early 2003 for ZAR 3,000. Nevertheless, when the LWC's contractor for the pump tried to fit it on B3bis, they realized that the borehole had collapsed and was no longer usable (information known by the DWAF since 1999). As a consequence, the LWC made an application to the DWAF for drilling another borehole (B3ter), which was eventually done in August 2003.

B2's breakdown: Competition for water?

East of Seokodibeng, a new village of around 100 houses, called Magobading, was built by Anglo-Platinum alongside the road to Lebalelo WUA's office (see figures 2 and 3). The inhabitants are from the Serafa area, more precisely from Makobakobe and Ga-Makgopa. Anglo-Platinum started developing a new mine for extracting platinum in this area, and hence proposed to relocate the inhabitants. In order to supply Magobading with water, two boreholes were drilled, fitted with electric pumps and connected to the electricity network. One of these two boreholes is close to Magobading (Bmine2, see figure 3) and the other one is 50m east of B2 (Bmine1). In August 2003, only Bmine1 was functioning. Eskom connected this borehole to the electricity line on B2's pole.

However, the cables of B2 were stolen twice and Anglo-Platinum used the opportunity to connect themselves to the same pole. The information gathered shows that there may be competition for water between Seokodibeng and Anglo-Platinum (box 3).

Box 3. The breakdown of borehole B2.

B2 was drilled and equipped with an electric pump by the Limpopo Province Department of Agriculture and Economics at the end of 2002, when I3 was implemented. When B2 was about to be switched on, a succession of events prevented it from functioning.

First, the cables connecting B2 to the pole were stolen in December 2002. The SDPC in charge of the scheme reported the problem to the LPDAE in Polokwane (formerly Pietersburg), which refused to commit extra money for repairs. The community also reported the matter to the police station and then tried to replace the stolen property, without informing Eskom. The SDPC did not want to leave room for Eskom to accuse the community of not taking care of their installations, according to FWC2. The SDPC used NDA money (without informing the NDA office) for buying the cables and replaced them in January 2003.

The cables were stolen again in February 2003, and this time the switch box and the meter box were damaged. When the community discovered this later in February, the meter box had disappeared from the pole and a new meter box from Anglo Platinum was installed on the same pole. This time the SDPC told Eskom immediately after it was damaged. In the meantime, Anglo-Platinum implemented a borehole (B1mine) in March 2003. The WC found out later that their meter box was kept by Anglo-Platinum in their office.

On 4 July 2003, two meetings took place. First, Eskom came with representatives of Seokodibeng to assess the damage. Second, a meeting took place at a local Anglo Platinum office to discuss the problem. The people who attended this meeting were Naledi Development, Anglo-Platinum's (and Lebalelo's) consultant for the communities; the Human Relations team of Anglo-Platinum; three persons from the community; and ITT, who drilled the borehole B1mine. The representatives of the community were first told that the meter box had been removed by Anglo-Platinum for safety reasons since it was damaged, and then that Anglo-Platinum asked Eskom in February about using the electric pole for connecting it to their borehole (CWC1). Eskom said that the pole was not used anymore and hence the mine could use it. However, the community told Eskom about the stolen cables earlier in February (FWC2). Furthermore, the WC was and is still paying Eskom for the electricity bill (around ZAR 400 per month). At the end of the meeting, ITT told the representatives from the community that the pump that had been installed on B2 was too powerful for supplying the pipes and that it would break the pipe. Consequently, ITT advised the representatives to replace the engine of the pump with a less powerful one (LSEC1 and FWC2). However, an engineer of the LPDAE had designed the capacity of the pump. Naledi and ITT promised to address the problems, and later Anglo Platinum agreed to reimburse the entire cost. Nevertheless, 2 months afterwards nothing had happened.

Domestic water supply management

Designed hydraulic functioning

The total supply capacity of the pump fitted in B1 is 200 m^3 per day. According to the scheduled functioning (which excludes breakdowns and misuse), none of the hand-pumps are working. The community gave up using the hand-pumps in 1994 as a consequence of DWAF's decision to stop catering for their maintenance. DWAF's decision was motivated by the costs involved and the uselessness of such pumps in the presence of a communal network supplied with diesel pumps. Three boreholes (B1, B2 and B3ter) provide water with electric pumps. B1 feeds reservoir R1, which supplies the SV for domestic use. B2 is supposed to feed R2, which only supplies I1 and I3 for irrigation purposes. B3ter is supposed to fill R3, which supplies the WV with water for domestic use, and R4, which supplies the communal garden I2 in the WV with irrigation water. Depending on the domestic water demand, the area between WV and SV is supplied by either R1 or R3, since there is a hydraulic continuity in the networkR1 can supply a part of the WV (the southern part of the WV), and reciprocally R3 can supply a part of the SV (the eastern part of the SV). Domestic users receive water from 34 communal taps spread throughout the entire village. The taps provide the users with adequate water-pressure at all times, so that there is no necessity for villagers to wait in queues for the purpose of filling buckets, and there is water in sufficient quantity for all types of uses (domestic, private gardening, communal gardening and brick fabrication).

Real Hydraulic functioning in 2003

The functioning of the pumps in 2003 was far from that designed. In August 2003, only B1 supplied water to the village. B3 and B3bis broke down (respectively, in 1994 and 1999) and B3ter and B2 are not yet functioning.

With B2 not working, I1 and I3 cannot be irrigated.[9] They are only used during the rainy season (summer) to grow maize. Hence, I2 is also only used to grow maize during the rainy season. Only B1 was working in August 2003 and it supplied the SV with domestic water through R1.

R3 and R4 are no more fed as B3ter is not functioning. Therefore, the WV does not receive domestic water from these reservoirs and I2 is not irrigated anymore. Water scarcity in the WV heavily impacts on the daily life of the villagers in this part of Seokodibeng (box 4).

[9]The section entitled "Rules and management for communal and private gardens" explains why the community does not use B1 to supply the communal gardens I1 and I3 with irrigation water.

Box 4. Impact of water scarcity in the west part of the village.

Because of the general slope from North to South and the water demand in the SV (both for productive and domestic use), there is not enough water-pressure to supply the whole WV. The northern taps, i.e., the ones situated at the end of the network, no longer receive water, are broken and even vandalized. The taps situated more upstream in the WV network are fed occasionally with water, when the demand is not too urgent in the SV, which is mainly during the night and very early in the morning. For instance, one of the taps usually works between 8.30 p.m. and 8 a.m. Because of this time constraint, too many villagers use the southernmost tap T1 (see figure 3).

Moreover villagers from the nonworking taps area have to walk long distances to fetch water, and this has two consequences. First, they cannot get as much water as they would like to since bringing back the desired quantity is very difficult, or not possible. Most of the time water is brought by women or children, on their head or using a wheelbarrow. For example, interviews with users revealed that a household in this area takes around 75 liters per day for the basic needs of around eight persons while the requirement is 125 liters a day. Second, some of these villagers have to make the choice of deregulating their rhythm of life and losing much time in order to fetch water. Villagers not living too far from T2 have to choose between a long wait to get water from T1 during the day, and waking up late in the night to get water more quickly from T2. According to the interviewed people, at T1 there is a minimum of 10 to 15 people waiting to fetch water during the night with a 30-minute to one-hour waiting period, and a maximum of 20 to 25 people waiting during the day with a 2 to 3 hour waiting time. At T2, people sometimes wait from 8.30 p.m. up to approximately 6 a.m. the following day in order to get water. An interviewed woman claimed that she wakes up at 2 a.m. to fetch water. Villagers who have cars or donkey-carts fetch water either from T1 or the SV where taps are not crowded.

The Water Committee and the recovery of costs

In 1992, the WC created several Sub-water Committees (SWCs), which are decentralized management teams. The SWCs comprise both members and nonmembers of the WC. The initial purpose was to collect money from house to house for the installation of the first two hand-pumps.

In 1993, with the implementation of the TLC scheme, the local DWAF office trained two persons from the community on how to operate diesel pumps and hired them as permanent employees for operating, maintaining and repairing the diesel pumps of the community. Diesel was supplied for free by the DWAF and, therefore, the community did not have to pay in order to obtain water. The WC fetched the diesel from the DWAF offices of Moroke, Praktiseer or Lebowakgomo. The DWAF did not impose any restriction on diesel consumption. The community used two barrels of 210 liters each month, and the two operators managed the diesel. As a consequence, the community was over-pumping (DWAF2 and FWC1). Villagers were allowed to take as much water as they wanted from the tap. There were no rules on water consumption for domestic purposes. However, villagers were not allowed to use water from the taps for irrigating their home gardens as the Mvula Trust strictly restricted the network utilization for only domestic use. For this reason and because the communal network was due to be implemented in 1995, private gardens were forbidden (they were nevertheless well-spread in the village in 2003, as described later).

Then in 1994, when the community started to work for the implementation of the communal network, the SWCs had the responsibility of allocating various tasks to the laborers. With the scheme implemented in 1995, the WC became in charge of paying for the operation and maintenance of the network. The DWAF remained responsible only for supplying such services for the boreholes (B1 and B3bis). The WC started asking for ZAR 5 per household per month from the villagers, while the completion report for the communal network indicated that ZAR 7.8 per household per month was required, and ZAR 10 was actually needed. According to FWC1, the villagers did not have enough money to pay ZAR 10 per month. From 1995 to 1998, the SWCs collected the money at each tap through four persons appointed by the SWC, called 'tap leaders.'

In 1998, several changes occurred. First, after two mandates of 5 years each, the WC members stepped down and another group was elected. Then, in November 1998, the DWAF stopped its policy of providing free diesel for the whole community. The community had to pay for the diesel on its own. Since a fee of ZAR 5 per household per month was not enough to cover the new charges for diesel, the new WC increased the fee to ZAR 10 per household, which was accepted by the members of the community. In addition to the diesel costs, the WC had to rent a car to fetch diesel. Because of these costs, it was decided to switch the two pumps B1 and B3b from diesel to electricity (cf. table 2). However, only B1 was shifted to electricity, as described above. Consequently, since 1999 the community pays only for electricity and they no longer use diesel.

In 2001, the TLC of Moroke proposed that Seokodibeng should change the management. If the community, through the WC, would bring them the money collected from the community for running costs (ZAR 10 per household per month), the local Council would take charge of the operation, maintenance and repairs of the network (pipes, taps and reservoirs), and the electric pump boreholes. Moreover, the Local Council would be in charge of dealing with Eskom for paying the electricity bills. In short, they would take charge of the whole management except for collecting money from the community. The WC agreed and suggested that villagers come directly to the community hall for paying, in addition to the usual way of paying through the SWCs. According to FWC2, this centralized collection was proposed by the WC to give some villagers who had problems with their tap leaders, an alternate way of paying their money. The WC would come to the community hall twice a month to receive the money. However, this centralized method of collecting money by the WC in the community hall, along with the usual way (through the SWCs), prevented the tap leaders from distinguishing the villagers who had paid from those who had not (FWC2). This was not accepted by the villagers and, therefore, around 70 percent of the villagers from Seokodibeng stopped paying (FWC1). The tap leaders were losing their commitment, and progressively gave up their task. Therefore, the idea of 'tap management' gradually disappeared.

By 2003, tap leaders had stopped their duty and villagers still had to bring the money to the community hall. According to FWC1 as well as calculations made for this study, at least half of the villagers do not pay (this can be confirmed using a broad estimation, since Eskom's debt is ZAR 2,600, 260 households paying should be enough to pay off the debt). Others pay with delays. Moreover, since the breakdown of B3bis in 1999, villagers from the WV refuse to pay for water. As a result, the WC experiences a serious shortage of money for paying electricity bills. Another reason for the recent decrease in the success of fees recovery is that although the local government made many promises regarding the provision of free basic services (water, electricity), these promises did not materialize.

In 2002, the WC did not pay Eskom's bill and the electricity supply was disconnected for a period of one month (box 5). The WC eventually managed to gather the funds by taking on the role of the former tap leaders,[10] and advised people to return to the former method of tap management by grouping themselves according to the tap they use and buying a lock with two or three keys. There are for instance three keys held by three villagers out of each group of ten households. When somebody wants to obtain water, he or she has to first collect a key from one of the key-holders, and then use the tap. If someone does not pay the fee of ZAR 10 per month, the other users do not allow him or her access to the key. This method of management is now used locally for approximately 6 taps out of 34. This way of management can be seen as a change in collective action, from a collective effort based on general trust to individual actions preventing nonpaying people from obtaining free water.

In August 2003, since Eskom did not send the bill regularly to the WC and as the WC did not collect the money regularly and efficiently from the users, the collection of fees amounted to the management of succeeding crises. The WC waits for the bill from Eskom in order to ask the villagers to pay. Therefore, since bills are not sent each month, the users have to pay a large sum of money when the invoice finally arrives. In August 2003, the only regular activities that were being carried out by the WC for collecting money were: i) sitting in the community hall twice a month to collect the fees of villagers who came to pay and ii) being present at a certain place in Seokodibeng where allowances for older people, disabled people and children were given by the government once a month.

In August 2003, the water committee was heavily criticized because of its way of managing finances and its lack of interest in water affairs (FWC1). While there was a meeting each month in 2002 to discuss water issues, there was only one in 2003. In December 2002, a meeting was held to discuss changes in the WC, but nothing was eventually decided (FWC2). Another meeting was held in March 2003 in order to discuss alternate ways of collecting money and the possibility of reverting to the former tap management system. It was considered as an emergency meeting because a large sum of money was still due to be paid to Eskom. The WC promised to revert to the former management system, and the tap leaders agreed to recommence their duties. However, according to interviews with the WC and LSEC1, it seems that the WC was waiting for the setting up of individual taps and meter boxes in each household.[11]

While the previous WC demonstrated from 1988 to 1998 the importance of speaking and understanding English in order to form and maintain relations with the donors, no one from the 2003 WC was able to do so. It is a constant problem with regard to dealing with donors, signing cheques or understanding the electricity bills. This factor is certainly in part responsible for the lack of communication with Eskom. Finally, the WC's chairman has also been criticised. Some villagers reproach him of having no knowledge about the daily life of the community as he lives isolated from the village.

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[10] E.g., at each tap, identifying nonpaying people and preventing them from getting water until they paid. However, they did not manage to get the entire amount, mainly due to the refusal of people from the WV to pay.

[11] An application to the ward councillor has been sent with regard to this matter.

Box 5. Cut-off of electricity in 2002.

> In November 2002, Eskom required the WC to pay a debt of ZAR 2,612. Since the WC did not pay, Eskom cut off their electricity supply in December 2002. No running water was available from the taps and villagers had to resort to other ways of getting water. Some villagers sold water in the village at around ZAR 10 for 200 liters (i.e., ZAR 50 /m^3, which is very expensive). Villagers started to stock water and reduce their consumption. However, this water was not sold everywhere in Seokodibeng. Some people, mainly in the extremities of the village, did not know when the sellers would come, or when they did, did not have the money. Others fetched water from outside the village, from areas like Ga-Phasha, south east of Seokodibeng, in order to get clean water from the mountain area. A day was required to fetch water. Others simply fetched untreated water from the Motse River. Diseases such as diarrhoea and cholera started to spread since these villagers did not boil the river-water (SC1). This situation lasted for 6 weeks, until the WC managed to get the money by forcing villagers to update their balance, using the former tap leader management system. The WC established a list per tap (LSEC1). Although some villagers from the WV probably never paid their bill, the WC managed to pay Eskom.

Rules and management for communal and private gardens

Although each irrigation scheme has its own management committee, their ways of functioning are quite similar. Each farmer has the same 340m^2 plot size. Entrance fees are collected from potential members: ZAR 60 for I1, ZAR 50 for I2 and ZAR 40 for I3 (LSEC2). The purpose of these entrance fees was to ensure members' involvement in the communal gardens' operation process. A fee of ZAR 10 per month per farmer was also collected for renting the tractor along with its operator for harvesting. The farmers started using I1 in 1994. However, the diesel pump of B1 was not able to supply enough water for domestic and irrigation uses in the SV, even though water was pumped continuously and the reservoirs and the network were in good shape. Villagers could not get enough domestic water and started complaining about this constant problem.

From 1995 onwards, the competition between irrigation and domestic water use kept increasing, both with regard to communal as well as private gardens. Rules were drawn up, forbidding the setting-up of private gardens, but were not respected (box 6).

Finally, in the WV, a problem of separating the costs of domestic and irrigation water uses exists. The management of the communal garden I2 is no longer under the WC's authority but under the LWC's. Since there is no borehole meant for agricultural activities in the WV unlike in the SV, the LWC is faced with the problem of separating the bills of domestic and irrigation uses. The LWC thought about making the farmers paying twice, which would be ZAR 20 monthly per household, but this suggestion is still under discussion (LWC1). The LWC also thinks it is impossible to prevent villagers from gardening in their yard (even though for the moment there are no home gardens in the WV because of the current water shortage) because, there are no individual meters, and as there are insufficient plots available in the communal gardens for every villager. Moreover, this distinction in the management between the WV and the SV makes the implementation of new policies that would be specific to the WV or the SV much more difficult because of issues within the village. For instance, asking home-garden holders to pay for their irrigation water consumption in the WV will certainly meet with the refusal of the population if a similar scheme is not activated in the SV (LWC1).

Box 6. Steady increase of private gardens.

Gardens were forbidden since the implementation of the communal network in 1993. However, they have been developed since not all villagers were given the opportunity of owning a plot in a communal garden. The number and size of private gardens have progressively increased. With this development, hosepipes were used to get water directly from the tap. Even though the use of hosepipes is forbidden, they are now widely used causing a reduction of pressure in the WV network, which in turn creates more serious water shortages in this area.

In 1995, the WC decided to implement restrictions on the use of water for irrigation in I1 (I2 and I3 had not been created by then. It was separated into two equal parts and each part could irrigate for only one day out of two. However, these restrictions were not sufficient to prevent problems with regard to domestic water use.

In 1996, the Moroke TLC came to Seokodibeng and proposed the implementation of a new electric pump borehole that would only supply I1 and I3 with irrigation water (B2). The community wished to separate the distribution of irrigation and domestic water so that they would no longer face restrictions and the users of I1 would not get water for free anymore. However, this was completed only in 2000. The restrictions became insufficient and villagers were increasingly complaining about problems with obtaining water for domestic use. Since the community knew from 1998 that the LPDAE would build a new pump for the irrigation scheme, it was decided at a meeting organized by the civic committee to stop irrigating I1, in order to satisfy domestic needs.

When I2 was created in 1997 in the WV, the WC decided to supply I2 for winter seasons without restrictions in order to study whether it would cause problems in domestic water use or not. However, B3bis broke down in 1999, and has still not been replaced by B3ter. According to FWC1, B3bis was supplying enough water in the WV for both domestic and irrigation uses and it should be the same once B3ter was installed. Therefore, I2 should be used to its full capacity only once B3ter has been implemented.

In 2003, the functioning of all communal gardens was stopped. Therefore, even villagers who had a plot in a communal garden started a home garden to continue their farming activities. This led to a notable increase in the number of home gardens. Moreover, villagers changed their opinions with regard to these gardens. While these gardens were initially used to ensure food security, villagers discovered that they could earn money by selling their products on the local market. In 2003, the WC was still considering forbidding home gardens once B2 started functioning, since those who had a plot in I1 or I3 would have to pay for water for domestic use as well as for irrigation, while villagers with private gardens would only have to pay for domestic water. But the WC probably does not have enough power to implement such a decision and they fear the villagers' reactions (FWC1).

Livestock water use

The two livestock dams LD1 and LD2 can only be used during the rainy season. During the dry season, when LD1 and LD2 are empty, breeders have to send their cattle more than 10 km away to get water. This rule was followed from 1995 to 2001. However, in 2002, a drought occurred and, due to the great distance that had to be covered in order to reach a source of water, as well as because they were weak, animals were dying on the way. Therefore, some farmers started using the communal taps for providing water to their cattle. Progressively, more and more livestock owners did this and thus the practice was institutionalised. It is not possible to conclude whether this change in habits was permanent or not, because the year 2003 was still a dry year. In 2003, roughly half of the breeders who kept their cattle in Seokodibeng used the taps to provide them with water (FWC1). Others still, kept their cattle for long periods in areas where water was available from rivers or springs. The breeders whose cattle remained in Seokodibeng would open the tap for a time period of 15 minutes up to one hour, which enabled the livestock to drink water from the puddle created. This practice did not take place only during the dry season. Even when water was available from LD2, some breeders still used the taps to avoid the walk up to LD2, which is situated at a distance of 3 km from the village.

The current situation raises four issues. First, breeders are using domestic water for livestock watering, while the water committee wants to separate the uses so that each consumer pays according to his or her consumption. Second, some taps are broken due to cattle agitation and fights around the tap-water points. Third, the puddles created lead to water-wastage, which is not acceptable in terms of resource conservation in a water-scarce environment, and stands in contrast to the agreement made between the community and the Mvula Trust, according to which any water-wastage would be seen by Mvula as a sign of bad usage or maintenance, and would affect future cooperation. Finally, the fact that breeders open taps for livestock watering when water is freely available from LD3, 3 km away from the eastern part of the village, can be seen as a sign of decline in the collective effort for an efficient management of water at community level. This issue is still being discussed within the community.

Conclusion on water-related project management

The problems discussed are not really due to technical faults (such as a lack of groundwater resources or a lack of pumping equipment), but more due to managerial problems. They are of two types: problems of internal organization and problems of interaction with external organizations.

First, the individual participation of the community members depends heavily on the collective functioning of the community. Collective effort is seen to trigger individual effort. Inversely, the community is very vulnerable to failure which acts as a trigger for the disengagement of an individual effort. Indeed, the situation in 2003 highlighted a large lack of the sense of community welfare, since many garden plots were cultivated in the SV, often using hosepipes for long periods during the day, while at the same time villagers from the WV struggled to get a minimal amount of water to meet their basic domestic needs.

Second, the delays in the drilling of B3ter and B2 show Seokodibeng's lack of access to external organizations like DWAF, LPDAE or Eskom. As the case of B2 shows, the village is not in a position to negotiate with large-scale stakeholders such as Anglo Platinum.

Possible Impacts of Seokodibeng's Connection to Lebalelo Pipeline on Productive Water Uses

Background and hypotheses

Like many other villages, e.g., in the nearby Bushbuckridge area (Pérez de Mendiguren and Mabelane 2001), Seokodibeng uses domestic water for a combination of domestic needs and productive water uses. The uses taken into account in the design of the communal network and authorized by the 1993-1998 WC were only those for basic human needs such as drinking, cooking, washing and sanitation. However, in practice, water was also used for productive uses and other water-consuming activities. Productive water use is defined as the use of water for economic purposes, in order to ensure food security or to generate income. Other water consuming activities refer to uses that are not focused on production, which mainly have religious or amenity significance such as the growing of flowers, trees or lawns. Their purpose is mainly to improve the household environment (Mokgope and Butterworth 2001).

This section focuses on water consumption for both productive and domestic water uses. The section presents an economic assessment to understand the importance of these productive uses within the community, and to assess their likely impact on the future Lebalelo Water Supply Scheme (LWSS). Indeed, the future system will probably be based on communal taps with a system of pre-paid cards, whereby each household will pay for its own amount of water used. Given these goals, the analysis is based on the four following choices.

1. The productive uses of water are hereinafter only considered as those using either the existing communal network, or the future LWSS. On the one hand, irrigation water for all communal gardens is included in this analysis. Even though these communal gardens are supposed to get their own water supply system, it is on the whole the same system. For example, the villagers can withdraw water from the irrigation supply system for their own domestic use. On the other hand, the watering of livestock in the dams and fruit-tree production using the waste domestic water are not considered here since they do not directly use water from the network.
2. Although all communal gardens had not been irrigated in August 2003, they are considered as still functioning in this section. They will most likely work again before the implementation of the rural domestic water supply, which will be connected to the Lebalelo pipeline and, it is of interest to understand how the LWSS will impact on their functioning.
3. The calculations of gross margins are done at an individual level. This means that the current price of water for productive uses is reduced to zero as the price of water that one household has to pay is standard (ZAR 10 per household per month) and does not depend on the household's production choices. Such a choice is made to assess the incentives for an individual to undertake an economic activity or not. If the assessment was done at a collective level, the irrigation water use would be considered as increasing water pumping costs of domestic water and, therefore, increasing the costs borne by the individual members.
4. The future minimal price of water given by the LWSS is taken at ZAR 2.5/m^3. It corresponds to the LWUA's estimation for the variable costs (LWUA2) but does not include the fixed costs (paid every 3 months for recovering the costs of the infrastructure by all the mines that are members of the LWUA), the purification

plant costs, nor the domestic network infrastructure and its running costs. Hence, the future of productive uses of water with the LWSS can be assessed favourably.

Methodology

A survey was first done to count all private gardens in the village. Their size and their distance to the nearest tap were estimated. Out of these 61 gardens, 34 were assessed for their domestic and gardening water consumption, and a full economic assessment was carried out on 10 out of these 34 gardens. For each level of assessment, a specific questionnaire was drafted and filled out collectively, with the members of the household present during the survey.

The most common productive water uses are, by order of importance, the following: i) vegetable production in the communal irrigated gardens (see the second choice made for the analysis in the list given above); ii) vegetable and fruit production in yard gardens; and iii) livestock rearing.

There are other uses of water, for example, in the production of beer, ice fabrication and in hair salons, etc. (cf. Pérez de Mendiguren and Mabelane 2001). However, these uses utilize a small amount of water compared to the three former ones, and their productivity of water is very high. These uses will not be affected by the shift to another water management system. For instance, it has been calculated that in Seokodibeng, around 230 m^3/yr (100,000 bricks) are used in the whole of Seokodibeng for brick fabrication. The fabrication of bricks amounts to very high productivity of water—a brick is sold at ZAR 2.5 per unit, i.e., around ZAR 1,000/m^3.

It was also requested during the interviews to separate the buckets used for gardening purposes, from those used for domestic purposes. It appeared that the villagers were clearly aware of the distribution of bucket water between each of these two uses.

Household gardens

Household gardens are also referred to as private gardens to differentiate them from communal gardens. All the private gardens are irrigated with domestic water. Tomato, spinach, beetroot, carrot and onion are the most common vegetables grown. Private gardens are generally small (a 100 square meters) as indicated in table 6. A total of 61 gardens were briefly assessed. All existing gardens are situated in the SV (see figure 3).

Table 6. General statistics on backyard gardens.

	Minimum	Maximum	Average	Median	Average deviation
Plot area (m^2)	4	900	121	60	104

The garden size ranges from 4 to 900 m^2 and the amount of time and effort dedicated to them varies from household to household. Women manage most of the gardens, largely because gardening is traditionally their responsibility.

Irrigation practices

Irrigation practices for vegetables gardens vary from household to household. Some villagers use a hosepipe for irrigation. It is interesting to see how hosepipe utilization is accepted within the community. When a hosepipe is connected to a tap, people walk to another tap or wait until the pipe is disconnected by its owner. Hosepipes are used for getting more water from the tap, in order to increase production. They are used in most of the large gardens, either for irrigating the garden directly, or for filling 200-liter buckets for irrigating later. Hosepipes are considered as an investment since their local price ranges from ZAR 200 to ZAR 400 per unit, depending on their length, and thus the costs have to be recovered from the production. Among the ten private gardens that were fully assessed, four used hosepipes.

Most of the villagers do not have hosepipes and fetch water from the tap for garden irrigation. Buckets of 20 or 25-liter capacity are the most common way used to fetch water, as they are relatively easy to bring back, balanced on the head or in a wheelbarrow. Other 200-liter drums are used to stock water when people's needs are high. Drums of 200-liter capacity are also used by villagers who fetch water from the taps using a car or a donkey-cart. This way of collecting water is used by only a small group of villagers. Whatever the way used to get water, furrow irrigation and plant-by-plant irrigation are the techniques used for irrigating private gardens.

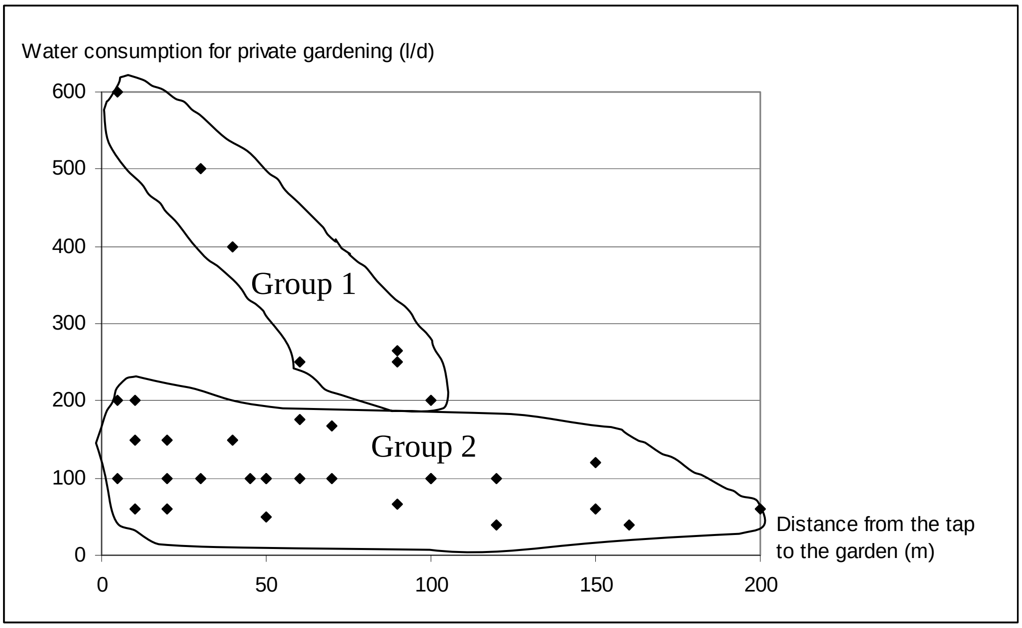
Prevalence of private gardens within the water-supplied area

The survey of backyard gardens reveals 61 private gardens in the village, all located in the SV (see figure 3), where water is more accessible. If a margin of error of 10 percent is taken to cater for possible gardens which would not have been accounted for, the number of private gardens reaches 67 for a total of 283 households in the SV, and 416 in the whole village, which means that 24 percent of the households in the SV have a garden (roughly one out of four). This figure is reduced to 16 percent for the whole village.

Apart from people in the WV who are not supplied with water, people who do not have a private garden: i) are too far from the taps and cannot bring water for both domestic and irrigation use; ii) already have a plot on a communal garden and are waiting for the communal garden to recommence or iii) have non-water related reasons to farm. The reasons for the latter are various—lack of interest, knowledge or skills in gardening, markets, or labor; difficult access to land; age (most of the gardens are cultivated by old villagers); size of the household; financial ability to buy seeds; etc. Figure 4 below shows the relation between the distance from the tap to the garden and the consumption of water in liters per day for gardening. The assessment has been made for 34 gardens of the SV. The study shows that distance has an impact on the consumption of water for gardening. From figure 4, it is possible to distinguish two groups of water users. For the first group (Group 1), the distance to the tap appears to be a constraint in the size of the garden Villagers near the tap can consume up to 600 liters per day, but those who are as far as 200 meters consume less than 100 liters of water per day. Indeed, many villagers with unused garden space indicated that increasing their plot size could not be done mainly due to the inconveniences involved in fetching an adequate amount of water, unless they are equipped with a hosepipe. The second group (Group 2) comprises villagers who have small gardens, whatever the distance to the tap. For this group, the factors limiting garden size may be the same reasons as for those who do not have a garden.

This analysis reveals that the availability of water is a necessary but not sufficient factor that determines a household's decision to be engaged in gardening activities or not. It confirms results from the AWARD study (Pérez de Mendiguren and Mabelane 2001). It also reveals that since the situation would be the same in terms of water supply to the SV as well as the WV, once B3 is implemented gardens will probably appear in the WV.

Figure 4. Relation between water consumption for private gardening and distance from the taps.



The existence of backyard gardens is an indicator of the status of the domestic water supply to the village. According to a study done by AWARD (Pérez de Mendiguren and Mabelane 2001), in villages where the network is considered as satisfying, most households grow vegetables. This situation exists in the SV. Conversely, in villages facing serious problems of water supply, the lack of water prevents villagers from starting home gardens—this situation occurs in the WV.

Fruit trees

Fruit trees, especially paw-paw and banana, were observed in many households, even in those that did not have private gardens. Although fruit trees are common in the village, most of them are irrigated with the remaining water of domestic activities (reused water). In such cases, fruit production was not taken into account in the economic assessment, as it does not specifically use water from the domestic network. However, fruit production was considered where the interviewed people were using domestic water especially for the irrigation of trees. It was then taken into account as another crop.

Water consumption and productivity for the irrigation of yard gardens.

The study yields the following information: i) domestic and irrigation water consumption; ii) the benefits per harvest, and iii) the productivity of water, which corresponds to the benefits per cubic meter of water used for irrigation.

All the yard gardens were studied, with three levels in data collection. First, the size of all the 61 private gardens was estimated. Second, domestic and irrigation water consumption were investigated for 34 gardens of the SV. Finally, the production of 10 out of these 34 yard gardens was assessed. The results of the economic assessment were then extrapolated to all the gardens. The estimation of irrigation water consumption was done in two ways. For people fetching and using water daily, it was done on the basis of the type of bucket (20 liters, 25 liters) and the amount of buckets used for fetching irrigation water, as well as the frequency with which villagers were irrigating. Households using hosepipes put a 200-liter drum in the garden to fill it at times during the day when the tap was not being used by other members of the community. The water is used for irrigation during the afternoon. The assessment was calculated on the basis of the number of days needed to empty the specific tank. With regard to the few people using hosepipes to directly irrigate their crops, getting an estimation was difficult and was roughly done by estimating the flow of the pipe and the daily amount of time it was used for.

On average, 2.88 liters of water per day per square meter of garden is used for irrigation (table 7). This figure is similar to that given by the AWARD study (Pérez de Mendiguren and Mabelane 2001) in villages from the Bushbuckridge area, which used an average of 2.5 liters/m^2/day and on the basis of similar irrigation practises in Seokodibeng.

Private gardens have really expanded since the communal ones were stopped. Moreover, once B3ter is implemented, there will be no more shortage of water, and private gardens may be developed in the WV in the same proportion as in the SV. The SV and the WV comprise 283 and 133 households, respectively. If it is assumed that the productivities and average size per garden are the same, there will be 3,450 m^2 of private gardens in the WV, with an average water consumption of 1,810 m^3/yr.

The study showed that these plots bring on average ZAR 600 per household per year (the AWARD study finds an average of ZAR 240 per household for villages with water supply problems and ZAR 945 per household for villages with a good water supply). The productivity of water in Seokodibeng is ZAR 30 /m^3, which is quite high compared to AWARD water productivity results (ZAR 13 /m^3). The explanation is that in Seokodibeng, villagers mainly use free manure and thus do not buy fertilizers,[12] which are used in the villages studied by AWARD. When the future LWSS is in place, villagers will have to directly bear the costs of irrigating their garden and thus they will have to take into account the water tariff of ZAR 2.5/m^3. This will actually not make a large difference, since it will amount to an increase in production costs of ZAR 9.6 per garden per month during 6 months of irrigation, and a decrease in productivity from ZAR 30 to ZAR 28 per cubic meter.

Villagers indicated that vegetable and fruit production were the first activities that they would undertake if they had access to improved domestic supplies such as household connections. The belief among the villagers is that part of the crops' output could be used to pay the water fees. Several case studies presented at the 2003 Johannesburg Symposium on productive uses of water at household level also showed that productive use improves the villagers' capacity to pay and thus eventually the sustainability of the water supply system itself (Moriarty and Butterworth 2003).

Communal gardens

The management system and the types of crops grown are quite common for all communal gardens, which all consist of regular size plots. Nevertheless, the communal gardens do not have the same irrigation infrastructure facilities, and the yields may differ among the

[12]The poultry scheme also aimed at providing free chicken manure as fertilizer.

gardens. Time shortage and the fact that the schemes were not functioning in August 2003 prevented us from assessing plots for each communal garden. As a consequence, the study conducted on communal gardens relied on the following hypothesis—all the plots are identical in the way they are cultivated and irrigated, and have the same yields. Interviews were conducted for past farming activities in only I1. For these reasons, the values found in table 7 must be considered as very approximate. It highlights a very low water consumption in the communal gardens (2,200 m^3/ha) where the plots were not fully used.

A daily consumption of 420 liters per day and per plot was reported before the water restrictions were imposed. The water productivity of communal gardens will drop from ZAR 11 to ZAR 8.6 /m^3 once the connection with the Lebalelo pipeline is completed.

Table 7. Average water consumption and productivity for yard gardens and communal gardens.

Type of garden	Total irrigated area	Water consumption		Total water consumption per year on the whole village	Productivity of water	
	m^2	$l/m^2/d$	$m^3/m^2/yr$	m^3	R/m^3	$R/m^3/m^2$
Private gardens	7,350	2.88	0.52	950	30.4	0.68
Communal gardens	60,700	1.24	0.22	13,300	11	0.033

Livestock watering

The village comprises around 300 breeders, who own around 4,700 head of livestock—2,400 cows, 2,000 goats, 150 sheep and 150 donkeys (according to FWC1, cow breeder). The water consumption of goats, sheep and donkeys was assessed as negligible when compared to the consumption of cows. Therefore, only the latter were considered. Only around 170 cows out of 2,400 can be found in the village during the dry season (June to October), because there is no grazing field around the village during that period. The other cows leave the village in order to find grazing fields and water. All the cows that remain in the village during the dry season are given water from the taps. During the rainy seasons, all the animals drink water from the two livestock dams of Seokodibeng (LD1 and LD2), or drink from rainwater puddles.

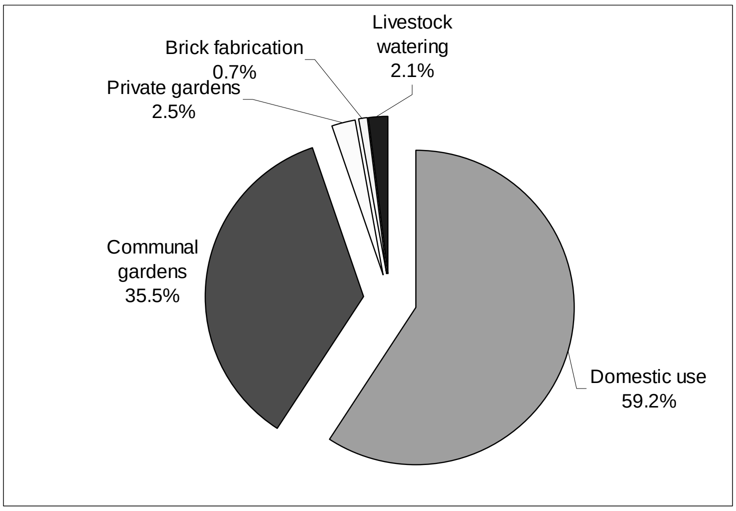
The survey showed that 170 cows are given tap-water for 6 months per year. For a first group of 20 cows, the breeder brings water from the tap to the yard, amounting to a consumption rate of 12 liters/cow/day, i.e., 43 m^3/yr for the whole group. Two other groups of cows drink water directly from the tap, and this creates high losses: 45 liters/cow/day is then necessary. Out of these 150 cows, it appeared that 20 drank everyday and 130 every other day (FWC1). Overall, these 170 cows use 770 m^3/yr from the taps (only during the dry period), i.e., 4.5 m^3 per cow and per year. This includes the losses of water at the tap. If the breeders have to for pay this water at ZAR 2.5 /m^3, it will amount to around ZAR 11 per cow, per year, which is small compared to the market price of ZAR 1,800 per cow.

Water balance at scheme level

The survey in the SV revealed a domestic water use consumption of 146 liters per day per household on average. This amount is close to the amount of water that the government has scheduled to provide free to all households in South Africa—25 liters/d/capita, i.e., 150 liters/d for a household comprising six inhabitants. Since the system was evaluated with B3bis functioning, it is possible to assume that the consumption will be the same in the WV. There are 416 households in the village. Therefore, the annual consumption rate of domestic water use is 22,200 m^3/yr for the entire village.

Figure 5 shows the overall distribution of water uses in the whole village (communal gardens included). This water use amounts to 37,500 m^3/yr, or 102 m^3 per day.

Figure 5. Distribution of water uses in the village.



Possible evolution of water costs in the future supply system

This section focuses on the economic sustainability of the main water supply system once the pumps start to function. Therefore, the irrigation use of communal gardens is expected to be disconnected from the main supply system and, hence, communal garden water use will be funded independently.

In order to do a very simple comparison of the water costs of the different uses with and without connection to the Lebalelo pipeline, it is assumed that the distribution of water use at the village level is also valid at the household level. Each household will probably be charged according to its own water consumption in the future. This will be the case, for instance, with a pre-paid water system, where villagers will have to insert their own cards into a meter to get water. Given these assumptions, the costs of water uses per household with and without connection to the pipeline are presented in table 8 below (the figures given in this table are defined using the distribution of water use at the community level, i.e., at the household level it gives an average value of the households that have private gardens and those which do not). In situations where there is no connection to the Lebalelo supply, the cost per use is calculated as a fraction of the total cost, which is here assumed to be only the electricity bill, which was in 2003 an average of ZAR 2,100 per month. Where connections to the Lebalelo supply existed, an amount of ZAR 2.5 /m^3 was used.

Table 8. Costs of water uses in the current and future supply system.

Uses of water	Water consumption in the whole village	Water consumption per household	Cost of the use without connection to the pipeline	Cost of the use with connection to the pipeline
	m^3/yr	m^3/d	ZAR/household/ month	
Domestic use	22,168	146.00	4.63	10.95
Private gardens	950	6.30	0.20	0.47
Brick fabrication	263	1.70	0.06	0.13
Livestock watering	772	5.10	0.16	0.38
Total	24,153	159.10	5.05	11.93

Costs of water use once Lebalelo supplies the village

In the situation where the village is connected to the pipeline and charged a fee of ZAR 2.5/m^3, the costs of water per type of household will be as follows:

- Domestic water for a household (146 liters/d) will cost ZAR 11 per month (this cost should be borne by the Municipality on the basis of the free basic water policy)
- Private gardening for a household with an average-sized garden (156 liters/d) will cost ZAR 11.7 per month for 6 months a year
- Communal plot gardening for a household with one plot (420 liters/d) will cost ZAR 31.5 per month for 6 months a year

Whether there is a connection to the pipeline or not, organizing a system of payment for water use in proportion to the volume actually used should improve the sustainability of the system, since the users who have a higher productive use of water will have to pay more, and the villagers who do not take part in any production activity will have to pay less. However, these high productivity values have a meaning in term of cost recovery only as long as villagers have access to the market and can indeed get cash from selling their produce. It may be of interest to keep the current system to provide for productive water use—the system is technically less reliable but cheaper to run in the long term.

It is important to note again that the fee of ZAR 2.5 /m^3 is a minimum tariff. A higher price will probably decrease water productivity especially that of communal garden water use. For instance, if the water tariff reaches ZAR 5 /m^3, a household will have to pay ZAR 22 per month for domestic water, which constitutes a high charge for the poorer villagers. As a consequence, these people could face great difficulties in paying for water until certain economic activities (poultry, communal gardens etc.) start.

Conclusion

The study assessed the current water management system in the Seokodibeng village, which is to be connected soon to a pipeline managed by the Lebalelo Water User Association. The investigation of the current uses of water and the institutions for water management helped us understand what the key issues following the forthcoming connection to the pipeline will be.

The analysis of the development of water supply equipment sheds light on the internal dynamics of the Seokodibeng village. It appears that individual participation of community members depends heavily on the success of management at community level. Collective effort triggers an individual effort. A committed Water Committee at community level led to an increased level of unity among villagers, and this in turn led to a higher rate of success in obtaining external funds to install water-related equipment. In contrast, the two problems of domestic water supply management and B3bis's breakdown showed that the community is vulnerable to failure, as it triggers individual disengagement. The current problems also demonstrate Seokodibeng's lack of capacity to lobby external organizations (e.g., the DWAF or the LPDAE) in case of a problem. Furthermore, the analysis showed that the networks were designed either for domestic water use or for irrigation, thereby negating the possibility of a multiple water use of the same water supply system.

The future distribution system will most probably set up a way of individualizing water consumption (for instance, communal taps with a card system, or individual taps with water meters). These new systems will provide the possibility of having each type of water use paying for its consumption. This should provide better incentives to save water.

The main problem of the current system is not one of water resources availability—the pumps can provide enough water if all of them function. Nor is it a problem of network operation—Seokodibeng's operator is trained by the DWAF and is qualified enough. The losses in the network are not large. Finally, it is not a problem of cost recovery since the village showed that they could organize the recovery of needed fees to a large extent. The main problem, however, is the absence of a reliable and accountable organization that would: i) be in charge of the maintenance of the pumps; ii) act quickly in case of problems; and iii) link the village with the relevant organizations at regional and national levels. Therefore, the main opportunity in the connection to the Lebalelo Water Supply Scheme does not lie in the upgrading of water infrastructure but in the nomination of a clear Water Service Provider. This study suggests that the costly connection of the Seokodibeng village to the Lebalelo pipeline may not be needed. It may be more efficient to invest in setting up a more accountable Water Service Provider, with the current water distribution system. This conclusion should, however, not be bluntly extended to other villages in the area of jurisdiction of the LWUA, since many of these villages face problems of water resource scarcity.

The involvement of the WC in the future management remains an open question. There is obviously a need for an organization representing the village, in order to discuss issues with the Water Service Provider. However, its future responsibilities are not clear yet.

As pointed out by Moriarty and Butterworth (2003), gardening can help households pay their water fees, and thus can contribute to the sustainability of the whole system. The current design scheduled for the villages in the LWUA area comprises the setting-up of communal taps. However, this study shows that the distance from the household to the nearest tap is one important constraint to household garden development. Individual household taps will, therefore, enable larger household gardens. Further economic studies are needed to compare the extra costs to the setting-up of individual taps, the increased production that this would enable and hence, the villagers' greater ability to pay.

Appendices

Appendix I

Table 1. Stakeholders interviewed.

Stakeholder	Reference	Number
Lebalelo WUA staff	LWUA1; LWUA2; LWUA3	3
Lebalelo sub-executive committee	LSEC1; LSEC2	2
Councillor of the Fetakgomo local municipality	FETA1	1
Current members of Seokodibeng Water Committee	CWC1	1
Former members of the Seokodibeng Water Committee	FWC1; FWC2	2
Seokodibeng development programme committee	SDPC1; SDPC2	2
Sanitation committee	SC1	1
DWAF local offices	DWAF1; DWAF2	2
Lesetse Water Committee	LWC1	1
Operator of borehole	OP1	1
Staff of the Greater Tubatse Municipality	GTM1; GTM2	2
Total		18

Scheduled dams

In 2003, only the De Brochen Dam, built in 1989, supplied the LWUA with water. However, its yield of 3 MCM/yr is insufficient to provide enough water to the mines, and several storage capacity development projects are scheduled.

First, the raising by 5 meters of the Flag Boshielo Dam has been approved (Republic of South Africa 2003). The yield of this dam should increase from 56 MCM to 72 MCM/yr. The investment should be around ZAR 130 million for the raising itself plus ZAR 60 million for the expropriation (LWUA1). Second, the Rooipoort Dam, located in the Middle Olifants, at Rooipoort near the Mafefe village has been considered for development. It should also allow the transfer of water to the town of Polokwane (Klvechuk 2003). The costs are estimated to be ZAR 350 million for a yield of 60 MCM/yr. The DWAF has completed the feasibility study. The Limpopo provincial government wants the construction of this dam to commence as soon as possible. However, the building of the dam will entail the displacement of local inhabitants (LWUA1). Third, as an alternative to the Rooipoort Dam, the De Hoop Dam may be built in the future on the Steelpoort River. Its total capacity is expected to be 160 MCM, with a yield of 87 MCM/yr, and the costs are estimated to be around ZAR 150 million. Only the pre-feasibility study had been completed by the DWAF in 2003. This dam should not have much social impact.

The dams on the Olifants River Basin will not be ready by 2007, which is the year when the water licence should be given back to the Arabie Scheme. However, given the considerable problems faced by this scheme in 2003, it will most likely use much less water than its total entitlement in 2007. This fact was taken into account during the planning stage of the building of this dam (Rouzère 2001).

The Lebalelo WUA infrastructure

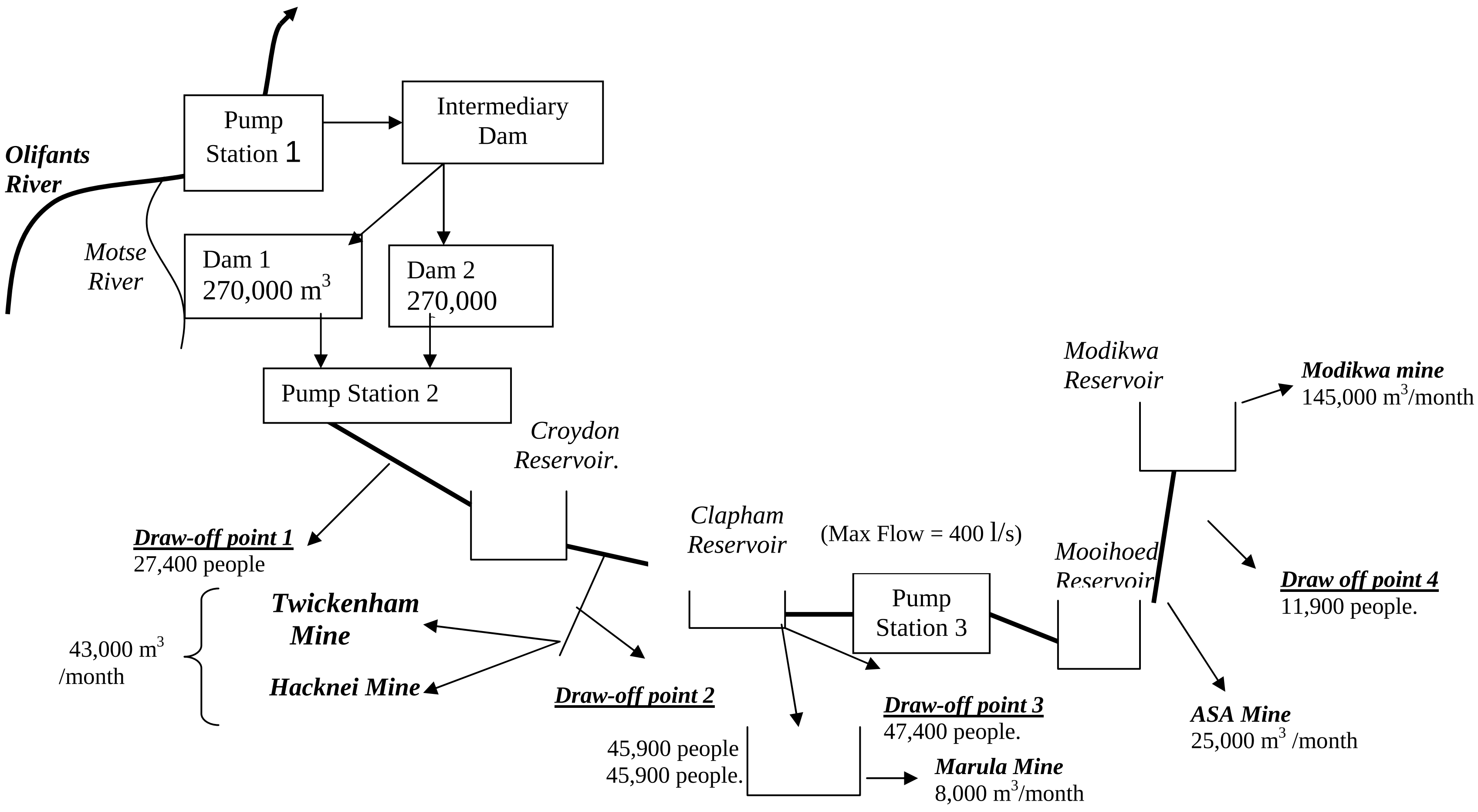
The main components of the LWSS are a pumping station that abstracts water from the Olifants River, and a 900-millimeter steel pipeline. The pumping station is located opposite the Havercraft Mine, at the confluence of the Olifants and the Motse rivers. The pipeline is 56 km long and its route follows the R37 up to Modikwa’s access road. The system as existing in 2003 is represented in figure 1.

A joint venture between Ninham Shand and SRK companies was responsible for the geo-technical and environmental aspects of the project, as well as the pipeline design, desalting works, pump stations and earth dams (SRK 2003). The pipeline is designed for 28 MCM/yr, at 20-hours pumping per day. The pumping infrastructure has a maximum capacity of 2,525,000 cubic meters per month, which is equivalent to 30.3 MCM/yr. In the future, it will be possible to increase the pumping to 24 hours a day by adding new pumps, thereby increasing the capacity by 20 percent (LWUA1).

In 2003, the LWUA was using only 12 percent of the scheduled capacity. For example, the amount of water pumped during the first half of the year 2003 varied between 138,000 m^3 and 277,000 m^3 per month. The main explanation is that the mines are still in the process of developing. The Madikwa Platinum Mine was expected to be near full production by the end of 2003. The Twickenham and Hacknei mines are still expanding, and the Marula Mine is not yet operating. Moreover, the Madikwa Mine’s water consumption from the LWSS has decreased since they found groundwater in large quantities. They now use their groundwater as process water for cleaning and cooling their systems, and use water from the LWUA as drinking water only.

In the future, the pipeline will be extended in two directions. The first extension will be done in the continuity of the main pipeline. It will start from Modikwa's branching and will proceed for 45 km alongside the R37 in the direction of Lydenburg. The second one will start from Twickenham Mine, and will go 45 km in a southwest direction (figure 1).

Figure 1. Plan of the Lebalelo Water Supply Scheme.



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